FOOD SECURITY FOR SOUTHERN AFRICA

Edited by

Mandivamba Rukuni and Carl K. Eicher

University of Zimbabwe UZ/MSU Food Security Project

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FOREWORD

This volume includes papers and research proposals prepared by researchers under the aegis of the University of Zimbabwe/Michigan State University (UZ/MSU) Food Security Research Programme in Southern Africa. The objectives of the UZ/MSU research programme are spelled out in Chapter One by Mandivamba Rukuni and Carl K. Eicher.

The papers in this volume (with the exception of Chapters Three and Five) are revised versions of papers that were presented at the University of Zimbabwe's Second Annual Conference on Food Security Research in Southern Africa, Holiday Inn, Harare, November 9-13, 1986.

But before we go further, lets step back and examine the context for food security research in Southern Africa. Currently, 70 million people live in the nine SADCC countries in Southern Africa. Since SADCC states are closely linked to the global food economy through capital transfers, exchange rate movements, food aid and trade, it is important to examine recent trends in the global food economy and the results of research over the past decade on the causes of food insecurity, hunger and malnutrition.

In the decade since the global food crisis of the early 1970s, four important lessons have been learned about the global food equation. First, the projected doomsday scenario of food shortages and higher real food prices in the late 1970s and early 1980s has not materialized. Instead, the global food models developed during and following 1972/73 world food crisis did not accurately foresee a world food economy of the 1980s with world maize prices at a twenty-five year low. In sum, the food pessimism of the early 1970s has been replaced by global food optimism of the 1980s. The dramatic change in the world food situation has important implications for food security policy analysis in Southern Africa.

The second lesson that has been learned over the past decade is that expanding research on food crops, increasing food production and achieving national food self-sufficiency will <u>not</u> automatically solve problems of hunger, malnutrition and famine. For example, India achieved national food grain self-sufficiency in the early 1980s, has a national grain reserve of some 30 million tons and became a food aid donor in 1985 when it donated 100,000 tons of food aid to Ethiopia. But today around 200 million or roughly one-fourth of India's population do not have access to enough resources to produce or income to purchase a calorie-adequate diet throughout the year. Based on the influential work of economists such as Reutlinger, Selowsky, Sen, Mellor and Timmer over the past decade, it is now recognized that poverty is a central cause of hunger and food insecurity and that raising the income of the poor is a strategic variable in combating hunger and malnutrition.

The third food lesson is that the most pressing food problems have shifted from Asia to Africa. Although, world opinion became transfixed with the Great African famine in Ethiopia in 1985, in fact, Africa's food crisis dates back to 1970 and earlier. For example, from 1970 to 1984 food production in sub-Saharan Africa grew at half the population growth rate.

The fourth lesson is that a food security research programme should not be restricted to food crops. For example, the most efficient way for many families in Rwanda to meet their calorie needs may be to produce more coffee for export rather than beans for home consumption. Likewise, expanding small ruminant (goats and sheep) and cotton production may generate jobs and income that will enable rural families to purchase a calorie-adequate diet. In short, the food security research agenda of technical and social scientist should not be restricted to food. In sum, the experience of the past decade has helped shift the food policy debate from Asia to Africa, and from food production and building more grain silos to marketing, trade, food for work programmes and access to food.

Food security research came of age in Africa in the early 1980s under the growing recognition that a number of complex food problems should be examined in a framework that incorporates both food availability (food production and storage) and access to food through home production, purchase in the market or public or private food transfers. This background provides the context for food security research in Africa and the role of the University of Zimbabwe in carrying out food security policy studies and networking in the SADCC region of Southern Africa.

In July 1985, the UZ/MSU research programme was launched in Southern Africa. The chapters in Parts I, II and II in this volume summarize the first 18 months of research by members of the Project. The remaining chapters discuss needed research on food security in Southern Africa, including preliminary research proposals by Mbwanda, Mudimu and Muchero. The results of UZ/MSU research carried out in 1987 will be presented at the University of Zimbabwe's Third Annual Food Security Conference in Harare from November 1-5, 1987.

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This volume is the outgrowth of close cooperation between social scientists, technical scientists, government officers and representatives of donor agencies in Southern Africa. The studies reported in this volume are part of a comparative analysis of food security in sub-Saharan Africa that is co-directed by Michael Weber and Carl K. Eicher of Michigan State University's Department of Agricultural Economics. The UZ/MSU's food security research programme is being carried out through a sub-contract with Michigan State University.

In the University of Zimbabwe our debts are many. Malcolm J. Blackie was instrumental in inviting Michigan State University to join hands with a group of scholars in the Faculty of Agriculture and develop a joint research programme that would train local researchers, improve the data base for policy analysis and provide information on food security policy trade-offs to SADCC's Food Security Programme and to SADCC member states. We are grateful to Kay Muir-Leresche and Steve Buccola for developing the original research plan in September of 1984.

We owe a special debt of gratitude to Sam Muchena, John Dhliwayo, Andrew Dhlakama, Peter Murphy, Sam Marume and Frank Drane of Zimbabwe's Ministry of Lands, Agriculture and Rural Resettlement. These civil servants have worked long and hard to develop SADCC's Food Security Programme and have provided valuable counsel on ways to increase the relevance of the UZ/MSU Food Security Project.

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We convey our thanks to Ms Thembi Sibanda for her superb job of organizing and managing the University of Zimbabwe's Second Annual Conference on Food Security Research in Harare from 9 to 13 November, 1986. To all those who helped make this conference an outstanding success - Lovemore Madziwanzira, Maxwell Chiwashira, Samson Maguhudze, George Nyamatemba and Ronald Sagwete - we are grateful.

We are grateful to Mrs C. Smith for her patience and dedication in typing successive drafts of the chapters in this volume during an extremely difficult personal period in her life and the life of her family.

PART I

OVERVIEW

CHAPTER ONE

THE FOOD SECURITY EQUATION IN SOUTHERN AFRICA

Mandivamba Rukuni and Carl K. Eicher

INTRODUCTION

The immensity of Africa provides a sober note of reality and humility in discussing food security policy issues and research priorities. Most scientists and policy makers are surprised to learn that the continent of Africa occupies a land area larger than the combined area of the United States, Western Europe and the Peoples Republic of China[1/]. The size of Africa is an important issue because empirical evidence throughout the world has shown that agricultural development is a highly location-specific process and it requires location-specific supporting research by social and technical scientists. Even if one moves from the 50 states in Africa to 45 states in sub-Saharan Africa, we are still dealing with an immense land area of six complex and diverse sub-regions, 45 states, seven colonial histories and more than 1,000 different ethnic groups.

The immensity of Africa should be juxtaposed against the desire of donor agencies to develop a general response, typically a strategy paper, to deal with some aspect of the "African Development Crisis". But in the rush to develop general policies, strategies and programmes for Africa, a word of caution is in order. Gerald Helleiner, a Canadian economist with 25 years of research experience on Africa, reminds us that:

1/ Africa occupies 11.70 million square miles of land compared with 11.06 million for the combined area of the United States, Western Europe and China.

> Beleaguered policy-makers in developing countries have become quite tired of generalised advice... Unhappiness with 'global' prescriptions has rarely been as vociferous as it has become in recent years in the context of the 'conditionality' attached to IMF, World Bank and other official lending. The IMF and the World Bank usually deny that they employ a single 'model' for all their member countries. Whether these institutions, qua institutions, do or do not, there can be little doubt that, within them, generalised prescriptions abound. (Helleiner, 1986, p.139).

Helleiner's views should be heeded by donors promoting one institutional model for Africa[1/] and by policy researchers. Experience has shown that economic policy research is just as location-specific as maize breeding and that generalized policy advice such as "getting prices right" is of little use to policy makers coping with food surpluses in Zimbabwe or food riots in Zambia.

There are at least four options available to researchers for organizing social science and technical research on a common problem such as food insecurity on a sub-Saharan Africa basis. The first option is the generation of cross-country statistical data covering a large number of countries. This approach is routinely used by the FAO and USDA, the two premier sources of agricultural trade data. The second approach is to go to the other extreme and carry out a few in-depth country studies, relying heavily on historical data. For example, two political scientists with several decades of experience in Zaire - Crawford Young and Thomas Turner - recently completed a definitive study - The Rise and Decline of the Zairian State (1985).

The third option is to carry out research on a common problem or sector in one of the six major sub-regions such as the Sahel, Central Africa or Southern Africa. The FAO's report SADCC Agriculture:Toward 2000 (1984) is an example

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1/ A classic example is the World Bank's promotion of the T&V extension model throughout Africa.

of this approach. The fourth option is to organize an Africa-wide programme of comparative country studies that are linked by a common analytical framework for the study of a policy issue such as food insecurity.

While there are obviously advantages and disadvantages of each of these four approaches, Michigan State University (MSU) agricultural economists, in cooperation with social and technical scientists in several countries in Africa, invested most of 1984 in developing a proposal to carry out a programme of comparative studies of food security in sub-Saharan Africa. The characteristics of the MSU Food Security Comparative Studies Programme are:

(1) a common research framework is used to examine the impact of technology, institutions and policy on food production and marketing in each country and/or region.

(2) the goal is to generate empirical information on how policy changes affect the achievement of household, national and, in some cases, regional (e.g. Southern Africa) food security objectives.

(3) each country study includes an explicit, up front commitment to develop indigenous scientific capacity to design and carry out empirical studies, process data locally and assist in strengthening local institutional capacity for policy analysis.

(4) the studies are designed to complement on-going food security studies such as the EEC-financed food strategies in Mali and Rwanda and SADCC's twelve food security studies and projects.

(5) research results are synthesized through conferences, seminars and working papers that are distributed free of charge within Africa.

MSU food security studies are underway in four countries - Senegal, Mali, Rwanda, Somalia and one sub-region- Southern Africa. In Southern Africa, the work is being carried out through a sub-contract with the Department of Agricultural Economics and Extension of the University of Zimbabwe. The

University of Zimbabwe has placed initial emphasis on studies in Zimbabwe in 1985 and 1986. The University of Zimbabwe is currently launching three regional studies - food access, household food security in low rainfall areas and the effects of market liberalisation on food security - in cooperation with local researchers in several countries in the SADCC region.

The MSU food security research programme has been underway about 18 months in Mali and Southern Africa, 12 months in Rwanda and six months in Senegal and Somalia. Naturally, there is a budget limit on every research project. If more funds were available, it would be desirable to undertake studies in a larger number of countries - perhaps 8 or 9 - to cope with the immensity and special problems of sub-Saharan Africa. For example, although 18 of the 45 countries in sub-Saharan Africa have a population of less than 3 million, MSU's research programme does not include any country with a population of less than 3 million.

We have organized our paper around around the theme - the food security equation in Southern Africa. The thesis of our paper is that there is a serious imbalance in food security research underway in the region. The bulk of the research is focused on the supply side of the equation - i.e. increasing food production, the development of early warning systems, studies of optimum storage levels and action programmes to reduce post harvest losses. More research is needed on the demand (food access) side of the equation in light of the co-existence of malnutrition and food surpluses in the region. High priority food security research priorities are: marketing, trade, exchange rate policies, household food security in low rainfall areas, the effects of market liberalization on the food security of various groups in society and research on institutional innovations that increase access to food.

THE FOOD SECURITY EQUATION : FOOD AVAILABILITY AND ACCESS TO FOOD

In 1976, two economists - Reutlinger and Selowsky - published an influential monograph on Malnutrition and Poverty (1976). The authors challenged the assumption that higher rates of economic growth, food production and market forces would bring about an improvement in nutrition in the Third World within an acceptable time frame[1/]. They also contended that researchers probing the causes of malnutrition have to address the distribution of food among different groups in the population.

In 1977, an Oxford economist - Amartya Sen - published an influential paper on entitlements and famine that reinforced the view that poverty, or what Sen called the lack of food entitlements (land, credit, income, family support systems), is a major cause of famine and hunger. Sen challenged the prevailing view that famine was caused primarily by a food production shortfall. Sen later expanded his entitlement thesis in his celebrated book Poverty and Famine (1981).

Food policy[2/] and food security came of age in the early 1980s. In an influential collection of essays edited by Alberto Valdes Food Security for Developing Countries (1981), food security was defined as "the ability of food deficit countries, or regions within countries, to meet target consumption levels on a year-to-year basis" (Valdes

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1/ Reutlinger noted that; "I do not think it is realistic to expect that general and agricultural development in the developing countries will proceed at the pace which would be required to reduce malnutrition substantially within the next 20 years" (Reutlinger, 1977, p.720).

2/ See Timmer, Falcon and Pearson (1983).

and Siamwalla, 1981, p.1), a definition that incorporates the effects of both supply and demand.

In 1986, the World Bank issued a food security policy paper Poverty and Hunger in which food security was defined as "access by all people at all times to enough food for an active and healthy life." Two essential elements are "the availability of food and the ability to acquire it" (World Bank, 1986, p.1). We believe the Bank's definition will gain wide international acceptance because it is simple but comprehensive and it reminds one that there are two interacting parts of the food security policy and research agendas in the SADCC region: (1) food availability through domestic production, storage and/or trade and, (2) access to food through home production, the market or food transfers.

In summary, it has taken about a decade for the results of research on the link between poverty and hunger, famine and malnutrition to gain acceptance in policy circles. This time lag is about the same - a decade - as technical scientists require to develop improved plant varieties.

To date, SADCC and donor agencies have given priority to the supply or food availability side of the equation. For example, food production research (e.g. ICRISAT/SADCC research on sorghum and millet), food production campaigns, early warning systems and expanded grain storage capacity - have been emphasized in the first six years of SADCC's history from 1980 to 1986.

On the food access side of the equation, Botswana has taken the lead in the SADCC region, and probably in all of Africa, in implementing four innovative programmes to cope with drought and household and national food insecurity. Botswana made a strategic decision following the 1979 drought to develop a permanent institutional capacity to cope with drought and to ensure that all members of society have access to a calorie-adequate diet. When the present drought (1982-86) started in 1982, Botswana expanded its Pula for work programme[1/], supplementary feeding for underweight children, school feeding programmes, and developed irrigation projects to reduce the dependency on rainfall. In 1986 about 600,000 or 60 percent of Botswana's total population received some type of assistance from these food security programmes at some time during the year.

With the exception of Botswana, the food access or demand side of the food security equation is an uncharted area in terms of research and policy experimentation in the SADCC region. There is a need for food surplus Member states to expand their policy analysis capability to determine how to achieve adequate food consumption for groups of the population who are inadequately nourished. In food deficit countries, a key research topic is how to develop efficient food production systems, including cost effective ways to increase the index of food self-sufficiency of key staple foods, while reducing the need to import food under present emergency conditions in the region.

In summary, each SADCC state should address the key policy question: What is the most cost effective mix of domestic food production and storage, trade and/or food aid to meet national food security needs in both the short and long run? Blanket endorsement of concepts such as food first, food self-reliance and food self-sufficiency do not answer this crucial question. However, food self-sufficiency can be a useful operational concept if it is supported with underlying economic analysis. For example, if Botswana wants to increase its self-sufficiency index of sorghum

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1/ Pula is the national currency. In 1985 workers in rural areas received two Pula (about US$ 1.20) for a six hour day working on infrastructure projects.

from 30 to 80 percent through subsidized credit, mechanization and irrigation projects, researchers should find out what these programmes will cost in real terms? How much additional employment will be generated? What is the political value of reducing the ratio of food dependency? These are hard political economy questions that can only be answered by in-depth research.

THE CHANGING FOOD AND AGRICULTURE SITUATION IN THE WORLD ECONOMY, AFRICA AND SOUTHERN AFRICA

The thesis of our paper is that current research on food security in Southern Africa is heavily biased in favour of increasing food availability. This production/storage bias is understandable in light of the 1982-85 drought in the region, and the continuing drought in Botswana in 1985 and 1986. However, because of the rapidly changing global and regional food outlook, it is important to re-examine the food security research agenda.

Global Overview of the Food Situation

The world food pendulum has swung widely every decade or so. India's disastrous harvests of 1965/66 triggered the 1966 world food crisis that was followed by the Sahalian drought and world food crisis of the early 1970s. But the doomsday predictions of the mid-1970s have been followed by a much more optimistic assessment of the world food outlook in the 1980s, punctuated by the great African Famine of 1985 where a conservative estimate of 300,000 people died in Ethiopia alone. The global food outlook is as follows:

* If food in the world were becoming more scarce, its real price would be trending upward. But the real price of wheat in world markets has been falling for well over a century. By the beginning of the 1980s, the real price of wheat in world markets was roughly half what it was 120 years earlier in 1860. Moreover, the price has declined significantly since 1980 (Schuh, 1986).

* The real price of maize in world markets started to decline after World War II with the spread of hybrid maize. Global maize stocks in 1986/87 are 160 million metric tons (a 25 year high) compared with 40 million metric tons in 1983-84).[1/]

* The export quotation for No. 2 yellow maize at US gulf ports was US$ 70/ton in late 1986 as compared with $US 100 in 1985 and US$ 160 in 1980.[1/] Maize is at an all time low in real terms.

* The production of rice is running ahead of demand in several large countries in Asia - e.g. India and Indonesia, requiring large adjustment programmes to shift to alternative crops.

* The production of sorghum is running ahead of domestic demand in China, India and Zimbabwe.

In summary, the code word of scarcity has been replaced by the appealing phrase that the world is "awash with grain" because of near record production and stocks of all major grains. As a result, there is a need for expanded policy research to cut back on grain production. However, only two percent of the operational research budgets of the 13 International Agricultural Research Centers (the CGIAR System) is for policy research.

Despite global food abundance, there are an estimated 300 to 900 million people suffering from malnutrition in the third World[2/]. The FAO estimated that 100 million or roughly one-fourth of the total population of sub-Saharan Africa were not receiving a calorie-adequate diet in 1985.

The central question that flows from this paradox of global abundance and malnutrition is whether malnutrition is primarily a food production or a poverty problem? There is now overwhelming evidence that among the forces that cause malnutrition, one stands out above all others - a lack of

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1/ Jim Longmire, Cimmyt, Nov. 1986.
2/ There is no standard international agreement on what constitutes a malnourished person.

purchasing power or poverty (Reutlinger and Selowsky, 1976; Reutlinger 1977), or what Sen calls a lack of food entitlements (Sen, 1977, 1981 and 1986). The central message that flows from these studies is that since poverty is the main cause of malnutrition, food security can be increased by raising the real incomes of poor households so that they can afford to buy enough food or by helping farmers acquire the resources (e.g. land, credit, etc.) to produce enough food for their families.

The Food Situation in Africa

In 1960 when 17 African states won their independence, Sub-Saharan Africa was a modest net exporter of food mostly because West Africa was a large exporter of groundnuts (Paulino, 1986, p.33). But Africa became a net food importer in the late 1960s because of the Sahelian drought, rapid population growth and declining crop yields. In 1985, sub-Saharan Africa imported 12 million tons of grain and three commodities accounted for 87 percent of grain imports: wheat 50 percent; rice, 22 percent; and maize, 15 percent (USDA, 1986).

The most important change in Africa's food import picture over the part two decades is the increasing importance of food aid. In the late 1960s, food aid accounted for 5 percent of the total grain imports, increasing to 18 percent in the mid seventies and 40 percent in 1983-85. From 1980 to 1985, food aid increased five fold while commercial food imports were stagnant. In 1985, food aid accounted for 7 of the 12 million tons of Africa's food imports. Africa's food crisis in the 15 year period from 1970-84 can be captured in a single statistic: food production grew at half the population growth rate during this period. But in 1985 food production made a dramatic recovery because of near normal rainfall throughout most of the sub-continent. Table 1 shows that indices of per capita food production increased in 1985. In 1986, the food situation continued to improve except in a few countries such as Botswana.

Food Situation in Southern Africa

Today, there are 70 million people in the nine SADCC states, up 12 million from the 58 million when SADCC was established in 1980. The population is growing at about 2 million per year and by the year 2000, there will likely be 100 million people in the region. Even though the rate of population growth is projected to level off at 2.9 percent by the year 2000, the population in the SADCC region will likely double from 100 to 200 million sometime between 2020 and 2030.

With 50 to 80 percent of the population in the region deriving their employment from agriculture and rural non-farm employment, it follows that raising the productivity of the agricultural sector is essential for raising the average standard of living in the region.

Presently there is no definitive assessment of food and agriculture in the SADCC region. The FAO report SADCC Agriculture : Toward 2000 (1984)is a hurried piece of work that has been overtaken by events. SADCC's MacroEconomic Survey, (1986) draws heavily on the FAO report for information on food and agriculture through 1984.

The following overview highlights some of the recent changes in the food situation in the SADCC region. The food economy in the nine SADCC states can be divided into a maize belt of three countries - Zimbabwe, Malawi and Zambia - and six food deficit countries. Maize accounts for half the calories consumed in Zimbabwe and Zambia, and 70 percent in Malawi. The maize belt has a backlog of farmer-tested varieties capable of producing a surplus for intra-regional trade under normal weather conditions. In early 1987 Zimbabwe had 2.1 million tons of maize in

TABLE 1: Africa

INDICES OF PER CAPITA FOOD PRODUCTION, BY COUNTRY, 1976-85
(1976-78 = 100)

COUNTRY	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
ANGOLA	105	101	94	93	92	85	85	83	80	79
BENIN (DAHOMEY)	98	101	100	102	90	87	83	77	93	102
BURUNDI	99	100	99	96	92	95	93	92	83	85
CAMEROON	103	103	93	96	93	92	86	82	86	89
ETHIOPIA	94	96	108	115	104	102	113	99	89	93
GHANA	106	98	95	102	100	95	89	74	87	88
GUINEA	101	99	98	95	95	91	96	92	93	96
IVORY COAST	95	101	102	112	118	120	110	103	120	120
KENYA	99	102	97	88	86	89	93	89	75	82
LIBERIA	101	102	97	98	100	100	98	100	101	99
MADAGASCAR	105	103	92	95	95	90	90	92	89	88
MALAWI	99	97	103	99	99	102	106	101	100	98
MALI	99	93	106	102	98	110	107	99	82	97
MOZAMBIQUE	96	100	102	100	99	99	96	73	78	84
NIGER	97	98	103	108	111	102	99	96	61	88
NIGERIA	99	100	100	101	103	99	98	84	93	97
RWANDA	102	99	98	105	100	104	105	105	84	93
SENEGAL	110	78	110	83	73	97	98	69	72	80
SIERRA LEONE	99	103	97	96	92	88	86	89	80	79
SOUTH AFRICA	96	101	102	96	101	109	94	80	85	90
SUDAN	97	102	100	80	88	103	82	78	67	98
TANZANIA	100	99	100	100	96	96	93	94	90	95
TOGO	101	93	105	109	104	103	98	89	98	102
UGANDA	100	98	101	92	87	90	94	96	96	95
BURKINA FASO(UPPER VOLTA)	96	100	103	103	94	104	102	94	87	109
ZAIRE	102	101	96	97	97	100	101	100	95	96
ZAMBIA	109	101	90	84	84	93	84	91	87	92
ZIMBABWE	102	100	96	81	83	99	86	64	71	95
AFRICA, SUB-SAHARA	100	100	100	99	99	101	97	89	90	95
SUB-SAHARA LESS REP SO AFRICA	101	100	99	99	99	99	98	90	90	96
ALGERIA	109	94	96	94	102	95	91	84	85	102
EGYPT	102	99	98	99	99	98	99	98	98	98
LIBYA	104	95	100	91	91	97	98	95	97	98
MOROCCO	109	85	105	99	99	78	98	90	91	93
TUNISIA	106	96	97	95	101	106	117	108	119	141
AFRICA, NORTH	106	94	100	98	100	92	99	95	95	101
ALL AFRICA	101	99	100	98	99	99	98	90	91	97
AFRICA LESS REP SO AFRICA	102	99	100	99	99	98	98	91	92	97

SOURCE: USDA, 1986

storage which is equivalent to about three years' normal domestic sales by the Grain Marketing Board (GMB).

The sources of productivity growth of white maize in Zimbabwe cannot be attributed to any single factor such as higher prices or favourable weather. Today, all commercial farmers and 85 percent of the communal farmers planting maize in "Zimbabwe use hybrid varieties that have been developed through decades of local research. For example, in 1960 Zimbabwe became the first country after the United States to introduce hybrid maize - SR 52 - to commercial farmers after 28 years of research on hybrids (Eicher, 1984). SR 52 is still the dominant variety used by commercial farmers in Zimbabwe. Because Zimbabwe and Zambia were members of the Federation of Rhodesia and Nyasaland when SR 52 was released in 1960, it was made available to Zambia where it was quickly adopted by commercial farmers.

Maize production is expanding rapidly in Zambia because of new varieties[1/], higher producer prices[2/], and the re-organization of the seed parastatal along the lines of a public/private corporation. In 1986 maize production reached 1.1 million tons, enough for domestic consumption until the next harvest begins in June of 1987.

In Malawi, maize is the staple food. The government is deeply committed to maize production and maize has been

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1/ Zambia's maize research team has introduced two hybrids and two open pollinated varieties in the past three years.

2/ Nominal producer prices were doubled from 28 Kwacha per 90 Kg bag in 1985 to 55 Kwacha per bag in 1986.

exported for seven of the past ten years. About 90 percent of maize production is based on open pollinated varieties because hybrids that are acceptable to consumer tastes have not been developed . Malawi's maize expansion appears to be a function of dramatically higher producer prices[1/], increasing the price of maize relative to other crops, large fertilizer subsidies, a vigorous extension programme and a government strongly committed to increasing food production.

The surge in maize production in SADCC's maize belt is the cumulative outcome of agricultural research, an array of institutional improvements and dramatic price increases beginning around 1980. In short, the hallmark of the maize expansion in the three countries is a balanced package of technology generation, price incentives, and institutional improvements. However, there are still a number of puzzles about maize? For example, why do consumers in Malawi resist hybrid varieties? Why is maize replacing sorghum in low rainfall areas? What are the household food security implications? Do these changes reflect a permanent shift in consumer tastes from white maize to sorghum or can they be reversed by higher yielding sorghum varieties, price policy and improvements in village sorghum processing technology?

Policy makers are now faced with some important adjustments in the maize belt. Zimbabwe and Malawi can no longer rely on the Zambian market for disposal of several hundred thousand tons of maize each year because Zambia achieved self-sufficiency in 1986. The challenge for Zimbabwe and Malawi is to diversify to oilseeds, higher valued export crops, import substitution crops for local industries (e.g. natural rubber), livestock and new food products and to develop

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1/ For example, the nomimal producer price of maize in Malawi was increased 144 percent from 1979-84.

institutions to expand employment for low income people in rural areas (maize for work programmes).

But it takes a decade, on the average, to produce and farmer-test new crops for diversification programmes. In this connection, SADCC's food-centered regional agricultural research programme should be reexamined in light of the need for crop diversification. For example, should SADCC develop a regional fruit and vegetable research programme? Should SADCC invest in research on jojoba, nitrogen-fixing trees and horticulture? Although some 3000 different fruit species are found in Africa, Asia, Latin America, the Caribean and the Pacific Islands "only four - bananas, pineapple, papaya and mango - have been developed into major crops" (Vietmeyer, 1986, p.1381). To restate, SADCC should pose the question: What are the strategic long run investments in basic science, post-graduate training, applied research, and infrastructure to speed agricultural diversification and rural industrialization in the maize belt over the next 10 to 15 years? But in the short run, the maize surplus in three SADCC states poses several tough questions for SADCC and for donor agencies.

(1) What can be done by donor agencies to assist the food deficit SADCC states with foreign exchange constraints in acquiring maize from Malawi and Zimbabwe?

(2) Can the backlog of maize varieties be transferred to some of the food deficit countries?

(3) How long will it take the ICRISAT/SADCC sorghum and millet research programme, located at the Matopos station outside Bulawayo, to generate white sorghum production technology for low rainfall areas in the region where maize is a risky crop? In short, can research help white sorghum achieve the same genetic potential of maize in the SADCC region?

(4) Should SADCC's food-dominated regional research portfolio (e.g. millet, sorghum and grain legumes) be expanded to include research on import substitution crops such as natural rubber and export crops such as jojoba, spices, cut flowers, etc.

No discussion of SADCC agriculture would be complete without a discussion of South Africa - especially its historical role as a major maize exporter. The objective of maize policy in South Africa is to maintain self-sufficiency and generate a surplus for export during normal weather conditions. Whereas maize production in Zimbabwe normally ranges from 2 to 3 million tons, maize production in South Africa reached a peak of 14.6 million tons in 1981, with about 50 percent used in livestock feed. The 1981 production record was the culmination of large price increases[1/] and extremely favourable weather. In 1981 and 1982, maize and maize product exports made up nearly 30 percent of the total value of agricultural exports. In 1982-85, because of the drought, South Africa imported maize and, in late 1983, it became a net food importer for the first time since World War II. Maize production returned to normal in 1986 (9 million tons) and South Africa is now exporting maize.

In summary, SADCC agriculture is composed of a maize belt of two surplus and one self-sufficient state and six food deficit states. This dichotomy of surplus and deficit sub-regions has important implications for SADCC's food and agriculture policy, for SADCC's food security studies and projects and the University of Zimbabwe's food security research programme.

SIX CHALLENGES FOR FOOD SECURITY RESEARCHERS IN SOUTHERN AFRICA

We now turn to a discussion of challenges for food security researchers in Southern Africa. Before proceeding, it is important to clear up several issues:

1/ Nominal maize prices were increased 230 percent from 1976 through 1984.

(a) the definition of food security,
(b) the need for a balanced research programme to address both sides of the food security equation,
(c) the need for multi-disciplinary research and,
(d) an appropriate time frame.

We propose adopting the World Bank's definition of food security - "ensuring that all members of society have access to enough food throughout the year to lead an active and healthy life". The two key components of food security are food availability (through domestic production, storage and/or trade) and food access (through home production, purchase in the market or food transfers).

It is important that food security is not defined as being synonymous with food self-sufficiency or agricultural development. Food self-sufficiency is a narrower concept than food security. Food self-sufficiency can be narrowly defined as supplying 100 percent of the staple food needs of a nation from domestic production and storage under all weather probabilities. Increasing the food self-sufficiency index of a particular crop may be a valid policy objective. But the challenge for food security researchers is to compute the real cost and the reduction of risk associated with increasing the self-sufficiency index of a particular commodity such as wheat in Lesotho or Zambia. But few SADCC countries currently have the data, analytical skills and time to carry out such exercises. The University of Zimbabwe/CIMMYT study of the wheat industry is an example of the type of research that is needed to add more "substance" to debates on food self-sufficiency.

Food security should not be confused with agricultural development - a process of increasing per capita agricultural output. If food security researchers define their research agenda as broadly as agricultural development, they will become bogged down with research on credit, land tenure, processing, etc. In sum, the food security research agenda should be restricted to a limited number of key policy questions and focus on both sides of the equation - food availability and access to food.

The second important issue is the balance between research on food availability (supply issues) and food access (demand issues). While the issue of the proper balance must be sorted out in a country specific context, we estimate that at least three fourths of on-going food security studies in Southern Africa are focused on food availability issues i.e. food production and storage issues. We believe there is a need to shift the ratio to at least 50 percent on food availability and 50 percent on food access research in the near future.

The third background issue is the need for a multi-disciplinary team to pursue research on both sides of the equation. While it is easy to achieve multi-disciplinary exchange of views at an international conference, it is difficult to bring researchers together from the appropriate mix of disciplines to carry out food security research. We are well aware that the discipline of economics is incapable of providing the breadth of analysis for the range of problems included in the food security research agenda. For example, the University of Zimbabwe's research team on household food security in low rainfall areas requires inputs from anthropologists, sorghum and millet breeders, agronomists, microeconomists, agricultural engineers, macroeconomists and food scientists.

The final background issue is the time frame. We believe there is a need for 40 to 50 scientists from numerous disciplines to come together to develop a food security research network for Southern Africa and carry out a programme of comparative studies within a ten year time frame. Plant breeders readily admit that it will take around a decade, on average, to develop a new plant variety and test it before it is ready for release to extension agents. Why should a food security team working on malnutrition promise results in two to three years when they know it will take 5 to 10 years to answer some of these difficult questions? For example, research on the nutritional impact of shifting from food to export crops has been plagued with the lack of longitudinal data. Most studies have been carried out by a member of a single discipline over a short time span. We are not aware of any study in the region that has examined this problem from a multidisciplinary perspective over a period of five to ten years[1/]. We believe there is a need for multidisciplinary research on household food insecurity problems, in which nutrition is included as one of the major variables addressed over a five to ten year period.

We have chosen to organize our remarks on food security research priorities in southern Africa around six challenges:

(1) the food and agriculture production challenge;
(2) the marketing, rural infrastructure and storage challenge;
(3) the challenge of raising rural per capita incomes and generating employment in rural areas;
(4) food access and nutrition challenge;
(5) national food security policy analysis; and
(6) regional food security policy analysis.

1. The Food and Agriculture Production Challenge

Today, some donors are raising questions about the need to continue investments in agricultural research in light of good harvests in 1985 and 1986 in Southern Africa. We believe that continuing research is needed on removing constraints on food and agriculture production in SADCC countries for the following reasons: (a) six SADCC states

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1/ For a review of the literature see Pinstrup-Anderson, (1985). See Coulson, (1984) for an anthropologist's view on household and village food insecurity. For methodological issues in carrying out research on households see Rukuni (1986).

are facing food deficits; (b) SADCC's population will increase by around 30 million (e.g. 70 to 100 million) by the year 2000[1/]; (c) annual population growth of 3 percent and income growth of 1 to 2 percent translate into an annual increase in the demand for food of 4 to 5 percent per year - rates that few countries have sustained for a decade or more, (d) lack of proven sorghum and millet packages for smallholders in low rainfall areas where household food insecurity is a major problem; and (e) the expansion of agricultural exports is central to foreign exchange and rural employment generation.

Research is needed on three production issues: (1) increasing food and agricultural production with emphasis on food deficit SADCC states, (2) reducing crop production instability and (3) diversification away from grain, especially in the maize belt. First, let us examine the food and agriculture production challenge. If SADCC states want to increase food and agricultural production, they will have to make large investments in agricultural research, human capital, infrastructure and develop a favourable economic policy environment. But most Third World countries have found it difficult to achieve and sustain annual food and agricultural production growth rates of 4 percent or more for one or more decades. Under conditions of rapid population growth in the SADCC region, food security researchers - especially in food deficit countries - should join forces with farming systems researchers in carrying out research on constraints on food and agricultural production. The second aspect of the food and agricultural production challenge is reducing crop instability[2/]. Since cereal

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1/ The population growth rate in the SADCC region (about 3.2 percent) is roughly triple the annual rate of growth in some industrial countries (e.g. Netherlands and Norway from 1850 to 1900 and Japan from 1878 to 1912) at a comparable stage in their economic history.

2/ For information on crop production instability in SADCC states for the 1960-80 period, see Koester (1986, p.45).

production is volatile in the SADCC region, the ICRISAT/ SADCC research on sorghum and millet is timely and much needed. Also research on irrigation should be expanded with due note taken of the vast number of failures of irrigation in Eastern and Western Africa. The third type of production research is the development of new production technology to diversify away from grain. This will require stepped-up research on new industrial crops (e.g. natural rubber), export crops (horticultural products, cut flowers) and high value crops such as spices.

2. Marketing, Rural Infrastructure and Storage

The emergence of maize surpluses in Zimbabwe and Malawi and the red sorghum surplus in Zimbabwe throws the spotlight on the need for marketing and trade research, a neglected topic by agricultural economists relative to research on farming systems and production problems (Eicher, 1986). The need for marketing research is reinforced by data showi-ng that farmers in Nigeria, Malawi, Tanzania, Kenya and the Sudan received 40 to 50 percent of the final consumer price of grain from 1975 to 1980, a substantially lower percentage than the 71 to 87 percent received by farmers in four Asian countries (Ahmed and Rustagi, 1985). Lower returns to African farmers were attributed to high marketing board charges and higher rural transport costs[1/]. Presently most studies of marketing, transportation and storage in the region are being carried out by independent teams. We believe that an integrated research programme on marketing infrastructure, transportation and grain storage is needed in SADCC states.

3. Challenge of Raising Per Capita Incomes and Generating Employment in Rural Areas

Typically, average per capita incomes in urban areas are

1/ Mellor (1984) reports that rural transport costs per ton mile in Africa are typically double those of Asia.

several times higher than in rural areas in Africa. Since research has shown that hunger and malnutrition in many countries is an income problem, the challenge for food security researchers is to help develop policies, programmes and projects to raise rural per capita incomes in farming and rural non-farm activities such as rural small scale industries, trading, etc.

One of the most direct ways of raising rural per capita incomes in food deficit countries is to increase food and agricultural production. Expanded food production can increase household food security, generate income from the sale of food, or release resources (land and labour) to produce non food crops or off-farm employment. Much of the increase in incomes that farmers will receive will be spent on locally produced goods and services. In food surplus countries, expanded food production can benefit the poor - especially net food purchasers - by driving down the cost of food so that families may eventually spend 20 to 30 percent of their disposable income on food rather than 40 to 60 percent - a common range in Africa.

SADCC's updated food and agriculture strategy explicitly recognizes that a direct attack on rural poverty must be broadly conceptualized and it must go beyond stepping up food production (SADCC, 1987). SADCC's present regional research programmes on sorghum, millet and grain legumes should be supplemented with research on export crops, industrial crops etc. in order to generate new production technology capable of producing new income streams and employment for rural people.

Closely related to research on raising rural incomes is research on employment generation. In the 1950s and 1960s, it was assumed that rural-urban migration was a desirable and inevitable feature of the development process. Today few economists argue for government policies to stimulate rural to urban migration. For example, in Botswana around

20,000 school leavers are coming on the market each year while 7,600 new jobs are forecast in the industrial-urban sectors over the 1985-91 Development Plan. In Zimbabwe's Five Year Development Plan (1986-1990), high priority is given to rural employment generation because roughly 85,000 school leavers have been added to the labor force for each of the past three years and only 6,000 or less than 10 percent are estimated to have found jobs in the industrial-urban sector (Zimbabwe, 1985, p6). The challenge is how to find productive employment for the remaining 90 percent in the rural economy until there is an expansion in industrial-urban jobs.

4. The Food Access and Nutrition Research Challenge

The FAO estimates that roughly one fourth of the people in sub-Saharan Africa or 100 million were malnourished in 1985. But data are scarce on the incidence of malnutrition by age, sex, income group and within households. Although some of the nutrition surveys are "classified" in the SADCC region, malnutrition is a problem in the region, even in food surplus countries.

Nutrition research is complex and fraught with conceptual difficulties. For example, Field (1977) describes the state of the art of nutrition as the "soft underbelly of applied knowledge". Surveys of seasonal food availability are fraught with conceptual difficulties in disentangling the separate effects of disease and low food intake on weight, height and nutritional well being.

Nutrition improvement programmes are running far ahead of the conceptual understanding of the determinants of nutrition. For example, although economists such as Reutlinger and Sen have emphasized poverty reduction as the key to improved nutrition, posing the malnutrition problem either as a food production (i.e. lack of available food) or a poverty problem is a vast oversimplification of the issues involved. For example, in a sample of 4,000 families in Nicaragua, Behrman and Wolfe (1984) found that higher income was a strategic factor in improving household nutrition at low levels of income. But as income levels increased, the income impact on nutrient demand faded and other factors such as womens' schooling and non nutritive characteristics of food such as taste, convenience, status conferral and time intensity - all played a role in influencing the nutrition status of households.

Because of conceptual and operational problems some donors are pulling back from nutrition improvement projects[1/]. Donors have found that nutrition interventions are dependent on other factors, such as improved health and clean water for successful execution. Moreover, the administrative and professional capacity of Ministries of Health to plan and implement nutrition projects is in short supply in many African countries. In sum, most donors are in a quandary on how to proceed with nutrition interventions.

What is the nutrition research agenda? In order to design effective food security programmes to combat malnutrition, one must first know who the malnourished are, what they eat, and why they are hungry? In much of Africa basic information is sparse on the incidence and causes of chronic malnutrition and on the socioeconomic characteristics of the malnourished. Methodological advances are needed to design more cost-effective means of gathering such information; traditional nutrition studies usually fail to elicit information on the relationship between income and consumption. Conventional income-expenditure studies, especially when conducted in rural areas, are

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1/ For example, in fiscal year 1986, the World Bank approved only one new nutrition project worldwide - a US$ 33.4 million nutrition and community-health project in Indonesia (World Bank, 1986a, pp.129-130).

extremely costly. Yet without such information it is impossible to determine the most cost-effective way of increasing caloric intake in a given rural area: Is it through improving home food production, reducing post-harvest losses, or expanding nonfarm employment, coupled with improvements in the food marketing system? In urban areas, knowledge of the consumption patterns of the poor is needed to design programmes that protect the poor from bearing an undue burden of the painful structural adjustments that many African countries are undergoing (Eicher and Staatz, 1985).

5. National Food Security Policy Analysis

National food security policy analysis is the crucial link between household and regional analysis.[1/] Because of the vast differences in ideology, institutions and opportunities for development, each SADCC state should develop a food security policy analysis capability in government and/or local universities. A critical question is: where is the optimum location of a food security planning/research unit - the Ministry of Agriculture, Ministry of Economic Planning or in the Office of the President? There is no guideline on this issue except to point out that the Botswana model is appealing in that four inter-ministerial Committees feed information on drought and food insecurity into a coordinating unit in the Ministry of Finance and Economic Planning. Currently there is untapped capacity in planning units in Ministries of Agriculture in most SADCC states that could be mobilized for food security policy analysis. Most planning units are smothered with project aid and consumed by its attendant reporting requirements[/2].

1/ In Malawi several national nutrition surveys have been completed by the Centre of Social Research of the University of Malawi. See Ettema and Msukwa (1985).

2/ In 1985 in Kenya there were roughly 1000 different development projects covering all sectors (Eicher, 1986).

Because of intra-regional trade linkages, if follows that national and regional research programmes should be developed as a unified package and undertaken in a regional framework. Moreover, since African economies are integrated into the world economy through trade and exchange rate linkages, a logical question is what type of economic model is needed to capture these linkages? Computable general equilibrium models (CGE) have been used for this purpose in Egypt, India and South Korea. DeJanvry reports that:

> The trade-offs implied between growth of different sectors, security of food entitlements for different social groups, and short-run versus long-run effects are far from obvious and were partially captured in the results we presented from multi-sector, multiclass economic models for India and Egypt. In this new context, Third World countries must, consequently, design their agricultural policies and their strategies of security of food entitlements with a clear understanding and an explicit quantification of these trade-offs (De Janvry, 1986, p.37).

But the number of macro economists with modeling skills to carry out general equilibrium studies in sub-Saharan African countries is extremely small relative to the number available in countries such as India and Egypt. Moreover, the data base is inadequate for CGE modeling in sub-Saharan Africa.

Most SADCC states do not have an adequate data base and local policy expertise to carry out comprehensive studies of food security policy options. For this reason, we believe that food security researchers in Southern Africa should initially concentrate on partial equilibrium and sub-sector studies (Shaffer, 1970). Priority for sub-sector studies should be given to one or two staple foods in the national economy[1/]. For example, because maize accounts for roughly half of the calories consumed by

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1/ For example, see the use of domestic resource cost (DRC) analysis in analysing the real cost to a nation of increasing the self-sufficiency index of wheat (Byerlee and Longmire, 1986).

the average Zimbabwean, the University of Zimbabwe research team is carrying out a comprehensive study of the maize and wheat sub-sectors, including primary data collection for 12 months. After maize and wheat, the sorghum and oilseeds subsectors will be studied because of their importance in household food security among communal (smallholder) farmers in low rainfall areas.

What is the record of national food strategies? We are of the opinion that most of the 30 national food strategies that have been prepared in Africa since 1979 on the recommendation of the World Food Council[1/] have been shallow exercises. Most have relied on secondary data of dubious quality. Most of the food strategies have been prepared with the assistance of expatriate teams over a short period of time. Most of these donor-financed national food strategy exercises do not include ongoing financial and technical assistance to help strengthen local capacity for policy analysis over a 5 to 10 year period. In sum, the World Food Council has failed to provide conceptual and intellectual leadership in showing how to prepare a national food strategy and how to carry out food security policy studies after a one to five volume national food strategy has been published and put on the shelf.

To our knowledge, there is no local agricultural economist in the SADCC region carrying out research on agricultural trade and exchange rate problems. Since trade and exchange rate policies may be more important than domestic agricultural polices (e.g. agricultural credit) in influencing the performance of the food and agriculture sectors in national economies, a logical question is: What can be done to train a new generation of agricultural economists and economists to devote their career to teaching and research on the macroeconomics of food and agriculture?[2/]

1/ See Williams (1985).
2/ See De Janvry, (1986), Kydd (1986) and Schuh (1986) for an elaboration of needed studies.

Because numerous Asian countries have decades of experience in dealing with food policy issues, including alternative institutions to increase access to food, it is important for researchers in the SADCC region to examine the Asian experience. Two institutional innovations in Asia - the Famine Codes of India and the free rice ration in Sri Lanka - are of special interest.

In 1880 the Famine Commission appointed by the British government issued a report that was a landmark in the history of famines and famine prevention in India. Soon after the report was issued, the Codes were enacted into law. The Famine Codes provided compulsory guidelines to the local administration throughout India for the anticipation, recognition and relief of famine..., including detailed contingency plans to deal with a food crisis within a legal framework (Dreze, 1986). Subsequent Famine Commissions of 1898 and 1901 refined the Famine Codes based on practical experience in providing dole, cooked food, food for work, etc. The backbone of famine prevention and relief in India today remains the same as 100 years ago - the organization of massive public works in food deficit areas that offered a subsistence (cash) wage. This method was successful in drawing food into deficit areas. The aim of the strategy was to "provide employment at a subsistence (cash) wage and at a reasonable distance from the homes to all who came forward for it" (Dreze, 1986, p.18). For those who were unable to work, food was provided in the form of doles or kitchens.

Botswana is the first country in Africa to set in motion what India did 100 years ago - establish a permanent institutional capacity to deal with drought and hunger. We believe that a SADCC conference should be convened to study Botswana's pioneering food security programmes that are detailed in Botswana (1985) and Holm and Morgan (1985).

The second Asian example is Sri Lanka's experiment with general (free rice ration for all citizens) and later with targeted food subsidies. Sri Lanka has been intensely studied because the advocates of Basic Needs have asserted that three social policies - subsidised food, free education and a free universal health care service - have enabled Sri Lanka to achieve upper income country standards of health, literacy and life expectancy while still a poor country. For example, with 16 million people and a per capita GDP of $360, Sri Lanka had a higher life expectancy at birth (70) than all but two of the 76 low and lower middle income countries in the world in 1984 (World Bank, 1986a).

Sri Lanka's general rice subsidy policy was started in 1960 when a free rice ration (2 lbs. per week) was made available to every member of society[1/]. In 1970 a new government supplemented the weekly free rice ration by another two pounds at a subsidized price. In 1977 with a new government, the general rice subsidy was replaced with a targeted program restricted to the poorest half of the population. (Since incomes were based on self-declaration, some leakage to wealthier households was inevitable). The replacement of the general subsidy with a targeted programme starting in 1977 was effective in reaching the poor (almost 70 percent of the bottom half of the population received food). Moreover, targeting has reduced the net food subsidies from a level of 14 percent of government expenditures in 1970 to 11 percent in 1979 and to less than 4 percent in 1984 (Bhalla and Glewwe, 1986, p.54). Sri Lanka's 26 years of experimentation with general and targeted food subsidy programmes should be closely examined by SADCC states.

In summary, research on national food security policy options in SADCC states is in its infancy. Research in

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1/ This case study is drawn from Bhalla and Glewwe (1986).

progress is heavily weighted toward the food availability side of the equation. The challenge for each SADCC state is to develop a research programme to accumulate a body of knowledge on the central food security question : How to assure adequate consumption of food for the entire population throughout the year at the least possible cost?

6. Regional Food Security Studies

The starting point for reviewing regional research priorities is to take stock of the studies being carried out by the Southern Africa Development Coordination Conference (SADCC). When SADCC was established in Lusaka in 1980, the aim of the organization was to accelerate regional co-operation by the nine Member states, further social and economic development and reduce the dependence on South Africa. Seven regional food and agriculture sector programmes were established by SADCC in 1980. Zimbabwe was requested to provide leadership in designing and implementing one of the programmes - regional food security.

The initial SADCC meeting in Lusaka in 1980 did not provide Zimbabwe's Ministry of Agriculture with a definition of regional food security (Murphy, 1983, p219). The Economics and Markets Branch of Zimbabwe's Agriculture Ministry was given six weeks to develop a regional food security programme of work for SADCC (Murphy, 1983, p.220). One of the first steps taken by the Branch was to set up an Inter Ministerial Committee. Subsequently, two technical level meetings were held comprised of officials from Agriculture Ministries of all nine SADCC countries. Over a period of several months in mid 1980, the various committees reached the following conclusions about the nature of food insecurity in the SADCC region and steps to meet it:

(1) regional food security was interpreted to mean that "the countries of the SADCC region should be

assured of food supplies adequate in both quantitative and qualitative terms to feed their populations".

(2) food production in the region was considered about ten percent below food needs.

(3) since the region had the potential to attain food security by increasing its own food production, this should be the strategic principle on which to base its future food security policy.

(4) "a number of measures (proposals) would be necessary which, taken together, would have the effect of reducing constraints to, and encouraging increase in, food production throughout the SADCC countries" .

(5) nine regional food security proposals were approved by the Council of Ministers at Maputo in November, 1980. These proposals were later developed into projects and they became the Region's basic food security policy and programme of action. (Murphy, 1983).

In December 1982, Zimbabwe established a Food Security Administration Unit in the Ministry of Agriculture to replace the Economics and Markets Branch in administering SADCC's regional food security programme.

The co-existence of malnutrition and food surpluses highlights the need to step up research on regional marketing, trade, nutrition and access to food. Moreover, since food insecurity in the SADCC region can originate in international price movements, it is important to include research on both intra-regional and international trade. Research is also needed on managing foreign exchange, food aid and trade.

SUMMARY

In the long run, economic growth is a powerful instrument for raising per capita incomes and helping the poor purchase a better diet. But there is substantial evidence that it may take a long time before growth will cure poverty. Therefore, African governments - like governments in industrial countries - are slowly beginning to realize that they have an obligation to intervene in the short run to ensure that all people have access to a calorie-adequate diet throughout the year. But the research base to guide government policy on food security is severely lacking in SADCC states.We have highlighted the importance of defining the food security research agenda to include both food availability and food access issues. Presently three fourths of the scientific man years are carrying out research on one half of the equation - i.e. food availability issues. A more balanced research programme is called for - i.e. one that devotes at least one half of research resources to each side of the equation.

The immensity of Africa, the complexity and diversity of agriculture and the weak data base on food consumption, nutrition, and marketing should be taken into consideration in laying out national and regional research programmes on food security. In the SADCC region, increasing food production in food deficit states is a major challenge for food security researchers working in combination with farming systems researchers. Presently there are no rules, models or guidelines on cost-effective policies and institutions to increase food access in SADCC states. The lack of research on alternative institutions to increase access to food should come as no surprise because, as Myrdal notes, the institutional issues are avoided by "most ordinary economists" (Myrdal, 1985, p.154).

We believe that food security researchers should argue for parity with plant breeders in terms of length of funding

for their research programmes. For example, ICRISAT has cogently made the case for a long term (10 to 20 years) research programme on sorghum and millet for both the Sahelian and the SADCC regions. If it takes ten years, on average, to develop and farmer-test a new plant variety, why shouldn't food security researchers lay out an initial ten year research programme on malnutrition, household food insecurity in low rainfall zones, food access, etc? At the end of the day, policy makers and donors should realize that the food security research agenda is complex, difficult and requires long term financial support.

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PART II

FOOD SECURITY FOR THE SADCC REGION

PART II

INTRODUCTION

The four chapters in Part II introduce the reader to the evolution of SADCC's strategy for food, agriculture, natural resources and food security from 1980 to 1987.

The Southern Africa Development Coordination Conference (SADCC) was established in 1980 and it includes nine member States: Angola, Botswana, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe. When the SADCC Heads of state held their initial summit meeting in Lusaka they pledged to work together to increase political and economic cooperation among member states, to reduce dependency on South Africa and to foster social and economic development in the region.

The economies of member States are open and highly integrated into the world economy (Koester, 1986). But a recent SADCC report points out that trade within the SADCC region is extremely small because of colonial transport routes, low level of industrialisation, foreign exchange constraints, war and sabotage (SADCC, 1986). For example, recorded intra-SADCC trade accounted for around four percent of the SADCC countries' total imports in 1982. On the other hand, the SADCC countries' trade with South Africa is considerably higher, representing 7 percent of their total exports and 30 percent of their imports.

When SADCC was established in 1980, some 70 percent of the 58 million people in the nine member States were in agriculture. Today, some 70 percent of the 70 million people in the region are dependent upon agriculture for their living.

Because of rapid population growth, total food production must be doubled every 15 to 20 years to keep up with population and income growth. Because of rapid population growth and slow absorption of labour into industry and mining, it follows that employment generations in agriculture must be given high priority by member States in the short and intermediate run. Finally, since agriculture contributes about 60 percent of the foreign exchange earnings in the five member states not dominated by mining, it follows that development policies and strategies should foster the growth of agricultural exports.

Because of the strategic importance of the agricultural sector to the achievement of SADCC's goals, the Heads of State agreed in 1980 to pool resources in developing regional action programmes for seven food and agriculture sub-sectors. Four member States were given responsibility to develop and implement regional programmes for the seven sub-sectors as follows:

1. Food security - Zimbabwe
2. Agricultural research - Botswana
3. Livestock production and animal disease control - Botswana
4. Soil and water conservation and land utilisation - Lesotho
5. Fisheries - Malawi
6. Forestry - Malawi
7. Wildlife - Malawi

Although member States were assigned responsibility for these seven sub-sectors in 1980, it took several years for member States to set up the machinery to get regional programmes underway. During the 1980 to 1983 period, numerous feasibility studies were carried out for key sectors such as mining, transportation, industry and agriculture.

In September 1983, the Director General of the FAO volunteered the services of his organisation to assist SADCC in figuring out how to achieve its goals of greater food security and self-reliance. The FAO report <u>SADCC Agriculture: Toward 2000</u> (FAO, 1984) was presented at SADCC's 1984 annual conference in Lusaka in February, 1984.

Later, in 1984, the SADCC Ministers of Agriculture met in Lesotho and accepted the main thrust of the FAO report. In Chapter Two, Eicher and Mangwiro critically review the FAO report on SADCC agriculture and conclude that it was another "False Start" for Africa.

In June 1986, SADCC's Council of Ministers met in Maputo and charged the SADCC Ministers of Agriculture to carry out an exhaustive review of the agriculture sector, including the nature, content and institutionalisation of the regional food and agriculture programme. SADCC's new policy and strategy for the development of food, agriculture and natural resources was approved by SADCC Ministers of Agriculture in October, 1986. A summary of the SADCC report Food, Agriculture and Natural Resources is reprinted in Chapter Three. K.J.M. Dhliwayo, head of SADCC's Food Security Programme, outlines SADCC's updated food security strategy in Chapter Four. He reports that SADCC's updated strategy defines food security to include both food availability and access to food. Dhliwayo discusses SADCC's transition to a broader food security action programme and includes a list of 12 regional food security projects in Annex A.

Because of the emergence of the maize surplus in the maize belt and food deficits in six SADCC states, a logical question is: What can be done to increase intra-regional food trade, including triangular food trade. In Chapter Five, Professor Nziramasanga discusses the political economy of food aid, food trade and triangular aid in the SADCC region.

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CHAPTER TWO

A CRITICAL ASSESSMENT OF THE FAO REPORT ON SADCC AGRICULTURE

Carl K. Eicher and Fidelis Mangwiro

"The principal danger in macro-economic exercises lies in their propensity to dazzle"
- W. Arthur Lewis, 1966.

INTRODUCTION

The Director-General of the Food and Agriculture Organization of the United Nations (FAO) proposed to SADCC in September, 1983, that the FAO undertake an analysis of SADCC's long-term food supply and demand prospects to year 2000. SADCC's acceptance of the offer was followed by the appointment of a Rome-based task force to carry out the study; the FAO team completed its report in six months and it was published as SADCC Agriculture: Toward 2000 (FAO, 1984).

The objective of SADCC Agriculture was to provide a framework by which planners can assess available resources and consider two alternative courses of action (strategies) "to promote SADCC's goals of greater food security and self-reliance" (p xiii). The report advanced twenty-three policy recommendations for implementation at both national and regional levels in order to accelerate agricultural development in the region. The focus of the FAO report is on measures to increase the level of food self sufficiency while assuming that people in the SADCC region will have the ability (land, income or jobs) to acquire a calorie-adequate diet.

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* This chapter is a revised version of a larger background paper that was prepared for a SADCC Meeting of Permanent Secretaries, Chief Economists, Food and Agriculture Sector Coordinators and Ministers of Agriculture, Harare, July 24-26, 1986 (See Eicher and Mangwiro (1986).

The purpose of this chapter is to present an independent assessment of the FAO report and draws some sobering lessons for external task forces and visiting "experts" preparing reports on SADCC agriculture.

METHODOLOGY

The FAO team preparing the report for SADCC drew heavily on the methodology and data generated in the preparation of Agriculture: Toward 2000 (FAO, 1981). The Rome-based FAO team developed three computer scenarios for SADCC agriculture from 1979-81 to year 2000. The team first examined the agricultural performance of SADCC countries from 1966-81 (adjusted for external shocks such as weather and wars). The team then used these historical data (e.g. average crop yields) in developing a computer scenario to trace the consequences of pursuing present food and agricultural policies during the 1980s and 1990s to year 2000. This is described as the trend (T) scenario. But the projections for the T scenario were gloomy. Under this scenario, population growth rates were projected to be twice as high as food production growth rates in year 2000. For example, the annual increase in demand for food arising from income and population growth was estimated to be 3.5 percent compared with 1.5 percent growth in agricultural production.

The trend (T) scenario was used as a benchmark to compare two alternative food and agricultural strategies: an Improved Performance (IP) and a High Performance (HP) food and agriculture strategy to year 2000. The FAO team used its computers in Rome to develop conditional projections[1/] of expected outputs of SADCC agriculture for each of the

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1/ The FAO team took pains to point out that they did not have the time, data and funds to make "forecasts" of what is likely to happen but instead presented conditional projections of "what could happen given certain policy assumptions" (p. xv).

three strategies for 1990, 1995 and 2000. The improved performance strategy (IP) for year 2000 assumes that the nine governments in the SADCC region would each step up public expenditure on agriculture, assumes agricultural researchers would be more productive[1/] and assumes that the agricultural production would more than double, from 1.4 to 3.2 percent per year. However, under the improved performance (IP) strategy, the 3.2 percent annual growth in agricultural production would still be less than the 4.0 percent assumed annual increase in the demand for agricultural products over the 1984-2000 period.

The high performance (HP) strategy assumes that SADCC governments would give even higher priority to agriculture than in the IP strategy, and assumes that even higher crop yields would be forthcoming. The results of the computer runs on the HP strategy were favourable and regional food self-sufficiency was projected to be achieved in all food categories by 2000, except for livestock. However, it was assumed that higher agricultural exports would finance livestock imports into the region.

In light of the weak data base in the region, it is a puzzle why the team relied so heavily on developing computer scenarios of SADCC agriculture?

AN ANALYSIS OF RESULTS

While one can take issue with the FAO on dozens of details of SADCC Agriculture, space permits us to mention only

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1/ This is a heroic assumption because of the serendipitous nature of research. Moreover, it takes a decade, on average, for plant breeders to develop, farmer test and release a new variety. But there are many "dry holes" in research and in some countries it takes several decades of research to develop new technology. For example, it took 28 years of research (1932 to 1960) to develop the famous SR 52 hybrid maize variety for commercial farmers in Zimbabwe (Eicher, 1984).

nine general reservations about the accuracy and usefulness of the report:

1. Production Estimates

The starting point in a study of the potential of increasing food and agriculture production in the nine countries in the SADCC region is to examine the micro data base with emphasis on crop yields, output and livestock off-take rates on a crop by crop and country by country basis. The FAO team approached this task by examining 27 commodities and constructing commodity balances (demand, production and trade) for each commodity for a base year (the three year average for 1979-81) and two future points: 1990 and 2000. The team then developed production projections on the basis of estimates by unidentified "authorities" on likely feasible yields for each of the 27 crops, cropping intensity, and the allocation of land to crops for six land-water classes in the SADCC region. Similar estimates were made for herd growth, off-take rates and carcass weights for cattle, buffalo, sheep, goats, pigs and poultry. Crop and livestock production estimates were then generated by the computer for the three scenarios and checked with projections of demand for food and other commodities at various years along the way to 2000.

The FAO experts glossed over the stark reality that the data base on crop and livestock production is extremely weak. The FAO task force should have been candid on this issue and attached a bibliography of data sources (with reservations and adjustments), including names of the unidentified "authorities" who provided their views on likely crop yields in 1990, 1995 and 2000[1/].

1/ The FAO report does not include a bibliography - a standard feature of a scientific report.

There are two standard data sets on world agriculture - FAO and the U.S. Department of Agriculture (USDA). But production estimates from these two institutions can vary by a factor of 50 to 350 percent in a given country. For example, Uma Lele and Wilfred Candler of the World Bank report that for 1973-74, the USDA estimate of sorghum and millet production in Tanzania was 3.5 times higher than that of the Ministry of Agriculture while the FAO estimate was 88 percent of the Ministry's (Lele and Candler, 1984, p.211). Moreover, Lele and Candler contend that:

> data on domestic agriculture in most African countries are too unreliable to ascertain the level of production in any given year. Further, year-to-year production fluctuations in reported statistics are often too large to estimate a trend with any degree of confidence. Judgements about deviations from a trend by amounts as small as five or ten percentage points would be nearly impossible (Lele and Candle, 1984, p 211).

If there are uncertainties about data quality in Tanzania two decades after independence, what about the quality of data on agriculture in Angola, Mozambique and Zimbabwe? In Zimbabwe, there are around 4,200 commercial farmers and 800,000 communal (smallholder) farmers. The data base on commercial farmers is probably the best in Africa but the data base on communal farmers is extremely weak. For example, the Commission of Inquiry into the Agricultural Industry of Zimbabwe reported after a year of fact-finding that:

> It is salutary to observe that Zimbabwe, in spite of its proud record of agicultural research, has an almost total absence of detailed data on conditions in the communal lands. This country urgently requires a comprehensive data base on socio-economic conditions in the communal lands both to guide agricultural policy and to ensure that resources devoted to agriculture are put to their best use. Without such data the improvement of productivity in communal areas will remain at best a "hit or miss affair" (Chavanduka, 1982. p.9).

In summary, the data base on crop and livestock production in the SADCC region is so unreliable that it raises serious questions about shoveling "official" data into computers and generating conditional projections for 1990, 1995 and 2000. The failure to alert readers to the unreliable data base of the computer senarios is disturbing - especially given the fact that the FAO is the official UN organization charged with collecting and maintaining historical data on world agriculture.

2. Demand Estimates

With population growing at 2.5 to 4.0 percent per year and per capita income growth projections of 0 to 2 percent per year, the annual increase in the demand for food will range from 2.5 to 5 or 6 percent per year in SADCC countries. However, the estimation of the demand for food five, ten and 15 years down the road is a complex and risky exercise. For example, there are almost no recent estimates of income elasticities for staple foods in the SADCC region. Although food consumption surveys were popular in Africa in the 1960's (Eicher and Baker, 1982), this area of research has been dormant in Africa for more than a decade[1/].

Several staple foods require special attention in demand studies, for example, since roughly two-thirds of the wheat consumed in the SADCC region in 1985 was imported, wheat dependency is a complex political economy issue that requires careful analysis. The FAO report states that "Zimbabwe is the only surplus producer of wheat" (FAO, 1984, p.7.13) in the SADCC region when, in fact, Zimbabwe has been importing wheat since 1982. For the FAO to report that Zimbabwe was a"surplus producer of wheat" in 1984 when it imported wheat raises further questions about the reliability and credibility of the FAO report. In 1986,

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1/ For example, Paulino (1987) concentrates on supply projections because of the dearth of demand data.

Zimbabwe imported about 15 percent of its domestic wheat requirements and restricted the demand for wheat through an informal rationing system of supplying only 20,000 tons a month to millers.

The importance of reliable demand estimates for the type of study that the FAO carried out for SADCC is stressed in a review of 10 studies of food balance projections that were initiated in the midst of the global food crisis of 1973/74. Fox and Ruttan (1983) concluded that the failure of the authors of the 10 studies to carefully examine the transitory demand - side factors of the global food market in the early 1970's led to an incomplete analysis and pessimistic global food projections for the 1980's.

4. Technology on the Shelf

We believe that the FAO report overestimates the stock of food crop technology on the shelf in the SADCC region. The FAO team asserts that "what is missing at both national and regional levels is an examination of why farmers have not accepted technologies" (p. 3.26). Presently, there is a backlog of maize varieties on the shelf in the maize belt (Zimbabwe, Zambia and Malawi) in the SADCC region and red sorghum for brewing. But technology is not on the shelf in most SADCC countries for the following food crops: white sorghum, millet, summer wheat, rice and groundnut varieties for small farmers. We believe that the FAO should have given more attention to a country-by-country inventory of present food crop technology and devoted more attention to measures to strengthen national research services for the development of improved technological packages.

There are many mysteries about science, technology and African agriculture[1/]. Why are some crops more robust in

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1/ For an elaboration of some of these puzzles see Carl K. Eicher (1982) and "Western Science and African Hunger" (1986a).

terms of international transfer? What explains the vast difference in the ability to move maize and wheat germplasm worldwide? For example, CIMMYT, the Mexican-based international research center on wheat and maize, reports that 45 million hectares of wheat but only 4 million hectares of maize varieties carry CIMMYT germplasm in developing countries (CIMMYT, 1985). This is one of the many puzzles about technology transfer that requires more analysis. In summary, the FAO report devotes superficial attention to science, technology and SADCC agriculture.

4. Human Capital

The shortage of professional agricultural manpower is acute in the SADCC region. For example, in 1985, expatriates represented 26 percent of all professional staff in research, extension services, agricultural training schools and faculties of agriculture in the nine SADCC countries (Devres, 1985, p. 46). Moreover there is growing criticism of expatriates and technical assistance in SADCC policy circles[1/]. For these reasons, one would expect that human capital improvement in the region would be examined in depth but, unfortunately, SADCC Agriculture devotes only three pages to human capital (pp 6.8 to 6.11) The report notes that "The main finding is that the principal requirement for greater food self-sufficiency is the effective mobilization of human resources rather than the development of physical resources" (p xix). The FAO report then advances the following banality for policy makers in the SADCC region: "manpower training is the most effective long-term approach to increasing absorptive capacity" (p. 6.10).

1/ See Eicher (1986) for a discussion of technical assistance - its cost, uneven quality, and its high turnover.

5. Institutional Puzzles

Most agricultural development specialists, including agricultural economists are specialists in a commodity such as coffee or maize, or a problem area such as maize streak virus, nematodes, credit or marketing. As a result of their specialised training, most agricultural development specialists display a singular lack of interest in the role of institutions - political, legal, social, technical, and cultural - in development. The FAO is no exception in this regard. The ignorance of the FAO team about SADCC institutions surfaces throughout the report. If the FAO team had more time, they undoubtedly would have devoted more attention to examining how to strengthen the institutional base - research, training and extension - for smallholder agriculture in the SADC region.

6. Food Losses

The FAO report asserts that "pre and postharvest losses from pests and diseases currently reduce food availability by 30 to 40 percent or more" (FAO, 1984, p3.9). But the FAO does not provide evidence to support this assertion. In a recent review of the literature on postharvest losses in developing countries, a big gap was found between "guestimates" produced by short term missions and actual losses recorded by careful research studies. Greeley reports that:

> eleven 'expert' guestimates on post-harvest losses of rice at farm level in Bangladesh were published between 1975 and 1980; their average was 26.8 percent. By contrast, a three year research project which physically measured losses in all post-harvest operations from cutting to cooking showed that total post-harvest rice losses at farm level were below 7 percent (Greeley, 1986, pp 340-41).

We are of the opinion that simple but thorough studies of actual losses from pests, disease and on-farm storage are needed before donors decide to invest in programmes to reduce post-harvest losses in the region.

7. Agricultural Growth Rate Projections

Central to the FAO projection exercise is the assumption that 21 policy reforms will spur economic growth and increase agricultural growth rates. In fact, the high performance (HP) scenario assumes that the rate of agricultural growth will be 4.8 percent per year over the 1979-81 to 2000 period (page 2.11). But a word of caution is in order. Few countries in the Third World have been able to achieve and sustain annual rates of growth of agricultural output of four percent for one or more decades. Reynolds (1986) recently compared the agricultural performance of forty-one countries for thirty years, 1952-1981. He found that none of the African countries achieved annual growth rates of agricultural output of 4 percent or more - for the entire period. Only one of the five high performance countries in Asia and Latin America, Thailand, achieved a growth rate above 4 percent in all four periods as shown in Table 1.

Table 1: Annual Growth Rates of Agricultural Production in Five Countries: 1952/54-1979/81

Country	1952/54-1959/61	1959/61-1969/71	1969/71-1979/81	1952/54-1979/81
South Korea	5.4	3.2	4.2	4.4
Thailand	4.5	5.1	5.1	4.8
Malaysia	3.0	5.6	4.8	4.4
Mexico	5.0	4.5	3.5	4.1
Venezuela	4.5	5.3	3.8	4.4

(Source: Reynolds 1986, pp.96-97)

In summary, most Third World countries have found it difficult to achieve and sustain annual food and agricultural production growth rates of 4 percent or more for one or more decades.

8. Nutrition

A decade ago two World Bank economists - Reutlinger and Selowsky (1976) - pointed out the fallacy of estimating a country-wide average of daily per capita calorie intake without taking the distribution of income into account[1/]. The FAO report on SADCC Agriculture estimates that the per capita calorie supply for the entire SADCC region will be 2,117 in 1990 and 2,188 in 2000 (page 2.10). These heroic guestimates make no allowance for distribution of income and the capacity of various classes in society to produce, purchase or acquire food. In sum, the two pages devoted to food consumption and nutrition in the FAO report have little scientific validity.

9. Policy Reform

The report lists 23 specific policy measures needed to achieve the targets set for 2000 by the Improved Performance (IP) scenarios. But instead of identifying specific policy measures, the report identifies general measures applicable to almost any country in Africa, Asia or Latin America. For example, policy measure No.16 on livestock improvement recommends that

> Measures in this area are also highly dependent on progress in changing the social role of cattle and on attitudes to communal grazing land; they are further constrained by the lack of extension workers. However, possibilities for action do exist. For example, livestock owners can be brought together with local leaders to form livestock associations, or they may be organized through village committees to bring about agreements on the use of communal grazing and to improve contacts with extension services (p.3.28).

1/ For example, the authors found that in Brazil the average daily level of calorie consumption (2,566) was more than adequate based on estimates of <u>average</u> calories consumed on a national basis (i.e. dividing estimated national food production by estimated population. But an analysis of calorie consumption by income groups revealed that 44 percent of the total population were calorie deficient (Reutlinger and Selowsky, 1976, pp.10 - 11).

OVERALL ASSESSMENT

The FAO study is an exercise in food pessimism and represents another "False Start" for Africa. The FAO's projections are at wide variance with the current maize surplus in SADCC's maize belt (Zimbabwe and Malawi) and the sorghum surplus in Zimbabwe. Whereas the FAO report identifies 23 policy reforms that should be undertaken by member states to increase crop and livestock production, favourable rainfall in 1985 and 1986 was obviously more important than policy reform in changing the short term food and agriculture situation in the region.

There are no quick fixes for African agriculture. This is the painful lesson that the Food and Agriculture Organization of the United Nations should learn from its maiden publication for SADCC. The FAO report on SADCC Agriculture is the product of a team that did the best it could, given the shaky data base and the time allotted - six months - by FAO's top management in Rome to complete the report. The team made a major methodological mistake by churning out computer scenarios when the underlying micro data base was so weak. Although these computer-based macro economic projection models "have a propensity to dazzle" as Nobel Laureate W. Arthur Lewis reminds us, they assume away the tough institutional, technical and political issues that govern hunger, poverty and access to food.

For donors interested in policy dialogue with SADCC states, there is no substitute for investing in strengthening policy research institutions in the SADCC region for the next 10 to 15 years. Since economic policy research is just as location-specific as maize breeding, it follows that visiting teams of "experts" and overseas-based task forces should be replaced by investments to strengthen economic policy research institutions on a country by country basis. Policy dialogue on food and agriculture requires a slow and progressive build-up of African capacity to address African problems. The biggest lesson that SADCC can learn from this assessment is to apply leverage on donors to help develop African research capacity to deal with the macroeconomics of food and agriculture in the region. What do visiting teams leave behind when they prepare a report for SADCC or a SADCC Member state?

It is interesting to note that SADCC's updated strategy for food, agriculture and natural resources that was approved by the nine SADCC Ministers of Agriculture in Mbabane, Swaziland on October 9, 1986 did not cite the 1984 FAO report (SADCC, 1987). A summary of SADCC's updated strategy is presented in the next chapter of this book.

Is it not understandable why the FAO report is gathering dust in government offices throughout the SADCC region?

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CHAPTER THREE

SADCC'S UPDATED POLICY AND STRATEGY FOR FOOD, AGRICULTURE AND NATURAL RESOURCES *

SUMMARY

Over the past six years, SADCC member States have gained a great deal of experience in designing and implementing regional programmes for food and agriculture. Responsibility for coordinating regional programmes is allocated to member States as follows:

Food Security	-	Zimbabwe
Agricultural Research	-	Botswana
Livestock Production and Animal Disease Control	-	Botswana
Soil and Water Conservation and Land Utilization	-	Lesotho
Fisheries	-	Malawi
Forestry	-	Malawi
Wildlife	-	Malawi

SADCC's food and agriculture programmes are designed individually and collectively to contribute towards regional food security through increased food production, and to raise income levels through production of cash crops. However, the emergence of food surpluses in some member States - in the midst of persistent malnutrition, underemployment and poverty - has brought into focus the complex nature of the food security situation in the region; and the need for a comprehensive approach to agricultural development. In June of 1986 the SADCC Council of Ministers called for a review of the regional food and agriculture programme with

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* This is a summary of SADCC's updated policy and strategy for the development of food, agriculture and natural resources. The full version is published as SADCC (1987) Food, Agriculture and Natural Resources. Report presented at the Annual Conference, Gaborone, Republic of Botswana, 5th - 6th February, 1987.

the objective of developing improved programmes and projects to increase agricultural production in the region. The Council also raised questions about the interrelationships between different sectoral programmes on the one hand, national and regional agricultural policies on the other; and the most appropriate approach to mobilize support for food and agriculture programmes from SADCC's cooperating partners. Following a review of the current programmes, some important modifications have been made to the regional strategy. The <u>highlights of the updated stategy</u> are as follows:

* Activities in this area will be broadly grouped into Food, Agriculture, and Natural Resources Sectors.

* The primary goal of the sector is to achieve food security at the household, national and regional levels.

* Food security is defined as ensuring that all members of a household, nation or region have access to an adequate diet to lead an active and normal life. Its two essential elements are food availability through expanded production, storage and trade and the ability of all people to acquire an adequate diet.

* Since poverty is a key cause of household food insecurity, expanding food production and the achievement of national food self-sufficiency will not automatically end food insecurity. Therefore, income and employment generating projects in rural areas (e.g. crops, raw materials for processing, small ruminants, fishing, small scale industry, etc.) are essential components of increasing national food security.

* Thus, SADCC's regional food security programme includes both sides of the food security equation - food availability and access to food.

* The strategy reiterates the importance of increasing food production; particularly in food deficit member States. It emphasises to both SADCC member States and SADCC's cooperating partners the need to give first priority to increasing food production in food deficit countries; and the need for the countries of the region to diversify agricultural activities into cash crops for both export

and domestic industrial use, horticulture and dairy production.

* Agro-industries and rural small scale industries are an integral part of the updated agriculture strategy.

* The activities of the regional agricultural research sector will be broadened to include cash crops, in order to generate production technology to expand rural incomes and foreign exchange earnings.

* Recognition of the need to anticipate rather than respond to changes in the world food economy: there is a need to strengthen the policy analysis capability in the region.

* The strategy emphasises the importance of professional training in agriculture and natural resources and charges SACCAR with developing a regional blueprint to stengthen such training, especially post graduate training on a long term basis. SADCC invites its cooperating partners - to work closely with SACCAR in planning and help implementing this important activity.

* The natural resources area will cover soil and water conservation, fisheries, forestry and wildlife; and programmes will be developed to exploit and manage the natural resource base in order to increase food, agriculture and livestock production.

* The strategy requires close liaison between the food, agriculture and natural resources sectors and the Industry and Trade sector in order to increase regional cooperation in the planning, production and trade in seeds, fertilizer, pesticides, farm machinery, processed and unprocessed food and other agricultural products; and the setting up of food processing and other agro-industries.

* Implementation of the SADCC strategy requires full cooperation from all relelvant ministries and institutions in the region. This is of particular importance with regard to programmes dealing with malnutrition and food insecurity.

In drawing up this strategy SADCC member States were conscious of their participation in a number of other multilateral fora which address problems of agricultural development. Of particular note in this regard are the recent initiatives of the OAU, the UN General Assembly and the various UN technical agencies. The implementation of the SADCC programmes in the Sector of Food, Agriculture and Natural Resources will therefore take full account of these other initiatives in order both to maximise the impact of the various activities, and also to avoid any duplication or wasteful overlap.

CHAPTER FOUR

SADCC'S UPDATED FOOD SECURITY STRATEGY

K.J.M. Dhliwayo

Perhaps the logical and most appropriate point to start the explanation of the SADCC's updated Food Security Strategy is to begin by a brief outline of the Region's concept of Food Security, determine the need for a Food Security Strategy and present a brief outline of the objectives of the Food Security Programme.

FOOD SECURITY

Food insecurity exists when there is not enough food for the people who need it. This situation can arise either because of problems in producing adequate food, distributing the food to the people who need it or because people connot afford to buy the food that is available. Food Security of the region therefore can only be achieved when all the SADCC Member states ensure that all members of their population have access to an adequate diet to lead an active and normal life throughout the year.

Two essential and integral components of Food Security are food availability (through expanded production, stocks, commercial or other food trade, or through expanded aid) and the ability of all people to acquire that food once made available.

Perhaps it should be emphasized that moves toward achieving national or regional food security begin at household/family levels, particularly in rural areas. Economic analyses indicate that, throughout the SADCC region the bulk of people who suffer either seasonal or semi-permanent food insecurity are in rural areas. Their poverty or food insecurity problems are a result , mainly of low agricultural productivity, low incomes and inappropriate income distribution. This is likely to continue to be the case for quite some time unless corrective measures are undertaken.

THE NEED FOR A STRATEGY : BACKGROUND

In many parts of the SADCC region, particularly in rural areas, seasonal food scarcity occurs annually before the harvest. This happens when food from the last harvest runs out before the new harvest comes in.

Last year's harvest may run out because enough food to feed the population may not have been produced. Until the new crop matures and is harvested, members of a household are hungry for weeks or even months at a time. Such seasonal shortfalls can be caused by a comlete lack of food production caused by either droughts, floods or invasion of crop pests and diseases or due to inadequate food delivery systems or the lack of peoples' access to food (effective demand). In the latter case, food may actually be present within a country or an area, but a large segment of the population may not have access to it simply because they lack adequate purchasing power.

The cost of the food may be so high that only the wealthy can afford it or that the poor people do not have the necessary cash to buy it even if it is available at a reasonable price.

Food insecurity may also be due to the fact that delivery/distribution systems breakdown or lack adequate capacity to move food to those in need of it, causing food to pile up or even rot in docks or silos.

In the SADCC region, the majority of people - men, women and children - who suffer from food insecurity (seasonal famine) live and work in rural areas. Many are landless labourers or peasant farmers who either do not own land or lack adequate productive resources with which to produce enough food for themselves. They often lack access to credit, agricultural inputs, adequate training and extension service and other technical and marketing facilities.

OBJECTIVES OF THE FOOD SECURITY PROGRAMME

Although the overall aim of the regional Food Security Programme is to increase food availability so that the region can be more self-sufficient in its basic foods needs, the strategy of SADCC's Food Security Sector clearly recognizes that household, national or regional food security cannot be achieved from increased production alone. Food production needs to be complemented by increased cash crop production, enhanced commercial movement of food and agricultural products and inputs within and among Member states and the development of other activities that can generate employment and incomes in order to ensure that people have both physical and financial access to food.

Within this broad aim, the three objectives of the food security programme are:

i) to satisfy the basic needs for food of the population of the region and progressively to improve food supplies to all the people in the region irrespective of their position in society:

ii) to achieve regional self-sufficiency in food supply to the maximum extent possible in order to reduce the region's dependence on external sources of food; and,

iii) to eliminate periodic food crises which affect some areas or countries of the region.

SADCC STRATEGY ON FOOD SECURITY

In order to achieve food security, the Food Security strategy focuses on a number of the major components of a food supply system, namely: improved food and agricultural production; food storage and processing and the distribution of food and other agricultural products on the one hand and, the accessibility of food to the majority of people in the region on the other.

It is strongly felt that the only long term solution to the problem of food security in the region is increased food production because no amount of food aid or other palliatives can solve the problem in a substantial sense. However, the task of increasing food availability and accessibility has to be undertaken in a broad development framework which includes the development of other agricultural enterprises, the provision of fertilizer, pesticides, appropriate technology, provision of adequate training and extension services and the involvement of large masses of people particularly the small-scale farmers and the landless in the process of development and employment.

The proposed strategy for the achivement of SADCC food security objectives, therefore consists of 8 principal elements, namely:

- development of a mechanism for the exchange of technical and economic information
- reinforcement of national food production capacity
- improvement of the food storage, distribution/ delivery, conservation and processing systems
- development of cash crops and other agricultural enterprises
- establishment of systems for the prevention of food crises and the development of national food security strategies

- establishment of programmes for the control of major crop pests and crop diseases
- the development of skilled manpower, and
- the development of intra-regional trade.

The Regional Food Security Strategy is an integrated policy package and its major elements are complementary. The principal element of the Stragety is the exchange of technical and economic information, experiences and know-how in agricultural production technology and food supply management. Cooperation on the exchange of information in agricultural production, food supplies, crop prospects, regional resources base, food trade, comodity prices and the constraints on the demand and supply of agricultural commodities, will contribute not only to regional food security but also to the rapid development of the national economies. In this regard, closer links are being developed among the Food, Agriculture and Natural Resources sectors and between these sectors and the other sectors in SADCC's Programme of action such as Trade and Industry, Transport, Manpower, Mining and Energy. However, food security will not be attained only through the exchange of ideas and skills at a regional level. At a national and village levels, this information must be used for the enhancement and reinforcement of national food production capacities i.e. by the farmers and the supporting service institutions such as the credit, research, training and extension organizations.

It is at the national level that the most potent and effective instruments - prices, tax, monetary/credit, budget, public investment and training and extension policies - are formulated and implemented with a view to encourage farmers to increase food production. It is at the national level that these policy instruments have a greater reach into the rural food economy than any that may be conferred upon at a regional level. However, through regional activities such as short-term or inservice training, exchange of manpower at mid-level management, problems-oriented seminars and courses, and through direct assistance in the planning and designing of projects, it is anticipated that the national production capacities will be enhanced and strengthened. Through these and other regional activities, greater emphasis will be given to the analysis of alternative national and regional food security and agricultural policies and the exchange of experiences in apppropriate public welfare interventions aimed at improving household food security.

The strategy fully recognizes that food production per se does not and will not occur evenly among the SADCC Member states nor will it occur evenly in all areas in a particular member State. Warehouses or silos in one member State or in one area of that country could be overflowing with surplus grains, but all this surplus would not contribute to food security unless it is delivered to the areas where it is needed and action taken to ensure that people have access to it.

It cannot be over-emphasized that food production per se does not guarantee food security unless there is an efficient system for the storage, processing, preservation, marketing or/and distribution of that food to where it is needed - a system for the efficient flow of food and other agricultural commodities both at a national and regional level.

The food security strategy therefore recognizes the need for an improved and efficient food storage and delivery system and the need to enhance intra-regional trade. A complementary way of ensuring greater national food security is to improve the ability of a country, both at the national and individual farmer levels, to store grain effectively once it is harvested so as to avoid large food losses. In the region as much as 20% of food/grains is destroyed every year by pests, rot and other storage-related problems. The percentage of losses incurred in other more perishable food crops such as potatoes, vegetables or fresh milk are probably even higher.

The establishment of a regional food reserve system as an insurance against the risk of food insecurity or famine in the region is underway. The size of the regional food reserve, because it is not costless, will of course depend on what the SADCC Member states are prepared to spend or invest collectively.

In addition to providing a hedge against the risk of famine and therefore improving food security, food reserves invariably have other externalities or benefits such as consumer price stability and the stability of incomes to the farmers.

Apart from enhancing food security at regional, national and household levels, inter-country trade and an efficient movement of agricultural commodities and inputs among Member states will also have positive consequences in other areas. It will expand the size of the SADCC market, make investments in marketing infrastructure much more cost effective and will encourage SADCC Member states to venture into some form of specialization not only in agricultural production but also in other economic activities in line with national endowments and technical/economic capabilities.

Empirical evidence has shown that expanded food production alone will not eliminate hunger nor can it achieve hosusehold food security. Experience has also shown that in some countries silos may be full and overflowing with grains, and that grain stocks may become an economic/financial menace while hunger and starvation continue to haunt a large proportion of their populations particularly in the rural areas. This demonstrates that it is not only the availability of food at a national or regional level that assures food security at the household level but also the ability of the population to secure that food.

In economic terms, therefore, food security can be seen as a function of, inter-alia: increased food supply (either through own production, storage or food aid); efficient food delivery systems and the level and distribution of incomes (effective demand).

Experience has also shown that the production of food fluctuates more than the production of any other basic commodity. The production of the major grains (maize in particular) is subject to weather conditions and other hazards in the region. When bad weather (drought) hits a small and relatively poor country, localized famine or food insecurity results from a food shortfall. The very small farmers (who are the majority) lose their only source of food and incomes. Shortages may begin which are bound to push up consumer prices and as price rise, more and more of these poor farmers find it difficult to afford even a minimum diet.

Given that incomes are an important factor in the achievement of household food security, SADCC's up-dated food security strategy therefore seeks to expand its scope to include agricultural-related activities that will generate employment and incomes for the rural population.

SADCC's updated strategy will identify initiatives which can be taken at the regional level to encourage SADCC Member states with a grain surplus to diversify crop production. This could include cash crops, horticultural and industrial crops, dairy and animal products and the establishment of agro-industries, including fruit and vegetable canning industries, milling factories, factories for the manufacturer of agricultural inputs and the development of an informal sector to produce simple but effective farm equipment.

Possibilities of moving towards some form of specialization by Member states, based on varying natural resource endowments and technical/economic capabilities, will also be encouraged and this, once adopted, will facilitate the flow and exchange of commodities between and among SADCC Member states and hence contribute to an integration of the region's economies.

The strategy recognizes that agricultural production and food production in particular are prone to weather conditions and other hazards. Inadequate rainfall (drought) and invasion of pests and diseases, all affect the production of food crops even in highly sophisticated agricultural systems.

In this respect, the strategy encourages Member states to establish systems for the prevention of food crises and food losses and to initiate programmes for the control of major crop diseases and pests. Concerted regional cooperation and action can: provide early warning in the advent of drought and outbreak of major crop diseases; help deficit countries to obtain imports more quickly from surplus countries; coordinate requests for emergency food aid; provide facilities for food storage and provide easier and more reliable access to food reserves within the region.

The strategy also acknowledges that, skilled manpower, just like land, water, fertilizers and energy, is an important input in agricultural production. Skilled and experienced manpower still poses a major constraint on agricultural production in the region. The strategy therefore incorporates training components in the specific project proposals of the Food Security Programme. This is to be viewed as an integral part of an effort to enhance the production capacities of Member states.

The development and strengthening of national and regional training institutions to complement project specific inservice training courses will be initiated and co-ordinated by SADCC's Manpower Development Sector. SADCC's twelve regional food security projects are listed in the Annex.

CONCLUSION

While the current Food Security Strategy may not fully achieve the intended objectives, it is anticipated that the strategy or its major elements taken together will take us to a point where we can begin to see the right path to the intended goal. As we attempt to implement the elements of the strategy, new ideas, approaches and yet unimagined components of a food security strategy may open up to us.

We are therefore not in danger of taking a wrong path; we could have been in danger of not taking any path at all. Some people may argue that it is always safer or perhaps more comforatble to wait until we are sure of the track. But waiting for the right solution is almost invariably a prescription for doing nothing at all. We therefore believe that getting on the path, even it it may be a wrong one, will generate enough information and the necessary experience about which the strategy can be made more efective or improved upon.

Our updated Food Security Strategy therefore is by no means to be taken as the Bible. Even the Oxford English Dictionary may be subject to periodic reviews. In any case the ability of the strategy to achieve the intended objectives depends largely on the region's commitment to the achievement of food security. The real challenge therefore is whether the region as an economic community, is prepared to move along whatever paths are available to it now in a way that produces the result that contribute to the attainment of food security. The answer to that question is YES. Yes, the region is willing to bring forth a new kind of commitment that will ensure that what can be done should be done.

ANNEX : SADCC'S REGIONAL FOOD SECURITY PROJECTS

Analyses by SADCC of the major issues concerned with the food security of the region led to the identification of a number of projects designed to address these issues which could be more effectively handled on a cooperative rather than on an individual national basis. These projects are:

Project 1 - A Technical Assistance Programme Designed to Achieve Coordination and Cooperation on all Agrarian Issues.

Project 2 - An Early Warning System for Food Security

Project 3 - A Regional Resources Information System

Project 4 - A Regional Inventory of Agricultural Resource Base

Project 5 - A Regional Food Reserve

Project 6 - Regional Post Production and Food Loss Reduction

Project 7 - Regional Food Processing Technology

Project 8 - Regional Food Marketing Infrastructure

Project 9 - Regional Food Aid

Project 10 - Retention and Recruitment of Professional and Technical Staff in the SADCC Ministries of Agriculture

Project 11 - Regional Seed Production and Supply

Project 12 - Improvement of Irrigation Management.

CHAPTER FIVE

FOOD AID, INTRA-REGIONAL TRADE AND ECONOMICS DEVELOPMENT IN SADCC*

Mudziviri Nziramasanga

INTRODUCTION

This paper focuses on two related issues. The first is how food aid in general can be given without impeding domestic production. Since it is probably not certain that any policy measures can be totally effective the focus may be best on how to best minimize the negative impact. The second issue to be examined is how food aid can be utilized to promote intra-regional trade. In addressing both issues we first outline briefly the major variables that determine the level of production, be they market forces or policy decisions. We then review the economic literature on the impact of food aid on the recipient country, most of which was stimulated by the concern over the volume of PL480 transfers to India over a period of over ten years. These two approaches are then married to produce, as it were, suggestions on the empirical methods of managing food aid so that it does not impede the progress toward meaningful (i.e. efficient) food self sufficiency at both the country and regional level.

Literature on the subject has focused on food aid for development as distinct from emergency aid. The distinction could be considered academic. Isenman and Singer (1977) point out that the major purpose of food aid is to feed the hungry. To the extent this is true all food aid can therefore be considered emergency aid. Since malnutrition saps the ability to work and productivity then food aid can also be considered an essential element for development, whether the need for such aid is

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generated by a long-term structural imbalance or a short term disruption in the production process. Indeed even the distinction between short term disruption and long term structural problems maybe very difficult to make. The food shortages in Ethiopia, Sudan and Mozambique may have been exacerbated by the drought or even started then, but the impact has become a long-term development issue. Because of this inter-relationship, no attempt will in this paper be made to distinguish between emergency aid and development aid.

Another problem has to do with the definition of self-sufficiency. Most of the literature does not attempt to give an economic interpretation of what has become, in addition, an emotional and political issue. Bigman and Reutlinger (1979) define self-sufficiency in terms of trade. A country is self-sufficient in the sense that, in a "normal" year when both the country's production and world prices are at their mean level, there would be no price differential between the country and the world, and thus no incentive for trade. Such a definition is rather absolute and may require qualification in the real world where there is hardly a world price that is totally market determined due to the existence of subsidies to producers, and where commodity names make such wide disparities in product characteristics as to jeopardize the concept of a single market; corn prices quoted in Houston apply to yellow corn and may not necessarily reflect the "world" price for white maize where there are a few "large" surplus producing countries in any given year.

Indeed, as Schuh (1979) and Schultz (1960) point out, food aid in the United States was an attractive alternative way of disposing of a huge surplus whose existence was evidence of an excess supply at the prevailing domestic prices. Disposal of these excess supplies through the normal trade channels would in fact depress world prices. The existence of these stocks thus indicated the presence of an imbalance in the world market as well. While food aid has shifted from being chiefly a disposal activity and has become an important component of foreign aid for both the U.S. and the EEC, the presence of these stocks nevertheless still indicates an imbalance in their collective (and therefore the world market) markets and casts doubts on the existence of a stable, market clearing world price.

Finally, the "incentive" to trade could be generated by factors other than deviations from "normal" production, the most obvious of these being the foreign exchange rate. The definition of self-sufficiency could however be used, with the provision that a price differential could exist but would not be large enough to stimulate trade or that if trade in food products existed in a normal year it would have a negligible negative effect on the balance of payments of the country or region.

THEORETICAL CONSIDERATIONS

A different body of literature has determined that the small-scale farmer in developing countries is much like any other farmer in that he responds to market and other policy incentives.

He seeks to maximize his net income (revenues less costs) subject to the technology available, the prices of output and inputs, the timely availability of those inputs and the ease with which the output can be marketed. For ease of analysis these factors all boil down to factors affecting the demand for the output (which in turn determine directly or indirectly producer prices) and the supply of that output. An increase in demand will translate into higher consumer (and producer prices) and, given appropriate policies, this will give appropriate signals to produce more food. An increase in supply (given the demand situation) that generates excess stocks will stimulate a downward trend in prices, thus depressing domestic production.

This impact of an increase in supply has been the basis for criticizing food aid. By increasing the availability of food it depresses consumer prices. This is translated directly or indirectly into lower domestic production. In addition, it is alleged that the deflationary impact of food aid involves very little domestic budgetary costs and is thus an attractive option to policy-makers who then are less inclined to implement the more unpalatable policies aimed at attaining self-sufficiency from domestic production, since these would involve agricultural research outlays and higher urban food prices. If the transfers are large enough they could depress domestic prices to a point where there is no incentive to generate commercial trade in food, and a dependency situation is thus reinforced: unpalatable policies are avoided at the cost of domestic production and the dependency on aid.

This brief summary of the analysis of the potentially negative impact of food aid is based on some very strong assumptions. The first concerns the determinants of prices. Downward or upward movements in prices are not generated by changes in supply alone. Rather it is the existences of surpluses or deficits that generates the tendencies for prices to change, and these surpluses/deficits must be a relatively significant proportion of "normal" supplies for such price movements to be relevant.

In the case of emergency aid in particular, it is highly unlikely that these short-term inflows are of such a magnitude that they generate a significant decline in consumer and producer prices. Even such a large program as the PL480 shipments to India were not large enough to generate substantial net downward price movements. The dynamics of producer price determination add another complication. Unless producer prices are market determined food aid may depress consumer prices but this would have to be translated into lower producer prices the next season if the aid is to have a negative impact. Guaranteed producer prices in most countries rule out the full impact of market forces and introduce policy as another, and probably more important determinant of what producers expect from their output.

Theoretical economic analysis of the impact of food aid on domestic production was best summarized by Fisher (1963). Under some assumptions about total supply he showed that the impact of imports of food (read, food aid) on domestic production is inversely related to the sum of the responsiveness of producers and consumers to changes in the prices they receive and pay respectively, as well as the ratio of total demand to total supply of food.[1]

Dudley and Sandilands (1975) looked at the post-1963 situation where PL480 shipments came tied to commercial imports. The recipient country had to pay for insurance and shipping (on US vessels) and in addition pay 15 per cent of the f.o.b. price as downpayment. The cost of aid thus increased since each ton of PL480 shipments was tied to commercial imports. Policymakers in countries that faced a structural problem and thus needed long term food aid had to try and satisfy domestic demand at minimum cost using three potential sources: local production, food aid and commercial imports. The result is the same, except the domestic price becomes an explicit policy variable, and the level at which it ~~is set~~ at in effect determines the socially acceptable level of food imports and food aid. In the case of Colombia which Dudley and Sandilands studied, this price was set at a level that did not reflect the full cost of food aid, and so domestic production declined. So much for the negative price effects.

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[1] In economic jargon, the percentage change in domestic production induced by food imports is equal to the inverse of the sum of the price elasticity of supply and that of demand, the latter appropriately weighted by the ratio of total demand to total domestic production. The higher the price elasticities, the lower the impact of imports on domestic production.

Isenman and Singer point out that the primary aim of food aid is to feed the hungry, particularly the nutritionally vulnerable groups, without a significant increase in the use of budget resources. Food aid does this by helping to contain food price increases and reducing price variability (and thus increasing welfare). They aid development by easing a major constraint on output and employment. This is because at low income levels a proportionately larger share of income goes to food grains and less to savings. Food aid as an income transfer thus raises real income and savings. On the other hand, they point out, the responsiveness of both supply and demand to prices is very low anyway. A one percentage point decline in producer prices would generate at most a 0.1 to 0.2 percentage point decline in domestic production, and its impact in fact can be neutralized by other factors such as the weather or timely availability of inputs. Their argument thus is based on food aid as a form of income transfer whose impact can be to generate an even higher demand for food, particularly if it was distributed outside of the normal market channels (at government subsidized prices, for example).

EMPIRICAL EVIDENCE THUS FAR

There are thus two countervailing forces at work. Food aid (whether short-term emergency aid or of a long term nature) is an income transfer from the donor to the recipient country. As income, it generates additional demand for all items, including food. This additional demand of course can be channelled to domestic sources of supply, particularly if such transfers are done outside of the normal marketing channels so they do not significantly affect producer prices. On the other hand, food aid does increase supplies and has a tendency to depress prices, thus acting as a disincentive to domestic producers. Policymakers also tend to become more dependent on it and are loathe to make some hard decisions that are necessary for the country to be self-sufficient in food.

Which of these has been more dominant in practice, the price effect or the income effect? The answer would seem to depend on the set of policies adopted by both the donor and recipient countries. Unfortunately, the empirical evidence is still sparse.

As already pointed out, Dudley and Sandilands concluded that PL480 shipments when tied to commercial imports had a net negative impact on the domestic wheat production in Columbia. Imports increased at the expense of domestic production. However, this was predicated on a policy of setting domestic prices that did not fully reflect the cost of imports. Hall (1980) showed that PL480 wheat shipments to Brazil were beneficial to domestic production because of the policy of that country to use the counterpart funds generated from the wheat sales to support producer prices. In this particular case, the relationship between producer and consumer prices was in fact reversed through a conscious policy decision. Roger, Srivastava and Heady (1972) showed the impact of food aid can be beneficial if channelled through distribution outlets outside of the normal commercial pattern. Kydd and Hewitt

(1986) think the World Bank programme that provided structural adjustment loans to Malawi permitted imports(including food) which allowed the government of that country to maintain its expenditure programmes which benefitted, among others, the peasant farmers. This is another variant of the income transfers approach. Schuh (1979) seems to make a case for dumping excess agricultural products on developing countries because of the potentially positive income distribution effects. By depressing consumer food prices there is a positive real income effect, which, if properly targeted for the poor, could be beneficial. He also asserts that PL480 shipments since the 1960s have aided the market development of such countries as Taiwan, Republic of Korea, India, Indonesia, Egypt, Japan and Spain, and this has led to an increase in their commercial imports of food from the US. This market expansion has been partly the result of increased per capita income, and as such, Schuh argues, is part of the development process.

Maybe this is true in the case of the countries he cites. It could be quite possible that the market development could theoretically lead to quite a different type of substitution -that of the new import at the expense of domestically produced foods. Thus food aid "hooks" the domestic consumer to imports at the expense of the domestically produced product. Consumer welfare may increase but that of the producer declines. Finally Schuh also cites the significant budgetary support that food aid gave to India and Bangladesh. The latter apparently received food aid equivalent to 25 per cent of its budgetary resources. This theoretically allowed it to maintain its public expenditure levels, including support of local agricultural producers. Whether this can be considered beneficial or not depends on the effectiveness of such support.

On the same lines one can cite the example of the powdered milk given as food aid to Zimbabwe over the period 1982-83. The allocation, made in July August 1982, was for 4,000 tones of milk powder and 1,000 tones of butter oil, all of which was designed to meet an already existing excess demand. This was not a case of interruption in supplies; rather it was the result of increases in demand stimulated by an increase in real income accompanied by the impact of consumer price subsidies on milk. While the price-induced component of the deficit could have been corrected by increasing the price of milk, the solution preferred by policymakers was that of imports to increase supplies. There was no need for an income transfer. Similarly, there would be no producer price since that was controlled by the state; producers got a guaranteed price. The development aspect would be promoted by the use of counterpart funds (generated from the sale of milk) to subsidize peasant milk producers so as to enhance their cash incomes and nutrition levels. There would be a minimal impact on the government budget.

The benefits accruing to the consumers are evident: a milk shortage was alleviated. Those accruing to domestic producers, however, depended on the effectiveness with which the counterpart funds were used and the additional supplies of milk generated.

The price effect would be zero unless policy makers were to lower producer prices as domestic supplies increased. As of August 1986, however, the incremental output has yet to be realized, although the sales have generated about $6 million in counterpart funds out of the estimated total counterpart funds to be generated by 1988 of $27 million.*

Another food aid programme was implemented at the same time as the EEC skim milk powder sales, and the counterpart funds so generated were also earmarked for the development of the dairy industry. A bulk milk tank delivery system was introduced in the large scale commercial farm sector using Norwegian aid funds. The rental of the bulk tanks currently generates $160,000 annually; they are expected to reach $350,000 annually or a total of $5.25 million over fifteen years. These funds are specifically earmarked for the development of the peasant sector milk production development programme.

So far only $1.6 million from both programmes has been disbursed. The EEC requires the formulation of a National Dairy Policy and Programme before the funds can be disbursed. A dairy development policy document was developed in 1985. It envisages the expenditure of $10 million of the counterpart funds and US $3.0 in foreign exchange. The foreign exchange component was not available at the time the programme was drawn up and this will have to be made available either as additional financial aid or

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* See <u>Dairying Development in Zimbabwe: A Policy Paper</u>, Ministry of Lands, Agriculture and Rural Resettlement, October 1985.

diverted from other projects. This delay could have been avoided had the programme been identified as part of the national development plan prior to the generation of counterpart funds. However, this was too soon after independence for development priorities to be well specified and it may be that the dairy development programme will not cause any resource misallocation. The point, however, has been made.

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To summarize, the main purpose of food aid should be borne in mind. The transfers are designed to feed the hungry and the primary concern, as Reutlinger (1984) points out, should be the efficient transfer of this type of income. The impact of such transfers on producer prices and domestic production, while important, are of secondary importance. In addition, it would seem from all the available evidence that these negative effects can be identified and their impact on domestic production minimized through appropriate policy and administrative measures.

Another issue has to do with the "food-for-work" concept and using food aid to stimulate production. Zimbabwe has a policy of distributing emergency food in return for services rendered. Most of the work involves public or community projects and non-governmental organizations are supposed to adhere to the policy. The merits of such a policy with respect to the creation of rural infrastructure are evident and need no repetition but the benefits can only be realized if the projects are within the overall development concept for the region.

Problems appear because most NGOs are not efficiently organized for the dual functions of food distribution and project management. There have been recent complaints about NGOs not demanding services from the food recipients in the Matabeleland Province. Such projects could be justified to the extent that they were a local responsibility in the first place and the services being rendered are not a substitute for central government budget outlays (because that would imply an inequitable regional distribution of resources). Otherwise, it would be far more useful to distribute food aid and let the individual utilize this income transfer on the basis of their own preferences.

The most important cause of the potentially negative impact of food aid on domestic production seems to be its depressing effect on producer prices. As suggested by Rogers, Srivastava and Heady (1972) one way to minimize this problem would be to market food aid through separate channels. Such a special concessional marketing channel could be the use of non-governmental agencies to distribute food aid to target groups or direct government participation in the process. The result is to drive a wedge between income transfers and producer prices such that the first does not cause an undesirable change in the second.

This process, in my opinion, is not necessarily a panacea, however. First, non-governmental agencies may be well adapted to deliver emergency supplies, after which supposedly they would hand over their functions to regular agencies. No problems should arise to the extent that such income transfers have to be separated from the "normal" market activities. It becomes a different story to say that they should effect the delivery of long term development food aid through a systematic marketing system of their own. Just because that channel exists does not guarantee that transfers among users will not occur. When they do, an informal market network is bound to develop and producer prices will be affected.

Even if this separation were effected the differentiated market system will have to end at some point and an integrated commercial system take over. Otherwise the additional domestic production will not be realized for lack of an efficient marketing system. Creating a separate distribution system may have its positive income transfer effects but it eliminates the possibility of using the aid flows to develop and strengthen the normal market channels. The current, massive food aid programmes by such NGOs as Band Aid may be suitable for delivering emergency relief supplies but the infrastructure they use may turn out to be very difficult to integrate into the normal systems should production in the drought stricken areas recover.

To use such outlets or even government-run delivery systems would be to create an aid-enclave outside of the "normal" development channels. A way out of this dilemma would be to differentiate the product by source rather than by marketing outlets, and to create a two-tier price system. Thus domestic producers get a producer price that reflects the appropriate incentive while the food from aid projects is labelled as such and marketed through the regular channels but at designated lower prices, and only to the target groups. This way, the income transfer effects are preserved while the impact of aid on domestic producer prices is mitigated.

This problem takes on a slightly different twist in the SADCC region because of the importance of transport costs. The price effect of food aid is eliminated by the existence of marketing boards and guaranteed producer prices. In Zimbabwe the evidence points to a level of producer prices that do not reflect the landed costs of such imports as maize, beef and milk. A study in 1985 showed that the maize producer in Zimbabwe received a price in 1981 that was about Z$38 below the f.o.r. price of exports. During the drought years 1982-83 there was a positive subsidy of Z$22 and Z$67 per ton respectively, but in 1984 the producer was paid a price that was Z$89 below the import price, and this was during a drought period. A similar situation held true for beef and milk. The World Bank also established that marketing boards in Malawi for a long time paid producer prices that were below the landed cost. In such a case food aid could be given subject to the provision that it is sold at a price that reflects the opportunity cost, and the realized proceeds are used to subsidize the producer price in the following season. The same can be applicable to countries such as Mozambique and Botswana where there will be a structurally-induced food deficit for a long time to come.

Food aid will also benefit domestic production if it is over and above the normal financial aid, i.e., it provides additional resources. The financial resources are a more effective form of income transfer and help to expand overall demand. If the aid is sold and generates counterpart funds then they must be used in the context of development programmes, and not tied to some other donor-oriented goal.

Sen (1960) asserts that should the aid be tied to projects outside of the development programme then the tendency is for policymakers to regard the counterpart funds as additional resources. They would then divert material resources to these projects, thus leading to inefficiency and inflation. This may be the case of the EEC powdered milk programme in Zimbabwe. Some of the projects in the programme to utilize the counterpart funds had been rejected from the public sector investment programme for lack of funds. Some appear to have been added in 1985 when the availability of funds was assured. Now, the problem is that the counterpart funds do not necessarily augment the scarce domestic resources needed for these projects; neither can they be imported save by diverting foreign exchange from other projects. Zambia also is having problems in utilizing the counterpart funds generated by the sale of about 18,000 tones of cereals per year since 1981 as well as dairy products.

If the food aid must be deducted from the total financial aid programme then the value of this food aid should reflect the landed cost of the commodity using world prices. Schultz (1960) contends that some costs charged to PL480 food shipments (such as the higher transport charges paid to U.S. shippers) do not add to the value of the commodity to the recipient country. To SADCC such conditions can have very significant negative consequences.

When Zimbabwe purchased wheat from the United States in 1986 (in a triangular deal) it insisted on an f.o.b. Houston price quotation and the freedom to choose the shipping company. The decision saved almost $700,000 in shipping 7,000 tons of wheat. It is not always the case that unit production costs in the recipient country are lower than those of the donor. In fact in the case just cited, Zimbabwe is a relatively high cost wheat producer. On this basis alone and in the absence of a foreign exchange constraint imports would be an efficient way of satisfying the demand for wheat. However, wheat is a winter crop and the lack of alternative land uses at that time lowers the social costs. Transport costs from traditional suppliers make domestic production an even more attractive proposition, particularly in the face of a balance of payments constraint. Should donors insist on using their own national lines then the difference between the cost and what would have been paid under more competitive conditions should be covered by financial aid that is over and above the normal levels. Subsidies to donor domestic transporters or producers should not be at the expense of aid recipients.

Finally donor countries should simplify the bureaucratic procedures and administrative infrastructure associated with receiving food aid. A case in point is that of Zambia. Since launching the Operation Food Production in 1980 Zambia has had a Government of Zambia-EEC Joint Committee (1982) which produced another plan of action "Special Programme of Action Against Hunger". The World Bank then stepped in and the discussions of structural adjustment policies led to a document, "Restructuring in the Midst of Crisis".

This was the basis for a Consultative Group meeting in May 1984 which discussed a food strategy among other issues. This Group met two more times in 1985, but it had already spawned an offshoot in 1984, i.e., a "Joint Monitoring Committee" which replaced the Joint Committee. The Joint Monitoring Committee included the World Bank, the EEC and other donors.

In the meantime Zambia on its own produced in 1984 an Investment Plan Task Force to formulate an agricultural action programme which donors immediately rushed to support. And in 1985 Zambia started discussions with the IMF in the framework of the Consultative Group. All this dialogue led to rather basic conclusions with regard to promoting agricultural production which could have been arrived at with less fuss, cost and enormous demand for administrators to attend these conferences. It would be ideal if basic policy decisions could be arrived at with regard to the disbursement of food aid within the region in order to maintain uniformity. Then programmes could be disbursed under conditions specified within such a framework and with a minimum of delay.

FOOD AID AND INTRA-REGIONAL TRADE

The recent history of droughts in Eastern, Western and Southern Africa would tend to give the impression that fluctuations in food production are uniform across countries in each region, or even over the whole country. A casual examination of the data proves otherwise. Data for the crop years 1985/86 and 1986/87 show that Southern Africa as a whole needed food imports (computed as the cereal equivalent) of 1.7 million tons and 1.6 million tons respectively.[3] Yet there were country differences.

Zimbabwe had surpluses during those two years of 1.0 million and 873,000 tons respectively, almost all of them maize and sorghum stocks. These surpluses would cover the deficits in Mozambique and Zambia under status quo nutrition levels.

This aggregate picture also masked differences in food requirements by commodity. Thus Zimbabwe had a maize surplus but a wheat deficit in both periods. The Table below shows the pairwise situation in the SADCC countries. It gives the commodities in excess supply in one country and those in excess demand in the neighboring country. A wider regional comparison shows an even larger trade possibility. Of course, the situation will vary from year to year, but the structural differences are bound to persist.

See US Department of Agriculture, World Food Needs and Availabilities, 1985.

Surplus and Deficit in Staple Foods Between Bordering Countries in the SADCC Region, 1979-1981

Country	Has Surplus Staple Foods	Shares Border With	Which Has Deficit in Staple Foods
Angola	Cassava, Millet and Sorghum	Zambia	Wheat, Rice, Millet and Sorghum
Malawi	Rice, Maize, Millet, Sorghum and Cassava	a) Mozambique b) Tanzania c) Zambia	Wheat, Rice, Maize Wheat Wheat, Rice, Millet and Sorghum
Swaziland	Wheat, Rice, Maize, Sorghum	Mozambique	Wheat, Rice, Maize
Tanzania	Rice, Maize, Millet and Sorghum, Cassava	a) Malawi b) Zambia c) Mozambique	Wheat Wheat, Rice, Millet and Sorghum Wheat, Rice, Maize, Millet and Sorghum, Cassava
Zambia	Cassava, Maize	a) Angola b) Botswana c) Malawi d) Mozambique e) Tanzania f) Zimbabwe	Wheat, Rice, Maize Wheat, Rice, Maize, Millet and Sorghum, Cassava Wheat Wheat, Rice, Maize Wheat Rice, Millet and Sorghum, Cassava (consumption so far negligible)
Zimbabwe	Wheat, Maize Millet and Sorghum	Botswana	Wheat, Rice, Maize, Millet and Sorghum, Cassava

Source: Koester, Ulrich, op. cit., Table 5.12.

The inter-country differences point to regional trade possibilities. The surplus countries have to be able to compete pricewise with other exporters because the deficit countries are not in the business of subsidizing high cost producers just because they are neighbors. Given the importance of transportation costs in getting imports from traditional food exporters to Southern Africa, however, surplus countries like Zimbabwe and Malawi should have a positive competitive edge in the region. Yet, Zimbabwe and Malawi have continued to accumulate surpluses since 1984 while Zambia, Mozambique and Botswana continued to have deficits; the net deficit of the region was really a mythical figure in the absence of trade in food commodities.

The most obvious reason of course is the scarcity of foreign exchange with which to facilitate straightforward intra-region commercial transactions. The second is that even if barter trade were an option between Mozambique and Zimbabwe the former does not produce the wheat to trade for the latter's maize; there are differences in consumption patterns and preferences but these are not matched by a development of specialization in the production of commodities.

The formation of the PTA clearing house should eventually widen the barter trade possibilities over time. This process can be made easier for essential food commodities if the SADCC countries adopted a common food policy objective and viewed food security more as a regional trade issue than one to be attained through the accumulation of individual country stocks. This means, among other things, co-ordinating national pricing policies which thus far have been implemented by the marketing boards with national objectives in mind.

That the resultant prices can discourage regional trade was illustrated in the case of the East African Common Market by Koester (1985). In 1961 Uganda had a maize surplus while Kenya and Tanzania had deficits. Yet Kenya did not import maize from Uganda because the relatively cheaper maize from the latter might have depressed Kenya's domestic consumer price. The Kenyan Maize Marketing Board would thus have incurred a loss because of the larger differential between the guaranteed producer price and the depressed price to millers. In addition Weber and Hartmann (1976) state that trade restrictions, rather than the lack of a trading potential, caused the decline in food trade among the East African common market countries.

The SADCC countries have agreed in principle to formulate a common food security strategy and Zimbabwe has been charged with the responsibility of formulating a food security programme. However, national considerations still dominate the internal pricing decisions of each country. It is not yet clear whether the difference in the annual variations in food production will be the basis for a strategy based on regional trade and international imports, or whether each country will use national stocks to stabilize its own food availability over time and use regional trade if and when necessary. There still is yet to be a common definition of what food security means and the least cost method of attaining it for the region as a whole.

The purpose of this discussion is not to speculate on the benefits of an integrated, regional food security programme. Those interested in a detailed treatment of the subject can find ample reading elsewhere. What is relevant here however, is that the potential for trade in food commodities among SADCC countries is there but has yet to be fully exploited. The constraints have to do with differences in national agricultural pricing policies, historical trading patterns, and balance of payments constraints. It is the point of this paper that food aid can be used to alleviate these constraints and promote regional trade. The mechanism for this of course is the so-called "triangular" purchases involving a donor and either two aid recipients or more commercial importer and one food aid recipient.

The uses of food aid for development as well as for trade promotion (through triangular transactions) are of course inter-related and the measures taken to promote the first inevitably also facilitate the second. If food aid can encourage recipient countries to base producer prices on the marginal cost of imports (i.e., world prices) then deficit countries will be indifferent with respect to f.o.r. prices and will certainly prefer a regional source if possible because of the lower transportation costs. Trade will thus be based on comparative advantage as it should be.

See, for example, Koester, op.cit.

Food aid can be used to explore potential trade links where none existed before, largely because the balance of payments impact on the recipient countries will be minimal; countries can afford to be more innovative, as it were. Finally, if the transportation costs are indeed lower within the region, then triangular deals can in fact increase the income transfer effect of food aid since more of the value of the transactions will be in the food rather than transport services.

Having said all this, however, it should be pointed out that the major criticism levelled against food aid in the 1960s has reared its ugly head to bedevil triangular transactions. Donor countries use food aid to dispose of surplus commodities, and domestic interest groups (mainly farmers and shipping companies) have a vital stake in the volume of food aid originating in the donor countries. This has acted as a constraint.

A few examples will serve to highlight the issues. Mozambique had a deficit of about 450,000 tons of cereals in the 1984/85 season and the United States pledged to make up about a third of this figure. Other donors also contributed. As already shown, all of this deficit theoretically could have been made up from stocks in Malawi and Zimbabwe, subject to the actual commodity composition. As it was, the United States executed one triangular operation totalling 10,000 tons, with 7,000 tons of maize from Zimbabwe (in exchange for wheat) and 3,000 tons from Malawi. The EEC estimated allocations for countries in the SADCC region totalled 35,000 tons for 1985 and 82,000 tons for 1986.[5] Of these amounts, only 23,000 tons and 36,000 tons respectively were likely to be coarse grains supplied from Malawi, Zimbabwe and Kenya. This is a relatively small proportion of the estimated requirements of coarse grains in the deficit countries (Angola, Tanzania, Botswana, Lesotho, Mozambique and possibly Zambia). It is also a small proportion of the potential volume of intra-regional purchases.

One could argue, as Lipton (1986) does, that this potential is sporadic and subject to the vagaries of the weather and potential disruptions of transport routes by the regime in the Republic of South Africa. The fluctuations in the volume of regional tradeable surpluses in cereals, from near zero levels during a drought to the current record (though small relative to world stocks) stocks may not warrant an overly optimistic outlook for attaining food self-sufficiency through intra-regional trade.

That approach, however, seems to miss the point. First, agricultural production in any single region is subject to uncertainty, though the long term trend in developed countries is upward. It is simply a case of fully taking advantage of an opportunity when it arises. Secondly, regional food security does not necessarily imply zero commercial imports from the international market. The definition of food self-sufficiency

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[5] See Meetomq Doςument: Meeting of Experts on Purchasing of Foodstuffs in Developing Copuntries, mimeo, Brussels, March 1986.

given in the first section actually implies an integration of regional commodity movements into the world trade patterns such that a deficit can be made up in the course of normal annual transactions. This is currently not the case because the existence of food stockpiles in a country adjacent to one with a perennial deficit is evidence of the lack of normal trade movements, whether such surplus stocks are transitory or not. The reasons for non-existence of trade have already been stated, and the use of food aid for the relaxation of these constraints is a pertinent subject.

One option has already been presented. Donor countries should consider increasing the quantities of food purchased in the SADCC countries themselves. This is said with the full cognisance that agricultural interests in both the U.S. and the EEC see the food aid programmes as an extension of their countries' domestic agricultural policies.

The EEC as a result restricts triangular purchases to those cereals unavailable on the Community market, while the range of these commodities (maize, millet, sorghum, rice) still leaves a considerable opportunity the policy itself is subject to a lot of interpretations. Are consumer preferences to be taken as given in the negotiations, for example, or will there be an indirect pressure to steer aid requests to commodities available on the EEC market? A stated objectives of the triangular operations was "market stabilization in that producing country whose production exceeds its needs for the product".

Now, it may be that the existence of 1.5 million tons of surplus maize in Zimbabwe is evidence of an imbalance in relative commodity prices; land is being shifted to maize because its producer price is higher relative to that of such crops as beans, sunflower, etc. It may even be because the country is a high cost producer relative to domestic income levels and the recent removal of subsidies has reduced consumption and increased stocks. If so, then triangular transactions based on the opportunity cost of maize and the other crops would help correct the situation. However, recent transactions do not support this assumption.

As already mentioned, USAID executed a triangular deal in 1986 whereby 7,000 tons of Zimbabwe maize were exchanged for 9,600 tons of U.S. wheat, with the maize sent as food aid to Mozambique. At the same time, 3,000 tons of Malawi maize were exchanged for 1,400 tons of heat for the same purpose. The landed cost of U.S. yellow corn in Zimbabwe borders would be about $U.S.200. The prices used in exchange were U.S.$106 a ton for wheat (f.o.b. Houston)' and $145 a ton f.o.r. for maize. The f.o.r. price for corn in Houston would have been U.S.$104. The actual transactions price for maize was thus between the world price abroad and the landed price in the regional market, and it can be taken to reflect true market conditions. This price also reflected relatively accurately the then current producer price of maize (U.S.$111.10).

The differential between the price per ton and that paid to producers, if it accurately reflects internal transport and handling charges, reflects the importance of improving the marketing channels. The point being made is that the production costs in the region were not completely out of line with world prices. Returning to the issue about the volume of such triangular transactions, it is noteworthy that a similar opportunity had arisen in 1985. Zimbabwe needed 56,000 tons of wheat and a similar exchange could have been made. The opportunity was lost because of potential opposition by U.S. agricultural interests which would not want to lose the opportunity of a straight commercial sale of wheat and a disposal of yellow corn stocks on concessional terms as aid. The intervention by domestic considerations in donor countries almost always turns the triangular transactions into rectangular negotiations and whittles down the size of income transfers as well as trade development of food aid programmes.

The impact of transportation costs is clearly illustrated in the U.S./Malawi/ Zimbabwe/Mozambique transaction. The value of Malawi maize in terms of wheat delivered in Blantyre was U.S.$142, slightly lower than that of Zimbabwe maize (f.o.r.). Of this amount, however, U.S.$87 went into transport services and as a result the country obtained 0.47 tons of wheat of every ton of maize, compared to 1.37 tons in Zimbabwe. Malawi paid $40.7 per ton ocean freight to ship in U.S. bottoms compared to a much smaller figure for Zimbabwe which had hard currency and could shop around for the lowest rates. If this conditionally (to ship in U.S. vessels) is insisted upon, then financial aid over and above the normal allocation should be granted to cover this shipping cost differentials.

The impact of domestic conditions in donor countries is also apparent in the cost of the commodity swap for the recipients. According to FAO data Zimbabwe received 27,970 tons of what from Australia in March 1986, in exchange for 33,000 tons of maize. At about the same time it also received 6,700 tons from Canada for 9,000 tons of maize. The Canadian barter rate of 1.34 tons of maize per ton of wheat is 10 per cent higher than that of Australia. The demarcation of the market may of course represent transportation cost differentials and not producer price support variations in the donor countries. It does, however, illustrate the fragmentation of the world market as far as the recipient country is concerned. About the only thing to be done in this case is to ensure that the differentials reflect differences in transportation charges only, and not some domestic subsidy.

Probably the most difficult issue would be to use food aid in order to "encourage" production patterns that directly promote the recipient country's comparative advantage, and thus encourage trade. Conditions in Mozambique may be such that its comparative advantage is not in maize production but some other food crop. The agricultural implements and seed packs being sent there as part of the food aid could reflect this long term consideration rather than increase the ability to directly substitute maize imports with local production. Such a policy decision will have to be the result of an overall regional food security package and will have to originate from the SADCC countries themselves to be successful. Without such an orientation, however, shortages induced by structural causes will persist and the benefits from specialization in production will be lost. Zimbabwe tried to use Japanese aid to develop rice production, a crop for which Malawi may have a relative comparative advantage. It even tried to produce fresh water prawns as a substitute for the Mozambican real thing. The list of agricultural goods with such trade possibilities is substantive, but it is not clear whether they can be economically produced in the region. Food aid could thus be used to directly finance the necessary research.

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PART III

FOOD SECURITY FOR ZIMBABWE: INTERACTION OF TECHNOLOGY, INSTITUTIONS AND POLICY

PART III

INTRODUCTION

The six chapters in this part report preliminary research findings on Zimbabwe's food economy. Zimbabwe's food and agricultural policy is in the international limelight because it has a 2.1 million ton stock of maize in storage, equivalent to three years domestic sales by the government parastatal - the Grain Marketing Board (GMB). Less well known to the international media is the important fact that smallholders have tripled the amount of maize marketed from independence in 1980 to 1986. However, Zimbabwe's maize surplus should be examined in historical perspective. Kay Muir-Leresche (1984) points out that Zimbabwe's agricultural policy is geared to producing a maize surplus for export under normal weather conditions. In fact, except for a few draught years, Zimbabwe's maize exports span three decades.

Zimbabwe's dual agrarian structure of roughly 4 200 commercial and 800 000 communal (smallholder) farmers was carefully examined by a government appointed commission in 1981/82 under the Chairmanship of Professor G. L. Chavunduka. The Chavanduka report was published under the title <u>Report of the Commission of Inquiry into the Agricultural Industry</u> (Chavunduka, 1982). The Chavunduka report is the starting point in understanding Zimbabwe's food and agriculture situation shortly after independence. But unlike Kenya, Botswana and most African countries, Zimbabwe's agricultural policy has never been rigorously examined, debated in parliament and published as a government White Paper. In the absence of an official White paper on Zimbabwe's post independence food and agricultural policy,

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1/ The number of commercial farmers was about 7 600 at its peak in 1976. The number fell to around 5 000 at independence in 1980 and then declined to around 4 200 in 1984, at which time the number stabilised.

Professor Malcolm Blackie, a member of the Chavunduka Commission and Professor of Agricultural Economics at the University of Zimbabwe from 1980 to 1986, examines the evolution of Zimbabwe's food and agricultural policy from 1965 to 1986 in Chapter Six.

Because of the belief that an efficient national food production system is the cornerstone of national food security policy, the UZ/MSU Food Security Project decided to concentrate its initial research programme on Zimbabwe in order to understand the sources of growth in food production with priority given to empirical research on maize, wheat, sorghum and oiseeds production. Moreover, because of the dearth of data on communal (smallholder) farmers, the UZ/MSU team decided to focus on communal farmers.

Because maize accounts for around half the calories consumed by the average person in the SADCC maize belt - Zimbabwe, Zambia and Malawi - it was decided to devote initial attention to research on the maize subsector in Zimbabwe using the subsector framework that has been pioneered by Professor James Shaffer of Michigan State University (Shaffer, 1973). In-depth empirical research on the maize subsector includes a study of smallholder maize production by Rohrbach (Chapter 7); a study of marketing, on farm storage and sales by Stanning (Chapter 10) and an analysis of national maize storage and trade policies by Buccola and Sukume (Chapter 11). Research on smallholder groundnut industry is underway because of the importance of groundnuts as a source of protein for small children and the precipitous drop in communal groundnut production over the past decade (see Makombe, Bernsten and Rohrbach, Chapter 8). Because all nine SADCC states import wheat, a crucial food security policy question is: What is the real cost of increasing the wheat self-sufficiency index compared with importing wheat from international markets - especially when world wheat prices are at an all time low. The UZ/MSU team was especially fortunate that Jim Longmire from CiMMYT, Mexico joined forces to carry out an empirical study of wheat production in Zimbabwe. For a preliminary report see Longmire, Ngobese and Solomon, Chapter Nine.

Turning to future research in Zimbabwe, the UZ/MSU food security team plans to launch a study of the oilseeds and food security (especially groundnuts and sunflower) over the 1987-1990 period (see Mudimu, Chapter 16). Finally, a study of smallholder sorghum production, on-farm storage, processing and marketing will be carried out by Mbwanda (see Chapter 14) and colleagues over the 1987-1990 period.

In summary, the UZ/MSU research team is strongly empirical in orientation and strongly oriented to communal farmers and their families because they represent the future of Zimbabwe agriculture. The results presented in Chapters 6 to 11 represent the first 18 months of research by the UZ/MSU food security research project. Final results of the Zimbabwe studies will be discussed at the UZ/MSU 1987 conference in November.

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CHAPTER SIX

THE ELUSIVE PEASANT : ZIMBABWE AGRICULTURE POLICY, 1965-1986

Malcolm J. Blackie

THE CONTEXT

The prospect of attempting to analyse agricultural policy in Zimbabwe over the years 1965 to 1986 is daunting. The period includes some of the most dramatic political and natural shocks absorbed by the Zimbabwe economy this century. The year 1965 marks the illegal assumption of independence (UDI) by the previous Rhodesia government. UDI preceeded the most intense phase of the liberation war; a war which was largely fought over, and in, the farming areas of Zimbabwe. Between 1965 and 1980, the economy had to withstand the economic sanctions imposed against the Smith government, and the inflationary shocks of the massive oil price rises in the 1970s. Agriculture was severely hit by these combined blows with whole farm gross margins declining by 22 percent in real terms between 1973 and 1979 (Chavunduka, 1982). In 1980 came legal independence and a total reversal of government political ideology. A series of droughts, including an almost unprecedented three year drought from 1982-83 to 1984-85, put further pressure on the agricultural sector.

Real GDP growth over the period 1965 to 1986 was somewhat less than 2 percent. Growth in total agricultural output was around 4 percent during the UDI period and little less than this since independence. In *per capita* terms, total agricultural production has remained virtually static over the twenty-one year period. In a typical year, nearly half of Zimbabwe's agricultural production is exported, with agricultural exports consistently accounting for around 40 percent of total exports. The aggregate picture is thus one of *per capita* stability, rather than growth in the agricultural sector. This is remarkable given the very difficult period through which the farming industries have passed.

The significance in policy terms is that this picture contrasts markedly with the evidence from the SADCC region and sub-Saharan Africa generally. Data from SADCC show a decline of around 2 percent annually in per capita agricultural production over the past 20 years. A similar picture emerges from aggregate sub-Saharan Africa figures. Thus, despite major political upheaval, drastically reduced terms of trade, and drought, the Zimbabwe agricultural sector has performed significantly better than the average over the past two decades. However, given that agriculture is the lead sector of the Zimbabwe economy, its performance has been insufficient to generate the level of growth necessary for a developing country facing a high population growth rate. The following review, therefore, is intended to enable a better understanding of the peculiar strengths and weaknesses of the Zimbabwe agricultural economy. From this disaggregated perspective, policy options to relieve critical areas of constraint can then be discussed.

LAND DISTRIBUTION AND ACCESS

Land distribution and access has dominated national policy since the first European settlement at the end of the last century. The reader interested in details of, and the debate over, land in Zimbabwe has an ample source of materials to choose from {see, for example, Hazlewood, (1985); Palmer (1977); Mupawose (1980); or Riddell (1979). The foundation for racial access to land was laid by the 1930 Land Apportionment Act and was strengthened by the Land Tenure Act of 1969. The subsequent repeal of the land Tenure Act in 1979 and black majority rule in 1980 has still left agricultural land use predominantly racially segregated.

Given the prominence of land issues in the politics of pre-Independence Zimbabwe and the clearly discriminatory manner in which land quality had been allocated between the two major racial groups in Rhodesia (see Chavunduka, 1982), the slow implementation of a more equitable land policy seems surprising. Pre-indipendence statements from senior figures in the current Zimbabwe government indicated a policy of radical land reform including land nationalization, collectivisation and communal village production units (Riddell, 1979). The reality has been different; the immediate post independence land reform plans envisaged the resettlement of 162 000 smallholder families on 9 million hectares of land transferred from the large-scale sub-sector over a three year period. By 1986, some 36 000 families had been resettled on 2 million hectares with plans to increase this to a total of 80 000 families on 4.6 million hectares by 1990 (Anon, 1986).

The reason for this remarkable gap between intentions and implementation of land redistribution lies in the direct relationship beween agricultural expansion and the growth rate of the Zimbabwe economy. Table 1 illustrates this relationship since independence. Although agriculture's share of GDP is no more than 15 percent of GDP, as opposed to industry's 25 percent, the close linkages between agriculture and industry result in the dominance of the agriculture sector in determining the health or otherwise of the Zimbabwe economy. There are four key elements to agriculture's strategic importance (Hawkins, 1986):

(1) As an exporter providing 40 percent of total exports annually.
(2) As the largest employer of labour with a quarter of the total workforce being directly employed in agricultural production.
(3) As the manufacturing sector's main supplier of raw material inputs.
(4) As the largest purchaser of industial consumer goods and input items.

Table 1: Zimbabwe: Growth Rates of Agriculture Output and GDP

Year	Agricultural Output	GDP
1980	3.1	11.3
1981	8.3	13.0
1982	1.0	0.0
1983	- 6.4	- 3.4
1984	12.8	1.0
1985 (Estimate)	25.0	6.0

Source: CFU

Many of the pre-independence promoters of radical reform chose to ignore the interaction between agriculture and the economy. Their analyses typically assume that the role of the agricultural sector would become primarily one of providing national requirements of traditional foodstuffs.

While the formal resettlement program is running behind schedule, this should not be interpreted as suggesting that land redistribtuion is diminishing in importance as a policy issue. The slow pace of resettlement is a direct result of the appreciation by the Zimbabwe government of the extremely tight constraints within which the resettlement programme must operate. Zimbabwe's basic policy document remains Growth with Equity and it;

> ".... is based on a strong belief that growth and equity are complementary tools needed for achieving real economic development... For meaningful growth to happen, there is a need for equitable distribution of the major factors of production and that to have equity, there should be significant growth" (Mahachi, 1986).

The production implications of land redistribution are the subject of inconclusive debate. For a review of the options see Chavunduka (1982); Kinsey (1983) and Munslow (1985). One common theme emerges; under conventional dryland smallholder practices, even with improved productivity, the arithmetic does not hold. Either resettlement needs to be slowed to allow time for the resettled farmers to achieve adequate productivity levels, or else highly optimistic and improbable assumptions need to be made regarding potential productivity of the resettled communities. This theme echoes the analysis done by Hume (1978). Hume initially considered two principal types of land reform; one in which equity in landholding was the sole consideration and the other, a 'selective' approach, in which considiration was given to to other objectives and factors (specified target groups, total production impact, ecological factors, regional differences etc.). He then considered variations on both these approaches to obtain a reasonable representation of the range of practical land reform packages. Hume acknowledged the simplistic nature of his model. However, the results showed clearly that it was most possible to meet equity and productive objectives of land reform with a package that retained a core of intensive large-scale farming. The outcome from this strategy is one in which productivity gains were achievable both immediately and in the long term. Such gains could be achieved over a range of situations in which 5 to 8 million hectares were transferred from large-scale commercial farming to resettlement. However, he pointed out that this process required some 200,000 hectares to be settled under some form of intensive settlement such as irrigated agriculture.

AGRICULTURAL CHANGE 1965-86

The period 1965 to 1986 saw a steady widening productivity gap between smallholder farmers in the communal farming areas and the large-scale commercial farmers. While some of this productivity difference may be attributed to land quality factors, the overall picture is more complex. The period following World War II was a watershed in Zimbabwe's agricultural history (Blackie, 1982). During this post-war period, the effects of racially segregated land ownership patterns became an overwhelming factor in agricultural development, with the peasant sector becoming progressively more disadvantaged. The productivity of this last sector was rapidly overtaken by settler farmers who came into Zimbabwe in large numbers during the early 1950's. The agricultural production mix also changed substantially, with the emphasis of production shifting from livestock to tobacco. By 1960, tobacco accounted for 76 percent of marketed agricultural output.

By 1965, many of the institutions that currently form the framework of the Zimbabwe agricultural sector were in place. To understand the implications of this framework, it is necessary to comprehend the close relationship between the Rhodesian government and the large-scale commercial farmers. The government and civil service were dominated by agricultural personalities. Political power was held by the commercial farming community in both the effective settler political parties - the United Federal Party and the Dominion Party. As importantly, two major farmers' organisations had emerged; these remain in existence and are currently named the Zimbabwe Tobacco Association (ZTA) representing the tobacco farmers, and the Commercial Farmers' Union (CFU), representing the large-scale commercial farmers generally. Both organisations were modelled on the powerful farm lobbies of Britain and the United States and included a strong central professional staff to provide both policy and technical support to members. The financing of the Unions was from statutory levies on all commodities sold through the parastatal marketing boards or the tobacco auction floors. Thus state involvement in the marketing of major commodities and the financing of the large-scale farmers' unions were directly linked.

The test of the resilience of this government/commercial farmer cartel came at UDI in 1965. Table 2 shows the remarkable transformation that took place within the large-scale commercial sector in the period 1965 to 1980. In anticipation of sanctions, tobacco farmers had been encouraged to move into other crops even before 1965. In value terms, tobacco output fell from 52 percent of total agricultural output in 1965 to 20 percent by 1980. Tobacco had been replaced by crops such as cotton, wheat, soyabeans and coffee; commodities either virtually unknown to commercial farmers or which were not grown at all. By any standards, this change was remarkable. It was the direct result of active and positive cooperation between the government and the commercial farming sector.

The national agricultural policy objectives that were set during that period remain intact in 1986. In essence, these objectives required the country to be self-sufficient in all significant food commodities, including products which could be regarded as luxuries, such as coffee, tea and wine. Agricultural exports remain important foreign exchange earners, with the emphasis on high value, low bulk products. The achievement of these policy objectives was the result of the well-targeted provision of marketing, research and financial services from government to the commercial farmers, based on frequent and effective dialogue between the two groups.

Table 2: Zimbabwe: Composition of Marketed Agricultural Output, by Value

Product	1965 Value (Z$m)	1965 %	1980 Value (Z$m)	1980 %
Tobacco 1/	67.6	52.6	97.4	19.8
Cattle 2/	19.5	15.2	85.7	17.4
Sugar	13.9	10.9	73.9	15.4
Maize	13.5	10.5	71.8	14.6
Milk	5.3	4.1	27.2	5.5
Pigs	2.9	2.3	7.0	1.4
Groundnuts	1.2	0.9	4.6	0.9
Cotton	2.6	2.0	71.4	14.5
Wheat	0.3	0.2	22.2	4.5
Soyabeans	-	-	14.9	3.0
Coffee	-	-	11.9	2.4
Other	1.7	1.3	4.8	1.0
TOTALS	128.5	100.0	492.8	100.0

1/ Flue-cured
2/ Slaughterings
Source: Central Statistical Office

Two fundamental changes have taken place since 1980. The first is that it is now government policy to work with all the farmers of Zimbabwe, with particular emphasis on redressing the imbalance in access to public services and infrastructure on the part of communal farmers.

The second is the corollary of the first; the issue with respect to communal production is not one of diversification from a largely monoculture production system but of encouraging a quantum leap in productivity of smallholder mixed farming systems. The basis for diversification has already been laid during the UDI period. Cotton producers have shown,. Zimbabwe smallholders have the capacity to capitalize rapidly on appropriate new technologies (Blackie, forthcoming). Yet the most effective means of intervening in the small-scale sub-sector remains elusive. Hyden (1986) has clearly documented the high degree of autonomy that African smallholders enjoy from other groups and institutions in society. His analysis shows that:

> "... African governments are structurally less well-placed to influence agricultural development than governments in Asia or Latin America. Access to the peasant producer is limited and often must be accepted on the latter's terms. The notion that agricultural productivity can be markedly enhanced by 'fine-tuning' the organisational instruments of government... is a costly illusion in most parts of Africa today (Hyden, 1986, p56)."

Hyden advocates what he terms the 'greenhouse approach' to the transformation of African smallholder production. The basis of such an approach is to focus on factors that encourage the growth of local institutions and mechanisms. The objective is to accelerate progress on the basis of what the community already offers.

AGRICULTURAL CHANGE: 1987-?

Thus it appears that for the immediate future, agricultural policy in Zimbabwe must be dominated by the issue of productivity with particular emphasis on smallhold farming systems. As the preceding section has shown, although previous policy has given the country a well diversified and stable agricultural sector, this picture must be balanced by an appreciation of remaining inequities with resepct to access to factors of production and of the inadequate growth in overall agricultural productivity. The bulk of poverty in Zimbabwe, in common with most developed and developing countries, lies in the rural areas with a two to threefold difference between <u>per capita</u> urban and rural incomes (Schuh, 1986). Schuh comments that:

> "... The challenge to policy-makers in the decade ahead will be great. The labour adjustment problems as we look to the next decades will be enormous in most countries, with the <u>severity of the problem directly associated with the success in the agricultural research programmes unless international trade should take up the slack</u> (my emphasis). The challenge will be to deal with this problem in such a way that labour does not have to bear all the adjustment costs and so that negative externalities are not imposed on rural areas. This will require incentives for the decentralisation of the industrialisation process into areas where labour is abundant, and training, education and relocation programmes to promote labour mobility" (Schuh, 1986).

Thus the two critical areas of future agricultural policy are those of agricultural research and agricultural trade. Schuh finds common ground with Hyden (1986) in that the policy issue facing Africa governments is as much an urban as a rural problem. Zimbabwe is no exception to this general case. There is no simple and obvious solution to the conundrum of simultaneously increasing agricultural productivity and painlessly generating the requisite industrial employment to absorb displaced farm workers.

Agricultural Research and Yield Increasing Technology in Europe and Asia

While the outlook is gloomy, the current situation is not without precedent. A review of the agricultural history of North America and Europe in the late 19th century, and of Asia in the mid 20th century, suggests that today's policy problems in African agriculture are neither unique nor insoluble. From 1825 to 1910, the output of the American economy grew at an average rate of 1.6 percent per capita, giving the United States the fastest economic growth rate in the world. Fundamental to this growth was the rapid increase in agricultural output. The contribution of low cost agricultural production from virgin lands, particularly in the prairies, together with dramatic improvements in transport, enabled the United States to raise the volume of, and create new markets for, agricultural products. This was not without its effect on the European agricultural economies. In Britain, for example, the impact of cheap American wheat on the incomes of English landowners resulted in the imposition of import duties on wheat under the 1815 Corn Laws. A series of disastrous harvests in Britain, and consequent severe shortages of food staples, led to the Corn laws repeal in 1846. To the politicians' surprise, the coming of free trade to the British agricultural economy brought an era of high prosperity. The growing size of the urban consumer market was reflected in rising demand for meat, butter and cheese, rather than cereals. The successful British farmers were those that met this demand by increasing their output of livestock products within a mixed farming system. British agriculture entered the era of capital intensive high farming, based on intensively fed livestock and the use of purchased inputs such as fertilizer. The groundwork for many of today's familiar agricultural technologies - high yielding varieties, fertilizers, improved livestock systems - was laid as the result of the flood of low cost food staples from America and Russia into Europe. Three critical factors were involved - crisis (the famines preceding the 1846 Corn Laws Repeal), rising real urban incomes (as the result of a significant decline in staple food prices following 1846), and the effective use of science to generate improved agricultural technologies to meet the growing (and changing) urban market for agricultural commodities. These factors combined to induce the quantum leap in agricultural productivity that differentiates the Western farming systems of the mid 20th century from those of a hundred years earlier.

A similar congress of crisis, urbanisation and agricultural science is perceived in the Asian Green Revolution of the 1960s. In the early 1960s, widespread and continuing famine in the absence of perpetual food aid appeared to be becoming the norm. Borlaug (1985,1986) has documented the dramatic turn around in this situation over the past two decades. The debate on the ethics of "triage" - the controversial concept of regarding the agricultural problems of some regions as insoluble - has faded into obscurity in Asia as the rapid adoption of high-yielding varieties has generated a major jump in agricultural productivity. India, for example, which imported 10 million tons of wheat in 1966 now has a current grain stock exceeding 30 million tons, including stocks held both for food security and public distribution (Swaminathan, 1986). More productive Asian farming systems have led to the development of new rural industries and employment. Again, as in Europe, lower real food prices have both stimulated aggregate demand and enabled the diversification of agricultural production into a wider range of commodities. The basis of agricultural policy in Asia, as in Europe, is one of merely maintaining national food supplies in the face of growing populations. Rather, agricultural policy involves substantially increased agricultural productivity as the leading edge of the development process. One common feature emerges from analysis of the European and Asian agricultural revolutions. Cheap food, based on low cost, high productivity agriculture, has been the driving force behind rural transformation. This change has not been costless; in particular, the technologies that fuelled the European and Asian agricultural revolutions displaced some categories of rural worker and altered the economic and social status quo in the countryside. They have also increased the dependence of agricultural producers on purchased inputs. These effects are inherent in the process of change itself and the available evidence suggests that they are neither as detrimental, or as widespread, as some development theorists suggest (Borlaug, 1986, Swaminathan, 1986).

Agricultural Research in Zimbabwe

Returning to Zimbabwe, therefore, the preceding historical analyses affirm the need to push food prices down; not through direct food subsidies but by agricultural productivity gains generated by a combination of improved technology and policy incentives. A strong and well funded national agricultural research system is, therefore, a fundamental component of agricultural policy. It is worrying to see Zimbabwe starting to follow the African trend of declining real budgets for agricultural research systems, and rising proportions of research budgets committed to salaries as opposed to other expenses (Chigaru, 1986). Chigaru also points out that in Africa, national research systems absorb a higher proportion of agricultural output than those in Asia. While most have larger staffs and infrastructure than 20 years ago, their effectiveness has declined.

Doubtless there are less favourable opportunities for African agricultural researchers to replicate the yield gains of Asia and European agricultural revolutions. This, as Binswanger (1986) observes, is related to the types of technology likely to be attractive to farmers under land abundance, as in much of sub-Saharan Africa, compared with the situation in the land scarce environments of Europe and Asia. Further evidence in this regard can be found in the different uptake of yield improving technology between land scarce Japan and Europe and land abundant North America in the first quarter of this century (Binswanger and Ruttan, 1978). In Zimbabwe, appreciable areas of the country have already experienced the closure of the land frontier and the data suggest that, by the end of this century, regardless of land redistribution, Zimbabwe farmers will be operating in a land-scarce environment (Chavunduka, 1982; Hume, 1978). It is essential that the research groundwork be commenced today to meet anticipated farmers' demand for yield increasing technology over the next two decades. In this regard, it is pertinent to observe that the diversification into cotton from tobacco after UDI in Zimbabwe was made possible by an investment in cotton research dating back to the 1920s but whose payoff only came in the 1960s (Blackie, forthcoming).

Agricultural Input Supplies for High Yielding Agriculutral Technologies

The scenario developed so far suggests that agricultural policy in Zimbabwe will continue to be based on the assumption that agriculture is the lead sector of the economy. To support this policy, substantial investment will need to be made in yield-improving technologies to drive food prices down and to increase the spending power of the consumer. From this spending will arise greater rural and urban employment and a more diverse economy. History and logic tells us that the yield improving technology will be input intensive and that important inputs such as fuel and fertilizer will need to be imported. Thus the allocation of foreign currency to the agricultural sector will be critical in determining the success or otherwise of agricultural policy in Zimbabwe.

Fertilizers: Opinion within the agricultural industry varies considerably on the volume of fertilizer requirements towards the year 2000. Some authorities suggest that the only significant change that is likely to occur is for a change in the market share from large-scale to that of small-scale agriculture, largely as a consequence of increased access to credit by smallholders. Other industry estimates suggest that the large-scale commercial sector will expand at a rate of approximately 3-4 percent and the communal sector at a rate of approximately 10-15 percent per annum. This would leave the market evenly divided between large-scale and small-scale farmers at about the year 2000, with total demand in excess of 1 million tonnes. The intrnational Fertilizer Development Centre estimates a conservative ten-year expansion path for the industry (see Table 3).

At present, foreign exchange allocations for fertilizer have been sufficient to meet national demand. On the basis of forecast demand figures for fertilizer, it is likely that adequate supplies will continue to be made available to the industry.

Machinery and Associated Imports: A rather different situation pertains in the case of machinery and associated imports. At independence, Zimbabwe inherited, as the result of continuing import restrictions during the UDI period, a heavily depreciated agricultural machinery fleet. Various estimates have been produced, some showing the average age of the Zimbabwe tractor as being as old as 14 years. A comprehensive survey undertaken for the Zimbabwe Seed Co-op in 1980 showed that the average age of tractors owned by seed maize producers was 7 years. Given that seed producers are a small group, probably in the top quartile of Zimbabwean large-scale farmers, this suggests that machinery replacement in Zimbabwe has been running well below normal levels. Since independence, the situation has worsened.

Table 3: Zimbabwe: Ten-Year Forecast Committee, Second Forecast, December, 1980
(000' million)

		N	P_2O_5	K_2O	Total Nutrient	Remarks
1969/70,	Actual	47	28	20	95	
1970/71,	Actual	52	29	22	103	
1971/72,	Actual	67	34	25	126	
1972/73,	Actual	66	35	25	126	Drought
1973/74,	Actual	65	37	28	130	11-month year
1974/75,	Actual	73	42	32	147	(anticipation of price
1975/76,	Actual	55	32	25	112	increase) rationing of AN
1976/77,	Actual	60	35	27	122	No rationing of AN
1977/78,	Actual	61	35	26	122	
1978/79,	Actual	61	37	28	126	Drought
1979/80,	Actual	60	43	27	124	Drought
1980/81,	Estimate	90	38	23	156	Increase in corn price
1981/82,	Forecast	77	38	20	135	AN rationing
1982/83,	Forecast	78	39	21	137	1,48% forecast increase
1983/84,	Forecast	79	40	21	139	1,46% forecast increase
1984/85,	Forecast	80	41	21	141	1,43% forecast increase
1985/86,	Forecast	81	41	22	144	2,13% forecast increase
1986/87,	Forecast	82	41	22	145	0,69% forecast increase
1987/88,	Forecast	82	41	22	145	0% forecast increase
1988/89,	Forecast	82	41	22	145	0% forecast increase
1989/90.	Forecast	82	42	22	146	0.69% forecast increase

Source: International Fertilizer Development Center

Note: Product actuals and estimates for 1980-81 are supplied by Windmill of Zimbabwe. Grade D formula was to change from 8-14-10 to 8-14-7 in 1980-81. Forecasts were made by the committee using two units of measure: compound and AN. In coverting forecasts, the compound used average 7-15-8, and the AN was 34.5%. Numbers were rounded off to the nearest thousandth.

Foreign currency allocations for both replacement agricultural machinery, and for spares, have been reduced dramatically since 1980, resulting in critical shortages in both new machinery and spares (Anon, 1986). Although some Z$22 million is reported by the CFU to have been allocated for tractors and spares during 1985, levels of availability of these items are well below minimum desirable levels. Current shortages are a result of a combination of reduced foreign exchange allocations for spares (a drop of 53 percent in the period 1980-85), depreciation of the Zimbabwe dollar (a drop of 61.4 percent against the US dollar in the period 1981-85) and increased procurement costs in the country of origin (a rise of approximately 20 percent in the period 1980-85).

At present, the machinery/spares issue is perceived mainly as a large-scale farming sector problem. However, this is almost certainly a misrepresentation. Economic studies of communal land farming systems in recent years have consistently identified lack of draught power and transport as major constraints on increased production. Arable land has been expanding at the expense of grazing areas and while cattle numbers have increased, this has been at a slower rate than the number of farmers. Thus ownership of cattle has been declining. In 1981, Collinson found that, in the Chivi communal area, less than 50 percent of farmers owned cattle and he confirmed the declining trend indicated above. Even in the more favoured communal farming areas, less than about 75 percent of farmers own cattle (see Table 4). Both Ministry of Agriculture and University of Zimbabwe surveys show that cattle owners have significantly higher production levels and incomes than non-owners.

Table 4: Availability of Draft Power in Some Communal Lands

Date of Survey	Communal Land/ Province	% of Households w/o Draft Power	Sample Size House-holds	Source of Information
1971	Gutu	27	n/a	Loxton and Ministry of Internal Affairs
1976	Matshetshe	27	96	R. Theissen-Rural TTL Development Re-sources Programme
1976	Gutu	36	102	R. Theissen op. cit.
1976	Chiweshe	41	110	R. Theissen op. cit
1976	Masvingo Province	44	n/a	Ministry of Internal Affairs
1981	Chibi South	52	96	Dept of Land Manage-ment, University of Zimbabwe
1982	Gutu	37	50	Dept of Land Manage ment, University of Zimbabwe
1984	Wedza	77		Agritex

Source: Rukuni (1984)

While draught animals will remain a major input into smallholder farming systems in Zimbabwe, their relative importance will decline. The competition for arable land will mean that the present encroachment of cultivation into grazing areas will continue. Thus purchased draught power, at least in part in the form of tractors, will become increasingly important in the small-scale sector.

With respect to small-scale producers, the cost of transport is substantial. Table 5 presents data from three groups of smallholder maize growers in Murewa during the 1982-83 season. In all three cases, hired mechanised transport is a major cost of production. Murewa is an area with good road access to Harare; in remoter, less accessible areas, transport costs of both inputs and outputs can be expected to be even higher.

The current critically low levels of foreign exchange for agricultural mechanisation also leads to the inefficient use of allocated foreign exchange. Emergency imports of single items (often by air) to deal with breakdowns of individual tractors and machines is wasteful of foreign exchange and adds substantially to the costs of machinery operation. To guard against the unavailability of spares, farmers and transport operators carry larger stocks than they would do normally. This increases shortages at the national level while adding to inventory costs at the farm level.

With respect to fuel, lubricants and tyres, the CFU estimate that the foreign currency requirement for the agricultural sector in 1985 was about Z$100 million and in 1986 about Z$130 million. Current estimates are that the sector uses about 25% of the fuel, lubricants and tyres imported. There have been periodic shortages of fuel due both to logistical constraints and to late provision of foreign currency. Lubricants and tyres have been in critical shortage over the past year largely due to inadequate currency allocations. Although the situation has improved, there remains a serious backlog of orders. Foreign currency, particularly for new machinery and spares, is therefore a major constraint on both the large- and small-scale agricultural sectors. Over the past few years, much of the currency that has been allocated for spares has come via various aid, soft loan and barter deals. But instead of being in addition to previous levels allocated locally, it has become part of the total.

Table 5: Transport and Other Production Costs for Maize Growers: Murewa Communal Land 1982

	Sample A	Sample B	Sample C
Number of households	28	53	121
Average area cropped (ha)	1.99	1.89	1.78
Labour costs/ha	31.49	186.49	23.88
Seed costs/ha	10.64	11.94	9.40
Fertilizer cost/ha	86.75	102.12	95.74
Crop Chemical costs/ha	0.46	0.67	0.29
Transport costs/ha			
Hired scotchcart	1.25	1.16	4.58
Hired lorries	24.50	28.04	27.30
Other hired transport	1.72	0.95	0.19
Total Variable Costs/ha	156.81	331.37	161.38
Total Sales/ha	478.79	542.37	568.13
Total Cash Gross Margin/ha	321.97	211.00	406.75

Source: de Swardt

Preceding paragraphs have shown that machinery, spares, lubricants and tyres that have borne the brunt of foreign currency restrictions. It is also apparent that improved allocation to the agricultural sector of these items would benefit directly both large- and small-scale agriculture in Zimbabwe.

Agricultural Trade

Finally, in this analysis, we turn to agricultural trade. Zimbabwe is currently self-sufficient in most food commodities and has been so for many years. The maintenance of a high degree of food self-sufficiency remains an important objective of national agricultural policy, particularly in view of the emerging economic isolation of South Africa. Yet the preceding section has shown that this self-sufficiency requires the continuing use of imported inputs by large- and small-scale farmers alike. Abernethy, Bunting and Kassam (1986) show that Zimbabwe is in that group of Africa nations that can technically meet their food needs at intermediate levels of inputs for the forseeable future. Although Zimbabwe has been a remarkably successful agricultural exporter, little analysis has been done on the reasons for this success. Neither the Zimbabwe Agricultural Policy Paper (Anon, 1986) or the paper by Muchena and Murphy (1985) deal in any detail with the future prospects for agricultural trade by Zimbabwe.

The reasons for this reticence to deal analytically with trade issues are twofold. Firstly, the UDI experience and the associated clandestine trading mechanisms have built up a tradition of secrecy regarding Zimbabwe's agricultural trade. Secondly, responsibility for trade issues is split amongst several public sector agencies. However, it is important that, in the future agricultural policy involves a more considered look at trade issues. This is not only because the income generated by increased trade will be needed to support the rural adjustment consequent upon Zimbabwe's forthcoming agricultural transformation but because the world trading environment is very different from that existing in the early 1960s. The nature of world trade has altered dramatically in the last quarter century. Schuh (1986) identifies the following critical changes:

1) The rapid growth in international trade, resulting in an international food and agricultural system,
2) the emergence of a large, well-integrated international capital market,
3) the introduction of bloc-floating exchange rates in 1973, and
4) the emergence of a great deal of monetary instability starting in 1968.

Schuh concludes that these changes have substantially altered the international economic order. In the 1960s, the international dimensions of agricultural policy were primarily concerned with ensuring the efficient delivery of appropriate commodities into selected markets. Floating exchange rates alone have today made the exchange rate the single most important price in the economy: Schuh (1986) comments on the implications of these changes on agricultural policy as follows:

"What we see are enormous changes in the economic environment in which world agriculture finds itself. These changes broaden the agenda for agricultural policy, with monetary and fiscal policies, exchange rates and exchange rate policy, international capital markets, and trade policy generally now being far more important than the more familiar domestic commodity programmes".

Regional Trade:

Zimbabwe, over the remaining part of this century will face a substantially altered trading environment. This is not only due to the factors outlined above, but also because of the changing relationships with South Africa and other countries in the region. South African trade continues to dominate Zimbabwe's trade patterns. Some 18 percent of all exports from Zimbabwe go to South Africa although this is a significant drop from the 25 percent before independence. The recent financial and political problems of South Africa will mean a continuing decline in trade with that country. Its significance, as a transit country for Zimbabwean trade, should not, however, be underestimated. Zimbabwe has made strenuous efforts, both within the SADCC framework and bilaterally, to expand regional trade outside of South Africa. Table 6 reports trade patterns within the SADCC region. Zimbabwe is both the largest exporter within the group with 44.5 percent of total SADCC exports and the largest importer with 37.5 percent of total SADCC imports.

Table 7 is an FAO projection suggesting a continuing deficit in food products for the remainder of the century. FAO (1984) has produced two scenarios to indicate the parameters around which SADCC economies could move to higher levels of national income. The 'improved performance' scenario assumed an annual growth in GDP of 4 percent (*per capita* 1.1 percent) and agricultural growth of 3.2 percent/annum (*per capita* 0.3 percent). The high performance scenario is based on 5.8 percent annual growth in GDP (3 percent *per capita*).

Table 6: Trade Within SADCC Region, 1981 (US$ millions)

Destination Origin	Angola	Botswana	Lesotho	Swaziland	Malawi	Mozambique	Tanzania	Zambia	Zimbabwe	Total Exports
Angola	-	-	-	-	-	0.5	-	-	-	.05
Botswana	8.94	-	.03	.01	.10	6.60	.01	1.21	21.74	38.64
Lesotho	-	.02	-	-	-	.11	-	-	.01	.14
Swaziland	-	.07	-	-	-	5.10	.11	-	4.34	9.62
Malawi	-	.57	-	-	-	1.58	.05	4.22	22.11	28.53
Mozambique	.79	.01	-	-	3.05	-	3.98	-	24.49	32.32
Tanzania	-	.01	-	.34	.17	3.99	-	1.88	.26	6.65
Zambia	-	.52	-	-	5.01	.08	3.99	-	35.57	44.57
Zimbabwe	1.16	40.25	1.74	2.02	20.81	10.23	1.54	51.04	-	128.79
TOTAL IMPORTS	10.89	41.45	1.77	2.37	29.14	27.74	9.08	58.35	108.52	289.31

- : No trade
Source: FAO (1984)

Table 7: Trends in Agriculture: Total and by Commodity Groups

	Annual Growth Rates %				% Self Sufficiency by year 2000
	Demand		Production		
	1966-81	1979-81 to 2000	1966-81	1979-81 to 2000	
Total					
Total Agric	2.9	3.5	1.9	1.1	72
Per Capita	0.1	0.6	-1.7	-1.5	
Cereals	3.1	3.4	1.6	1.0	52
Basic Food	2.7	3.5	1.7	1.8	62
Livestock products	3.3	4.3	2.3	1.7	74
Other Food	2.7	3.1	2.1	1.5	57
Total Food	2.9	3.5	2.0	1.5	64

Scource: FAO (1984)

Agricultural growth is 4.8 percent per annum (1.9 percent *per capita*) .

Under both scenarios, the region remains in overall food deficit although the high performance scenario generates greater self-reliance in all food categories except Table livestock products. Total agricultural exports, however, would be sufficient to finance imports and to contribute to a sector surplus in the balance of trade.

Regional trade in food appears a promising avenue for Zimbabwe. The country is already performing at the 'improved performance' level of production and with appropriate investment in the agricultural sector, should be able to achieve the 'high performance' levels. Over recent years, Zimbabwe has been able to negotiate "triangular" trade deals with agencies such as the World Food Council, EEC, Australia and USAID. Such deals involve the export of Zimbabwe maize to a SADCC maize deficit country in return for a matching supply of overseas wheat. While currently such deals are on a government/donor agency basis, it is entirely foreseeable that comparable commercial arrangements could be made if economic conditions in the region improved. These arrangements appear to make better use of scarce transport and foreign currency resources than conventional food aid programmes.

International Trade:

With respect to international trade, Zimbabwe has for years followed a strategy of exporting high quality exports and stablishing a record of reliable production. The location of the country, and the nature of its export routes, mean that only low bulk, high value exports are normally likely to be competitive on the world market. The export of bulky food products out of the region has rarely been profitable for Zimbabwe (see Table 8 for an analysis done by the Zimbabwe Tobacco Association). The major international export commoditities remain tobacco, cotton, beef, sugar and coffee.

Table 8: Export Values/Railway Wagon

	Tonnage/Wagon	Average Export price/tonne (Z$)	Value/Wagon (Z$)
Tobacco	17	2 770	47 090
Cotton	20	1 330	26 600
Maize	39	125	4 875

Scource: ZTA

With respect to tobacco, Zimbabwe has recovered some of the world market share lost during UDI. However, since independence, input costs have risen sharply, especially labour. It is unlikely that there will be major expansion of tobacco production in the absence of a significant increase in auction price. Although world production is now close to annual consumption, over 10 000 tonnes of tobacco are in storage. Demand is increasing consistently but slowly. Any increase in tobacco production will be at the expense of other crops rather than being derived from an acreage expansion.

Cotton production in Zimbabwe is expanding, through an increase in *per hectare* yields, and in area planted, in the small-scale and the large-scale farming areas. In Zimbabwe dollar terms, cotton exports increased 56.7 percent in 1984 over the previous year, the greatest percentage increase in any commodity export except gold and beef. Continued expansion of this crop relies heavily on the ability of Zimbabwe to maintain the integrity of its current production and marketing system. Internationally, cotton production exceeds substantially world demand and there are large stocks overhanging the market. Zimbabwe has been able to expand its exports on the basis of its ability reliably to supply accurately graded cotton lint. This lint is primarily used for the production of quality, high value cotton goods for sale in specialized markets. Thus, Zimbabwe's cotton does not compete directly with the bulk of world production but rather is confined to significant but specialised market niche.

Some 60 percent of Zimbabwe's land area is defined as being primarily suitable for ruminant livestock production. The country has a long history of beef exports, primarily to Europe and South Africa. The beef export trade over the last decade has been erratic, largely as a result of war and drought. Beef exports in 1984 rose to Z$36.9 million, an increase of 106.1 percent over 1983. The final conclusion of the agreement with the EEC for an annual quota of 8 100 tonnes of beef under ACP Lome terms can be expected to lead to continuation of beef exports into the future. Prices for beef in Europe are about twice those in the Middle East which is possibly the best major alternative market for Zimbabwe's meat exports. Under Lome II, the combined access of Botswana, Kenya, Madagascar, Swaziland and Zimbabwe was 38 100 tonnes of beef. Only some two thirds of this quota has ever been taken up. Zimbabwe, together with Botswana, is potentially well placed to utilize some of the unclaimed quota. The Cold Storage Commission and the Botswana Meat Commission have been working in close collaboration over the past few years. Both countries have the necessary size of national herd and the ability to maintain foot and mouth disease-free zones. These are essential to being able to take significant advantage of ACP access. Internationally, beef prices are likely to continue to decline with the EEC moving to a projected export surplus of 660 000 tonnes by 1990. The outlook for Kenya's beef export potential outside the ACP agreement is gloomy. A similar situation would appear to apply to Zimbabwe (Schluter, 1984). On the other hand, the Middle East does offer an important potential market for sheep and goats. Exports to the Middle East of these products from Zimbabwe started in mid-1985. The Middle Eastern consumer prefers locally slaughtered fresh meat derived from range-fed, lean animals. Live African sheep and goats thus sell at a premium against frozen or chilled meat and against fat Australian or New Zealand lambs. In Kenya, export markets for sheep and goats offered a 70 percent premium over local markets. Thus Zimbabwe is well placed to remain a significant exporter of meat. ACP access to the EEC provides the main outlet for beef while new market development in the Middle East for goats and sheep appears promising.

During 1984, sugar exports increased by 5.6 percent to Z$55 million. Internationally, largely as a consequence of the CAP and protectionism in major Western markets, the sugar market is depressed. Further growth in sugar exports will require that Zimbabwe reduce production costs. With little prospect of increases in international sugar prices, the potential for increasing sugar exports from Zimbabwe is gloomy except possibly along the lines of the triangular arrangements already discussed for maize. Other commodities, such as coffee and horticultural products, are relatively small, but important, components of Zimbabwe agricultural export strategy.

Reliable communications with the outside world will be critical to returning Zimbabwe's reputation as a reliable supplier of high quality agricultural commodities. Although considerable effort has been made to shift reliance away from South African ports, South Africa remains the dominant route for many of Zimbabwe's exports.

EPILOGUE

The period 1965 to 1986 has been one of major change in Zimbabwe. Superficially, it would appear that this change has brought about only marginal shifts in agricultural policy. The post independence resettlement programme is smaller and more cautious than originally planned. The major agricultural institutions remain in place with an expanded mandate to serve all the farmers of Zimbabwe as opposed to a previous bias towards large-scale producers. The country is regarded as an agricultural success in African terms. In spite of both war and drought, Zimbabwe has managed to maintain per capita agricultural production.

This review has concentrated on three areas of agricultural policy - land reform, agricultural research and agricultural trade. The Zimbabwe government commitment to land redistribution is politically inevitable and consistent with its equity objectives. However, population growth and the closing of the land frontier require the adoption of higher yield agricultural technologies not only to resettle an acceptable high number of smallholders but also to push food prices down, and consumer demand up in the economy generally. History has shown that this last effect is an essential prerequisite to the labour readjustment necessary for agricultural transformation. Thus, agricultural research, land reform and economic growth are closely interlinked. Without economic growth, land redistribution achieves little except short term gains for the minority of resettled farmers.

There are disturbing signs that the importance of investing in agricultural research is insufficiently appreciated. Yet unless these investments are made today, the prospects for sustained economic growth are poor. In spite of Zimbabwe's considerable achievements, per capita growth rates in agriculture are insufficient to generate the surpluses necessary for rapid economic growth and to enable labour to move out of agriculture in a reasonably painless manner. Agriculture is, and will remain into the medium term, the lead sector of the economy. Efficient, low cost agricultural production is essential both for national food supplies and to maintain and expand agricultural exports. High quality market-oriented agricultural research and the more direct involvement of both agricultural researchers and policy makers in trade issues will be required in the rapidly changing trade environment of the last part of this century. There is no simple answer to the agricultural policy dilemmas facing Zimbabwe. Available evidence suggests that not only is change necessary and inevitable but it will also be difficult to manage. This review suggests that Zimbabwe has much of the institutional structure and capacity to nurture its coming agricultural revolution. To achieve this, however, will require important shifts in investment and perceptions.

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CHAPTER SEVEN

A PRELIMINARY ASSESSMENT OF FACTORS UNDERLYING THE GROWTH OF COMMUNAL MAIZE PRODUCTION IN ZIMBABWE

David D. Rohrbach

INTRODUCTION

Zimbabwe's maize production reached record levels of almost three million metric tons in 1985. This was one-third greater than the highest production level of the 1970s and twice the current level of total domestic consumption. Estimated harvests in 1986, though 15 percent lower than 1985, will increase the large stocks already in storage. While many African countries face food shortages and rising food import bills, Zimbabwe recently initiated a two-tiered pricing scheme designed to limit cereal grain production in 1986/87[1/].

The sharp post-independence gains in maize production came almost entirely from the communal farm sector[2/]. According to official estimates, communal production was essentially stagnant, between 1970 and 1979, at 400-500 thousand metric tons or roughly 30 percent of domestic maize supplies. From independence to 1985, however, communal maize production more than tripled to an estimated 1.6 million metric tons, or 50 percent of Zimbabwe's total output. In contrast, following record 1981 production levels, commercial output had declined. (Figure 1)

Most of the increase in communal maize production over the past five years has been sold to the government Grain

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1/ During the 1987/8 market year, producers will receive a 55 percent price reduction on maize sales in excess of 91 mt plus one-half the level of their previous year's marketings.

2/ Responsibility for maize production in Zimbabwe is divided between 2,000 large-scale commercial farms, 8,500 small-scale commercial farms, roughly 40,000 resettlement farmers and 900,000 communal farmers.

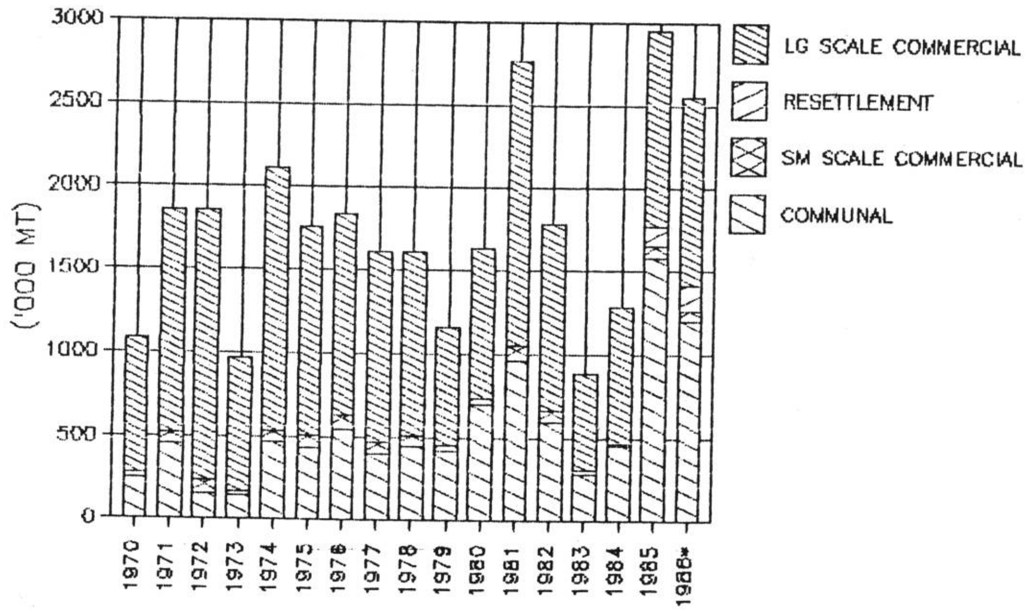

Figure 1: Zimbabwe Maize Production (1970-86 Harvest Year)
Source: CSO (1985, 1986), AMA (1985. * estimate

Marketing Board (GMB). Before 1980, communal maize sales averaged less than 5 percent of GMB intake. A fifteenfold increase in market deliveries by 1985 raised the communal sector's contribution to over one-third of the GMB's receipts, equalling the 1985/86 level of GMB domestic sales. Estimates based on GMB intake to October 31 suggest a new communal maize sales record could be set during the 1986/87 sales year despite the incidence of drought in some drier parts of the country. The proportion of GMB intake from the communal sector will increase further as a result of the new pricing policies (Figure 2).

Maize accounts for 70 percent of Zimbabwe's cereal production area and supplies a similar proportion of calories in the average diet (UNFAO, 1984)[1/]. The crop provides the centerpiece of the cropping system of most smallholders. The expansion of communal sector production has fostered the maintenance of high aggregate levels of

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1/ This may be an overestimate.

per capita production. More importantly, these production gains have benefitted a larger proportion of the crop's principal consumers, communal farmers. These producers not only have more maize to consume, but income gains resulting from larger crop sales have stimulated rural investment and employment generation.

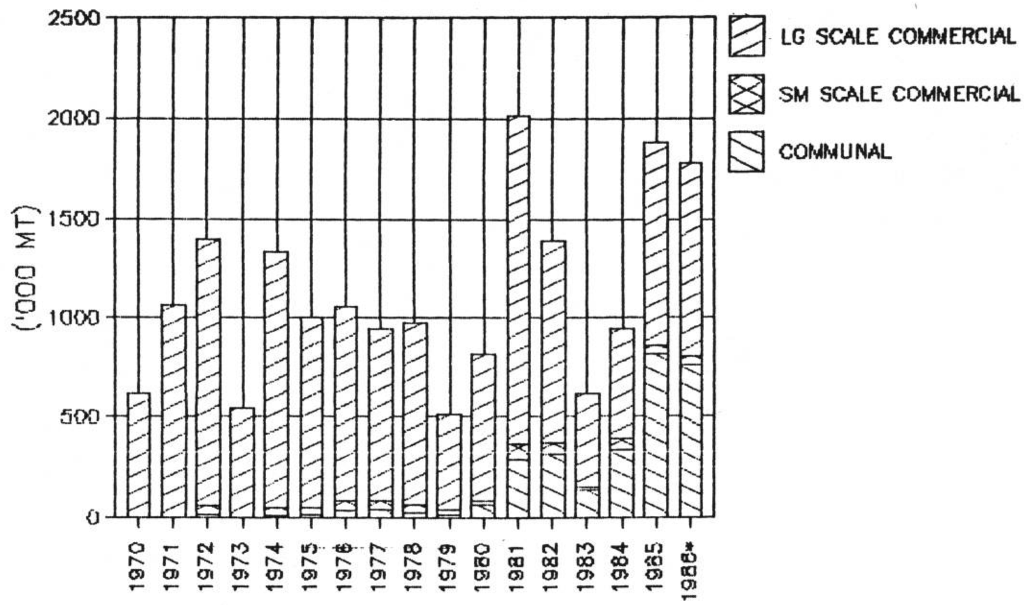

Figure 2: Zimbabwe Maize Sales to the GMB (1970-86 Harvest Year)
Source: AMA (1986) GMB (Misc. years), Muir-Leresche (1985). * estimate

This paper analyzes the sources of the large post-independence increase in communal maize production and market sales. It shows that the explanation for these gains can broadly be found in policy, institutional and technological incentives favoring the communal farmer. Relative maize prices were increasing while an expansion of market infrastructure reduced the costs of input and product delivery. Decades of local research on hybrid maize were complemented by the expansion of credit, input delivery and extension support necessary to utilize the technologies efficiently. A unique combination of public and private institutions with long experience in serving the commercial farm sector, recognizing the potential for communal production growth, quickly redirected their efforts to meet the expanding smallholder production requirements.

More specifically, the study reviews the differential influence of these interventions on two representative groups of smallholders situated in distinct agroecological regions. Highlighting the importance of policy, institutional and technological interrelationships, the analysis shows the impact of pricing policies depends heavily upon the availability of local market infrastructure and the opportunity to expand production at the household level. The availability of improved technologies will not foster efficient use without an effective set of input markets, access to investment capital and instruction guiding methods of application. Further, the impact of any given intervention will depend on the agroecological and socioeconomic characteristics of target populations.

The preliminary results of the analysis indicate most of the increase in communal maize production can be attributed to the return of the refugees after the war, the expansion of input and product market infrastructre and the adoption of improved maize technology. Pricing policies per se had less influence on communal production decisions than rising production profits associated with increasing yields. Improved access to inputs, resulting from the availability of credit and increase in the number of market sources, both promoted adoption, and more importantly, raised rates of application. Greater access to market outlets, reducing transport costs, stimulated maize sales. The following discussion examines the interplay of these relationships in the two communal regions. Future analysis will look more closely at the distributive impact of such inteventions, and identify the requirements for both sustaining and extending production trends.

METHODS OF INQUIRY

This study began with an examination of aggregate communal sector production and market statistics and a review of the results of previous research on communal production. In January 1986, a detailed set of household surveys of a sample of communal producers in high and low rainfall regions of Zimbabwe were launched. These primarily examine farm level production patterns and the household characteristics influencing production decision making. The farm level surveys are being supplemented by a brief set of institutional surveys of local input suppliers, product purchasers, transporters, credit supply agents and extension agents. These assess the availability and quality of local production and market support services. Interviews are also being conducted with members of the agricultural research community and ministry, parastatal and industry representatives in Harare. The survey work will continue through January 1987.

The household surveys are being conducted in Mangwende, a high rainfall communal area approximately 80 km east of Harare, and Chibi, a low rainfall communal region centered 370 km to the south (Figure 3). The sample area in Mangwende covers Natural Region IIa, an intensive farming area receiving a moderately high unimodal rainfall of 750-1000 mm per year. During the 1985/86 season the area received about 840 mm of rain during the production season. Natural Region II as a whole covers roughly 8 percent of Zimbabwe's communal areas though it may contain upwards to 15 percent of the communal population. The Chibi sample zone is situated in Natural Region IV (the southern part of Chibi District) a semi-extensive farming region with unimodal rainfall averaging 450-650 mm. This area is subject to periodic droughts and severe midseason dry spells. During the 1985/86 season the survey area in south Chibi received roughly 600 mm of rain, but experienced a long midseason drought substantially reducing yields and necessitating food aid deliveries. Primarily suited to drought tolerant crops and livestock production, Natural Region IV encompasses 45 percent of Zimbabwe's communal lands (Table 1).

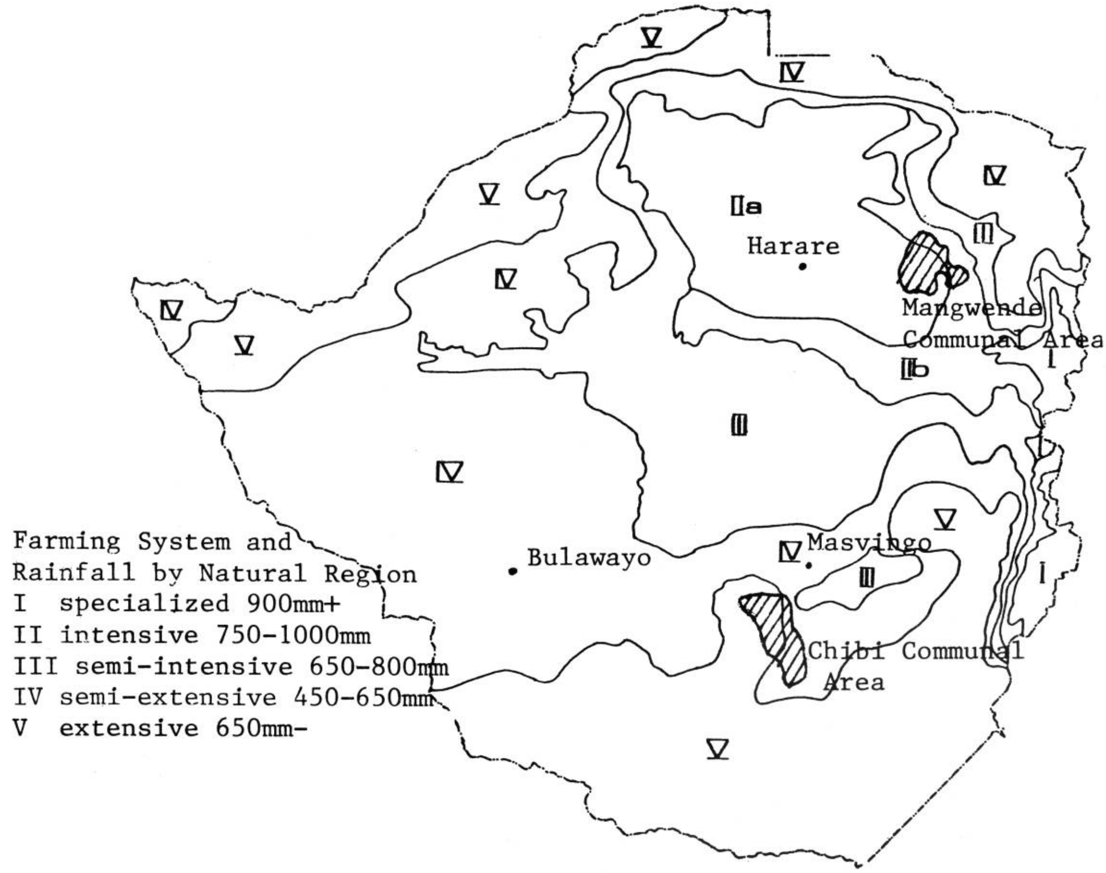

Figure 3: Zimbabwe Natural Regions and Survey Locations
Source: Whitsun Foundation (1978)

Table 1: Zimbabwe: Land Tenure by Natural Region, 1980

Natural Region	Large-scale Commercial		Small-scale Commercial		Communal Areas	
	Ha (000)	%	Ha (000)	%	Ha (000)	%
I	430	3	10	1	140	1
II	4330	28	250	18	1270	8
III	3240	21	540	38	2820	17
IV	4020	26	520	37	7340	45
V	3650	23	100	7	4780	29
Total	15680	101	1420	101	16350	100

Source: Zimbabwe Statistical Yearbook (1986)

Chibi and Mangwende communal areas were chosen for their diverse agroecological conditions and because both have particpiated in the expansion of communal maize production. In addition, past survey work conducted by the Department of Research and Specialist Services (R&SS) in each area (in 1981 and 1982) provides additional information about shifting production patterns. Further, the results of ongoing agronomic trials in each area augment the production data supplied by the farm surveys. These regions are believed to be reasonably representative of the farming conditions most communal producers experience.

A sample of 102 households was chosen in each communal area divided between six villages. Three of the villages were defined by local ward and village leaders as having relatively good market access. Three had poorer market links. A set of four interviews have been conducted with each household. The first followed the planting period, the second followed the weeding period and the third came after the harvest. A final interview with the same set of households was conducted in January of 1987 to collect information on the past season's marketing, the new season's production decisions, and to fill critical gaps in information discovered in the course of early data analysis.

Participants in the market and extension agent surveys were chosen to include all institutional support representatives with whom the sample farmers had contact. A less formal series of discussions are being held with local credit supply agents. Table 2 presents further information on survey coverage and content.

The following discussion is based on a preliminary analysis of a portion of the data collected to date. A series of complementary reports discussing various aspects of the data in greater depth will be issued during the coming months. Also, one report will review the methodology for

Table 2: Schedule and Composition of Surveys

Survey	Information Collected
First Cropping Practices Survey: January-February 1986 (208 Households)	Family composition, land use, area allocations, 1985 crop sales, input purchases, input adoption credit use, plot data.
Second Cropping Practices Survey: February-March 1986 (208 households)	Production decisions, crop storage, cattle ownership, implement ownership, plot data.
Input Sales Agents Survey: March-July 1986 (22 retail outlets)	Period of operation, volume of business, input prices, services offered, operational constraints.
Product Buyer Survey: March-July 1986 (7 depots and approved buyers)	Period of operation, volume of business, crop prices, services offered, operational constraints.
Transporter Survey: March-July 1986 (18 transporters)	Period of operation, business volume, prices, services, constraints.
Yield Data Collection: April-June 1986 (208 households)	Plot yield data.
Field Measurement Exercise: May 1986 (208 households)	Measurements of plot sizes.
Third Cropping Practices Survey: July-August 1986 (208 households)	Harvest and planned utilization, crop storage, groundnuts consumption, alternative income levels and sources.

Surveys Still Planned:
Extension Worker Survey: January 1987.
Fourth Cropping Practices Survey: January 1987

conducting this sort of sub-sector study in other countries in the region. A final review of lessons and recommendations derived from the study should be available by the middle of 1987.

SOURCES OF GROWTH IN MAIZE PRODUCTION IN THE MANGWENDE AND CHIBI COMMUNAL AREAS

The stagnant level of communal maize production during the ten years prior to 1980 harvests reflects surprising consistenty in maize area planted and yields. (Figures 4 and 5) Area harvested averaged around 675 thousand hectares and yields around 650 kg/ha. Neither appear, in available estimates, significantly affected by either the incidence of periodic droughts or the disruption caused by the war.

Most of the recent increase in communal maize plantings occurred, according to official data, between the 1979/80 and 1981/82 seasons. Maize area doubled during this period, then remained roughly constant to the present. Most of the increase in average maize yields occurred in 1985. However, a pattern of yield growth beginning in 1978 was offset by the 1982/84 drought. Without this, communal yield gains may have been more consistent. Survey results show that most of the increase in communal production in the first two years of independence resulted from the growth of maize area. Since the drought, higher yields have been important. These trends generally correspond with the pattern of production growth in both the Mangwende and Chibi communal areas. An explanation for each trend is best sought by more closely examining the factors influencing production in each communal region. Trends in area planted are first examined.

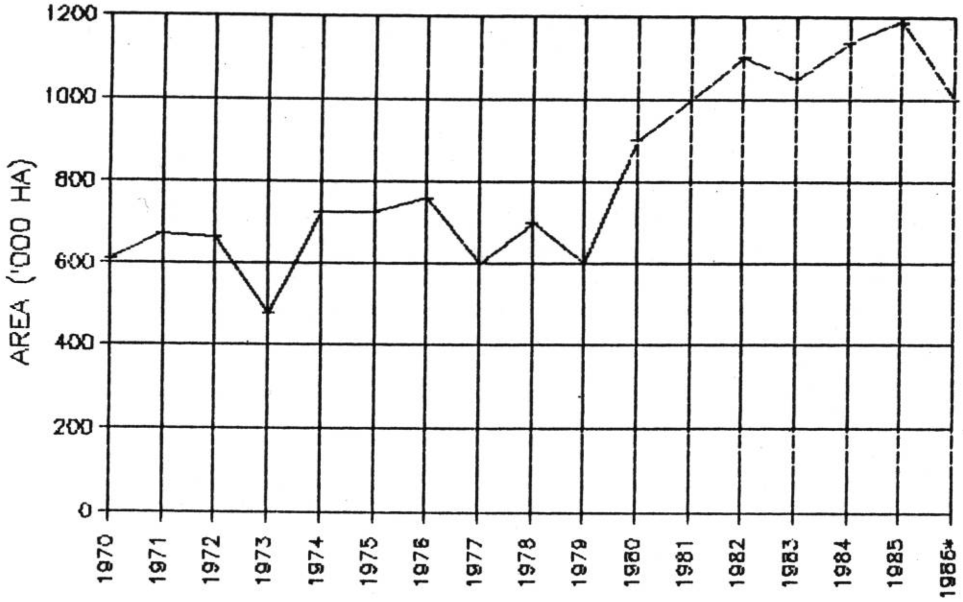

Figure 4: Zimbabwe Communal Maize Area(1970-86 Harvest Year)
Source: CSO (1985, 1986), AMA (1985). * estimate

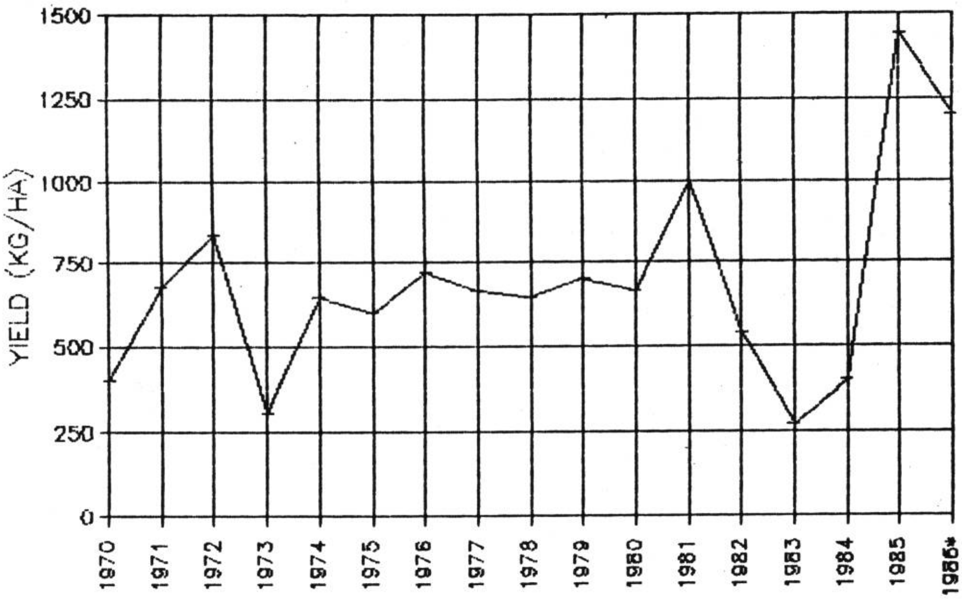

Figure 5: Zimbabwe Communal Maize Yields (1970-86 Harvest Year)
Source: CSO (1985, 1986), AMA (1985). * estimate

Maize Area Trends in Mangwende

The average farmer in Mangwende has access to 2.8 hectares of arable land and shares communal grazing rights in a locally defined grazing area. During the 1985/86 growing season, roughly three-quarters of this was planted. The remaining one-quarter was left fallow, though in many cases a portion of this is used to produce vegetables during the winter. Sixty-nine percent of cropped land was allocated to maize, 10 percent to groundnuts, 9 percent to finger millet, and the remaining 13 percent for sunflower, roundnuts, rice and other minor crops. During the past eleven years, the total area planted per farm increased by one-quarter of a hectare. Land allocated to maize increased by 0.3 hectares. Marginal gains occurred in average plantings of sunflower and nyimo while allocations to groundnuts, finger millet and rice declined (Table 3). This cropping pattern is fairly consistent across the sample.

The Mangwende survey data reveals a 90 percent increase in the area planted to maize over the last eleven years. Over one-half this gain resulted from an increase in the number of cultivators in the area and the remainder came from an increase in the average amount of land planted per household. The total gain seems to have been fairly steady throughout the period, although the larger proportion of growth occurred after independence. According to the survey data, population growth also fostered aggregate gains in the area planted to all other major crops (Figure 6).

The principal historical source of official production estimates is a series of crop forecasts prepared by local Agricultural, Technical and Extension Services (Agritex) officers (Agritex, various years). These indicate the entire gain in maize area occurred in one year, 1981. It should be noted, however, questions about the accuracy of these forecasts has led both Agritex and the Central Statistical Office (CSO) to experiment with new estimation techniques. Agritex's 1986 estimate of the Mangwende maize area is 14 percent higher than extension officer forecasts and 10 percent above these survey estimates (Johnson, Personal Communication). This new estimate was based on random location checks derived from aerial photograph grids. The CSO data are not available at the communal area level (cf. CSO, 1985b).

Table 3: Mangwende Cropping Patterns: 1974 and 1985

	1974 (n=67)			1985 (n=102)		
Crop	Area Ave. Ha	Total ha (%)	Farmers Growing (%)	Area Ave. ha	Total ha (%)	Farmers Growing (%)
Maize	1.20	61.6	99	1.49	68.6	100
Groundnuts	0.25	12.7	73	0.21	9.5	90
F. Millet	0.24	12.1	60	0.19	8.6	75
Rice	0.07	3.8	25	0.02	0.7	10
Roundnuts	0.07	3.5	43	0.09	4.3	71
Sunflower	0.04	2.2	10	0.11	4.9	27
Other	0.02	4.1	43	0.04	3.4	51
Total	1.89	100.0		2.15	100.0	

Source: Mangwende Survey Data

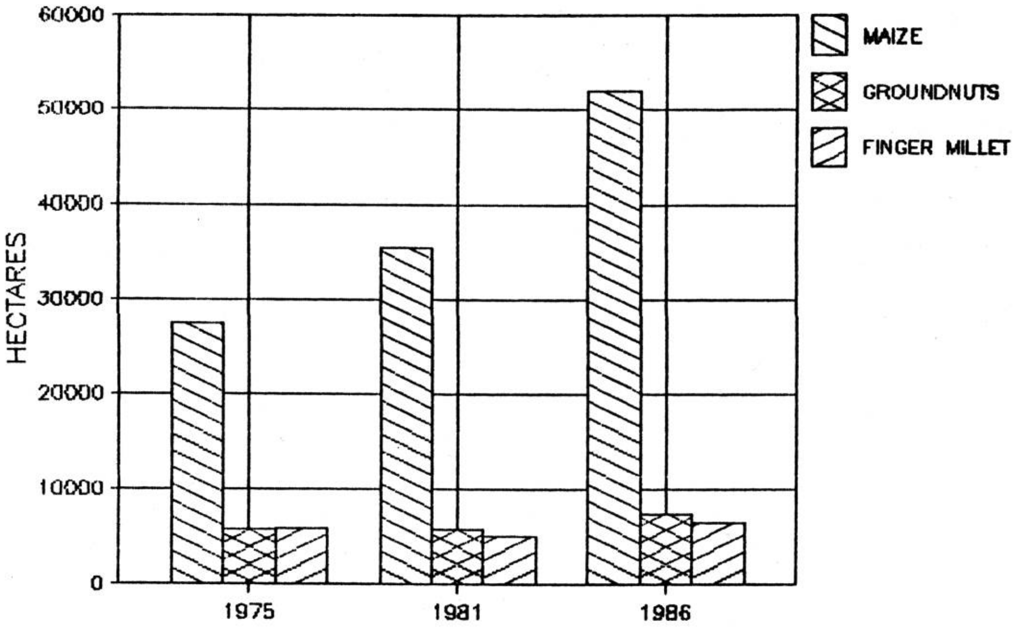

Figure 6: Mangwende Crop Area Trends (1974/75 - 1985/86)
Source: Mangwende Survey

Maize Area Trends in Chibi

The average Chibi cropping system is surprisingly similar to that in Mangwende despite the region's lower average rainfall and the likelihood of midseason dry spells. Individual holdings average 2.4 hectares of which 2.15 hectares are planted to summer season crops (Table 6). During the 1985/86 cropping season, almost 60 percent of this land was allocated to maize; 13 percent, groundnuts; 12 percent, finger millet; and 16 percent to roundnuts, sorghum, bullrush millet and other minor crops. While the more drought tolerant sorghum and millets represent a larger proportion of this system compared to Mangwende, the area allocated to these crops is declining. In 1985, maize-finger millet and maize-groundnuts intercrops were common, though they account for less than 10 percent of average cropped area. No data are available on the historical prevalence of intercropping. In earlier years the practice was popular, but extension workers have since discouraged it.

Table 4: Chibi Cropping Patterns - 1974 and 1985

	1974 (n=46)			1985 (n=106)		
Crop	Area Ave. Ha	Total ha (%)	Farmers Growing (%)	Area Ave. ha	Total ha (%)	Farmers Growing (%)
Maize	1.15	42.3	93	1.27	59.3	100
Groundnuts	0.46	17.1	74	0.28	12.9	69
Sorghum	0.31	11.3	43	0.09	4.2	30
B.R.Millet	0.30	11.3	37	0.07	3.4	15
F. Millet	0.29	10.6	61	0.25	11.6	70
Roundnuts	0.12	4.4	46	0.14	6.4	78
Other	0.05	3.1	36	0.05	2.3	36
Total	2.68	100.1		2.15	100.1	

(Maize, Groundnut and Finger Millet data incorporates intercrops).
Source: Chibi Survey Data

Between 1974 and 1985, the average number of hectares planted per household declined by 20 percent. In contrast, average maize plantings increased by 10 percent. Roundnut plantings also rose marginally. These gains were largely offset by a 0.6 hectare decline in area allocated to groundnuts, sorghum and bullrush millet.

The combined effect of population growth and increased household plantings led to an increase in total maize area of 125 percent since 1974. Eighty-four percent of this gain resulted from an increase in the number of cultivators, and 16 percent from a rise in maize area planted per household. The largest share of area gains occurred by 1981. Population growth contributed to an increase in area planted of all other major crops except sorghum and bullrush millet (Figure 7).

Historical Agritex crop forecasts show a sharp decline in Chibi maize area between the 1979 to 1981 period and 1985. The 1978/79 estimates, the earliest available, indicate a maize area twice the level suggested by the survey data. Crop estimates for 1986 cite a maize area 409 percent greater. However, the new Agritex random location checks estimate maize area only marginally greater (8 percent) than survey figures.

Cropping Preferences

The dominance of maize in both Mangwende and Chibi cropping systems reflects its importance as the principal staple. Maize is strongly preferred both for its taste and ease of processing. Finger millet remains important in both regions as the major ingredient in beer and is recognized as valuable for its drought tolerance. However, except on special occasions, maize is always consumed first. Groundnuts are widely recognized for their nutrient value, particularly for young children. These are also sought to

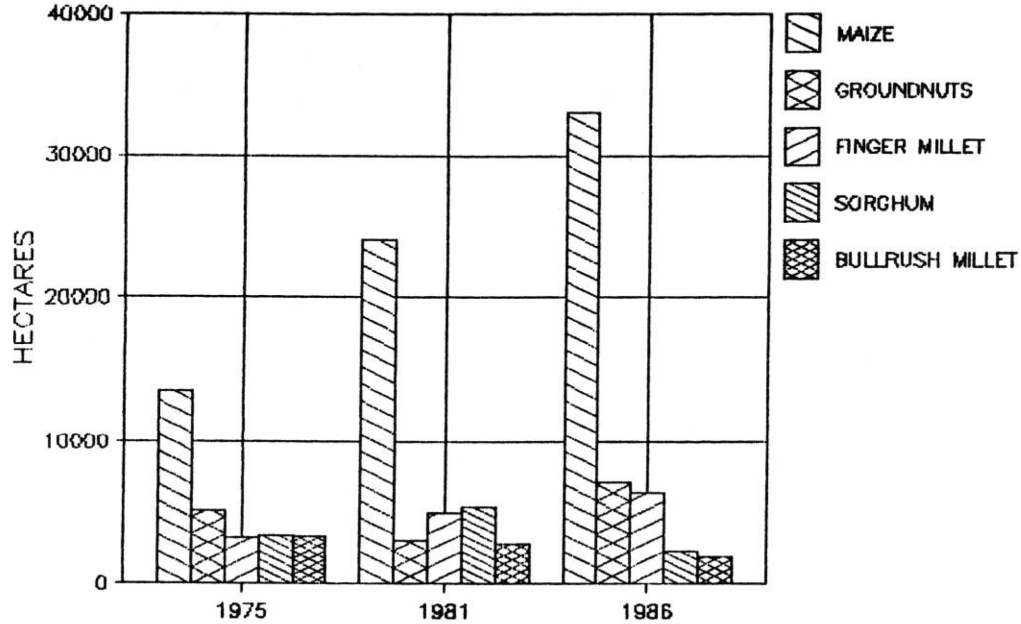

Figure 7: Chibi Crop Area Trends (1974/75 - 1985/86)
Source: Chibi Survey.

diversify the maize based diet. But groundnuts are being replaced by manufactured cooking oils, particularly by younger families, for reasons of taste and convenience.

Vegetables are becoming a more important relish. Sorghum and bullrush millet acreages are declining as the rising incidence of bird damage and the difficulty in processing these crops for consumption offset their drought tolerant characteristics.

SOURCES OF GROWTH IN MAIZE AREA PLANTED

1. Growth in the Number of Cultivators

The 1982 census estimated an annual population growth rate for Zimbabwe of 3.1 percent since 1969 (CSO, ND). Population growth was estiamted at 2.5 percent in Mangwende and 2.0 percent in Chibi. The survey estimates, based on producer estimates of when they started farming in each area, are substantially higher than this. The reason for the large difference is not clear. In both areas the survey data suggests a steady increase in numbers, with relatively larger gains just after the war. In Mangwende, one-third of the last decade's total increase in cultivator numbers came between 1979 and 1981. In Chibi, a similar percentage of producers started operations in 1980 and 1981. Remarkably, there is little corresponding evidence of outmigration during the early and mid 1970's.

During the first household survey, village leaders and some farmers in Chibi were questioned about these trends. Both groups confirmed there had been substantial immigration into the area. This movement of cultivators still continues at low levels.

In 1980, an estimated 230,000 families, or close to one-third of the communal population was estimated, according to Agritex files (Agritex, 1980), to have returned as refugees from the war to reestablish farms in the communal areas. These files also indicate 17,000 of these families, or roughly 65 percent of the region's current population, settled in Chibi. Comparable data are unavailable for Mangwende, though the influx of cultivators in this area was large enough to justify setting up a farmer training center as part of the refugee resettlement programme in the district center. Most refugees are believed to have returned to their original home areas. Yet, many also used this period to move from one communal area to another.

Insofar as a portion of the Mangwende and Chibi population growth represents households shifting the location of their farms, the trends in area growth in each region, and contribution of population growth to these tends, will be greater than national averages. An increase in cropped area and production in the survey area would be offset by a decline elsewhere. What seems clear, however, is that the combined impact of national population growth and the return of war refugees significantly increased the total quantity of communal land under cultivation.

2. Relative Crop Prices and Market Participation

Maize is widely viewed in both regions as the principal potential source of cash earnings. Farmers are generally aware of the relative level of producer prices and seem subjectively to view maize as the most profitable enterprise. Farmers identified many individual fields of maize grown specifically for marketing. This was true of few other food crop plots.

At first glance, the rise in proportion of land allocated to maize per household appears linked to the sharp post-independence increase in relative maize prices (Figure 8). Nominal maize prices doubled between 1979 and 1981. The ratio of the price of maize to groundnuts increased by 20 percent. The maize-sorghum price ratio rose by 40 percent. Further increases in the nominal price of maize occurred in 1984 and 1985. In the latter period, however, corresponding increases in both groundnuts and sorghum prices left maize ratios relatively even. Though the real maize price rose sharply in 1980 and 1981, it then declined 25 percent by 1986.

Producer response to government pricing strategies depends on the availability of farm to market transport and efficiency of local market outlets. In Mangwende, the increase in relative maize prices came during a period of expanding market infrastructure. Prior to the opening of the GMB depot in Murewa in 1977, farmers could either sell their crops through marketing cooperatives or transport their grain to depots in Marondera and Harare. The combination of distance and lack of transport facilities discouraged direct sales to the depots. The two principal

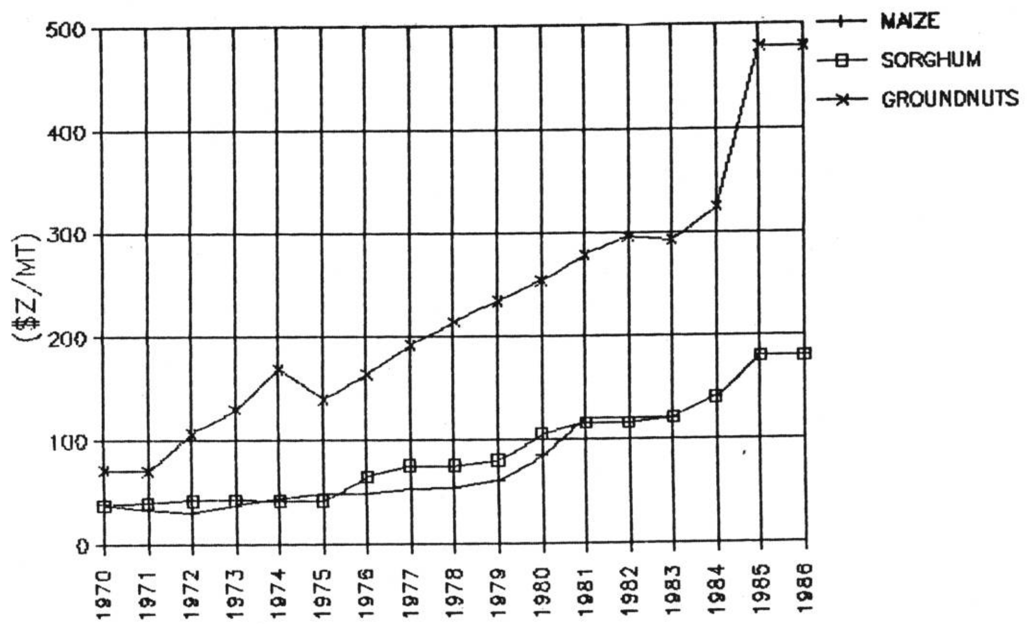

Figure 8: Zimbabwe Nominal Producer Prices (1970-86 Harvest Year)
Source: AMA

cooperatives in the survey zone did not begin operations until the late 1970's. Even then, high cooperative handling costs discouraged sales through these channels. At present, both simply maintain operations as input suppliers.

The establishment of these market outlets coincides with the growth of producer participation in official grain markets. Prior to 1977, only 8 percent of the producers in the sample sold produce to the GMB. A few sold to local shopkeepers or mission schools. Most, however, only sold to their neighbours. By 1980, 22 percent of the sample had sold to the GMB, and by the 1985/86 market season, 75 percent of the Mangwende sample producers had sold through this channel. Others were selling through GMB authorized Approved Buyers. Only 19 percent of the sample has never sold grain through official or GMB authorized channels.

The market development trend is matched by a rapid growth in the number of local transporters operating in the area.

Of the 14 transporters interviewed who were serving sample farmers in 1986, only two transported produce in 1980. Four of these had started their transport operations in 1985. Though most complained of rising costs of spare parts and petrol, and the resulting lack of profitability of providing such services, the overall availability of such services seems to be increasing.

In 1985, the GMB established two collection points in Mangwende to bulk local crop deliveries for transshipment to the nearest depot. One was located in the survey area. However, the relative efficiency of locally available transport services and unhappiness about delayed grain weighing and grading led most farmers to deliver directly to the district depot.

This pattern of expanding market infrastructure corresponds with the growth in regional grain sales. GMB maize receipts tripled from Mangwende in 1981, doubled in 1982, and rose another 50 percent by 1985 (Figure 9). While the increase in deliveries in the early part of the decade may, in part, have been in response to the increase in producer price, the continuing gains in 1984 and 1985 cannot be so ascribed. A large percentage of the sales increase during the period must also be attributed to the rise in cultivator numbers and rising per hectare yields.

The role of improved market infrastructure in stimulating communal maize sales is even more pronounced in Chibi. The principal GMB depot serving Chibi was established in 1958 in Masvingo, 70 km to the north of the nearest survey village. But limited transport in the region severely restricted grain trading opportunities. By 1980, only 2 percent of the producers in the region had sold crops to the GMB. A similar proportion had sold to the single operating Approved Buyer just north of the survey zone. Though several small marketing cooperatives were in operation in the region, these were not used by farmers in

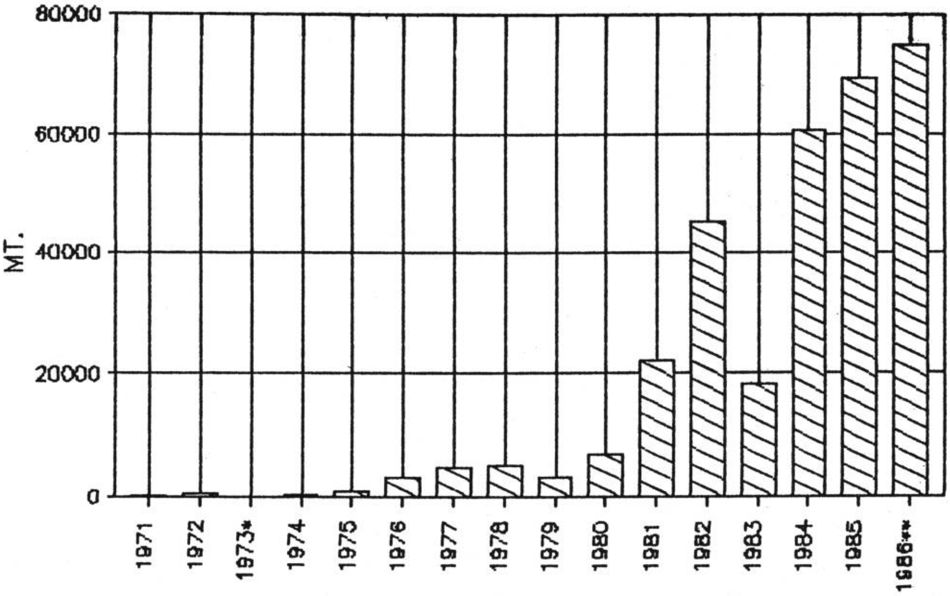

Figure 9: GMB Maize Intake from Mangwende (1971-86 Harvest Year)
Source: GMB (various years) * not available, ** estimated from 31 October deliveries

the sample. Rather, complaints were made about the costs and quality of these services. Those few farmers with production surpluses sold largely to neighbours and occasionally to small shopkeepers in the region.

In 1985, the GMB established a collection point at the center of the Chibi survey area, and another just to the north. The significant reduction in transport costs offered by these buying points provided a strong market incentive to local producers. Thirty-five percent of the farmers in southern Chibi sold to the GMB in 1985, most for the first time. Altogether, the four collection points set up throughout Chibi increased GMB intake 600 percent from the previous 1981 high (Figure 10).

The significance of the transport constraint in southern Chibi is evident in the fact that only 19 percent of those producers selling crops in 1985 used cars or trucks for transport and none of these were operated by regular

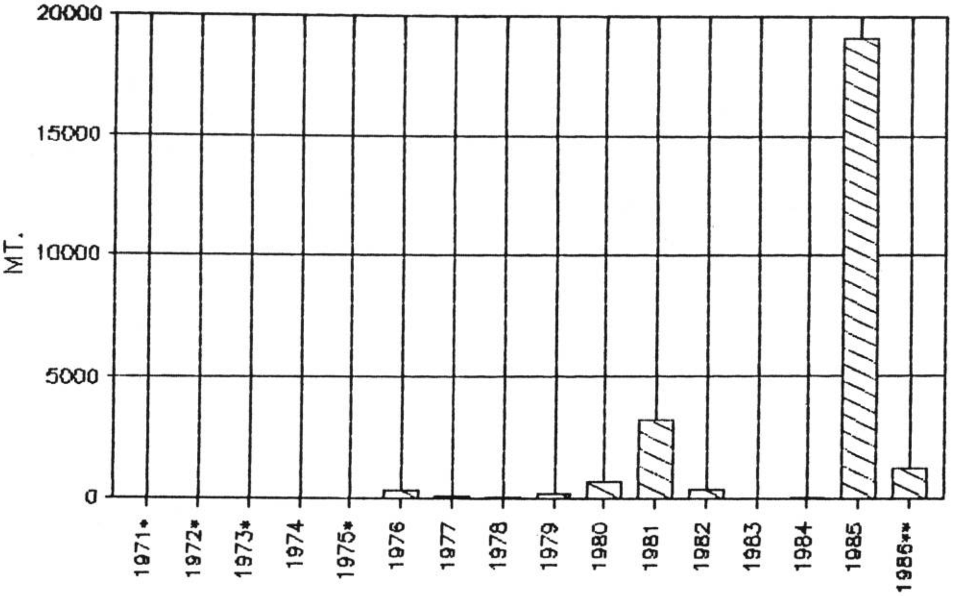

Figure 10: GMB Maize Intake from Chibi (1971-86 Harvest Year)
Source: GMB (various years). * not available, ** estimated from 31 October deliveries

transporters in the region. Most producers carried their grain by oxcart, while a few used buses, animals and wheelbarrows. Survey farmers commonly complained about the lack of organized transport facilities.

The establishment of GMB collection points in Chibi was unknown at planting time in late 1984. Producers, accordingly, had no opportunity to adjust their area allocations in response to the new availability of market outlets. Instead, the quantity of local maize deliveries in 1985 was a function of both the unusually good quality of the growing season and a latent need for cash.

3. Maize Profitability

When production technology and associated crop management practices are fixed, changes in the producer price generally provide a good indication of changing enterprise profitability. The commercial sector response to the adjustment of relative maize prices reflects this relationship. The sharp increase in 1980 and 1981 relative prices induced large increases in commercial maize area. In contrast to the communal sector, commercial maize area then declined as relative maize prices declined and the relative cost of maize inputs increased.

Production technology in the communal sector was rapidly changing over the past five years. As a result, higher returns associated with increasing yields offset the rising cost of purchased inputs. Where yield gains resulted from improved crop management, returns increased with minimal investment costs (see Makombe, Bernsten and Rohrbach, 1986). These, too, stimulated the growth in maize area planted. More importantly, they led to substantial increases in production from land already planted to maize. The justification for yield gains must accordingly be examined.

SOURCES OF GROWTH IN MAIZE YIELDS

Maize yield trends in Mangwende and Chibi were estimated on the basis of historical area allocations suggested by the survey participants, GMB sales records and survey estimates of retentions during the 1985 and 1986 harvest seasons. A production figure was derived from the sum of sales and retentions and then divided by area planted to obtain average maize yileds.

Rough calculations suggest maize yields increased sharply in both Mangwende and Chibi, particularly in the post-independence period (Figures 11 and 12). The estimates for the 1986 harvest are marginally below those derived from plot specific data in the respective survey zones because the survey was based in the higher rainfall component of each communal area. Latter period Agritex extensions

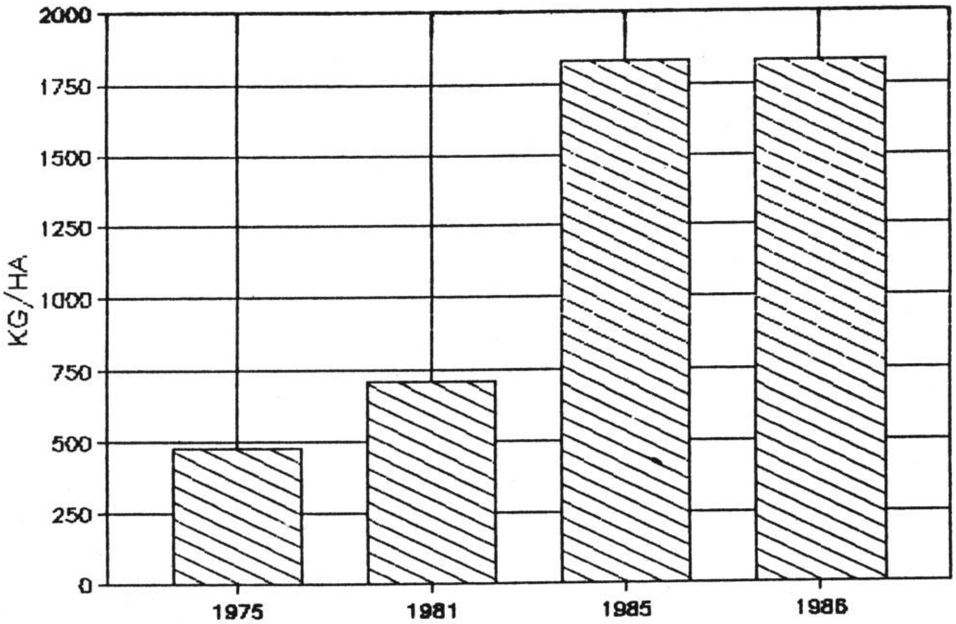

Figure 11: Maize yields in Mangwende (Harvest Years)
Source: GMB (various years), Mangwende Survey.

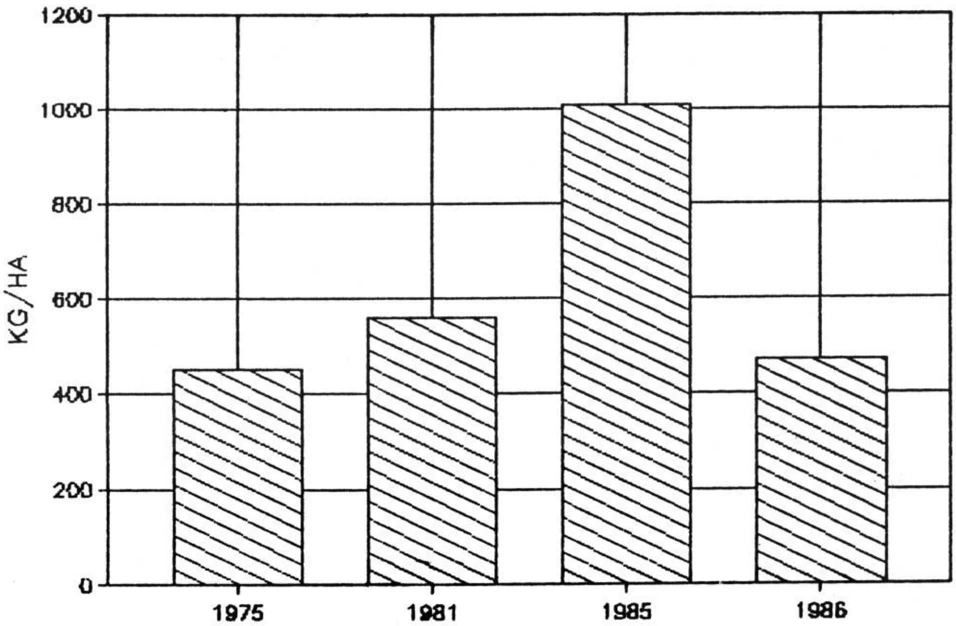

Figure 12: Maize Yields in Chibi (Harvest Years)
Source: GMB (various years), Chibi Survey

officer estimates are similar. Yet these claim Mangwende yields have remained stagnant since 1981 (Agritex, various years). Both Agritex and survey estimates are well below the yields identified in R&SS surveys (CIMMYT, 1982, Shumba, 1985). The increase in maize area planted over the last ten years brought yields gains associated with the extraction of residual soil nitrogen in lands newly coming under cultivation. Larger and more consistent increases, however, resulted from the rapid adoption of improved management practices. An assessment of the factors underlying these trends can be used in designing future strategies for sustaining them.

1. Adoption of Hybrid Seed

Decades of investment have led to the development of locally adapted hybrid maize for both low and high rainfall regions of Zimbabwe. The first major breakthrough came in 1960 with the release of SR52 and SR14, both long season varieties. Ten more years of intensive and sustained breeding work brought the release of the first of a series of short season varieties, R200.

This offered qualitites of drought avoidance associated with early maturity and a longer flowering period. Improved yields and storeability characterized two later short season releases, R201 in 1974, and R215 in 1976. Initial adoption, without fertilzier, is estimated by the principal maize breeder at R&SS to have increased communal sector yields by 30 percent (Olver, personal communication).

Roughly 85 percent of communal maize area is now planted to hybrids (Louw, personal communication). In Mangwende, 42 percent of the producers farming in the area in 1975 had adopted hybrid seed. Five years later the proportion had risen to 77 percent, and by 1985, 99 percent purchased hybrid seed. (Figure 13). Less than 1 percent of the fields in Mangwende were planted to recycled seed last year. Once farmers began purchasing hybrids, they seem to have consistently applied them to all of their plots. This implies that much of the yield gain associated with the use of this input alone was achieved before 1980. However, the full yield potential of this seed was not exploited until higher rates of fertilizer were applied.

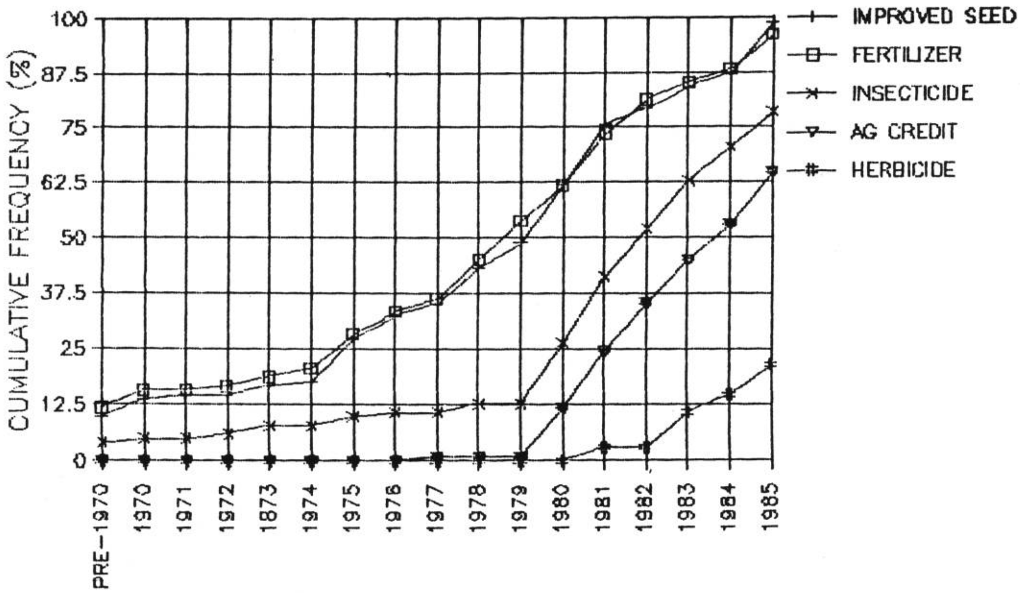

Figure 13: Mangwende Agricultural Technology Adoption (1970-85)
Source: Mangwende Surveys

In Chibi, farmers remarkably seem to have adopted hybrids much earlier than in Mangwende (Figure 14). One-half of the Chibi producers reported they had adopted hybrids by 1975. This was unexpected, since only long season hybrids (SR52 and SR14) were available at that time. Five years later, after the release of the short season hybrids (R200 and R201), 90 percent of the producers had tried the new seed. All producers in the sample were using hybrids at the time of the survey. Only in rare cases was a plot planted with recycled seed. These early adoption rates may have resulted from strong extension promotion or drought

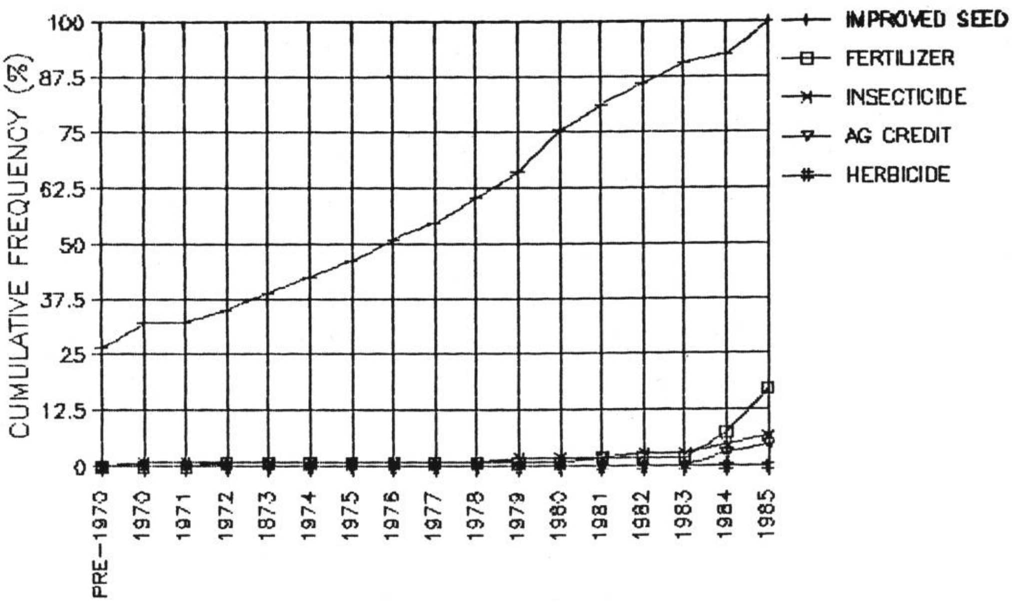

Figure 14: Chibi Agricultural Technology Adoption (1970-85)
Source: Chibi Surveys

induced frequent seed purchases. When asked why they had adopted hybrids, most producers cited higher yields even, apparently, in years of dry spells and drought. Again, this data indicates most of the yield gain made available by hybrids without fertilizer had been obtained before independence.

2. Adoption of Fertilizer

Fertilizer deliveries to the communal sector were essentially stagnant in the years before independence. In 1980, however, deliveries tripled. This was partly due to a substantial government purchase under a program of providing inputs to returning refugees. But half of this gain, and the increase in purchases which followed, can be attributed to rising producer demand. Since 1980, deliveries have grown at a 9 percent average annual rate (Table 5). Sales to the communal sector now average roughly 175 kg per household or 140 kg per hectare of maize.

Table 5: Fertilizer Deliveries to the Communal Sector (1974-1985)

Planting Year	Deliveries (MT)	Planting Year	Deliveries (MT)
1974	24 000	1980	90 000
1975	19 000	1981	96 000
1976	20 000	1982	98 000
1977	25 000	1983	109 000
1978	25 000	1984	128 000
1979	27 000	1985	150 000(est)

Source: Windmill, personal communication

In Mangwende, the adoption of fertilizer generally ocurred either at the same time hybrids were first used or one to two years later. By 1975, 45 percent of Mangwende farmers had tried fertilizer. By 1980, the proportion had risen to 70 percent and in 1986, 95 percent of the producers had used this input. Ninety-one percent used fertilizer in 1985-86. No information is available on historical rates of use in Mangwende. The rapid post independence growth in fertilizer deliveries to the communal areas suggests application levels rose sharply in the early 1980s. This will be subject to further investigation.

The yield gains associated with fertilizer use in Mangwende are clearly evident in the survey data. In 1986, yields on non-fertilized fields averaged 527 kg/ha. Application of only 90 kg per hectare (26 kg N) doubled yields. At the recommended levels of 600 kg per hectare (101 kg N) farmer yields averaged almost three metric tons per hectare. While these estimates do not take account of fertilizer type, timing or method of application, nor the use of associated inputs and improved cultural practices, they indicate the general magnitude of farm level response to fertilizer use. (Also, cf. Tattersfield, 1982; Fenner, 1985).

The average fertilizer application rate in Mangwende last year was 348 kg/ha (75 kg N), the larger proportion of which was Ammonium Nitrate top dressing. If half this level was applied in 1980, the increased usage could alone account for most of the yield gain over the past six years.

In Chibi, by contrast, few farmers have tried fertilizer. By 1980, less than 1 percent of the cultivators had adopted this input. Last year, 17 percent had tried it. However, only 12 percent of these cultivators were using fertilizer during the 1985/86 cropping season.

The yield response to fertilizer in the drier regions of Zimbabwe has not been subject to as much research as in the higher rainfall zone of Mangwende. Sharp fluctuations in the timing and level of yearly rainfall constrain the interpretation of experimental data. The response depends heavily on such associated variables as planting date and soil quality. Recent crop trials indicate little response under extreme drought conditions (R&SS, 1985) but the possibility of stong response under conditions of average rainfall (Olver, personal communication).

Ninety percent of the respondents' maize fields in southern Chibi received no fertilizer this past season. Yields from these fields averaged 460 kg per hectare. Farmers applying fertilizer generally did so at low levels averaging 135 kg per hectare (11 kg N) divided equally between basal and top dressing applications. Despite the poor quality of the season, this increased average yields to 1.2 mt/ha. A portion of this gain, however, likely resulted from the combined effect of earlier planting and better crop management practices.

3. Adoption of Insecticide

In Mangwende, patterns of insecticide adoption generally lagged behind those for fertilizer by one to four years. By 1975, only ten percent of Mangwende farmers had tried insecticide. This proportion increased to 25 percent in

1980 and jumped to 76 percent in 1985. This adoption rate does not, however, indicate broad agreement regarding the input's usefulness. Only 33 percent of the sample employed insecticide during the 1985/86 season. Initial production function estimates confirm farmer judgement showing insecticide application to have an insignificant effect on yields. This may result both from low average rates of application and prophylactic use rather than application as treatment for insect infestation.

Only eight percent of the farmers in southern Chibi have ever tried insecticide. Five percent used these chemicals during the 1985/86 growing season. There was similarly no significant yield response associated with these treatments.

4. Adoption of Herbicide

Herbicides were first used by Mangwende farmers in 1981. By 1985, 22 percent of the producers had tried these chemicals. Yet most had quit using them after a brief trial period. Of the 15 farmers who had tried herbicides before 1985, only four were still using them during the last cropping season. Most users in 1985 were doing so for the first time. Most of the farmers who had tried herbicides were located in one survey village where the extension worker had strongly promoted such experimentation. No yield response is measurable from these applications, though some weeding labour may have been saved. No farmer had tried herbicides in Chibi.

INSTITUTIONS PROMOTING TECHNOLOGY ADOPTION

Farmers in Mangwende and Chibi commonly sought the advice of their neighbours when deciding on land allocation patterns, management practices and whether to purchase new inputs. This provided one of the most important bases for evolving production patterns. Yet several external institutions also played an important role in stimulating techological change. These clearly influenced adoption timing, the consistency of input use and rates of application. They include input suppliers, farm credit agencies and extension agents.

1. Input Markets

Interviews with the input suppliers used by Mangwende farmers indicate manufactured inputs became widely available on a localized basis around 1980. Though these inputs were available in the district center by 1960, local availability increased with the establishment of cooperatives in the two main business centers in the survey area. Also, small broadbased retailers started to stock low cost inputs such as seed and insecticides as demand increased. Local transport services for carrying inputs from the district center or Harare to the farm became available around 1975. The number of transporters carrying inputs increased steadily with the volume of business.

In Chibi, one of the major factors limiting the adoption of inputs other than seed is the lack of retail outlets and input transport facilities. While farmers reported purchasing seed from over 15 different general merchandise retailers in the region, only one of these now stocks small amounts of fertilzier. Farmers complained about having to travel to Masvingo, 70 km to the north, or Cheredzi, 60 km to the southeast, for major purchases of fertilizer and farm implements. While input deliveries received with credit are delivered to Chibi under the loan agreement, transporters carrying these goods are reluctant to deliver directly to the recipient's village.

2. Agricultural Credit

The Agricultural Finance Corporation (AFC), the country's principal source of production credit, first made loans to communal farmers in 1979. Prior to this limited credit was available to a few producers through church groups. There is no local system of moneylending for production credit. AFC loans to the communal sector expanded from 3,000 in 1979 to over 65,000 in 1984 under a World Bank financed Small Farm Credit Scheme. The average size of loans increased from Z$ 170 to about Z$ 500 (Table 6).

Table 6: Agricultural Finance Corporation Communal Sector Credit Delivery 1979/1985

Planting Year	Communal Total Number of Loans	Communal Total Average Amount ($)	Mangwende Number of Loans	Mangwende Average Amount ($)	Chibi Number of Loans	Chibi Average Amount ($)
1979	2 850	170	n/a	n/a	0	0
1980	18 000	200	n/a	n/a	123	189
1981	22,000	450	2 402	198	147	174
1982	39 000	336	4 784	228	104	246
1983	52 500	533	5 961	377	200	330
1984	64 000	470	7 632	385	564	352
1985	n/a	n/a	8 922	450	643	549
1986(est)	n/a	n/a	n/a	n/a	823	580

n/a = not available
Sources: AFC, personal communication

The availability of credit is often cited as the major factor stimulating the growth in purchased input use in Mangwende and in Zimbabwe as a whole. Prior to 1980 only one sample farmer in Mangwende had received agricultural credit from a local church group. By 1981, 25 percent of the farmers had received loans. In 1985, two-thirds of Mangwende producers received short term production credit. However, repayment problems following the drought limited loan disbursement to only 41 percent of these cultivators during the past agricultural season. These loans were for designated packages of production inputs including seed, fertilizer and insecticide. Most credit has been allocated for maize production.

The fertilizer companies suggest the availability of credit stimulated the sharp increase in fertilizer deliveries to the communal areas following independence (Windmill, personal communication). Most farmers adopting fertilizer did so before receiving a loan. Yet credit availability substantially increased the quantity of fertilizer demanded. In 1985, those who received credit purchased more than twice as much fertilizer as farmers purchasing fertilizer without credit. More significantly, they now purchase less fertilizer with their own resources.

Adoption of insecticide, however, does seem to be linked with the availability of credit. Only 40% of the farmers who had used insecticide did so before receiving credit. In addition, 70% of producers applying insecticide last year received it as part of their credit package. Since credit is not generally provided for herbicide, there is no apparent link here.

AFC lending is more problematic in Chibi. To obtain credit a farmer must prove he can repay the loan, ideally on the evidence that he or she has marketed crops in earlier years. Yet few Chibi farmers sold produce to the GMB before 1985. Further, such sales resulted from a better than average year. Chibi District as a whole faces drought conditions two years out of three. While rainfall tends to be higher in southern Chibi, the probability of drought still severely limits the viability of credit without a complementary crop insurance scheme. Under such conditions, even the basic economic viability of recommended extension packages for the area remain subject to question (Johnson, personal communication).

As of 1985, only 5 percent of southern Chibi farmers had ever received credit. Most of these farmers had tried fertilizer and insecticide before receiving loans. But 80 percent of the producers using insecticide in 1985 received it in a credit package.

3. Extension Assistance

Formal interviews with extension agents have yet to be conducted. Available evidence suggests, however, that improved extension support probably also contributed to the adoption of purchased inputs and better management practices in each region. Since independence, extension agents have been provided subsidized loans for the purchase of motor bikes increasing extension coverage. Agents serving the communal areas are receiving more training and experimentation with alternative extension methods is underway. This includes working with farmer groups, radio listening programs, and a trial Training and Visit programme. Extension officers are now being encouraged to carry out surveys and on-farm agronomic trials.

In Mangwende, two-thirds of the farmers claim to have seen an extension agent sometime in the twelve months preceeding the survey. Most of these have met with extension workers more than once. Members of farmer groups are substantially more likely to see extension workers than non-group members. Seventy percent of farmers in Mangwende are group members and 83 percent of these received extension advice. By contrast, only 29 percent of those remaining outside of groups received extension advice. All farmes who received advice, obtained it for maize, though most also received advice for other crops. The most common sorts of advice, according to farmers, were for planting, fertilization, herbicide use, insecticide use, marketing and credit. A smaller proportion of producers received advice on weeding, ploughing, harvesting and crop storage.

In Chibi, extension support was more limited. Only 35 percent of Chibi farmers saw an extension agent in the twelve months before the survey. Only 25 percent saw an extension agent more than once. Though 84 percent of the farmers belong to groups, largely to share weeding labour, these do not seem as well utilized as in Mangwende. The extension advice emphasized maize production practices, particularly for ploughing, planting, fertilizer use, insecticide use, harvesting and marketing.

4. Input Distribution Under the Refugee Resettlement Programme

In 1980, input packages for five major crops were distributed free to returning war refugees under a donor funded resettlement programme (Agritex, 1980). Roughly 60,000 input packages comprising seed, fertilizer and insecticide were distributed for maize. A similar quantity of packages were available for sorghum and bullrush millet while smaller numbers of packages were distributed for groundnuts and cotton. These were supplemented by farmer training in the methods of input application.

There is little evidence, however, that many of the farmers in the sample received these inputs. There is no correlation between input adoption rates and the date of package delivery. Some believe this programme, by demonstrating the value of input use, had an important impact on technology adoption patterns. Evidence from the survey areas suggests its influence was limited.

SOURCES OF MAIZE PRODUCTION GROWTH REVIEWED

From the above evidence, a rough estimate of the contribution of various policy, institutional and technological variables to maize production growth over the last ten years can be made. In Mangwende, approximately 50 percent of the increase in production after 1974 came from an increase in the area of maize planted. Sixty percent of this can be attributed to an increase in the number of cultivators and the remaining 40 percent to an increase in the average area planted per household. A major part of the population gain seems to have resulted from the return of refugees and movement of producers after the war. The increase in household plantings resulted from the combined impact of expanding market institutions and rising maize profitability. The direct producer price response was probably small.

One-half of the increase in maize production resulted from an increase in yields. Most of this can be associated with the adoption of hybrid seed, and more importantly, with the application of increasing levels of fertilizer. These gains were made possible by the expansion of market infrastructure for input supply and the availability of credit. Greater extension support also probably contributed to the adoption of improved crop management practices.

In Chibi, approximately 45 percent of the increase in maize production over the last ten years similarly resulted from an increase in area planted. Almost eighty percent of this gain appears attributable to an increase in the number of cultivators. Twenty percent resulted from an increase in area planted per household. Here also, a large number of producers began farming just after the war. The increase in area allocated to maize in the average holding seems to have resulted from perceptions of maize profitability and the declining productivity of drought tolerant sorghums and millets. Adjustments in producer prices seem to have had little impact due to severe market constraints.

The justification for increasing maize yields is more difficult to establish. Part of this gain probably resulted from the exploitation of residual nitrogen in newly farmed lands. Yield gains were also associated with the adoption of hybrid seed, and to a lesser extent, the use of small quantities of fertilizer. The relative contribution of improved crop management practices will be subject to further examination.

ISSUES FOR FUTURE ANALYSIS

The research underlying the above analysis is still underway. These results should be viewed as preliminary. Many of the relationships apparent in the data collected have only initially been reviewed. However, a few observations can be extracted of importance for future development planning.

The analysis indicates the recent rate of growth in communal maize production will be difficult to sustain. Much of the gain occuring in the years around independence resulted from a one time increase in maize area due to the return of refugees. Tighter restrictions on the opening of land in previously designated grazing areas will limit opportunities for further area expansion simply associated with population growth. In addition, farmers benefiting from the exploitation of limited amounts of residual soil nitrogen will find this resource quickly depleted.

Future increases in production will have to be found in maize yield increasing technology. This will require the further expansion of input markets, efficient credit delivery and greater improvements in extension support. More research is required on economic levels of input application, particularly in drier regions. Extension recommendations will need to take account of the impact of rising input prices and the greater skills required for efficient use of more complex technologies such as insecticide and herbicide.

Future analysis will examine more closely the distributional impact of government policy and institutional reform. A common shortcoming of many discussions of communal development is the failure to distinguish target groups within the smallholder population. Many farmers have benefitted from the recent shift toward the provision of greater support for the communal sector. Incomes have increased and the rise in maize retentions suggests consumption levels have improved. The recent policy, institutional and technological changes, however, have strongly favoured producers who are better endowed. Specialized assistance may be required to aid communal farmers with more severe resource constraints. Similarly, new strategies may be required to extend the gains in maize production across a wider range of crops. Further analysis will seek both to reinforce our understanding of communal producer response to expanding market and technological opportunities and to evaluate the food security implications of these adjustments.

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CHAPTER EIGHT

THE ECONOMICS OF GROUNDNUT PRODUCTION BY COMMUNAL FARMERS IN ZIMBABWE

G. Makombe, R.H. Bernsten and David D. Rohrbach

INTRODUCTION

Since independence in 1980, the Zimbabwe government has made a concerted effort to raise the standard of living of the 4.3 million people living in the communal areas. As the majority of these people are subsistence farmers, agricultural policy has been the primary tool to stimulate communal area development.

Maize is the most important crop in the communal sub-sector, planted on 1 million hectares in 1985/86. Official estimates indicate that communal farmers planted 169,000 hectares of bullrush millet, 140,000 hectares of sorghum, 120,000 hectares of groundnuts, 115,000 hectares of cotton, and 107,000 hectares of finger millet (CSO, 1986). Most farmers include at least three of these crops in their farming systems.

Government efforts to promote communal crop production have emphasized maize. An unanticipated consequence of this decision has been a decline in the area planted to groundnuts. Official statistics suggest the area planted to groundnuts has fallen by 60 percent over the last ten years. Combined with a decline in yields, this has led to an 80 percent fall in groundnut production. The dramatic decline in production is a central issue in food security policy because groundnuts are the most important source of concentrated energy and protein in the communal areas. With declining groundnut production, the nutritional status of young children in particular is threatened because they have difficulty in consuming sufficient maize meal to meet basic nutrition requirements.

The purpose of this chapter is to analyze recent trends in the area planted, yields and sales of groundnuts in communal areas; assess the impact of price policy on the decline in groundnut area; analyze farm level constraints on the expansion of groundnut production in two communal areas; evaluate the technical potential and economic viability of the existing groundnut package; and draw conclusions for designing policy interventions to reverse the downward spiral in groundnut production.

The hypotheses guiding this analysis are:

(1) communal groundnut area and production have declined, largely due to groundnuts being replaced by maize which is more profitable;

(2) pricing policy favouring maize and sorghum over groundnuts is partially responsible for the relative decline in groundnut area;

(3) technical change has had a significant impact on maize production, but no impact on groundnut production;

(4) the available groundnut technology package is yield increasing, but not more profitable than current production practices;

(5) adoption of components of the groundnut package has been thwarted by difficulties in obtaining improved inputs;

(6) further institutional, policy and technical interventions are needed to increase the profitability of communal groundnut production.

RESEARCH METHODS

The research underlying this paper involved a review of aggregate communal sector data on groundnuts production, area planted, sales and consumption; several household level surveys; and interviews with local marketing agents, credit agency representatives and agricultural researchers. The following analysis represents an initial review of this information.

In 1985/86 farmers were surveyed in two smallholder farming regions: Mangwende Communal Area a high rainfall zone, centered 80 km east of Harare and Chibi Communal Area, a low rainfall zone roughly 370 km to the south. The Mangwende survey area covers Natural Region IIa in the southern part of the district. This region receives an average annual rainfall of 750-1000 mm consistently beginning in late October and continuing through April. It is representative of roughly five percent of Zimbabwe's communal lands, though contains a higher proportion of the smallholder population. Rainfall during the 1985/86 season was typical. This area is well suited to maize and farmers place highest priority on this crop.

The Chibi survey area is located in Natural Region IV in the southern part of Chibi district. This agroecological zone covers 45 percent of Zimbabwe's communal areas. Annual rainfall generally averages 450-650 mm with rains beginning in November and continuing through March or April. However, severe mid-season dry spells and drought are frequent. During the 1985/86 season, rainfall was high, but the area experienced a long mid-season dry spell. Monoculture maize is the dominant enterprise, but farmers often intercrop maize with groundnuts, finger millet and other minor crops as a strategy to offset risks associated with drought. In addition, farmers in Chibi plant sole stands of drought tolerant sorghum, finger millet and bullrush millet. Given the low rainfall and its variability, many experts argue that maize is not suited for the area. Yet, farming systems researchers from the Department of Research and Specialist Services (R&SS) report that, as in the rest of Zimbabwe, farmers have dramatically increased their maize plantings in recent years. Besides the incidence of intercropping, their production system is surprisingly similar to that found in higher rainfall Mangwende.

Multi-stage random sampling procedures were used to select the household sample (Table 1). At the first stage, Mangwende and Chibi were purposely selected as sites representative of communal areas in Natural Regions II and IV, respectively. In each location, local ward and village officials provided information which the team used to characterize village access to input and output marketing channels. At the second stage, three villages were purposely selected to represent villages with good and poor market access, respectively. Finally, key local informants helped compile a list of households in each village. A random sample of 17 households was then selected from each village. In one village a complete census of households was required. Market surveys included all agents providing services to sample farmers.

Table 1. Zimbabwe: Distribution of Household Sample, by Natural Area and Access to Marketing Facilities, 1985/86

Stage 1: Clusters	Stage 2: Market Access			
	Good		Poor	
	Villages	Households	Villages	Households
Natural Region II: Mangwende	3	51	3	51
Natural Region IV:	3	52	3	54
TOTAL	6	103	6	105

COMMUNAL GROUNDNUT PRODUCTION AND MARKET TRENDS

Communal area groundnut production, over the past decade, has been characterised by declining plantings, stagnant yields, and sharply fluctuating sales (Table 2). These trends are particularly unsatisfactory in comparison with contemporaneous sharp increases in area, yields and sales of maize (see Rohrbach, 1986).

Table 2. Zimbabwe: Communal Sector Groundnut Production and Sales 1970-1986

Harvest Year	Area (000 ha)	Yield (kg/ha)	Production (000 mt)	Sales (000 mt)
1970	245	122	30	N/A
1971	216	75	16	N/A
1972	220	75	17	6
1973	200	96	10	N/A
1974	290	646	187	4
1975	310	355	110	5
1976	325	532	173	7
1977	275	472	130	2
1978	200	504	101	5
1979	240	417	100	2
1980	175	383	67	5
1981	300	333	100	3
1982	240	396	95	2
1983	180	125	23	1
1984	144	90	13	1
1985 (est)	118	346	41	2
1986 (est)	120	278	33	7

N/A = Not available
Sources: CSO (1986); GMB Files (various years); AMA (1986) and CSO (1985)

Trends in Groundnut Area Planted

Communal groundnut plantings consistently increased between 1970 and 1976. A sharp decline in plantings occured during the 1977/78 and 1978/79 seasons due to the effects of the war and drought. As refugees returned, the area planted again rose to mid-1970's levels and then rapidly declined through the post-independence years.

The decline in groundnut production in the early 1980's stands in sharp contrast to the historically high maize plantings during this period (Figure 1). The ratio of maize to groundnuts area almost tripled between 1979 and 1985.

Trends in Groundnut Yields

According to official estimates, groundnut yields have

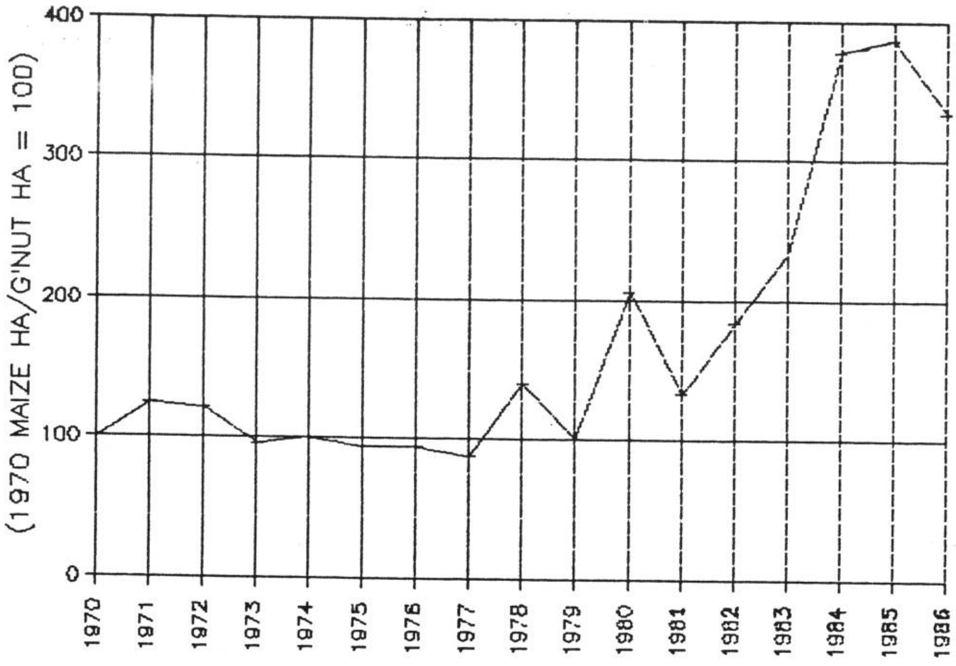

Figure 1. Zimbabwe: Index of Maize to Groundnut Area, (1969/70-1985/86)
Source: CSO (1985); CSO (various years)

broadly fluctuated over the last fifteen years. Yields reached their highest levels during the 1973/74 season. Thereafter, yields were highly dependent on the level and timing of rainfall. During the latest 1982/83 and 1983/84 drought, yields fell to their lowest levels since the early 1970s and then recovered in 1985 and 1986.

While groundnut yields in 1985 remained no higher than 1978 levels, average maize yields had doubled as shown in Figure 2. The variation in groundnut yields between poor and good rainfall years approaches that for maize despite the fact that groundnuts are generally viewed as a more drought tolerant crop. Smallholder groundnut yields are less than 25 percent of the level achieved by dryland commercial farmers.

Trends in Groundnut Sales

Historically, groundnut sales have been very low relative to total production. Groundnuts are primarily grown as a

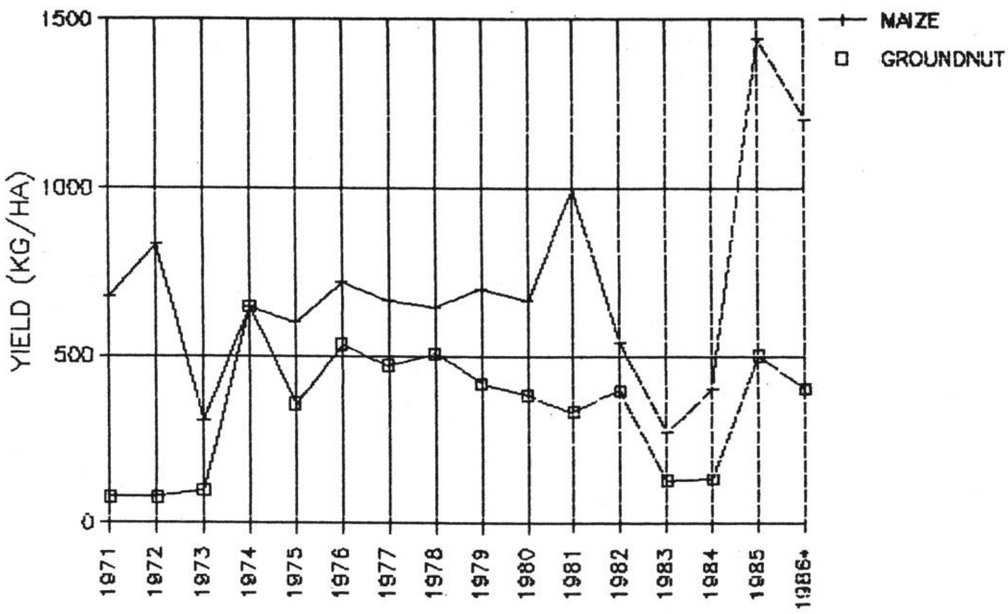

Figure 2. Zimbabwe: Communal Maize and Groundnut Yields, (1970/71-1985/86)
Source: CSO (1985); CSO (various years) * estimate

subsistence food crop. Surpluses above family food requirements are sold in local markets and to the government Grain Marketing Board (GMB). Sales to the GMB averaged 5,000 mt (shelled) before independence, and declined to 1,000 mt during the latest drought. Paradoxically sales now appear to be returning to the highest level of the 1970s, based on a projection from 31 October, 1986 GMB receipts (Figure 3).

Surprisingly, groundnut sales show little correspondence with estimated production figures. Since 1974, smallholder groundnut sales have fluctuated between 3 and 21 percent of total production. In recent years, sales generally represent a larger proportion of production. This may in part be attributable to an improvement in market infrastructure. Even so, this historical discrepancy raises questions about the accuracy of the production estimates, particularly during the 1970s.

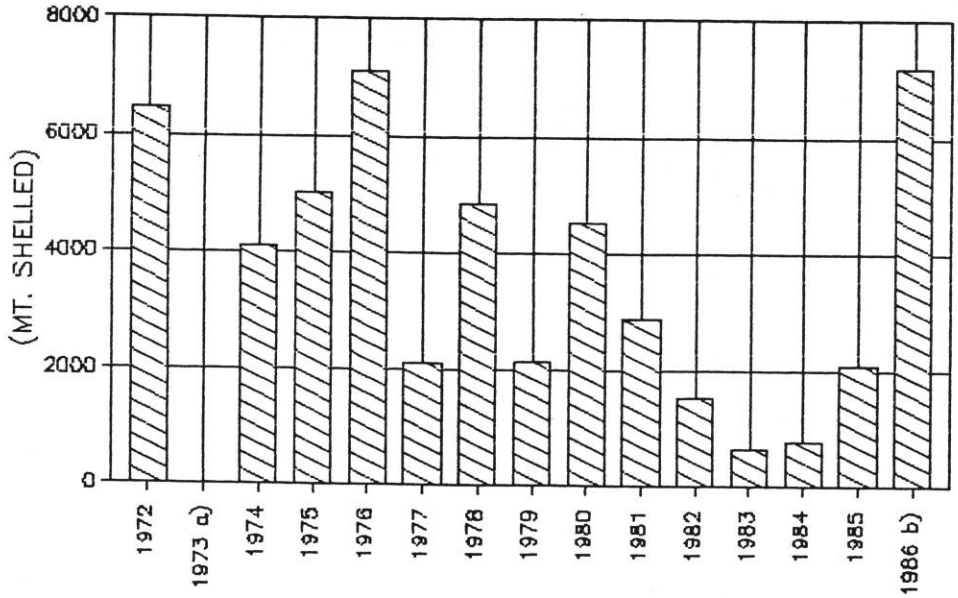

Figure 3. Zimbabwe: Communal Groundnut Sales, (1971/72 - 1985/86)
Source: GMB (various years); a/ not available; b/ estimated from 31 October deliveries

Government Price Policy

One factor helping to explain the post-1979 decline in groundnut area, as compared with the sharp increase in maize plantings, is the maize to groundnuts producer price ratio which increased 70 percent between 1978 and 1981 and remained relatively high thereafter (Figure 4). The relative profitability of maize production further increased with rising maize yields. The sharp increase in groundnut sales in 1986 could represent a delayed response to price. Yet, historical trends suggest factors other than producer price, particularly those affecting smallholder yields, may also be significant determinants of production and marketings. A micro level analysis of household production characteristics and market support was used to evaluate these relationships further.

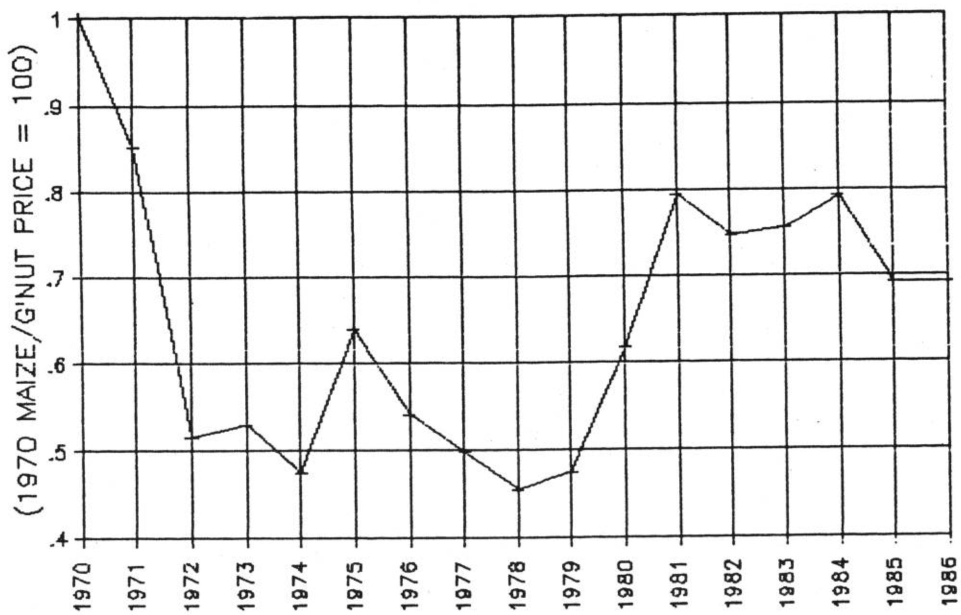

Figure 4. Zimbabwe: Ratio of Maize to Groundnuts Price Indices, (1969/70-1985/86)
Source: AMA

GROUNDNUT PRODUCTION IN CHIBI AND MANGWENDE

Groundnuts are the second most important crop in the Mangwende and Chibi farming systems. As in all agricultural systems, households use available resources to produce preferred food, cash crops and livestock. These commodities are grown in cropping and livestock systems which have evolved over time to meet household objectives, given food preferences, the agro-ecological environment, available labour, technology and the institutional setting. The major characteristics of the farming system, focusing on maize and groundnuts, are now assessed.

Household Resources

Land is allocated by the village head, to men at marriage. The recipient holds a use right until death. Land may be lent to another person, but not leased, share cropped or sold. At death, the use right usually passes to male family members. In both sites, average cropped area was 2.15 ha per household (Table 3). In addition, households have access to communal grazing land.

Labour is primarily drawn from the household stock, although labour is frequently shared among households during weeding and occasionally labour is hired. Household size (6.5 - 6.6 members) is very similar in both areas, but most household members - particularly children - only work part-time on the farm (Table 3). Full-time workers averaged 1.8 persons per household in Mangwende, compared to 2.7 in Chibi. In both Mangwende (64 percent) and Chibi (53 percent), most male household heads undertook off-farm work during the year.

Savings are generated primarily from maize, but also from groundnuts, finger millet and other crop sales. In most households, non-farm employment is an important source of savings. Credit to purchase agricultural inputs has been widely available in Mangwende since 1980, but is still not readily available in Chibi.

The male household head is largely responsible for making major crop management decisions, particularly with respect to crops destined for the market or plots receiving purchased inputs. Women take greater responsibility for the production of food crops and for management of the farm on a day-to-day basis. Some households distinguish plots of maize for the market as opposed to those for home consumption. Marketed maize tends to receive higher levels of inputs and is managed more closely by men. Groundnuts production is largely the responsibiliy of women.

Food Consumption Patterns

In both Mangwende and Chibi, maize is the food staple. It is ground, cooked into sadza and eaten with a relish (sauce). Relish is a major source of protein and vitamins,

Table 3. Zimbabwe: Communal Production System and Household Characteristics - Mangwende and Chibi Communal Areas (1985/86)

Characteristic (sample means)	Unit	Mangwende (N=103)	Chibi (N=105)
Production System			
Cropped area	(ha)	2.15	2.15
Monoculture (major crops)	(%)	100	84
Area share:			
Maize	(%)	68.6	59.3
Groundnut	(%)	9.5	12.9
Finger Millet	(%)	8.6	11.6
Roundnuts	(%)	4.3	6.4
Bullrush millet	(%)	0.6	3.4
Sorghum	(%)	0.4	4.2
Other	(%)	8.0	2.2
Total	(%)	100.0	100.0
Draft/stock animals	(no.)	6.4	3.7
Equipment owned:			
Plow	(%)	65	74
Harrow	(%)	11	18
Cultivator	(%)	37	15
Sprayer	(%)	12	1
Household			
Family size		6.5	6.6
Full time workers		1.8	2.7
Do off-farm work	(%)	64	53
Male household head	(%)	82	94
Education of household head	(years)	5.0	5.6

Source: Farm Survey, Food Security Project

especially for children who cannot consume enough bulk to meet their needs through less concentrated sources. Meat is infrequently consumed. Relishes includes a variety of homegrown vegetables. Frequently, groundnuts are consumed in relishes in the form of peanut butter. Groundnuts are also consumed raw, roasted and boiled as a snack. Sorghum, finger millet, and bullrush millet are used to make both beer and sadza.

In Mangwende, 1985/86 retentions for household consumption averaged an estimated 676 kg for maize and 78 kg for unshelled groundnuts. For the average household, maize retentions provide 72 percent and groundnuts 17 percent of minimum daily caloric requirements. Chibi retentions in 1985/86, despite the mid-season dry spell, averaged 606 kg of maize and 32 kg of unshelled groundnuts. Yet most households had well below this level. As a result, food aid was distributed in the area in 1986.

Cropping Pattern

Land is continuously cropped. Farmers pursue a grain and legume rotation strategy, however, the small area planted to legumes in any given season limits the extent of this practice. In Mangwende, crops are grown in monocultures, although low intensity clusters of pumpkins and cowpea are intercropped with maize (Table 3). While monoculture is dominant in Chibi, about 16 percent of the cropped area is intercropped with combinations such as maize and groundnuts, maize and fingermillet or maize and roundnut.

Maize is the dominant crop in both Mangwende (68.6 percent) and Chibi (59.3 percent) as shown in Table 3. Groundnuts are planted on 9.5 percent and 12.9 percent of the land in Mangwende and Chibi, respectively. Over the past ten years the average area planted to maize per household has been increasing. Household groundnut plantings, particularly in Chibi, have declined.

Labour Use

Labour is one of the principal household resources. Survey data show that labour input varies significantly between the two communal regions, between crops and between the same operation across crops. In Mangwende, groundnuts required 149 workdays/ha compared to 201 workdays/ha for maize (Figure 5). Finger millet (rapoko) requires the same labor input as groundnuts (146 workdays/ha); bullrush millet (mhunga) requires 115 workdays/ha, roundnuts demand 112 workdays/ha and sunflower uses 94 workdays/ha.

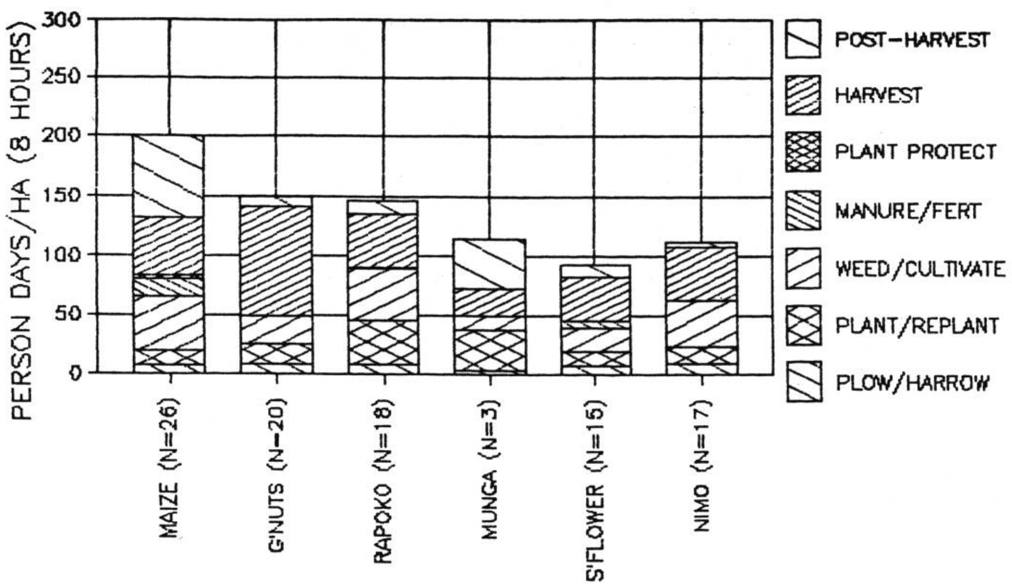

Figure 5. Mangwende: Labour Use by Crop and Operation
Source: Mangwende Surveys

In Chibi, groundnut production requires 174 workdays per hectare compared to 118 workdays for maize (Figure 6). Sorghum requires the same labour input as groundnuts. Finger millet requires substantially more labour.

In Mangwende, Harvesting requires the largest groundnut labour requirement per hectare. In Chibi, weeding requires the most labour. The relatively larger demand for harvest labour in Mangwende is a function of higher yields. The difference in labour use in weeding between the two areas is surprising. One would expect greater weed growth in the higher rainfall zone with an associated increase in the labour requirement. However, higher plant populations and stronger, more rapid crop growth in Mangwende may reduce the level of weed competition. In addition, farmers may

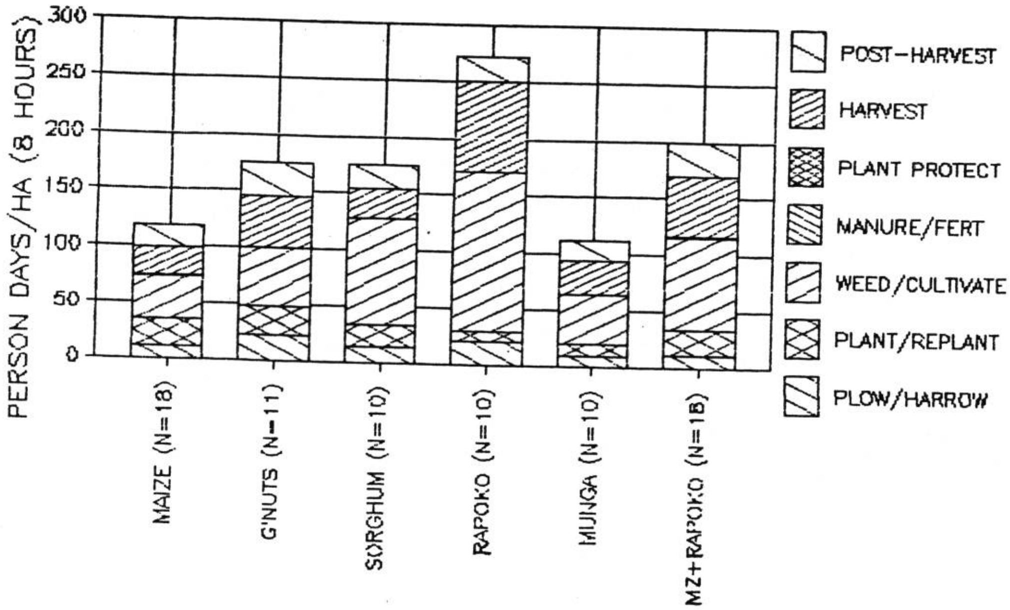

Figure 6. Chibi: Labour Use by Crop and Operation (1985-86)
Source: Chibi Surveys

simply allocate greater resources to the production of marketed crops such as maize. Post-harvest labour demand for all crops in both regions also requires further study. Labour requirements were underestimated in our survey if shelling did not immediately follow the harvest. Groundnuts tend to be shelled as they are required for consumption1/.

The sexual division of labour is well documented. Adult males dominate maize production and females control groundnuts in both areas. For example, in Mangwende, adult males (over 14 years of age) provide 48 percent of labour used to produce a hectare of maize and 19 percent of labour required for groundnuts. In Chibi, adult males provide 50

1/ This data questions the general assumption that groundnuts are always more labour intensive than maize. The survey is small and requires further inquiry. Yet labour use clearly seems to depend upon relative crop management practices, yields, agroecological conditions and possibly also the relative importance attached to a given crop.

percent of the labour in maize production and 37 percent in the production of groundnuts.

Technology Use and Yield Levels

While improved maize technology has been widely adopted by Mangwende and Chibi farmers, few farmers have used improved groundnut inputs. This contrast is particularly significant in Mangwende (Figure 7) where virtually 100 percent of the high rainfall zone producers used hybrid maize seed and fertilizer during the 1985/86 season. Most had tried insecticides and almost one quarter of the sample had used herbicide on maize. By contrast, only 14 percent of these farmers planted the recommended groundnut varieties. Only one producer applied fertilizer to groundnuts. No groundnut plots received insecticide or herbicide.

In Chibi, although hybrid maize seed was also employed by 100 percent of the sample farmers, only 2 percent planted certified groundnut seed. Few farmers used fertilizer or insecticide. These were only applied to maize. No farmer used herbicide (Figure 8).

These adoption patterns are clearly reflected in the average level of crop yields. Maize yields in Mangwende averaged 2,160 kg/ha compared to 532 kg/ha in Chibi. Shelled groundnut yields averaged 449 kg/ha and 262 kg/ha in the two regions respectively. More significantly, over the last ten years, maize yields have more than tripled in Mangwende and more than doubled in Chibi. In comparison, groundnut yields have remained stagnant.

Institutional Support

Since independence, government has made a considerable effort to strengthen institutions supporting agriculture, particularly those serving the communal areas.

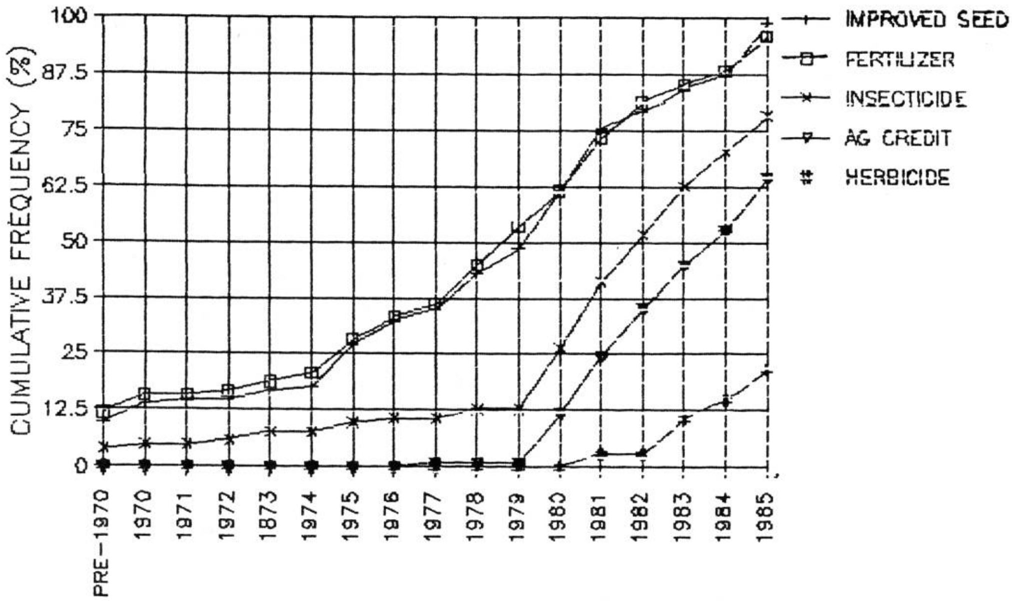

Figure 7. Agricultural Technology Adoption in Mangwende Communal Area (1970 - 1985)
Source: Mangwende Surveys

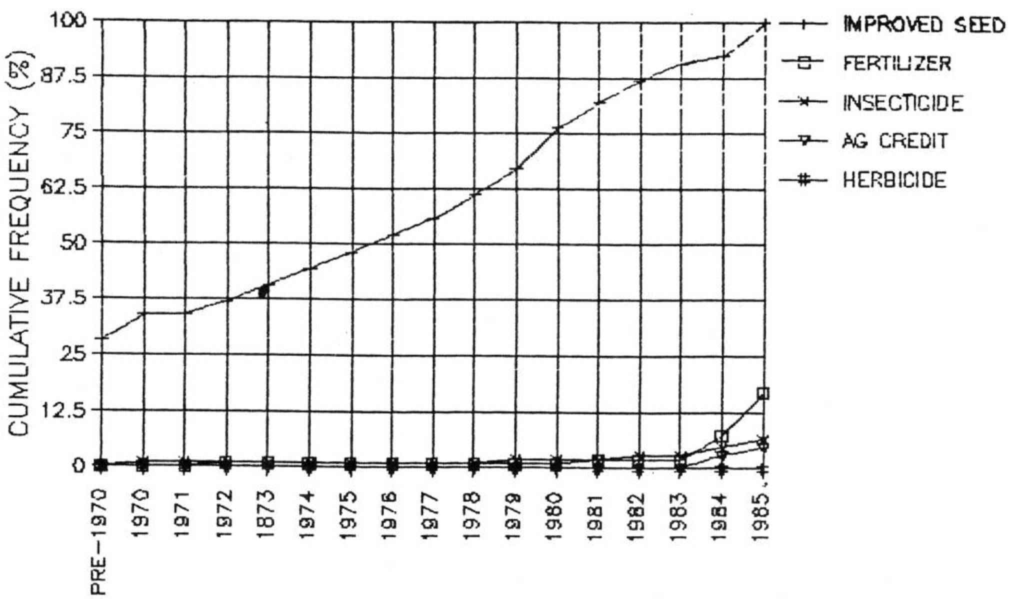

Figure 8. Agricultural Technology Adoption in Chibi Communal Area (1970 - 1985)
Source: Chibi Surveys

Input Delivery. Farmers can purchase seed, fertilizer, insecticide and herbicide at stores or cooperatives in their area or at a nearby town. These outlets are expanding rapidly as the demand for inputs increases. The Mangwende survey area farmers used seven major retail outlets for inputs, including two cooperatives, two wholesalers and three general merchandise retailers. The wholesalers and cooperatives, established in the late 1970s and early 1980s, provide a broad range of inputs including seed, agricultural chemicals and farm equipment. The retailers tend to stock low priced items such as seed, insecticide and small amounts of fertilizer. Most of these services are directed towards the needs of maize producers. None of the local input suppliers interviewed currently sell groundnut seed or fertilizer specifically recommended for groundnuts.

In the Chibi Survey area, sample farmers purchased inputs from 14 retail outlets. Most stock maize seed and insecticide. One stocks small quantities of fertilizer, primarily for vegetable producers at a nearby irrigation scheme. Four sold groundnut seed during the past season, but several retailers complained about not being able to obtain adequate supplies following the recent drought. Most locally sold seed is locally grown and uncertified. Locally sold seed tends to be locally grown and uncertified. To purchase farm equipment and large quantities of fertilizer, farmers generally travel 60 to 90 km to a large town.

Credit. The Agricultural Finance Corporation (AFC) is the major source of credit to communal farmers. Loans first became available to Mangwende and Chibi farmers in 1979. Most farmers in Mangwende have received credit in the past, although due to repayment problems associated with the drought, only 41 percent received loans in 1985. All loans to sample farmers were for maize.

In Chibi, only 4 percent of the sample received credit last year, all for maize. The low participation rate is due to high production risk associated with the high probability of drought in the area.

Extension. Three extension workers are assigned to each of the Mangwende and Chibi survey regions. The extension worker to farmer ratio is roughly 1:1000. In Mangwende, two-thirds of the sample farmers received advice, most frequently for both maize and groundnuts. Only one-third of the Chibi farmers received advice. Most of these received assistance with maize production, but some also obtained advice for groundnuts.

Output Marketing. In both areas, the Grain Marketing Board (GMB) buys all major crops except roundnuts. Farmers may sell to the local GMB depot, at a collection point, through a cooperative, or to Approved Buyers. In Mangwende, most farmers sell to the depot, approximately 25 km from the center of the survey area. Many also sell to approved buyers to by-pass stop orders on crop loans or to obtain immediate cash.

Farmers in Chibi had limited opportunity to market crop surpluses before 1985 as the nearest GMB depot was 90 km from the center of the survey area and farmers experienced severe transport constraints. In 1985, the GMB established a series of collection points in the area which substantially reduced marketing costs. As a result, during the past year, many farmers marketed crops for the first time.

ECONOMICS OF GROUNDNUT PRODUCTION

Relative enterprise profitability, and more importantly, returns to total land, labour and capital investments are important determinants of enterprise choice. A series of budgets were constructed to evaluate relative enterprise profitability in both Mangwende and Chibi. Input costs were valued at local market prices, with groundnut seed priced at its opportunity cost of sale because few farmers purchase this input. Labour was valued at an opportunity cost of Z$ 1.00 per day. This is less than the average wage rate in both regions during peak labour demand periods when labour is hired. However, the lower figure probably more accurately reflects the average opportunity cost of labour for the entire cropping season. In both Mangwende and Chibi, a single groundnut budget was calculated reflecting the similarity of low input production practices across farmers in each region. These budgets incorporate average plot yields and region-specific labour requirements. Separate budgets were constructed for maize in each area to reflect the different levels of inputs and associated labour requirements. In Mangwende, maize budgets were constructed to represent low, medium and high input use. In Chibi, only low and medium input budgets were constructed as no farmers applied high input levels.

Mangwende Budget Analysis

A surprising result of the Mangwende budget analysis is that groundnuts yield roughly equivalent returns as the medium input and most profitable maize enterprise (Table 4). The "gross margin", the "rate of return on total cash and opportunity costs" and the "return to labour before post-harvest operations" are essentially the same for groundnuts and the medium input maize enterprise. The gross margin per hectare is roughly Z$ 190, the rate of return to cash and opportunity costs is 20 percent and the return to labour prior to the post-harvest operations is about Z$ 1.40 per day. This is 1/3 the level of the national minimum wage for agricultural labour. Given groundnut's low requirement for cash investment, this enterprise gives substantially higher return per $Z 100 of cash costs. Yet, producers primarily concerned about the level of cash costs would find low input maize a more attractive venture. The last measure of profitability, "return to total labour", favours groundnuts. However, this estimate is problematic insofar as it was difficult to obtain an accurate measure of post-harvest labour requirements, particularly for groundnuts. Also, as post-harvest operations tend to take place when the aggregate demand for household labour is low (i.e. during the off-season), the actual opportunity cost of this labour may be less than the Z$ 1.00 per day average rate used to value labour in the budget analysis.

The relatively low returns to high rates of fertilizer application on maize are worth comment. This level of usage supplies only slightly less nitrogen than the extension recommendation. This result may be a consequence of the fact that recommendations have not changed as relative fertilizer prices have increased.

Also, the level of response to fertilizer seems to depend critically on other maize management practices.

Further evidence is required to evaluate why, despite the relative profitability of groundnuts in our budget analysis, production of this crop remains only a minor component of the average communal cropping system. One explanation is that farmers' perceptions of groundnut profitability may be influenced by the sharp decline in relative groundnut prices over the 1979 to 1981 period. The impact of the decline of the groundnut price relative to maize is shown in a new budget indicating the relative returns to groundnuts if the 1979 maize to groundnuts price ratio had remained consistent (Table 5). This shows that the profitability of groundnuts has significantly declined, in comparison with the alternative maize enterprises, since independence. All measures of returns except those to Z$ 100 variable costs strongly favour groundnuts.

Table 4. Zimbabwe: Crop Budgets, Mangwende Communal Area, 1985/86

PLOTS	Groundnut (unshelled) (N=102)	Maize Input Level: Low (N=26)	Medium (N=52)	High (N=41)
YIELD (mt/ha)	.65	.53	2.32	3.25
GROSS OUTPUT VALUE a/	309.57	94.86	417.60	585.18
VARIABLE COSTS				
Contract plowing	.00	.00	.00	.00
Seed	90.00	21.33	22.91	22.12
Fertilizer	.00	.00	143.60	417.56
Insecticide	.00	.08	.45	.53
Transport to farm	.00	.00	7.52	13.14
Loan application fee	.00	.00	5.00	5.00
Loan interest	.00	.00	17.24	44.52
Bags	1.82	.53	2.32	3.25
Transport to market	25.27	7.32	32.22	45.15
TOTAL VARIABLE COSTS	117.09	29.25	231.26	551.27
GROSS MARGIN: TOTAL	192.48	65.61	186.34	33.91
PER Z$100 VARIABLE COSTS	164.38	224.29	80.58	6.15
RETURN ON VARIABLE+OPP COSTS(%)	19	-25	21	-18
RETURN PER LABOR DAY:TOTAL b/	1.29	.59	.89	.13
RETURN PER LABOR DAY: EXCLUDING POST HARVEST LABOUR c/	1.37	.69	1.38	.22

a/ Gross Ouput Value = yield x producer price; Gross Margin = gross output value - total variable costs; Gross Margin per Z$ 100 Variable Costs = gross margin/total variable costs x 100; Return on Variable and Opportunity Costs = gross margin - total variable costs - opportunity cost of labour ($ 1/day) - plough depreciation ($10/ha) all divided by total variable costs + opportunity costs of labour + plough depreciation, with the resulting value multiplied by 100; Return Per Laour Day = gross margin/labour days.

b/ Total labour requirements: groundnuts - 149 days/ha; low input maize - 111 days/ha; medium input maize - 209 days/ha; high input maize - 201 days/ha.

c/ Labour requirements excluding post harvest; groundnuts - 141 days/ha; low input maize - 95 days/ha; medium input maize - 135 days/ha; high input maize - 154 days/ha.

It should also be noted that it was during the period of declining groundnuts profitability that Mangwende farmers first began selling large quantities of crops to the GMB. Further, maize production, after 1980, was being strongly promoted with the rapid expansion of input supplies,

Table 5. Zimbabwe: Crop Budgets, Using 1979 Price Ratio, Zimbabwe, Mangwende Communal Area 1985/86

COMMODITY:	Groundnut (unshelled)	Maize Input Level		
		Low	Medium	High
PLOTS:	(N=102)	(N=26)	(N=52)	(N=41)
YIELD (mt/ha)	.65	.53	2.32	3.25
GROSS OUTPUT VALUE	446.41	94.86	417.60	585.18
VARIABLE COSTS				
Contract plowing	.00	.00	.00	.00
Seed	116.40	21.33	22.91	22.12
Fertilizer	.00	.00	143.60	417.56
Insecticide	.00	.08	.45	.53
Transport to farm	.00	.00	7.52	13.14
Loan application fee	.00	.00	5.00	5.00
Loan interest	.00	.00	17.24	44.52
Bags	1.82	.53	2.32	3.25
Transport to market	25.27	7.32	32.22	45.15
TOTAL VARIABLE COSTS	143.49	29.25	231.26	551.27
GROSS MARGIN: TOTAL	302.91	65.61	186.34	33.91
PER Z$100 VARIABLE COSTS	211.10	224.29	80.58	6.15
RETURN ON VARIABLE+OPP COSTS(%)	55	-25	21	-18
RETURN PER LABOR DAY:TOTAL	2.03	.59	.89	.13
RETURN PER LABOR DAY: EXCLUDING POST HARVEST LABOUR	2.15	.69	1.38	.22

extension support and the distribution of production credit. As shown in the discussion of institutional support above, improved production inputs and credit were not widely available for groundnuts.

Nevertheless, in 1986, groundnut sales from Mangwende could reach their highest levels over the past 15 years[1/]. The crop clearly has not been ignored as a cash earning enterprise and it is still the second most important crop in the average household's production system. Farmers broadly suggested an increase in price would lead them to increase production and sales further.

1/ Projection based on deliveries to 31 October 1986. GMB (various years)

Chibi Budget Analysis

In southern Chibi the budget analysis suggests maize generally gives a higher return than groundnuts, even in a year such as the 1985/86 season when farmers experienced a long mid-season dry spell. If the rains had been better, judging from 1984/85 season yields, maize production would have been even more advantageous.

The medium input maize gross margin of Z$ 82.72 is 50 percent more profitable than the gross margin (Z$ 54.19) for groundnuts (Table 6). Low input maize, without fertilizer, is marginally less profitable by this measure. But when the "return to each $Z 100 of variable costs" is considered, the low input maize enterprise gives the highest return. Hereby, maize is three times more profitable than the groundnut enterprise.

This measure is important because very few Chibi farmers receive credit and cash resources for investing in purchased inputs are extremely limited. When labour costs are considered, the returns to both low and medium input maize are higher than those for groundnuts. Here, it makes no difference whether post-harvest labour requirements are included. Farmers concerned about the limited availability of labour are better off producing maize. If the 1979 maize to groundnut price ratio had remained the same, the profitability of groundnuts would have been substantially higher (Table 7). Only farmers with a variable cost constraint would have favoured low input maize.

These budget figures justify the land allocation trend in southern Chibi towards smaller household plantings of groundnuts and larger plantings of maize. While farmers continue to produce groundnuts as a household staple, they do not view it as a cash crop. Even in years of high rainfall such as the 1984/85 season, Chibi groundnut marketings remained lower than those for maize, finger millet and sunflower.

Table 6. Zimbabwe: Crop Budgets, Chibi Communal Area, 1985/86

COMMODITY:	Groundnut (unshelled)	Maize Input Level	
		Low	Medium
PLOTS:	(N=48)	(N=156)	(N=17)
YIELD (mt/ha)	.38	.46	1.16
GROSS OUTPUT VALUE	180.64	83.34	208.44
VARIABLE COSTS			
Contract plowing	.00	.00	.00
Seed	90.00	18.96	21.33
Fertilizer	.00	.00	51.50
Insecticide	.00	.08	.11
Transport to farm	.00	.00	5.44
Loan application fee	.00	.00	5.00
Loan interest	.00	.00	2.58
Bags	1.06	.46	1.16
Transport to market	35.39	15.43	38.60
TOTAL VARIABLE COSTS	126.45	34.86	125.72
GROSS MARGIN: TOTAL	54.19	48.48	82.72
PER Z$100 VARIABLE COSTS	42.85	139.10	65.80
RETURN ON VARIABLE+OPP COSTS(%)	-36	-40	-40
RETURN PER LABOUR DAY:TOTAL a/	.31	.44	.49
RETURN PER LABOUR DAY: EXCLUDING POST HARVEST LABOUR b/	.37	.51	.65

a/ Total labour requirements: groundnuts - 175 days/ha; low input maize - 110 days/ha; medium input maize - 169 days/ha

b/ Labour requirements excluding post harvdst; groundnuts - 145 days/ha; low input maize - 95 days/ha; medium input maize 127 days/ha

It also should be noted that at least on the basis of the past year's evidence, and this was a slightly poorer than normal season, maize profitability may increase further with yet higher rates of fertilizer application. While one year's data provides a limited basis to draw conclusions, this strongly suggests that at least in Naural Region IV, maize production has further expansion potential under existing price relationships. Yields of groundnuts would have to increase substantially to be competitive with maize.

Table 7. Zimbabwe: Crop Budgets using 1979 Price Ratio
Chibi Communal Area, 1985/86

COMMODITY:	Groundnut (unshelled)	Maize Input Level	
		Low	Medium
PLOTS:	(N=48)	(N=156)	(N=17)
YIELD (mt/ha)	.38	.46	1.16
GROSS OUTPUT VALUE	260.49	83.34	203.44
VARIABLE COSTS			
Contract plowing	.00	.00	.00
Seed	116.40	18.96	21.33
Fertilizer	.00	.00	51.50
Insecticide	.00	.08	.11
Transport to farm	.00	.00	5.44
Loan application fee	.00	.00	5.00
Loan interest	.00	.00	2.58
Bags	1.06	.46	1.16
Transport to market	35.39	15.43	38.60
TOTAL VARIABLE COSTS	152.85	34.86	125.72
GROSS MARGIN: TOTAL	107.63	48.48	82.72
PER Z$100 VARIABLE COSTS	70.41	139.10	65.80
RETURN ON VARIABLE+OPP COSTS(%)	-16	-40	-40
RETURN PER LABOUR DAY:TOTAL	.62	.44	.49
RETURN PER LABOUR DAY: EXCLUDING POST HARVEST LABOUR	.72	.51	.65

ECONOMIC RETURNS TO THE RECOMMENDED TECHNOLOGY

AGRITEX Package

The Agricultural, Technical and Extension Services (Agritex) has developed recommended packages of technology for groundnut production in Natural Regions II and IV (Agritex, 1985). However, these Agritex recommendations have not been adopted in Mangwende or Chibi. The results of agronomic trials employing the major components of these packages were reviewed and an economic analysis of package profitability was conducted to evaluate why. The recommendations are similar for the two agroecological regions. These encompass the following practices:

- Seed Type: Short season varieties (130-135 days): Natal Common, Valencia R2, Plover.
- Seed Dressing: Thiram to prevent crown rot.
- Planting: mid November or with first rains.
- Seed rate: 120 kg/ha.
- Fertilizer: NRII 300 kg/ha Compound L or D (52 and 42 kg P_2O_5 respectively). 200-300 kg/ha Gypsum at flowering. NRIV 200 kg/ha Single Super Phosphate. (37 kg P_2O_5). 200 kg/ha Gypsum at flowering.
- Disease control: Seed dressing, rotation, correct spacing. Dithane M45 mixed with Agricura Fungicide for Cercospora Leaf Spot, Monocrotophos for Aphids.
- Harvest: When pods 40 - 50% mature.

Agritex provides roughly the same recommendations for dryland commercial groundnut producers.

Agronomic Potential

The Department of Research and Specialist Services (R&SS) has yet to launch a systematic, long term, multilocational testing programme to evaluate the agronomic and economic potential of the groundnut package under communal farming conditions. Summarizing the results of Agronomy Institute survey and experimental research on groundnuts in the Mangwende region, Shumba (1983) concluded, however, that yield loss tends to be associated with delayed planting, poor quality seed, low plant populations and low soil fertility. A recent series of farming systems research trials were conducted to test these hypotheses (Shumba, 1986). These were conducted in Mangwende. The cropping practices and yields of five researcher managed trials were compared with the traditional practices of 20 farmers (Table 8). The research trials encompassed most Agritex recommendations.

R&SS found a doubling of yields associated with statistically significant differences between planting dates, varieties used, fertilizer application rates, plant population

Table 8: Groundnut Husbandry Variables in the Yield Gap Study, Mangwende Communal Area, 1985/86

	Yield (Y)	Winter Plow (x1)	Plant Date (x2)	Variety Used (x3)	Ferti- lizer (x4)	1st Weed Time (x5)	Plant Popula tion (x6)
Farmers' Crop (N=20)							
Mean	0.51	44	26.3	16	16	36.6	108,224
SE	0.24	51	13.2	37	37	17.4	43,667
Trial Crop (N=5)							
Mean	1.04	20	14.2	100	100	18.8	195,555
SE	0.36	45	6.8	0.0	0.0	4.5	24,024
t a/ values	4.17	0.97	1.98	4.94	4.94	2.25	9.52

a/ P <0.10 = 1.71; P < 0.05 = 2.05; P < 0.01 = 2.80

Variable Description:
Y: Yield, t/ha
x1: % winter plowing
x2: days from November 1
x3: % recommended varieties
x4: % applying fertilizer;
farmers: 50 kg/ha SSP
trial crop: 200 kg/ha SSP, 200 kg/ha gypsun
x5: days from planting
x6: plants/ha at harvest

Source: (Shumba, 1986)

and the time of first weeding. The analysis does not show a causal relationship between yield and any of the hypothesized variables. Much of the observed yield gap may be due to one or two of the components of the package. Further, the Farming Systems Research Unit of R&SS reports that the results of their groundnut trials have been inconsistent. Yet these resuslts indicate the yield gain which might be achieved with the adoption of improved practices.

Economic Returns to the Agritex Recommended Technology

Yield and input data from the trials reviewed above were entered into the Mangwende groundnut budget to assess the economic returns to the package. Adjustments were made to labour requirements to reflect the use of fertilizer and higher yields.

The results show that the trial technical package gave a gross margin of Z$ 481.41; a gross margin per Z$ 100 variable costs of Z$ 204.30; a return to variable cash and opportunity costs of 17 percent; a return per day of total labour of Z$ 1.21 and a return on labour excluding post harvest work of Z$ 1.29. The gross margin provided by the recommended package more than doubled from that obtained when no purchased inputs were employed as a result of the 60 percent increase in yields. Returns per Z$ 100 variable costs increased 25 percent but still remain below the cash returns to low input maize. Interestingly, however, returns to the combination of variable and opportunity costs and returns to labour remained unchanged. This suggests farmers concerned about labour returns or returns to total costs have no incentive to adopt the package of improved technologies. Only farmers concerned about gross margins would find adoption highly profitable. Individual components of the package such as improved seed may independently provide higher returns to labour. Both the package and its components, however, require further evaluation.

SUMMARY AND IMPLICATIONS FOR FURTHER RESEARCH

Communal groundnut production in Zimbabwe has declined from 130,000 mt in 1974 to an estimated 41,000 mt in 1985. Communal maize production has tripled during this same period. While smallholder groundnut sales were declining until 1986, maize sales increased more than fifteenfold. Multiple factors underlie the stark contrast between these trends. The groundnut sector has clearly not benefited from the degree of policy, institutional and technical support provided maize. Improved inputs for groundnut production are not readily available. All credit provided by the Agricultural Finance Corporation (AFC) to farmers in the two survey zones was directed toward maize. Decades of maize breeding and agronomic investigation, largely directed toward the needs of the commercial sector, provided the genetic base to develop shorter season hybrids for communal producers. By comparison, R&SS has devoted minimal research to communal groundnut production.

Shifts in relative crop prices since 1979 have strongly favoured maize. While groundnut production at low input levels still appear profitable in Natural Region II, the return to maize appears substantially greater in the drier part of Region IV where much of the country's groundnuts are currently produced. Returns to the adoption of recommended groundnut technologies are mixed.

This analysis should be regarded as preliminary because survey data were collected for only one year. The analysis does, however, highlight an important range of issues for further investigation. Chief among these is the need to better define the relationship between production strategies for food and cash crops. More specifically, what constrains the growth of communal groundnuts as a food enterprise and as a cash generating enterprise? Is the recommended groundnut technology inappropriate for communal circumstances? What is the significance of the fact that groundnuts are primarily viewed as a woman's crop?

Little has been said about groundnut consumption in this paper. Yet there are important questions about how groundnut production contributes to household food security. Should groundnut commercialisation be promoted? If so what are the implications for household food security?

Finally, this study raises a series of questions about how to target policies and institutional change to the requirements of crops in different agroecological zones. Should there be a single groundnut package for both commercial and communal farmers? Should AGRITEX promote different packages for communal farmers in different natural regions? Future investigation is needed to resolve these issues.

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CHAPTER NINE

WHEAT POLICY OPTIONS IN ZIMBABWE AND SADCC COUNTRIES: Preliminary Findings

Jim Longmire, Peter Ngobese and Solomon Tembo

WHEAT IN THE SADCC REGION

Traditionally, wheat has not been a major staple food in the SADCC countries. However, demand for wheat is growing rapidly in the region. At the same time, few of the countries have a sizeable domestic wheat industry. Thus, the region relies on imports for two-thirds of its wheat consumption. Table 1 shows that only 4 SADCC countries have wheat production exceeding ten thousand tonnes per annum. The scope for expanding production in the region is limited because environmental conditions of some SADCC countries simply do not favour the economic production of wheat. Nevertheless, wheat's productivity in more tropical environments is being improved (CIMMYT, 1985). Some economic considerations for developing a domestic wheat industry are discussed in Byerlee and Longmire, (1986).

This chapter reports on work being conducted on wheat in Zimbabwe, the largest wheat producing country of the SADCC region. We hope that the study will serve as a model for similar studies in other SADCC countries, and other countries of Africa. In the Zimbabwean case, much of the analysis is on the question of the real costs of expanding domestic production versus importing wheat, especially when world wheat prices are at an all-time low. For some other SADCC countries, other issues might receive more attention.

Zimbabwe has a policy of seeking self sufficiency in basic foodstuffs, including wheat. Although 85 percent of consumption of wheat is locally grown, the demand for bread and other wheat products is growing faster than demand for other food staples. By the year 2000 Zimbabwe could

Table 1: Wheat Supply and Utilization in the SADCC Region, 1985

Country	Production	Imports	Consumption	Self Sufficiency
	'000 t	'000 t	'000 t	Percent
Angola	7	174	180	4
Botswana (1)	1	28	29	4
Lesotho	18	77	95	19
Malawi	0	30	28	0
Mozambique	3	103	106	3
Tanzania	85	56	134	63
Swaziland (1)	1	14	15	7
Zambia	15	74	89	17
Zimbabwe	210	112	248	85
SADCC Total	340	694	924	37
South Africa	2 200	0	2 000	110

Source: US Department of Agriculture, Economic Research Service
(1) FAO data 1984. Consumption estimated as production plus imports.

readily be consuming more than double the amount of bread and other wheat products currently consumed. Because of rationing, the amount currently consumed is also lower than would be the case with unrestricted allocation of supplies.

The plan of this paper is as follows. A brief analysis of growing demand for wheat products in Zimbabwe is followed by a review of wheat production, drawing heavily upon a 1986 University of Zimbabwe survey of commercial wheat growers. The questions of expanding domestic production, slowing consumption growth and importing wheat are then considered. The focus of this part is on the economics of expanding production. Finally, we present the main findings and suggest high priority areas for both technical and economic research.

WHEAT CONSUMPTION TRENDS

Demand for wheat has grown rapidly in Zimbabwe, in the past 25 years (Table 2). Consumption of wheat products has trebled from 84 000 tonnes in 1965 to just under 250 000 tonnes last year. This represents an annual growth of almost 5 percent. In the late 1970s the country was more than self sufficient in wheat. However, very strong demand growth since then has led to the need for imports. Furthermore, millers and bakers contacted recently indicated that consumption could expand by more than 10 percent if the rationing of wheat to millers, implemented in 1982, was removed.

The principal causes of this growth in demand have been the increase in population and real income per capita, rapid urbanization, changing lifestyles, shifting consumer preferences and bread subsidies. Similar patterns of demand growth have been observed in many countries of the developing world (Byerlee, 1983). Bread is a convenience food, requiring much less time and fuel in preparation than other major food staples. High costs of fuel for cooking have probably been an important factor encouraging households to switch to bread. Another important factor is the increased emphasis being placed on convenience. The growth in demand for bread in Zimbabwe is not confined to the cities. Consumption has grown rapidly in rural areas as well and has the potential for further expansion, especially if additional outlets were to become available. Of the 33 registered bread bakeries in 1980, 29 were located in major cities.

Using the following data, and the assumption that a 10 percent increase in real income per capita leads to a 5 percent increase in per capita bread consumption, consumption was projected to the year 2000. A projected population of 14 million was used and total consumption of wheat products in the year 2000 is estimated to be around 500 000 tonnes, or a doubling over the next 15 years.

Table 2: Wheat Consumpion in Zimbabwe, 1965 to 1985

Year	Total Popul-ation	Consumption Total	Per Capita	Real Income/ Capita	Real Price Bread	Real Price Maize Meal
	mill.	'000t	kg	Z$	Zc/loaf	Zc/kg
1965-66	4.4	84	19.0	441	42	30
1970-71	5.3	116	22.0	724	50	28
1975-76	6.3	146	23.4	840	48	26
1980-81	7.2	205	28.5	951	42	20
1985-86	8.4	248	29.7	758	45	30

Source: GOZ and Grain Marketing Board
Note: One loaf of bread weighs 500gm.

WHEAT PRODUCTION IN ZIMBABWE

Although wheat has been grown since 1890 in Zimbabwe, a sizeable industry has only emerged in the past 20 years. In 1965, only 4000 tonnes of wheat were grown in the country, meeting 4 percent of total requirements. The 1986 crop yielded 245 000 tonnes. The development of Zimbabwe's wheat industry has been largely due to expansion of irrigation facilities and the adoption of input-responsive semi-dwarf wheats. The national average wheat yield of Zimbabwe is well over 5 t/ha and is the highest in the Third World. Currently, wheat is grown exclusively during the cool winter period (May-September) under irrigation.

Over the past two decades the wheat industry has expanded mainly on 350 to 400 large-scale farms, which presently contribute 94 percent of the wheat crop. About 4 percent is produced on state farms. Communal farmers are producing around 2 percent of total output, most of which is for home consumption or local markets. Wheat production by the latter has been historically confined to the Eastern Districts.

Within the large-scale commercial sector, about 70 percent is produced on the highveld, above 1 200 metres. Soils in this region range from sandy-loams to heavier clays. The remainder is produced in the middle and lowveld, down to 400 metres. The soils of the latter are more alluvial, with greater variability than the highveld. Wheat in the highveld is grown between latitudes 16.5 - 20 degrees south, and 19.5 - 22 degrees south in the lowveld.

Water Applied

Wheat in Zimbabwe is largely irrigated by sprinkler, in contrast with flood irrigation in most other developing countries. The main equipment used in Zimbabwe is hand-moved, although it is recognised that mechanically-moved systems offer benefits in reduced labour input, lower pumping costs and more precise application. Pumping is virtually all electrical, so charges for electricity are an important cost component.

The amount of water applied to wheat varied considerably across the 41 commercial farmers surveyed during the 1985/86 season. On average the total water applied to wheat was 570 mm/ha. However, some farmers were applying as little as 360 mm/ha and others more than 800 mm/ha. Most farmers have adopted some form of water scheduling to cut back on water applied. Those with relatively low rates of water application have managed to save on water and costs of application without an apparent loss of yield. This is demonstrated in Figure 1, which shows the relationship between water applied and wheat yield by farm.

The relationship is very weak, suggesting that there is potential to save water without significant losses of yield. From the chart it can be seen that some farmers can achieve yields of 5 t/ha with around 400 mm/ha applied while others achieved the same yield even though they applied more than 600 mm/ha.

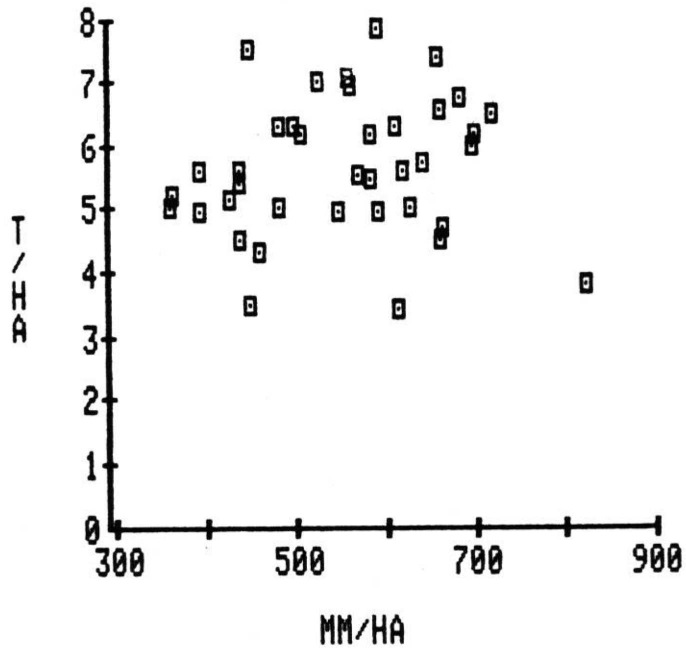

Figure 1: Wheat Yield Related to Water Applied
Source: Wheat Survey, 1986

Analysis was undertaken to attempt to explain the amount of water applied on wheat. The key variables hypothesised to affect this were: soil types, location, water source and pumping costs. However, these variables explained less than 5 percent of the variation in water applied between farmers. When the average application by source was calculated, some differences were observed. The average application by source was:

Borehole	500 mm/ha
Own dam	530 mm/ha
Government dam	540 mm/ha
Shared dam	550 mm/ha
Flow right	630 mm/ha

This pattern suggests that the water applied is responsive to institutional and economic factors.

A stronger relationship was hypothesised to exist between water applied per hectare and unit cost of water applied ($/mm), Figure 2. Other than giving an indication of the average cost of applying a unit of water ($0.35/mm), the relationship was also found to be weak.

The water efficiency in growing wheat was calculated by dividing wheat yield (t/ha) by total water applied per hectare (mm/ha). The average of this was 10.6 kg wheat/mm of water applied. There was wide variation in water efficiency on wheat, ranging from 4.6 to 16.7 kg/mm.

Further analysis of water application efficiency was conducted and the main relationships are presented in Figures 3 and 4. Figure 3 shows that as wheat yield increased water efficiency also increased, indicating that, in general, farmers with higher yields were more efficient in their water application. However, an even more significant finding of the analysis was that increased

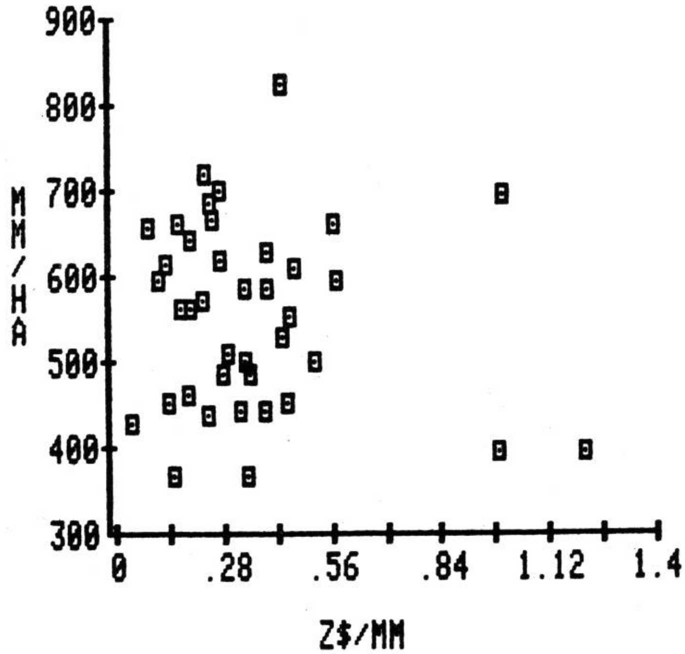

Figure 2: Water Applied Related to Water Cost/mm
Source: Wheat Survey, 1986

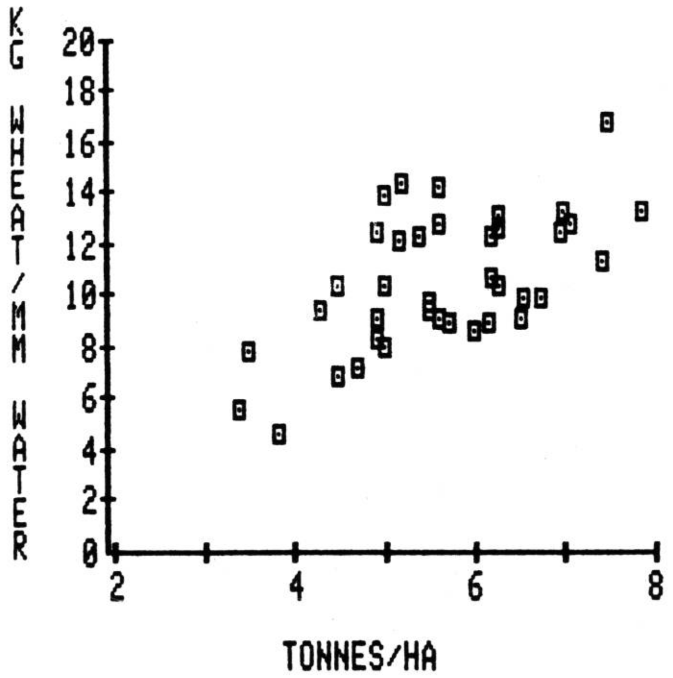

Figure 3: Water Efficiency against Wheat Yield
Source: Wheat Survey, 1986

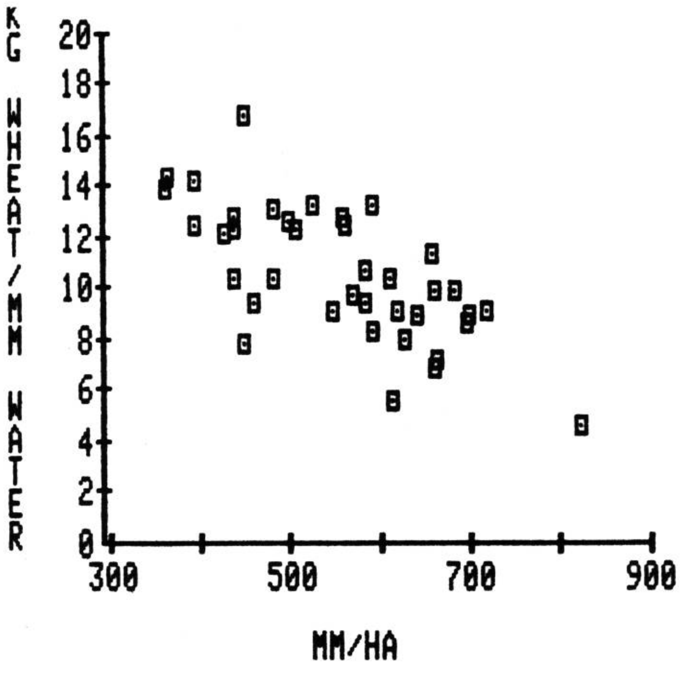

Figure 4: Water Efficiency Against Water Applied
Source: Wheat Survey, 1986

application of water resulted in a general decrease in water efficiency, as shown in Figure 4. This preliminary evidence also suggests that there is scope for improving water efficiency by reducing water use.

Factors Determining Wheat Yield

A regression analysis was undertaken to determine the key factors affecting wheat yields across farmers surveyed. The explanatory factors included in the analysis were: variety, amount of nitrogen applied, amount of water applied, previous summer crop and soil type. The equation estimated for 1985 yields was:

$$\text{Yield} = -5.2 + \underset{(1.44)}{.105}\ \text{Variety} + \underset{(2.63)}{.012}\ \text{Nitrogen}$$

$$-\underset{(-.18)}{.00022}\ \text{Water} + \underset{(1.59)}{.501}\ \text{Summer Crop} + \underset{(1.39)}{.437}\ \text{Soil Type},$$

$$\bar{R}^2 = .23, \quad \text{D.W.} = 2.47$$

where:

Yield	=	average wheat yield, t/ha
Variety	=	year of release of variety, if released in 1982, equals 82
Nitrogen	=	average nitrogen application, kg/ha
Water	=	average water application, mm/ha
Summer Crop	=	1 if previous summer crop is leguminous, 0 if non-leguminous
Soil	=	1 if clayey, 0 if sandy, and t-statistics are in brackets.

Although this equation explained only 23 percent of the variation in wheat yields, it generally conformed to expectations. For example, the estimate of the varietal effect suggests that an extra 105 kg/ha per year has been associated with the release of new varieties and related production practices of farmers growing new varieties. The positive relationship between nitrogen applied and yield suggests that on average each unit of nitrogen added

12 kg of wheat per hectare. The yield of wheat following leguminous crops is estimated to be about 500 kg/ha higher than yield of wheat following non-leguminous crops. Similarly, yields on clayey soils on average were over 400 kg/ha higher than yields on sandy soils.

Interestingly, no meaningful relationship between wheat yield and water applied is observed in the above equation. A non-linear (quadratic) relationship between wheat yield and water applied was then estimated with the other variables above remaining in the new equation in linear form. Again a very weak statistical relationship was estimated between water applied and wheat yield. However, from these estimates the point of maximum yield with respect to water applied was calculated. This was calculated to be approximately 580 mm of water applied. This adds further to the hypothesis that a sizeable number of farmers might be over-watering wheat.

THREE BASIC OPTIONS

There are three basic options that can be used to meet the growing demand for wheat products in Zimbabwe. These are:

- o expand wheat production
- o adopt policies to slow consumption
- o import wheat

Which of these options or combination of options to pursue is ultimately for commercial and political judgement, but in the next three sections we consider some economic factors to aid in making important for the policy choice.

EXPANDING WHEAT PRODUCTION

The survey and developments over the last twenty years have shown that further expansion of wheat production in Zimbabwe is feasible. What is at issue is the extent and cost of such expansion. These considerations are affected by the availability, cost and efficiency of use of water, a key limiting factor to further wheat expansion. Also important are the prices that would be necessary to induce expansion and to encourage substitution at the margin towards wheat.

The farmers surveyed were asked to rank the constraints on increased wheat production on their farms in order of importance. The results of the open-ended question in the survey were as follows:

Constraint on Higher Production	Percentage
Low profitability	46
Lack of irrigation water	21
Cost of capital for irrigation development	18
Land fully utilised	8
Lck of combine capacity	3
Other	4

The first three of these factors are considered in the discussion that follows.

Wheat farmers were also asked a follow up, on what can be done to double wheat production in Zimbabwe in the next fifteen years. This was also an open-ended question. The results were as follows:

What can be done to expand	Percentage
Increase the producer price	49
Government build more dams	26
More low-cost irrigation credit	10
Reduce input costs	8
Greater availability of farm machinery	5
More yield research	2

What do the above results tell us? Farmers believe that production can be expanded in various ways, and it is a question of weighing these different suggestions. In addition there are two other ways of possibly expanding wheat production considered here: using water more effectively and growing summer wheat.

Producer Prices

Studies from a number of countries suggest that industry-wide production of wheat is responsive to price incentives. The question for Zimbabwe is how responsive to producer prices in the future will wheat production be? The adjustments of the industry to price changes in the late 1970s and in the early 1980s suggests there is some responsiveness. Evidence from other countries with irrigated wheat grown in rotation with summer crops also adds weight to this point. For example, Seeley (1985) reports that for every 10 percent increase in producer prices in Pakistan, India, and Egypt farmers responded by increasing production between 1 to 8 percent.

In the case of Zimbabwe, the degree of price responsiveness is likely to be on the low side of these estimates. This is because of some constraints faced by the industry (e.g. lack of combines, spare parts, etc.) as well as the lack of opportunity to increase yield further by applying more purchased inputs. Generally, studies of supply response in many African cases suggest that responsiveness to prices is low because of constraints faced by industries (Eicher, 1986). Hence, raising real producer prices might have a limited impact on total output and would tend to be an income transfer to wheat farmers.

Another factor affecting the aggregate area planted to wheat will be the real price to farmers and the relative profitability of alternative crops (Figure 5). Since wheat already occupies 95 percent of the winter irrigated area on wheat farms, there is little potential for further substitution of wheat for other winter crops on existing wheat farms. However, there is scope for substituting water away from summer crops to wheat. In addition, some farmers

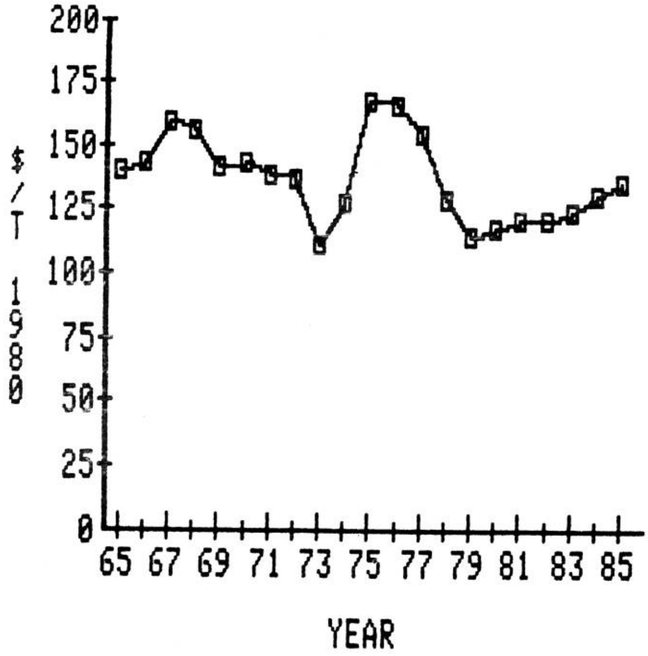

Figure 5: Real Producer Price of Wheat
Source: Wheat Survey, 1986

currently not growing wheat might be encouraged to start producing wheat if prices of export crops decline relative to wheat. Such thinking might be currently occurring as commercial farmers seek to diversify out of maize.

Previous studies suggest that the producer price of wheat in Zimbabwe has been around import parity, or slightly above (Muir-Leresche, 1984). Most export crops have been priced above export parity, notably maize. Currently, with severly depressed international prices, both the producer prices of wheat and maize are above the world equivalent prices based at the farmgate. There is probably a good case for setting a price of import-competing goods, including wheat, above import parity in Zimbabwe, and in other SADCC countries, given the current shakeout in the international grains markets and the potentially high costs of future importation through South Africa. On the same basis the price of export crops moving into the world market via export ports in Southern Africa would have to be lowered.

Expanding Irrigation Water

The potential for irrigation development in Zimbabwe has been reviewed by a number of specialists (Watermeyer 1981, Blackie et al, 1984 and World Bank, 1984). Currently, the total area irrigated is 165 000 hectares. The area of land suitable for irrigation has been estimated to be 600 000 hectares. However, estimates by the Ministry of Energy and Water Resources and Development indicate that there is sufficient water from runoff in Zimbabwe to irrigate approximately 430 000 hectares. This suggests that there is scope for future development of irrigation, although most remaining water developments will be in less accessible and naturally suitable locations. Moreover, the demand for water for urban and industrial use is growing rapidly. A number of catchment areas in wheat regions have been restricted from further private water development.

The main constraints on future irrigation development are economic. The costs of schemes are increasing over time, especially the costs of capital and the increasing cost of construction and delivery systems for less suitable sites. Some indication of how costs of development of dams for irrigation was obtained by asking wheat farmers the actual costs of dams built, the volume and the year of completion. Only a limited number of responses were obtained. These are summarised in Table 4. The real (inflation adjusted) costs of dam construction per unit area irrigated are shown in Figure 6. These indicate that over time private dams are becoming increasingly expensive. A similar trend probably exists for public sector dams. Data were obtained on the budgeted cost of 11 proposed public dams (Mitchell, 1986). The average unit cost of water from these public sector dams was estimated to be Z$132 per thousand cubic metres, similar to the unit costs of water from private dams in 1985.

More Effective Use of Water

From the results of this preliminary study, more effective use of irrigation water on wheat is a strategy worthy of further research in Zimbabwe. There is little information on the response of wheat varieties to water applications in Zimbabwean conditions. If more efficient use of water can be achieved, greater wheat output will be realised from a given stock of water by applying less water per hectare for equivalent yields and applying the additional water to a larger area of wheat. Alternatively, less water might actually lead to reduced yields, but the water saved would more than offset this reduction when applied to a larger area. In addition, reducing application losses through improved irrigation technology would add to the amount of wheat that could be grown from the water available.

The economic aspects of such a strategy were analysed for this study. Using preliminary wheat budgets, the profitability of wheat under different water regimes and associated levels of yield was calculated. Although a reduced input of water would probably be associated with reductions of other purchased inputs, for this analysis we held those constant. Thus, the only factors varying in this analysis were the amount of water applied and associated wheat yield. The relationship between wheat yield and water applied was based upon data reported in the following studies (Fischer, Lindt and Glave, 1977; French and Schultz, 1984; and CIMMYT 1986). The results are presented in Table 5.

Some interesting relationships can be drawn from the data above. First, the point of maximum water efficiency is well below the point of maximum wheat yield (also the point of maximum gross returns per hectare). Maximum water efficiency is around 350-400 mm/ha, whereas yield is assumed to peak at around 650-700 mm/ha. However, the point of maximum net returns to land (including capital and

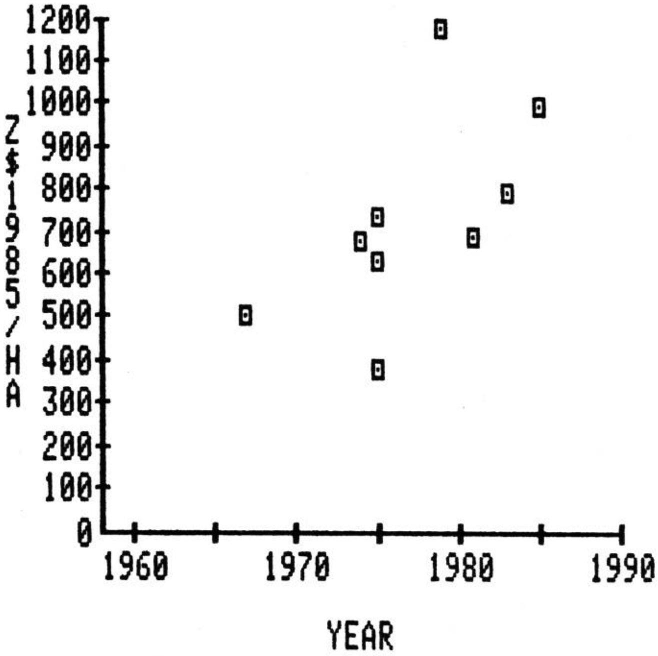

Figure 6: Real Capital Costs of Private Dams
Source: Wheat Survey, 1986

Table 4: Capital Costs of Constructing Dams on Selected Wheat Farms in Zimbabwe, 1967 to 1985

Year Instal-led	Capital Cost	Capacity	Cost per Unit of Water	Cost per Unit of Area
	Z$	$000m^3$	Z$/$000m^3$	Z$/ha
1967	23 000	1 000	23	115
1974	33 000	810	40	204
1975	40 000	850	47	235
1975	5 000	125	40	200
1975	12 000	500	24	120
1979	120 000	300	400	2 000
1979	20 000	185	108	540
1981	96 000	1 160	83	414
1983	170 000	1 320	129	643
1985	37 000	187	198	989

Source: Wheat Survey, 1986

management) is around 500 mm/ha. But land is not the limiting factor in wheat production. Net returns to water, an even more important criterion, occurs at an application level of around 440 mm/ha. These results are based on a

Table 5: Estimated Levels of Profitability for Assumed Levels of Water Applied and Assumed Wheat Yields, Natural Region II, Zimbabwe, 1986 Prices

Water Applied	Number Irrigations	Wheat Yield	Water Efficiency	Net Returns to: Land	Water	Labour	Cash
mm/ha		t/ha	kg/mm	Z$/ha	Z$/mm	Z$/hr	%
792	18	6.00	7.6	199	.98	1.32	22.6
748	17	6.05	8.1	249	1.06	1.56	26.3
704	16	6.10*	8.7	298	1.15	1.81	30.2
660	15	6.10*	9.2	333	1.24	2.03	33.3
616	14	6.05	9.8	356	1.31	2.21	35.6
572	13	6.00	10.5	378*	1.39	2.41	38.0
528	12	5.88	11.1	381*	1.45	2.53	39.0*
484	11	5.70	11.8	369	1.49	2.59	39.0*
440	10	5.50	12.5	352	1.53*	2.63*	38.5
396	9	5.05	12.8*	267	1.41	2.29	32.3
352	8	4.50	12.8*	156	1.17	1.70	23.2
308	7	3.20	10.4	-166	0.22	-0.59	-6.3
264	6	2.00	7.6	-442	-0.94	-3.43	-27.2

Source: Preliminary Budgets for wheat.
Note: Net returns also includes returns to capital and management. Maximums are denoted by an asterisk.

simplified crop-water relationship. However, they are probably indicative of tradeoffs involved.

Farmers are also concerned about risk in their water management and the results summarised in Figure 7 indicate some of these considerations. Because of the steep decline of net returns to water to the left of the point of maximum, risk averse farmers would optimally apply more water than at the profit maximising level. This might explain partly why some farmers are applying high amounts of water.

The above analysis considers profitability per hectare. The farm wide perspective is also of interest. For example, take a hypothetical scheme of 40 hectares irrigation in which a farmer is maximising yield. He will be applying 660 mm/ha, a total water application on wheat of 264 000 cubic meters. If the farmer then applied this water at the rate of maximum net return to water, 440 mm/ha, he could irrigate 60 hectares. This would mean an

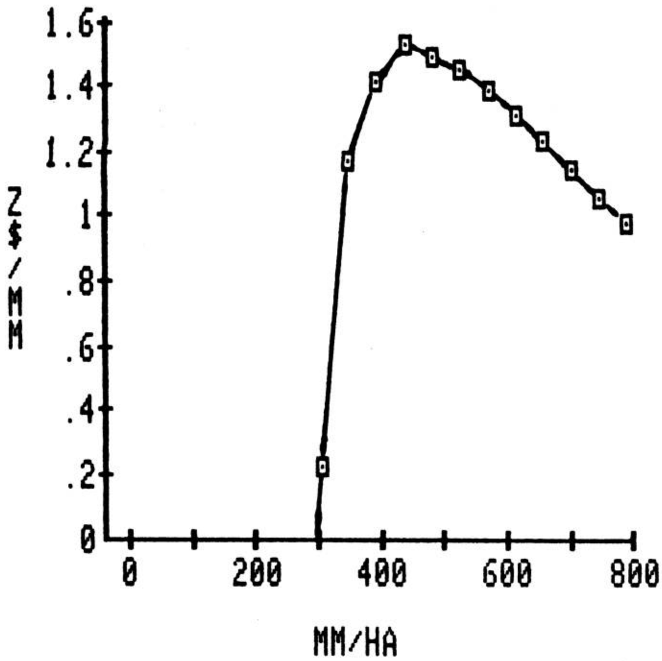

Figure 7: Net Returns to water and Water Applied
Source: Wheat Survey, 1986

increase in total wheat production from 244 tonnes from 40 hectares to 330 tonnes off 60 hectares. In addition, net returns from the 40 hectares would be Z$13 320 and Z$21 120 from 60 hectares . In this particular case, if this increase in net returns is sufficient to cover the interest and finance costs of expanding the wheat area and associated risks, then the change would be attractive.

Clearly, these results depend upon the relationship between wheat yield and water application and the assumption that extra irrigable land is available. There is scope for further refinement of this analysis, especially with more precise technical relationships. Nevertheless, this is one promising option for expanding wheat production in Zimbabwe that deserves further investigation.

Other Productivity Increasing Strategies

In addition to more effectively utilising water, there is also the potential for further improving wheat productivity in Zimbabwe. The most obvious way that this can be achieved is through varietal improvement. The estimated increase associated with varietal improvement and related crop management has been sizeable, probably close to 100 kg/ha per year. There is no obvious reason why this underlying rate of productivity should slow down in the next 15 years. A speed up in the adoption of new varieties would also add to this productivity growth. Yet another way of adding to this productivity growth in Zimbabwe's case is the selection of more water-efficient wheat varieties.

Overall, the scope for yield increases through additional fertilizers and chemicals seems limited. It appears that farmers are applying close to the economically optimal levels of these inputs. If the prices of these inputs were reduced from current levels, relative to wheat prices, an increase in input use would occur. If the machinery fleet could be upgraded and increased, some marginal gains in yield could also be expected. Other new crop management methods might have the potential to increase yields. However, there is a considerable time lag in learning to apply these methods to the Zimbabwean situation. Overall, the skills and managerial capacities of wheat farmers are high so the scope for improvement through extension and training is marginal. It is interesting to note that much of the extension advice and an increasing share of crop management research on wheat in Zimbabwe is being conducted in the private sector.

Summer Wheat

Summer wheat production is an option for expanding production that is being studied. Wheat is currently being tested for suitability to high rainfall areas in the cooler eastern highlands. In addition, some trials have been conducted near Harare. The critical factor in the development of summer wheat is its ability to cope with diseases. In addition, there is a concern that summer wheat could act as an incubator of diseases and transfer these to the winter crop. Given the conditions in the cooler eastern highlands, triticale might be worthwhile evaluating there. Triticale is a man-made crop, formed by a cross between wheat and rye with strong disease tolerance.

Maize yields in the areas where summer wheat has been targeted are around 2.5 t/ha on small farms. With the ratio of farm prices of wheat to maize being 1.7 on small farms in this region, summer wheat yields would break-even with maize at around 1.5 to 2 t/ha and would probably have to be significantly higher on farmers' fields before they would adopt the technology. On larger farms now receiving lower prices of maize for the 1986/87 crop year, the breakeven summer wheat yield would probably be higher. Whether or not such yields can be achieved is an issue for crop research.

SLOWING GROWTH IN CONSUMPTION

There is little doubt that the underlying demand for wheat in Zimbabwe will grow strongly in the next 15 years. However, there is the opportunity through price policies, food product development and milling research to have an impact on the rate of growth of demand for bread. By increasing prices of bread to prices of maize and other staple foods, there is the scope to slow the growth in consumption of bread in Zimbabwe over the longer term. Similarly, new maize product development and further mixing of flours, especially those of maize and sorghum, might help slow the growth in consumption of wheat.

Wheat is a regulated product in Zimbabwe with the Grain Marketing Board having sole responsibility for trading in the commodity, both imported and domestic. Pricing of wheat or wheat products is controlled at the producer level, mill level, and the wholesale and retail levels in Zimbabwe. Generally, the margins for the milling, baking and retailing of wheat products in Zimbabwe are low (Longmire and Heid, 1985). There have been direct subsidies on wheat products in the past. These took two forms, payments to the Grain Marketing Board to make up losses on trading accounts and direct payments on flour to millers by the Ministry of Trade and Commerce.

The subsidy on flour was terminated in 1984, and bread prices rose accordingly. However, deficits have been made on the trading account for wheat in 1983-84 and 1984-85 amounting to Z$ 24.97/t and Z$ 20.16/t, respectively (Grain Marketing Board, 1984, 1985). These losses come from selling grain to millers at prices below those actually paid by the Board, plus the Board's administrative costs. For example, the cost of imports of grain, landed Zimbabwe, were Z$ 296.92/t in 1984-85. For the same year, the average price realised in domestic sales of wheat to millers was Z$ 272.67. After allowing for some quality differences, any difference between the two prices would represent a subsidy that is distributed in part to domestic wheat consumers.

An equation relating per capita consumption of wheat products to real per capita income and the ratio of prices of bread to maize meal was estimated to assess the price and income responsiveness of consumption. The data were for Zimbabwe and the years 1965-1985. The results of this aggregate and preliminary analysis were:

$$\log_e \text{CONS/CAPITA} = \underset{(2.22)}{2.79} + 0.473 \log_e \text{INCOME/CAPITA}$$

$$- \underset{(-.55)}{0.205} \log_e \text{PWHEAT/PMAIZE}$$

$\bar{R}^2 = .30$ D.W. $= .76$

where: t-statistics are in brackets

Although there are obvious weaknesses with this equation, it tends to suggest that consumption is income responsive. Thus a 10 percent income increase in per capita income leads to just under 5 percent increase in bread consumption. The price responsiveness is insignificant statistically, and somewhat below the expected degree of responsiveness. However, we remain convinced that consumers are responsive to bread and maize product prices.

If retail prices of bread and maize products are set to reflect the supply prices of these grains at the producer level, this would probably increase bread to maize meal prices and slow the growth in consumption of wheat products over the longer term. However, since rationing of wheat is a current practice, the likely impact of higher relative bread prices would be to reduce the amount rationed. There would probably be little observable impact on actual consumption up to the level of price at which rationing became unnecessary.

IMPORTING WHEAT

Three considerations are important for Zimbabwe in the decision to import wheat commercially. These are:

(1) developments in international markets for wheat and other commodities,

(2) difficulties that Zimbabwe faces with high costs of importing wheat and being dependent on South Africa for inland transportation,

(3) foreign exchange concerns.

There have been dramatic declines in world wheat prices in the past year (Figure 8). From a level of around $ 130/t in mid 1985, U.S. export prices of wheat have fallen to around $ 100/t in recent months. Currently, world wheat prices are at all-time low when allowance is made for inflation. The sharp decline in world wheat prices has

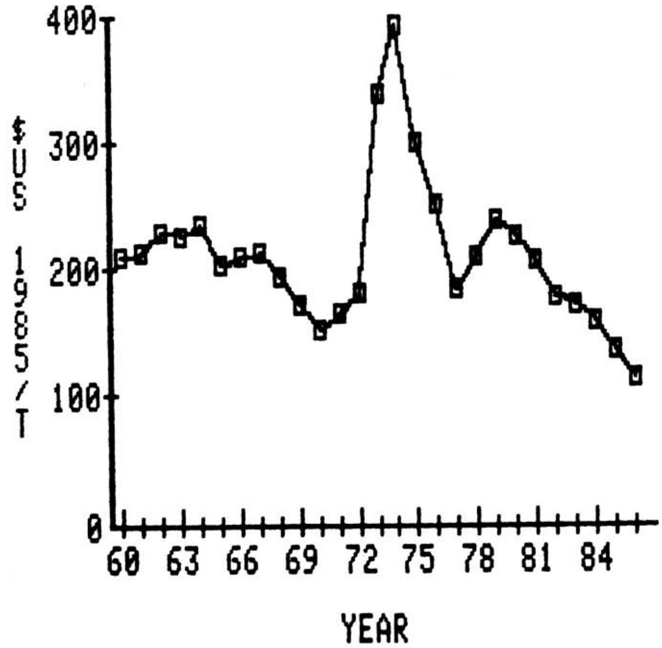

Figure 8: Real Export Price of Wheat, USA
Source: Wheat Survey, 1986

been exacerbated by several bountiful global grain harvests, but much of the instability of world wheat prices is policy induced. A recent study suggests that the variability of international wheat prices has been quadrupled by the combined effect of domestic policies in many countries of the world (Tyers and Anderson, 1986).

The 25 percent reduction in support prices for the 1986 wheat crop in the U.S. has flowed on to international prices. In addition, bonuses equivalent to up to $US 15/t have been offered to make U.S. wheat exports more competitive. With the EEC continuing to use variable export subsidies to export wheat, other grain exporters have been forced to lower their offer prices. The world is in a grain subsidy war, not very different from that of the late 1960s and early 1970s.

Cheaper wheat is good news for importers and consumers. However the question that must be asked for Zimbabwe and other SADCC countries is: how long will the current low prices persist? There is every indication that the grain exporters will take some years before the adjustments are made to bring supply more into balance with demand. Many important producing countries have divorced local production incentives from the world price, so many farmers as yet do not intend to significantly reduce output. With other grains also experiencing sharp price declines, alternatives to wheat are generally not attractive.

Another implication of the prospects of relatively large supplies of wheat entering the world market in the next 5-10 years is that food aid is likely to remain at high levels. Although food aid in wheat has fallen recently from the levels of 1984, exporting countries will obviously be keen to continue aid programmes with wheat. Zimbabwe and SADCC countries might take advantage of this situation. A continuance of some imaginative barter trading will allow some of this aid to be switched to domestic maize, thus saving on heavy freight costs both ways.

Zimbabwe's transport situation means that a high cost of moving grain from port to mill and higher risk of disruption of transport routes should be factored into future deliberations on the local wheat industry. High transport costs should also be attached to export crops moving into markets via ports. An important implication of potentially higher costs of transport is that prices of import-competing crops relative to export crop prices would increase. Thus the ratio of farm prices of wheat to maize in the country would increase if guided by international developments. This has occurrred with recent pricing announcements on maize.

Zimbabwe has had very tight restrictions on foreign exchange for a number of years. Given the strong emphasis placed on foreign exchange, an important factor to consider is the net foreign exchange effect of continuing to import wheat commercially or to move towards self-sufficiency. In follow up work, we plan to undertake an analysis of the net foreign exchange savings of alternative strategies for expanding wheat production, including an analysis of the domestic resource cost of the alternatives.

CONCLUSIONS

Overview of the Options

This paper has focussed on various options that Zimbabwe might adopt with respect to domestic wheat production, consumption and imports. Although our analysis is preliminary, some indiction of the relative costs of different options can be deduced from our work to date.

First, with regard to expansion of irrigation water supplies, there appear to be no easy low-cost options. The increasing real costs of future dam construction and irrigation schemes means that water will be increasingly expensive, and other demands for water will tend to reinforce this. Thus expansion of total irrigated area appears to be a high-cost option. In addition to the high cost of water, irrigation equipment costs and pumping costs are very high in Zimbabwe.

A potentially lower cost option is to encourage farmers to economise on water use and to expand wheat area with the water saved. This, however, requires further technical, and economic research. Another method for expanding production of wheat is to encourage farmers to switch their resources towards wheat and away from other crops. While export crop prices are low and high transport costs must be factored into Zimbabwe's commodity trade, this approach is also probably a relatively low-cost option to the country, although farmers will find these adjustments more costly.

On-going varietal improvement is probably the least expensive method of expanding wheat production. Some speeding up of the pace of adoption of new varieties would also add to productivity gains, and seed distribution and extension play key roles in this. The opportunity to expand output from greater use of purchased inputs appears limited, and therefore, relatively expensive. However, greater availability of critical spare parts would reduce losses that farmers incur with delays.

An option for Zimbabwe in dealing with growing demand for wheat would be to increase prices on bread and other wheat products. This would reduce and eventually remove direct budgetary costs incurred. However, there are costs involved which would be thrust on consumers in the form of higher prices. There are obvious equity considerations involved with this. Nevertheless, with relatively cheap bread (see Table 2) it seems unlikely that Zimbabwe can expand of production to keep pace with growing demand[1/].

The other option for Zimbabwe and SADCC countries is to use earnings from export crops and other export products to pay for commercial wheat imports. But the general decline in world commodity prices has made this option less attractive and this is exacerbated by the high costs of transport and geopolitical realities of the region. New transport routes that worked efficiently would remove some of these concerns and open up considerable opportunities for trade, thus allowing countries to specialise more in those crops in which they have a natural and economic advantage.

Further Research

Given that water is the principal limiting factor on wheat production in Zimbabwe, a high priority area for research is analysing the response of wheat to different amounts of water applied, to different amounts applied per watering

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1/ In November 1986, the government increased bread prices by 11 percent or from Z$ .45 to .50 for a 500 gram (1/2 kilo) loaf.

and to timing of irrigations. Further research ought to be undertaken to evaluate alternative irrigation technologies. Although soil types will account for some differences, it is uncommon for more than 5-6 irrigations to be applied to wheat in other developing countries, including Mexico, Pakistan and India. But our 1986 wheat survey revealed that farmers in Zimbabwe applied an average of 13 irrigations. Related to research on water should be further analysis of wheat's response to different levels of fertiliser and alternative planting dates and densities under different watering regimes.

With regard to varieties, our analysis suggests that an important criterion for selection should be water efficiency. In the case of summer wheat, a key criterion is resistance to diseases. Triticale might offer some advantages over wheat in this regard and ought to be evaluated, especially as flour of triticale can readily be blended with wheat flour.

In addition to production related research, there is scope for further food technology research on milling and blending and on new maize and sorghum products which might substitute for bread. A number of maize products in the Americas have convenience properties and offer attractive alternatives to bread.

Follow-up research on the economics of wheat in Zimbabwe will concentrate on three issues. First, more analysis will be done on the economics of irrigation development and on alternative irrigation methods with crops, wheat and summer crops. Second, more detailed analysis of the farm survey will be undertaken with emphasis on profitability. Third, the analysis will be undertaken of the net foreign exchange earning capacity of different crops and development strategies. Similar analyses of the economics of wheat should be pursued in other SADCC countries, including pricing policies, transport, infrastructure, trade and the geo-political realities of Southern Africa.

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CHAPTER TEN

HOUSEHOLD GRAIN STORAGE AND MARKETING IN SURPLUS AND DEFICIT COMMUNAL FARMING AREAS IN ZIMBABWE : PRELIMINARY FINDINGS

J. Stanning

I INTRODUCTION

Over the period 1980-1985 there has been an overwhelming increase in the marketed surplus of staple food grains from Zimbabwe's communal and small-scale producers. Sales to the Grain Marketing Board (GMB) have increased tenfold and accounted for forty two percent of total intake of grain crops (excluding wheat) in 1985. In terms of national marketed grain surplus the performance of the smallholder sector has become increasingly significant.

The increased participation in the market by smallholders can probably be attributed to a combination of post-independence changes, including improvements in smallholders' access to agricultural support services, such as extension, credit and marketing, and increases in producer prices. However, an understanding of the way in which various factors influence the flow of food grains through local and national marketing systems, and the manner in which farmers' choices interact with government policy, is not well developed. Many questions remain about the extent and manner in which market participation by smallholders varies between regions within Zimbabwe and amongst households in the same area. Such issues are approached both by moving away from national statistics to a more diaggregated view of grain flows, and through a closer investigation of the factors influencing grain production, storage and marketing at the household level.

This paper presents some preliminary findings arising out of a study of the production and disposal of food grains by smallholder producers in Zimbabwe[1/]. Disaggregated statistics on production and marketing are used to examine grain output and the degree of market participation at the provincial level, whilst information collected in surveys of three communal areas is used to describe and compare grain transactions at the household level.

II THE DATA

2.1 Sources of Data

The study draws on both secondary and primary data sources. Crop production estimates and official purchases, have been compiled for individual districts in Zimbabwe from secondary sources and provide the basis for analysing recent trends at the provincial level and identifying grain-surplus and deficit areas. The main emphasis in the study has however been placed on the collection of primary data from farm households in different types of grain producing areas. The surveys provide quantitative information on household grain flows and storage patterns together with observations on related variables such as resources, income flows and grain consumption.

Table 1 provides a summary of the primary data collection programme. Three fieldwork locations were selected to study both grain-surplus and deficit areas. (See Map - Figure 1). Urungwe district, a grain-surplus region, and Binga district, generally a grain-deficit area, contain farm households operating in contrasting agro-ecological regions with different resource endowments and disparate access to market opportunities and agricultural support services, external factors that are likely to have a significant influence on the production and marketing of grain crops. Bushu Communal Land, a grain surplus area,

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1/ For a description see Stanning, J.L. (1985).

Figure 1 ZIMBABWE

NATURAL REGIONS & FARMING AREAS

AND SURVEY AREAS

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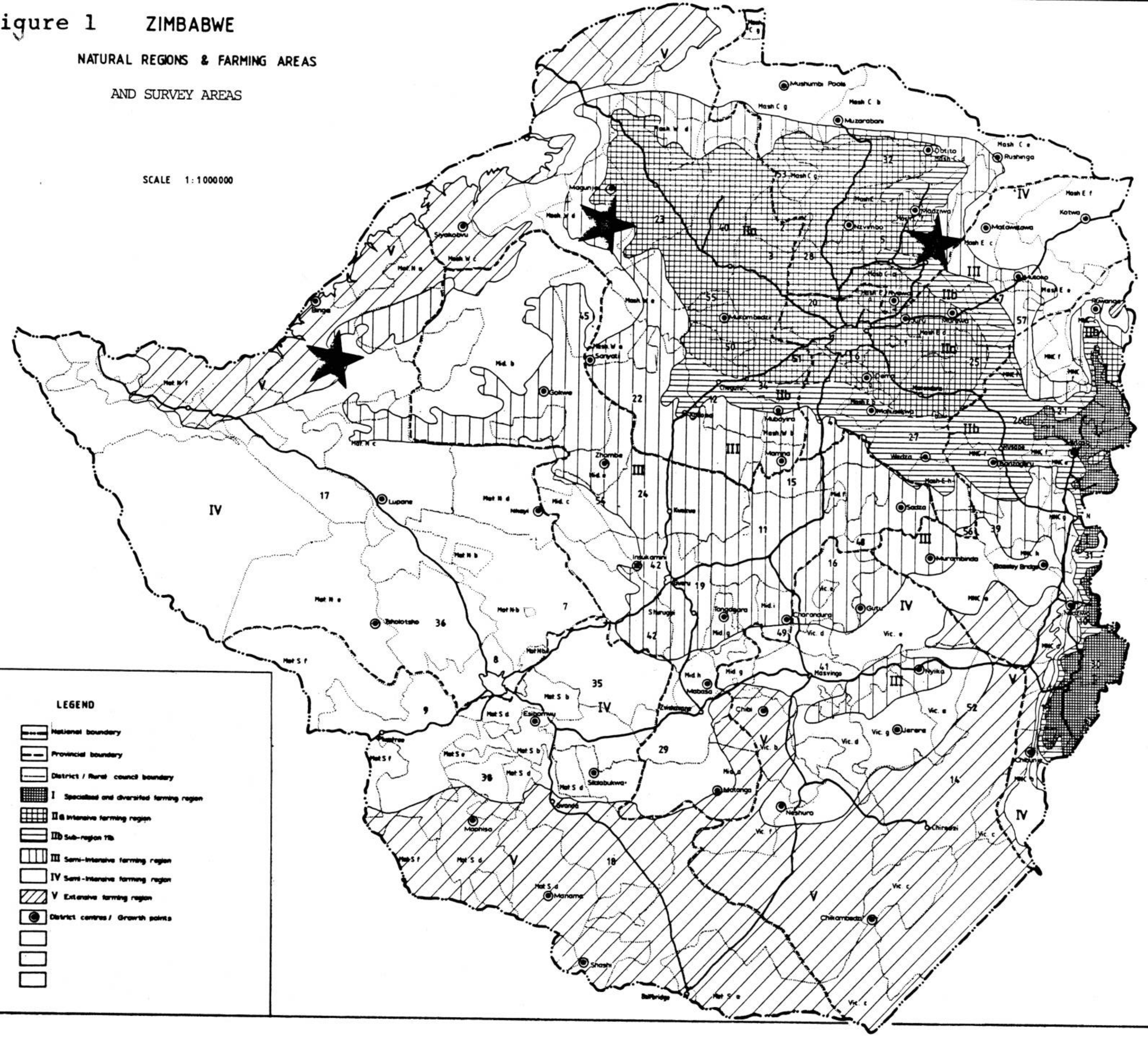


DISTRICT COUNCILS

NAME OF DC	CODE NO.	NAME OF DC	CODE NO
Beit-Bridge District L A	Mat S a	Umzingwane L G A	Mat S b
Insiza DC	Mat S c	Gwanda DC	Mat S d
Matobo DC	Mat S e	Bulalima Mangwe DC	Mat S f
Binga DC	Mat N a	Hlangabeza (Bubi) DC	Mat N b
Kusile DC	Mat N c	Nkai DC	Mat N d
Tsholotsho DC	Mat N e	Hwange DC	Mat N f
Kubatana Bindura Council	Mash C a	Mazarabani DC	Mash C b
Chiweshe DC	Mash C c	Pfura DC	Mash C d
Rushinga DC	Mash C e	Chaminuka DC	Mash C f
Guruve DC	Mash C g	Goromonzi Kubatana DC	Mash E a
Rudhaka DC	Mash E b	U.M.P. Zvataida DC	Mash E c
Murewa DC	Mash E d	Mutoko (1980) DC	Mash E e
Mudzi DC	Mash E f	Harava DC	Mash E g
Wedza DC	Mash E h		
Sanyati Council	Mash W a	Mhondoro Council	Mash W b
Nyaminyami DC	Mash W c	Hurungwe DC	Mash W d
		Chirorodziva DC	Mash W e
Buhera DC	MNC a	Gazaland DC	MNC b
Nyanga DC	MNC c	Mabvazuva DC	MNC d
Chilepo DC	MNC e	Maungwe DC	MNC f
Mutare DC	MNC g	Mberengwa DC	Mid a
Chirarya Gokwe Council	Mid b	Manyame DC	Mid c
Mashambazhou DC	Mid e	Chikomba DC	Mid f
Shurugwi DC	Mid g	Zvishavane DC	Mid h
Takawira DC	Mid i		
Bikita People's Council	Vic a	Nyanungwe DC	Vic b
Gaza Komanani	Vic c	Masvingo DC	Vic d
Gutu DC	Vic e	Batanai DC	Vic f
Zaka DC	Vic g	Zimunya-Marange DC	MNC h

RURAL COUNCILS

NAME OF R.C.	CODE NO	NAME OF R.C.	CODE NO.
Acturus R.C.	1	Ayrshire R C	2
Banket/ Trelawney R C	3	Beatrice Harare South RC	4
Bindura R C	5	Bromley Ruwa RC	6
Bubi RC	7	Bulawayo Esigodini R C	8
Bulalima Mangwe RC	9	Coshel RC	10
Charter R C	11	Chegutu R C	12
Chipinge RC	13	Chiredzi R C	14
Featherstone RC	15	Gutu Chatsworth R C	16
Gwaai Valley RC	17	Gwanda RC	18
Gweru Shurugwi RC	19	Harare West RC	20
Inyanga R C	21	Kadoma RC	22
Karoi RC	23	Kwekwe RC	24
Macheke RC	25	Makoni RC	26
Marandera RC	27	Mazowe RC	28
Mberengwa RC	29	Chimanimani R C	30
Mutare RC	31	Mvurwi R C	32
Mwenezi Beit Bridge R C	33	Norton Selous RC	34
Nuanetsi RC	35	Nyamandhlovu R C	36
Shamva RC	37	South Matopos RC	38
Tsungwesi R C	39	Umguza RC	40
Masvingo RC	41	Vungu & Upper Ngezi R C	42
Budya R C	43	Chesa Karuyana RC	44
Chitenderano RC	45	Chikomberwezi R C	46
Chitowa RC	47	Chivhu RC	48
Kubatana Tugwi RC	49	Msengezi RC	50
Muda Manrangwe RC	51	Nyahunda Hunguzi RC	52
Nyakapupu RC	53	Silobela RC	54
Zowa RC	55	Zvinyambe RC	56
Mutoko RC	57		

TABLE 1: Summary of Fieldwork Programme

Survey Area	Location	Natural Region *	Grain Producing System	Sample Size	Date Fieldwork Commenced	Information Collected
Urungwe District	Mashonaland West	IIa III IV	MAIZE Grain surplus Area	80	May 1985	Baseline questionnaire: May 1985 Monthly questionnaire: June '85 - May '86 June '86 - present Supplementary questionnaire: May '86
Binga District	Matabeleland North	IV V	SORGHUM/MILLETS Grain deficit Area	27 **	May 1985	Baseline questionnaire: May 1985 Monthly questionnaire: June '85 - May '86 June '86 - present Supplementary questionnaire: May '86
Bushu Communal Land	Mashonaland Central Shamva District	IIb III	MAIZE Grain surplus Area	69	June 1986	Baseline questionnaire: June 1986 Monthly questionnaire: July '86 - present Supplementary questionnaire: June '86

Notes:

* Zimbabwe is classified into five natural regions on the basis of soil type, rainfall and other features. The first three regions are suitable for intensive crop and livestock production, whereas the remaining two offer limited scope for agricultural development based on cropping.

** Initial sample size was 27 but due to the security situation in one fieldwork area, 7 households had to be dropped from the sample in January 1986.

was incorporated into the survey at the end of the first year of data collection. Survey households in this area face relatively uniform environmental conditions and differ little in access to markets and the like. The Bushu sample is therefore particularly interesting in providing a basis for determining those socio-economic characteristics of farm households which influence major inter-household differences in grain exchange relations.

Three separate questionnaires were prepared for the survey:

(a) Baseline questionnaire

This questionnaire was administered to each head of household and all family members who had land or owned livestock. The questionnaire designed to collect data on household composition, size of land holding, livestock and crops grown and grain transactions in the 1983-84 and 1984-85 seasons.

(b) Monthly questionnaire

This questionnaire was administered to the heads of household on a monthly basis. Data collected included grain flows, grain consumption and storage, income and expenditure and the types and sources of food consumed by the household.

(c) Supplementary questionnaire

This questionnaire was administered to all heads of household and cultivators within the household. It covered crops grown and crop inputs in the 1985-86 season, reasons for growing crops, marketing behaviour, grain production goals, family food requirements, frequency of seasonal grain shortages and likely sources of additional grain and income to purchase grain.

2.2 Sampling Procedure

A stratified random sampling method was used to select representative farm households from Urungwe and Binga districts. Extension-worker areas in each district were stratified into three categories according to whether farmers in these areas had good, moderate or poor access to market. Areas for fieldwork were selected from each category; and cultivator lists, compiled by Agritex, were then used to draw a random sample of households from each location.

The selection of sample households from Bushu communal land did not involve any form of stratification in the sampling procedure but simply entailed selecting systematically from recently compiled lists of cultivators provided by local extension staff.

In all three survey areas the sampling unit was taken as the 'farming household' of the selected cultivators. In Binga, the 'farming household' often contained multiple family units because of the tendency for married men to have more than one wife, and because it is common for an extended family to be living together at a single homestead. In administering the survey, care was taken to ensure that grain transactions were enumerated from all the people residing at the homestead.

With this brief explanatory background of research objectives and survey methodology, the remainder of the paper discusses preliminary analysis of both the secondary data and the information collected from sample farm households in the baseline and supplementary surveys. Data from the monthly questionnaires are not yet analysed.

The paper is divided into two main sections:

1. The regional pattern of communal sector grain production and marketing trends for 1980-85, and
2. Production, storage and marketing patterns at household level.

The final section looks at the general implications of these findings for developing socio-economic models of the factors influencing the storage and marketing of food grains in Zimbabwe's communal farming sub-sector.

III REGIONAL PATTERN OF COMMUNAL SECTOR GRAIN PRODUCTION AND MARKETING, 1980-85

A first step in taking a disaggregated view of grain flows in the communal sub-sector was to investigate whether regional patterns of grain production and official purchases exist. Provincial statistics on estimated grain production and official marketing for the period 1980-85 have been calculated from district level data extracted from Agritex crop forecasts and the computer records of the GMB. These are presented in Tables 2 and 3. A number of limitations of the data should be noted. Firstly, Agritex figures are based on estimates submitted by regional agricultural extension officers. These estimates are obtained from a visual assessment of crops and thus are not very reliable. Secondly, provincial totals of production estimates may not add up to national totals published by the Central Statistical Office because the national crop forecasting committee in the Ministry of Lands, Agriculture and Rural Resettlement generally adjusts the figures provided by Agritex to incorporate other estimates made by other institutions such as the Central Statistical Office and the GMB.

The official marketing statistics extracted from GMB records can generally be accepted as reliable, although some minor discrepancies were found between the computer run of marketing from communal and small-scale farmers and the information detailed on the computer run of marketings from all sub-sectors. A final problem that should be mentioned is that whilst production estimates cover the communal farming sub-sector, marketing data are for the entire smallholder sector which, although predominantly communal farmers, also incorporates small-scale commercial and resettlement farmers. This fact inhibits direct comparison of production and marketing data. However, both sets of information can be used independently to identify regional trends in production and marketing and to develop

TABLE 2: Estimated Grain Production in the Communal Farming Sub-sector by Type of Grain and by Province, 1980-85 (tonnes)

A. Total Grains

Province	1980 Production (tonnes)	1980 Per capita Production	1985 Production (Tonnes)	1985 % Total	1985 Kg per Capita	1985/1980
Manicaland	N/A	N/A	404,200	17.6	658	N/A
Mashonaland Central	42,727	225	165,720	7.2	723	3.88
Mashonaland East	28,047	79	268,673	11.7	682	9.58
Mashonaland West	57,062	296	212,102	9.2	968	3.72
Matabeleland North	24,698	99	92,430	4.0	330	3.74
Matabeleland South	97,904	352	197,136	8.6	621	2.01
Midlands	216,103	449	587,523	25.5	1,043	2.72
Masvingo	285,325	502	372,538	16.2	576	1.31
Total	N/A	N/A	2,300,322	100.00	N/A	N/A

Province	1980 Production (tonnes)	1980 Kg per Capita	1985 Production (tonnes)	1985 % Total	1985 Kg per Capita	Mean Production (tonnes) 1980-1985	Std Deviation 1980-1985
B. Maize Production							
Manicaland	N/A	N/A	264,053	15.4	429	N/A	N/A
Mashonaland Central	41,111	216	158,962	9.3	693	87,517	(41,085)
Mashonaland East	20,344	58	237,278	13.8	602	113,043	(82,330)
Mashonaland West	54,610	283	208,444	12.2	951	121,316	(52,901)
Matabeleland North	11,831	47	60,198	3.5	215	30,579	(17,066)
Matabeleland South	45,888	165	84,317	4.9	266	42,188	(32,631)
Midlands	158,060	329	502,532	29.2	892	227,855	(154,104)
Masvingo	188,108	330	202,643	11.7	313	136,140	(82,701)
Total	N/A	N/A	1,718,427	100.0	-	N/A	N/A
C. Sorghum Production							
Manicaland	N/A	N/A	44,448	20.2	82	N/A	N/A
Mashonaland Central	139	0.7	2,675	1.2	14	6,183	(10,098)
Mashonaland East	285	0.8	8,487	3.9	24	2,351	(3,098)
Mashonaland West	1,490	7.0	2,153	1.0	11	1,157	(711)
Matabeleland North	8,069	32.0	29,996	13.6	120	12,701	(8,955)
Matabeleland South	27,945	101.0	56,257	25.5	202	24,050	(19,899)
Midlands	5,673	11.0	31,000	14.1	64	11,265	(10,374)
Masvingo	16,331	29.0	45,219	20.5	79	21,368	(16,045)
Total	N/A	N/A	220,235	100.0	-	N/A	N/A
D. Mhunga Production							
Manicaland	N/A	N/A	79,362	32.3	146	N/A	N/A
Mashonaland Central	159	0.8	2,284	0.9	12	1,394	(812)
Mashonaland East	5,799	16.0	18,392	7.5	52	8,462	(5,003)
Mashonaland West	203	1.0	77	-	0.4	62	(74)
Matabeleland North	4,798	19.0	2,072	.8	8	4,723	(2,461)
Matabeleland South	20,915	75.0	52,807	21.5	190	29,921	(19,931)
Midlands	25,322	53.0	22,114	9.0	46	11,408	(10,505)
Masvingo	41,717	73.0	68,702	28.0	143	28,189	(24,112)
Total	N/A	N/A	245,810	100.0	-	N/A	N/A
E. Rapoko Production							
Manicaland	N/A	N/A	16,377	14.1	30	N/A	N/A
Mashonaland Central	1,318	7	1,799	1.6	9	1,086	651
Mashonaland East	1,619	5	4,516	3.9	12	2,425	1,547
Mashonaland West	759	4	1,428	1.2	7	1,025	501
Matabeleland North	-	-	164	0.1	0.6	173	313
Matabeleland South	3,156	11	3,755	3.3	14	1,555	1,693
Midlands	16,390	34	31,877	27.5	66	14,829	11,289
Masvingo	39,169	69	55,974	48.3	98	28,921	19,652
Total	N/A	N/A	115,850	100.0	-	N/A	N/A

Notes: Population figures used to determine per capita grain output levels are derived from the 1982 population census of Zimbabwe. The population growth rate between 1969-1982, in each province, was used together with 1982 population figures to estimate population over the period under study.

SOURCE: Computed by author from district totals compiled from Agritex crop forecasts.

TABLE 3 : Total GMB Purchases from the Communal and Small Scale Farming Sub-Sectors, by Province, 1980 - 1985

Province	1980 (tonnes)	1981 (tonnes)	1982 (tonnes)	1983 (tonnes)	1984 (tonnes)	1985 (tonnes)	% 1985 Total	Average 1980-1985	Standard Deviation 1980-85
Manicaland	10,904	42,154	33,410	3,673	28,502	109,956	11.9	38,100	(37,997)
Mashonaland Central	14,296	65,713	87,663	46,503	92,217	135,030	14.6	73,070	(41,363)
Mashonaland East	19,205	62,049	111,517	29,750	97,125	178,722	19.4	83,061	(59,194)
Mashonaland West	22,381	86,254	83,810	66,827	107,364	163,756	17.7	88,399	(46,664)
Matabeleland North	205	3,382	1,326	917	13,562	35,971	3.9	9,227	(14,007)
Matabeleland South	1,207	3,842	2,464	847	1,665	6,330	0.7	2,756	(2,062)
Midlands	12,944	71,647	32,684	2,228	47,801	152,629	16.5	53,325	(54,587)
Masvingo	6,661	35,650	114,679	24	50,073	136,934	14.8	57,336	(56,568)
Miscellaneous	2,053	3,292	3,925	6	4,272	4,731	0.5	3,046	(1,755)
	89,856	373,983	471,478	150,775	442,581	724,079	100.0	-	-

MAIZE

Province	Harvest Year 1980	1981	1982	1983	1984	1985	% 1985 Total	1985/80	Average 1980-1985	Standard Deviation 1980-85
Manicaland	9,765	38,349	32,261	3,597	24,612	69,845	8.4	7.15	29,738	(23,654)
Mashonaland Central	14,121	65,407	87,492	46,340	91,922	133,990	16.1	9.49	73,214	(41,289)
Mashonaland East	19,033	61,885	111,312	29,686	96,268	170,311	20.5	8.95	81,416	(56,508)
Mashonaland West	22,282	86,211	83,700	66,729	106,825	162,245	19.5	7.28	87,999	(46,173)
Matabeleland North	180	3,319	1,320	913	13,373	33,911	4.1	188.39	8,836	(13,221)
Matabeleland South	1,202	3,833	2,464	846	1,662	5,907	0.7	4.91	2,653	(1,916)
Midlands	12,838	68,035	32,547	2,176	46,033	141,777	17.0	11.04	50,568	(50,467)
Masvingo	5,959	33,001	11,411	20	47,807	110,287	13.2	18.50	34,748	(41,132)
Miscellaneous	2,041	3,234	3,911	5	4,188	4,392	0.5	2.15	2,962	(1,680)
Total	87,421	363,274	366,418	150,312	432,690	832,674	100.0	9.50	-	-

SORGHUM

Province	Harvest Year 1980	1981	1982	1983	1984	1985	% 1985 Total	1985/80	Average 1980-1985	Standard Deviation 1980-85
Manicaland	1,139	3,805	1,149	76	1,414	12,884	37.7	11.31	3,411	(4,802)
Mashonaland Central	175	306	171	163	283	647	1.9	3.70	291	(185)
Mashonaland East	172	164	205	64	499	2,055	6.0	11.95	527	(763)
Mashonaland West	99	43	110	98	523	671	2.0	6.78	257	(268)
Matabeleland North	25	63	6	4	127	1,241	3.6	49.64	244	(490)
Matabeleland South	5	9	-	1	3	353	1.0	70.60	62	(143)
Midlands	106	3,612	137	52	1,107	5,030	14.7	47.45	1,674	(2,135)
Masvingo	702	2,649	268	4	1,442	11,191	32.8	15.94	2,709	(4,263)
Miscellaneous	12	58	14	1	11	93	0.3	7.75	32	(36)
Total	2,435	10,709	2,060	463	5,409	34,165	100.0			

Province	MHUNGA Harvest Year 1984	1985	% 1985 Total	RAPOKO Harvest Year 1984	1985	% 1985 Total
Manicaland	59	1,792	14.2	2,417	25,435	57.0
Mashonaland Central	8	297	2.4	4	87	0.2
Mashonaland East	57	1,538	12.2	301	4,818	10.8
Mashonaland West	15	608	4.8	1	232	0.5
Matabeleland North	16	340	2.7	46	479	1.1
Matabeleland South	-	42	0.3	-	28	-
Midlands	101	2,454	19.5	560	3,388	7.6
Masvingo	125	5,535	43.9	699	9,921	22.2
Miscellaneous	-	-	-	73	246	0.6
Total	381	12,606	100.0	4,101	44,634	100.0

SOURCE: Computed by author from district totals derived from Grain Marketing Board's annual records of quantities purchased.
NOTES: Miscellaneous includes all marketings not allocated to a specific district.

hypotheses about the main factors influencing grain disposal by smallholder farmers.

3.1 Grain Production

This section looks at grain production by province in the communal sub-sector over the last six years and incorporates population data to show how per-capita production levels may be useful in identifying grain-surplus and deficit regions.

Information compiled on grain production in Zimbabwe's eight provinces is shown in Table 2. Between 1980 and 1985, estimated total grain output increased two- to fourfold in most provinces, except in Mashonaland East where there has been a tenfold increase and in Masvingo where the increase in output has been less than twofold. Even allowing for the possibility of an unfavourable 1979-80 season, the growth in total output in Mashonaland East would still be exceptional. Relative to other provinces, Mashonaland East probably had the best infrastructure and market access before independence and was therefore in a better position to respond to price incentives.

In 1985, the Midlands was the dominant province in terms of total grain production and per-capita output. Manicaland and Masvingo were the next most important provinces followed by Mashonaland East and West. Although Mashonaland West accounted for less than ten percent of total grain output in 1985, it had the second highest per-capita output. The province accounting for the smallest proportion of communal sub-sector grain output and also producing the lowest output level per-capita in 1985 was Matabeleland North.

Over the period 1980-85, maize dominated communal sector grain output. In all provinces except Matabeleland North and South, maize accounted for a higher proportion of grain output than sorghum, mhunga and rapoko combined. The only other provinces where significant quantities of grains besides maize are produced are Manicaland and Masvingo.

From Table 2B it can be seen that Midland's dominance in total grain output reflects its strong performance in the production of maize. Mashonaland West, however, had the highest per capita production of maize in 1985. Whilst both Mashonaland West and Masvingo produced similar levels of maize output in 1985, the performance of the latter in terms of per capita output was much lower.

The overall provincial pattern in terms of the types of grain dominant in each region is therefore quite clear and corresponds closely to the distribution of Zimbabwe's natural farming regions (See Figure 1).

The most interesting feature highlighted by the production data in Table 2 is the provincial variations in level of per-capita output. Estimates of household grain retentions derived from field-work over the last two seasons suggest that retentions in the order of 150-250 kg per capita, are, depending on region, probably necessary to meet a farm household's food and non-food grain requirements (see Tables 17 and 21). On the basis of these figures, all Zimbabwe's provinces, including Matabeleland North, produced sufficient grain in aggregate terms in 1985 and had grain surpluses of varying degrees.

3.2 Marketed Grain Output

Official purchases of grain crops by the GMB over the period 1980-85 are given in Table 3. The millets, known locally as mhunga and rapoko, have been handled by the GMB only since 1984.

Since 1980, the marketed surplus of grains from the smallholder sector has risen more than tenfold and realised a record level in 1985. The Mashonaland provinces made the highest average contribution to total grain marketings over the period 1980-85 and fairly substantial marketings were maintained even during the 3-years drought period 1982-84.

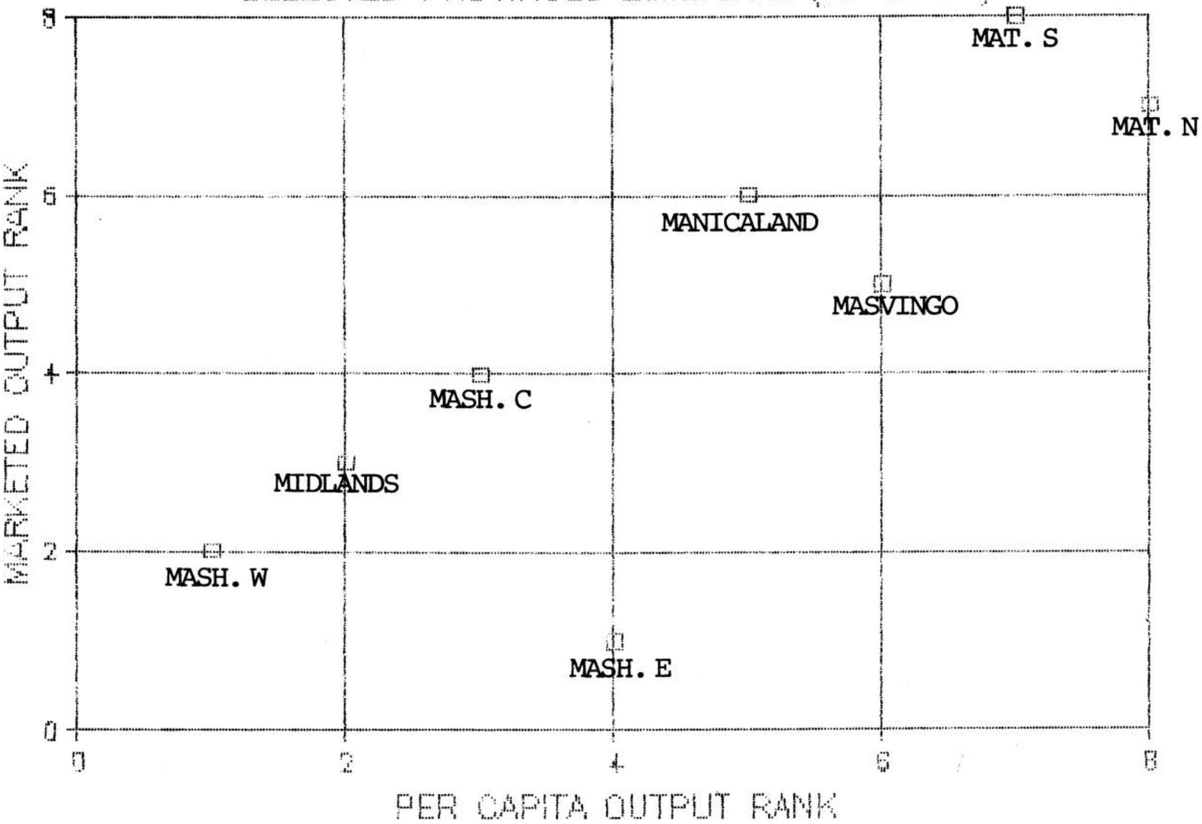
A comparison of maize purchases by province in 1985 (Table 3) with 1985 per-capita maize output figures (Table 2) suggests a very close association between these variables. In fact the hypothesis that they are a positively correlated was tested using Spearman's rank correlation coefficient and found to be significant at the 95 percent confidence level. Figure 2 shows the rank values for marketed output and per capita output plotted graphically.

A very clear pattern emerges from the provincial sales of sorghum and millets in 1984 and 1985. Manicaland and Masvingo provinces together provide the bulk of GMB's sorghum intake from the smallholder sector. Masvingo is also the most important province with regard to official sales of mhunga, whilst Manicaland provides more than half of the rapoko purchased by the GMB.

Although a preoccupation with household-level data has thus far prevented an in-depth analysis of secondary data on district-level production and marketing of grain crops, the preliminary findings presented here support the assertion that a disaggregated analysis of grain flows in the smallholder sector is valuable in assessing the impact of national food policy on different regions within Zimbabwe. Clearly any changes in Government's maize pricing policy are likely to have their greatest impact on farmers in Mashonaland and the Midlands, whereas farm households in Manicaland and Masvingo will be more strongly affected by policies related to sorghum and millets.

FIG 2. RANK VALUE: MAIZE SOLD, OUTPUT/CAPITA

SELECTED PROVINCES ZIMBABWE (rs=0.809)



Source: Computed by author from Agritex 2nd crop forecasts and Grain Marketing Board's records.

IV PRELIMINARY RESULTS OF THE SURVEY

Decisions affecting grain storage and marketing involve farmer's choices and actions. These in turn will be related to farmer's goals, resources and physical and socio-economic circumstances. This section presents a descriptive analysis of the socio-economic characteristics, resources and objectives of households included in the survey in order to identify factors which need to be taken into account when exploring household grain storage and marketing behaviour. In addition, patterns of household grain storage and marketing for the 1983-84 and 1984-85 seasons are examined.

The results presented in this report utilise information on farmers' objectives and transactions in grain derived from the baseline and supplementary questionnaires and do not derive from a regular monitoring of grain flows. They can therefore provide only an approximate picture of the pattern of grain transactions at the household level in the three regions surveyed. A second limitation of the data arises from the fact that the baseline survey was administered one year later in Bushu than in Urungwe and Binga and therefore the seasons for which details of grain flows were collected do not coincide exactly although they do overlap.

4.1 Socio-economic Characteristics of Households

Statistics on socio-economic characteristics of households are provided in Tables 4 and 5 and are discussed below.

4.1.1 Household Composition

Table 4 reveals that the composition of households in Urungwe and Bushu is similar except that the number of absent male members is higher in Bushu. These households

TABLE 4: Average Household Composition in the Three Survey Areas

Category of Household Member	Household Members living on farm *			Total Household Members		
	Urungwe	Binga	Bushu	Urungwe	Binga	Bushu
Adult Males	0.8 ** (0-3)	1.1 (0-3)	0.7 (0-6)	1.1 (0-3)	2.0 (1-6)	1.4 (0-10)
Adult females	1.4 (0-4)	3.1 (0-10)	1.2 (0-5)	1.5 (0-6)	3.3 (1-10)	1.3 (0-5)
Unmarried post-school children (17-24 years)	0.7 (0-4)	0.2 (0-3)	0.8 (0-6)	0.8 (0-4)	0.4 (1-3)	1.1 (0-6)
School age children (6-16 years)	2.8 (0-11)	3.8 (0-14)	2.2 (0-5)	2.9 (0-11)	4.3 (0-19)	2.3 (0-5)
Pre-school children	1.3 (0-5)	2.5 (0-7)	1.4 (0-9)	1.4 (0-5)	2.5 (0-7)	1.5 (0-9)
TOTAL	7.0 (1-21)	10.7 (2-32)	6.3 (1-22)	7.7 (1-21)	12.5 (2-40)	7.5 (1-26)

* Normally living with the household 9 - 12 months per year
** All figures are mean number per household with range in parentheses

TABLE 5: Selected Household Characteristics in the Three Survey Areas

Household Characteristic	Urungwe	Binga	Bushu
Average years household head resident* in area	15.4 (1-73)	10.8 (1-28)	38.5 (1-84)
Average age of household head (years)*	49.3 (21-83)	48.3 (24-68)	46.3 (26-84)
Female-headed households %	11.0	0.0	9.0
Household with household head absent 4-12 months per year (%)	17.0	17.0	38.0
Proportion of households with at least one member of the household in full time employment (%):			
(a) locally	15.0	17.0	9.0
(a) away from home	28.0	51.0	48.0

SOURCE: Data from author's food grain study 1985-86
* Mean, with range in parentheses

support 6-8 persons on average. Households in Binga are larger since most Tonga households are polygamous.

4.1.2 Household Characteristics

Table 5 gives details of selected household characteristics which may be relevant in explaining household behaviour.

The average length of residence of household heads shows significant variation between the three survey locations and highlights differences in their history of settlement. Bushu is an old established communal land and many household heads were born in the area. Some parts of Urungwe have been settled for a long period but the district has experienced considerable in-migration of families from areas of land pressure in other parts of Zimbabwe. The majority of people in Binga District were resettled from the Zambezi River Valley when it was flooded by Lake Kariba.

The proportion of female-headed households is about ten percent of households in Urungwe and Bushu and nil in Binga, where homestead units of extended families are common. However, in order to establish the extent of households effectively headed by women farmers, we also need to take into account the proportion of homesteads where the male head is absent for most of the year. From Table 5 it can be seen that 17 percent of male household heads are absent in Urungwe and Binga whilst 38 percent are absent in Bushu. The incidence of women farmers is likely to be an important influence on farm-household decision-making since, in situations where the household is managed by a woman for most of the year, production activities will compete with farming activities for the allocation of her time.

The number of households with at least one member in full-time employment locally or away from home demonstrates the extent to which families have access to non-farm income sources and may also be an indirect indication of the extent to which farming is regarded as a sufficient source of livelihood in each location. Around half the households in Binga and Bushu have at least one member of the household working away from home, compared with fewer than one third in Urungwe.

4.1.3 Land Holdings

Access to land is a determining factor in a farm household's ability to meet its food needs and participate in the market. Table 6 shows that there is considerable variation both within and between areas in the amount of cultivatable land available to the households in the sample.

Table 6: Land Holding for each Household in the Three Survey Areas

	Urungwe	Binga	Bushu
Field area (ha)	3.9 (0.6-14.6)*	5.8 (0.8-17.0)	1.8 (0.5-7.3)
Garden area (ha)	0.1 (0.0-0.75)	0.2 (0-5.0)	0.1 (0-1.0)

* All figures are mean, with range in parentheses.

The average size of land holding appears to be inversely correlated with the length of time an area has been settled since average holdings are smallest in Bushu (1.8ha) and largest in Binga (5,8ha). Amongst Urungwe household land holdings are intermediate (3,9ha). Whilst most households members in Urungwe and Bushu cultivate their fields together, it is common amongst the Tonga in Binga, who have a matrilineal society, for the women to own land and cultivate separately. This characteristic is highlighted in the frequency distribution of the percentage of households with various numbers of cultivators (Table 7). Over two-thirds of households in Binga contained more than three cultivators.

Table 7: Frequency Distribution of the Number of Cultivators in Each Household in Survey Areas

Number of Cultivators per Household	Percentage of Households Urungwe	Binga	Bushu
1	78	24	96
2	15	10	4
3	7	18	0
4	0	14	0
5 or more	0	34	0

4.1.4 Livestock Holdings

Farm households keep animals for a variety of reasons. Cattle are kept mainly for their draft power, manure and milk and as a store of wealth in time of need. Small stock (sheep and goats, pigs and chickens) are a source of meat for the household and are also an important store of wealth amongst poorer households and households in areas climatically unsuited to cattle.

From Table 8 it can be seen that cattle ownership is on average highest in Urungwe although in all three areas about one-third of households own no cattle (Table 9). Ownership of sheep and goats is highest amongst Binga households although 28 percent of sample households owned no small stock (Table 10). Pig rearing is quite common in both Urungwe and Bushu. It is usual to feed pigs on low-grade maize that has been damaged or declined in quality in storage. Table 11 shows the proportion of households without livestock. Bushu, had the highest incidence of families in this category which probably reflects a shortage of grazing land, since this area has the highest population density of the three surveyed.

TABLE 8: Livestock Ownership for each Household in the Three Survey Areas

Livestock type	Urungwe	Binga	Bushu
Average No. of cattle	6.8 (8.7) *	4.4 (4.7)	3.9 (6.2)
Average No. of donkeys	0.2 (1.2)	0.3 (1.7)	0.0 (0.0)
Average No. of sheep and goats	6.7 (8.8)	22.2 (33.0)	1.8 (3.1)
Average No. of pigs	1.5 (3.5)	0.1 (0.6)	0.4 (1.9)
Average No. of poultry	17.5 (12.7)	14.5 (14.8)	11.6 (11.2)

* All figures are mean per household with standard deviation in brackets

TABLE 9: Frequency of Cattle Holdings by Households in the Three Areas Surveyed

Number of Cattle per Household	Percentage of Households		
	Urungwe	Binga	Bushu
None	34	31	35
1- 5	24	38	44
6-10	16	17	12
11-15	10	14	7
16-20	5	0	0
21-25	6	0	1
More than 25	5	0	1

TABLE 10: Frequency Distribution of Sheep and Goat Holdings by Households in the Three Survey Areas

Number of Sheep and Goats per Household	Percentage of Households		
	Urungwe	Binga	Bushu
None	32	28	62
1- 5	26	10	22
6-10	23	10	10
11-15	10	7	2
16-20	3	14	0
21-25	1	7	0
26-30	1	4	0
31-40	3	6	0
41-50	1	0	0
More than 50	0	14	0

TABLE 11: Proportion of Households with no Cattle, Donkeys, or Sheep and Goats in the Three Survey Areas

Percentage of Households		
Urungwe	Binga	Bushu
17	14	28

SOURCE: Data from author's food grain study 1985-86

4.1.5 Income Sources

The diversity in income generating strategies of rural households is a salient characteristic of the rural sector. The vast majority of households surveyed engage in some form of 'diversified' farming (i.e. they grow two or more types of agricultural products), raise livestock and engage in a wide variety of other on-farm and off-farm activities, including vegetable production, beer-brewing, home industry, casual labour, full-time employment, fishing, and in the case of Bushu households, gold panning.

Table 12 shows the diversified nature of income sources contributing to the livelihood of households over a one-year period. A number of preliminary observations about household income strategies can be made from this data.

Most of the families interviewed are attempting to secure their cash needs by a combination of methods. Only in Bushu and Urungwe is crop production a significant source of income and in these areas maize is the most frequently marketed crop. In all three areas remittances and sales of fruit and vegetables are common sources of cash. Whilst livestock, and livestock products and beer brewing are quite common sources of income for households in Urungwe and Binga, they appear to be minor sources of income for households in Bushu. To understand the significance of these income sources will require further analysis of the contribution of each source to total household income.

4.2 Patterns of Agricultural Production in Survey Areas

The statistics on agricultural production in Tables 13 and 14 are based on farmers' own estimates of areas cropped and output. Data on agricultural production for the Bushu sample is only available for 1984-85. Information relating to cropping patterns in the 1985-86 season was collected in

TABLE 12: Frequency Distribution of Income Sources for Households in the Three Survey Areas over a One-year Period

Income Source	Percentage of Households		
	Urungwe	Binga	Bushu
Maize	77.7	-	67.0
Sunflower	20.7	-	-
Groundnuts	4.8	-	4.3
Cotton	8.5	-	52.0
Miscellaneous crops- beans, soyabeans	2.4	-	-
Fruit and vegetables	48.7	17.2	39.0
Cattle sales	22.0	6.9	-
Sheep and goats	23.2	31.0	-
Poultry and eggs	26.8	65.5	7.2
Milk	1.2	-	1.4
Brewing	43.9	34.5	2.9
Full-time work	6.1	10.3	17.4
Casual labour by males	20.7	13.8	7.3
Casual labour by females	8.5	-	2.9
Home Industry (men)	19.5	3.5	14.5
Home Industry (women)	7.3	17.2	8.7
Remittances in cash	24.4	41.4	36.2
Store	2.4	3.5	1.4
Fishing	8.5	6.9	-
Herbalism	-	3.5	-
Gold	-	-	2.9
Miscellaneous (rabbits, puppies, gifts)	1.2	3.5	-

1. Urungwe and Binga: April 1984 - March 1985
   Bushu: April 1985 - March 1986

SOURCE: Data from author's foodgrain study 1985-86 the supplementary questionnaire but not analysed for this paper.

4.2.1 Cropping patterns

A large proportion of cropped land in all three survey areas was devoted to the production of staple foodgrains; maize is the dominant staple crop in Urungwe and Bushu, and sorghum and mhunga are the two most important staple crops in Binga (Table 13). From Table 13 it can be seen that grain crops accounted for 70-80 percent of cultivated area in Urungwe and Bushu, and almost half the households in the former area and a third in the latter area grew nothing except food crops. Further analysis of data for individual households will be valuable in examining whether these households have any particular characteristics. Crop production by sampled households in Binga was almost exclusively grain crops. It should be noted that it is quite common in Binga for farmers to intercrop sorghum and mhunga, sometimes together with maize. This practice presents severe difficulties in estimating the area of land allocated to each crop. In this study the area was simply estimated by dividing the total area intercropped equally between each grain.

A significant observation is that whilst the average cropped area by Urungwe households is three hectare, twice that of Bushu households, this differential is largely expressed in the area planted to maize rather than in more land being devoted to non-grain crops, such as cotton and oilseeds. Both areas have fairly similar amounts of land devoted to non-grain crops. Two partial explanations could be (i) that maize requires less labour than alternative crops and, (ii) that maize requires less cash input than alternative crops. This issue deserves further investiga-

TABLE 13: Mean Land Area Under Crops Per Household and the Proportion of Households Growing Indicated Crops

Crop	URUNGWE						BINGA						BUSHU		
	1983/84			1984/85			1983/84			1984/85			1984/85		
	Area (ha)	Range	% Growing	Area (ha)	Range	% Growing	Area (ha)	Range	% Growing	Area (ha)	Range	% Growing	Area (ha)	Range	% Growing
A. GRAINS															
Maize	2.26	(0-9.7)	98.8	2.40	(.4-9.7)	100	0.78	(0-4.9)	65.5	1.03	(0-4.0)	72	0.95	(0-8.0)	93
Sorghum	0.02	(0-0.4)	11.1	0.03	(0-0.4)	9	1.87	(0-5.7)	79.3	1.67	(0-5.0)	86	0.02	(0-1.0)	7
Mhunga	-	-	-	-	-	-	2.60	(0-10.5)	93.0	2.83	(0-13.4)	90	-	-	-
Rapoko	0.10	(0-1.2)	22.0	0.08	(0- .8)	24	-	-	-	0.01	(0-0.2)	14	0.04	(0-1.0)	14
Total	2.38	-	-	2.51	-	-	5.25	-	-	5.54	-	-	1.01	-	-
B. NON-GRAINS Total	0.65	(0-6.1)	53.1	0.78	(0-6.5)	61	0.01	(0-0.2)	3	0.01	(0-0.4)	3	0.58	(1-10.0)	70
C. TOTAL CROPS	3.03	-	-	3.29	-	-	5.26	-	-	5.55	-	-	1.59	-	-
D. ESTIMATED FALLOW	0.87	-	-	0.61	-	-	0.54	-	-	0.25	-	-	0.19	-	-

TABLE 14: Proportion of Households Growing Various Non-Grain Crops and Percentage distribution of Cropped Area Under Each Crop

	URUNGWE				BINGA				BUSHU	
	1983/84		1984/85		1983/84		1984/85		1984/85	
	Growing	Total Area	Growing	Total Area	Growing	Total Area	Growing	Total Area	Growing	Total Area
	percent		percent		percent		percent		percent	
Cotton	25.9	43.8	36.0	53.2	-	-	-	-	49.3	90.2
Sunflower	30.8	42.5	31.7	31.2	-	-	3	100.0	2.9	1.8
Groundnuts	22.2	12.5	25.6	15.6	3	100.0	-	-	15.9	8.0
Soyabeans	3.6	1.2	-	-	-	-	-	-	-	-
Total	-	100.0	-	100.0	-	100.0	-	- 100.0	-	100.0

SOURCE: Data from author's food grain study, Urungwe and Binga districts (1983/84 and 1984/85 seasons) and Bushu Communal Land, 1984/85 season tion especially in the light of Zimbabwe's current maize surplus and the need to encourage even communal farmers to diversify.

From Table 14 it can be seen that the main non-grain crop grown in Bushu is cotton, whereas cotton and sunflowers are of almost equal importance in Urungwe.

4.2.2 Households' Objectives and Strategies with Respect to Grain Crops

An insight into farmers' objectives and strategies is provided in Tables 15 and 16, which together describe households' production goals and their main reasons for growing particular grain crops[1/]. In both Urungwe and Bushu, the majority of respondents stated that they aimed to grow more maize than required for home consumption so that they could sell some. Around sixty percent of farmers in Urungwe indicated that they either did not use sorghum or rapoko, or grew very little and depended on local trading. The majority of respondents in Bushu stated that they did not grow or use sorghum and rapoko.

The most common production goal of survey households in Binga with respect to sorghum and mhunga, is to produce more grain than the household needs so that extra can be stored in case of a 'bad season'. With regard to maize, most households simply aim to produce sufficient for home consumption since it does not store as well as either sorghum or mhunga.

1/ Only those farmers growing a particular grain crop in 1985-86 season were asked to state their reasons for growing that grain.

TABLE 15: Household Production Goals for Maize, Sorghum, Mhunga and Rapoko in the Three Survey Areas

Production Goal	URUNGWE				BINGA				BUSHU			
	Maize	Sorghum	Mhunga	Rapoko	Maize	Sorghum	Mhunga	Rapoko	Maize	Sorghum	Mhunga	Rapoko
More grain than the household needs so that you can sell some AND store extra in case of a bad season	46.2	7.7	-	12.8	31.3	37.5	31.3	-	82.4	-	-	1.5
More grain than the household needs so that you can sell some	41.0	3.8	-	3.8	-	-	6.3	-	5.9	4.4	-	5.9
More grain than the household needs so that you can store extra in case of a bad season	6.4	1.3	-	7.7	6.3	62.5	62.5	-	2.9	-	-	1.5
Just enough grain for the household needs	6.4	9.0	-	16.7	62.5	-	-	-	8.9	2.9	-	2.9
Less grain than the household needs	-	1.3	-	-	-	-	-	-	-	-	-	-
Little or no grain and buy all the grain the household needs	-	28.2	-	24.4	-	-	-	-	-	-	-	-
Do not grow or use this grain	-	48.7	100.0	34.6	-	-	-	100.0	-	92.6	100.0	88.2

SOURCE: Data from author's food grain study, 1985-1986

TABLE 16: Proportion of Households Giving Indicated Reasons for Growing Various Food Grains (% of Producers)

STATED REASONS FOR GROWING MAIZE	First Reason Given			Second Reason Given			Third Reason Given		
	Urungwe	Binga	Bushu	Urungwe	Binga	Bushu	Urungwe	Binga	Bushu
Food	84.6	100.0	98.5	15.4	-	-	-	-	-
Cash	15.4	-	1.5	74.4	13.3	97.0	-	13.3	-
Beer-brewing	-	-	-	3.8	46.7	-	25.6	6.7	1.5
Livestock feed	-	-	-	3.8	-	-	29.5	-	29.5
Labour Payment	-	-	-	-	-	-	-	-	-
Mahewu	-	-	-	-	-	-	12.8	-	-
For exchange	-	-	-	-	-	-	-	-	-
No other reason given	-	-	-	2.6	40.0	3.0	32.1	80.0	68.6
REASONS FOR GROWING SORGHUM									
Food	15.0	100.0	100.0	20.0	-	-	5.0	-	-
Cash	25.0	-	-	10.0	-	-	5.0	31.3	-
Beer-brewing	30.0	-	-	25.0	100.0	100.0	-	-	-
Livestock feed	5.0	-	-	10.0	-	-	5.0	-	-
Labour payment	-	-	-	-	-	-	-	-	-
Mahewu	25.0	-	-	10.0	-	-	-	-	100.0
For exchange	-	-	-	-	-	-	5.0	-	-
No other reason given	-	-	-	20.0	-	-	80.0	68.8	-
REASONS FOR GROWING MHUNGA									
Food	-	100.0	-	-	-	-	-	-	-
Cash	-	-	-	-	-	-	-	31.3	-
Beer-brewing	-	-	-	-	100.00	-	-	-	-
Livestock feed	-	-	-	-	-	-	-	-	-
Labour Payment	-	-	-	-	-	-	-	-	-
Mahewu	-	-	-	-	-	-	-	-	-
For exchange	-	-	-	-	-	-	-	-	-
No other reason given	-	-	-	-	-	-	-	68.7	-
REASONS FOR GROWING RAPOKO									
Food	42.9	-	71.4	3.6	-	28.6	7.1	-	-
Cash	14.3	-	14.3	28.5	-	42.9	10.7	-	14.2
Beer-brewing	28.5	-	14.3	14.3	-	28.6	10.7	-	-
Livestock feed	-	-	-	-	-	-	-	-	-
Labour payment	-	-	-	3.6	-	-	-	-	-
Mahewu	14.3	-	-	21.4	-	-	-	-	-
For exchange	-	-	-	-	-	-	3.6	-	-
No other reason given	-	-	-	28.6	-	-	67.9	-	85.7

SOURCE: Data from author's food grain study 1985-1986

Table 16 shows that households in all three areas grow maize primarily for food and secondly for acquiring cash. Note that beer-brewing in Binga is usually done with the purpose of selling the beer to obtain cash and sometimes for labour exchange.

For sorghum, households in Binga indicate that the primary reason for growing this crop is for food. The brewing of beer and preparation of mahewu, a sweet, nutitious and non-alcoholic beer, are the main motives for growing this crop in Urungwe.

Mhunga is grown only in Binga, primarily for food and secondarily for beer brewing. Most producers grow rapoko primarily as a food crop although beer and mahewu brewing are also primary reasons in some households. A significant secondary reason for growing rapoko is to obtain cash.

Overall, producers' stated objectives are consistent with our understanding that small-scale farmers have multiple objectives, but meeting food requirements takes priority over other goals.

4.3 Production, Marketing and Storage Patterns at the Household Level

4.3.1 Production and Disposal of Food Grains

Table 17 shows estimated production by households and the disposal patterns of grain crops in the 1983-84 and 1984-85 seasons in Urungwe and Bushu districts and the 1984-85 season in Bushu communal land.

TABLE 17: Production and Disposal of Grain by Households in the Three Areas Surveyed, 1983-84, and 1984-85

	URUNGWE						BINGA						BUSHU		
	1983/84			1984/85			1983/84			1984/85			1984/85		
	Mean (kg)	Std. Devia-tion	% Total	Mean (kg)	Std. Devia-tion	% Total	Mean (kg)	Std. Devia-tion	% Total	Mean (kg)	Std. Devia-tion	% Total	Mean (kg)	Std. Devia-tion	% Total
MAIZE															
Production	5836	(6414)	100	5793	(6483)	100	113	(320)	100	368	(741)	100	2352	(2522)	100
Sales	4366	(6018)	74.8	4486	(6091)	77.4	-	-	-	-	-	-	1415	(2143)	60.1
Retentions	1378	(859)	23.6	1247	(785)	21.5	94	(231)	83	368	(741)	100	853	(737)	36.3
Other uses	92	(221)	1.6	60	(158)	1.1	19	(101)	17	-	-	-	84	(244)	3.6
SORGHUM															
Production	12.7	(45.8)	100	14.4	(60)	100	281.9	(692)	100	664.8	(1178)	100	11.5	(60)	100
Sales	3.3	(22.5)	26.4	8.3	47	57.6	34.5	(186)	12.2	-	-	-	6.6	(39)	57.4
Retentions	9.4	(35.2)	73.6	6.1	21	42.4	247.4	(520.5)	87.8	664.8	(1178)	100	2.2	(13)	19.1
Other uses	-	-	-	-	-	-	-	-	-	-	-	-	2.7	(15)	28.5
MHUNGA															
Production	-	-	-	-	-	-	347.6	(583)	100	1978	(4275)	100	-	-	-
Sales	-	-	-	-	-	-	-		-	124	-	6.3	-	-	-
Retentions	-	-	-	-	-	-	347.6	(583)	100	1854	(3660)	93.7	-	-	-
Other uses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RAPOKO															
Production	69.2	(171.6)	100	54.1	(137)	100	-	-	-	8.2	(45)	100	39.1	(119)	100
Sales	12.7	(58.7)	18.4	11.3	(50)	20.9	-	-	-	4.1	(22)	50	20.5	(87)	52.5
Retentions	56.5	(157.6)	81.6	42.8	(122)	79.1	-	-	-	4.1	(22)	50	10.2	(43)	26.1
Other uses	-	-	-	-		-	-	-	-	-	-	-	8.4	(29)	21.4
TOTAL GRAINS															
Production	5917.9	-	100	5861.5	-	100	742.5	-	100	3019.0	-	100	2402.6	-	100
Sales	4382.0	-	74	4505.6	-	76.9	34.5	-	4.6	128.1	-	4.2	1442.1	-	60
Retentions	1443.9	-	24.4	1295.9	-	22.1	689.0	-	92.8	2890.9	-	95.8	865.4	-	36
Other uses	92.0	-	1.6	60.0	-	1.0	19.0	-	2.6	-	-	-	95.1	-	4
Grain Retentions * per Capita (Kg)	206.3	-	-	185.1	-	-	64.4	-	-	262.6	-	-	137.4	-	-

SOURCE: Data from author's food grain study, Urungwe and Binga Districts (1983/84 and 1984/85 season) and Bushu Communal Land (1985/86 season)

NOTE: * Total grain retention divided by average number of household members living on farm.

Total estimated output of all grains averaged some 5.9 tonnes and 2.4 tonnes for Urungwe and Bushu households, respectively, and maize accounted for the bulk of production. Weather variation affected production in Binga, and total grain output was estimated to be four times higher in the 1984-85 season than in the previous drought season. Mhunga and sorghum are the two most important food grains in Binga and together account for around 80 percent of the quantity of grain produced in both seasons.

Households in Binga retained most of their grain for home consumption, whereas a large proportion of maize produced by households in Urungwe and Bushu was surplus to domestic requirements and was marketed. In fact, households in Urungwe marketed an average of 75-77% of total maize output in 1984 and 1985.

There exists considerable difference between the two surplus areas in their level of grain retentions. Households in Urungwe retained on average one and a half times more maize than those in Bushu. This difference cannot be adequately accounted for by variation in average household size and may arise because people in Urungwe consume more maize or because they retain more maize for non-food uses such as labour payments, exchange and stockfeed. Such retentions should have been recorded under the category 'other uses', but these are difficult for households to recall and are therefore probably under-recorded. Retention and domestic grain consumption can be more easily examined using the records of grain flows collected with the monthly questionnaire.

4.3.2 Marketing Activities

Table 18 provides some information about the extent to which households in each survey area utilize different marketing channels. It is evident that the GMB is the most

TABLE 18: Frequency with which Households Market Food Grains Locally and to the Grain Marketing Board (%)

Frequency	MARKETING TO GMB (percentage)			MARKETING LOCALLY (percentage)		
1. MAIZE PRODUCERS *	URUNGWE	BINGA	BUSHU	URUNGWE	BINGA	BUSHU
Every year	35.9	-	10.4	2.6	-	1.5
Most years	29.5	-	19.4	9.0	-	6.0
Some years	17.9	-	43.3	43.6	26.7	37.3
Never	16.7	100.0	26.9	44.9	73.3	55.2
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

* Excluding households not growing maize in 1985/86 - Urungwe (0%), Binga (6%), Bushu (2.9%)

2. SORGHUM PRODUCERS *						
Every year	10.0	-	-	-	-	-
Most years	10.0	-	-	5.0	-	-
Some years	5.0	-	-	15.0	31.3	100.0
Never	75.0	100.0	100.0	80.0	68.8	-
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

* Excluding households not growing sorghum in 1985/86 - Urungwe (74%), Binga (10%), Bushu (98.6%)

3. MHUNGA PRODUCERS						
Every year	-	-	-	-	-	-
Most years	-	-	-	-	-	-
Some years	-	-	-	-	37.5	-
Never	-	100.0	-	-	62.5	-
TOTAL	-	100.0	-	-	100.0	-

* Excluding households not growing Mhunga in 1985/86 - Urungwe (100%), Binga (0), Bushu (100%)

4. RAPOKO PRODUCERS *						
Every year	-	-	-	10.3	-	14.3
Most years	3.4	-	-	20.7	-	-
Some years	3.4	-	71.4	31.0	-	14.3
Never	93.2	-	28.6	37.9	-	71.4
TOTAL	100.0	-	100.0	100.0	100.0	100.0

* Excluding households not growing Rapoko in 1985/86 - Urungwe (65%), Binga (100%), Bushu (89.9%)
SOURCE: Data from author's food grain study, 1985/86

important outlet for maize producers and that participation in local markets is very limited. Over 70 percent of producers in Urungwe said they deliver maize to the GMB every year or most years. Only 17 percent responded that they never sold maize to the GMB. In comparison, only 12 percent of Urungwe households said they sell maize locally every year or most years and 45 percent never sell maize locally. A smaller proportion of maize producers in Bushu market maize, but the GMB is also the main marketing channel in this location. No maize producers in Binga sell to the GMB and only around one quarter said they market locally in some years.

The small proportion of Urungwe farmers growing sorghum, produce mainly for home consumption, although a few producers regularly market to the GMB. Producers in Binga do not generally have a surplus to market locally.

In Urungwe and Bushu, households appear most likely to dispose of surplus rapoko locally rather than sell to the GMB. This is due mainly to the fact that the local price for rapoko is higher than the official guaranteed price and because farmers only have small quantities to market.

The overall picture with regard to the participation of survey households in grain markets is one of relatively inactive local markets in the grain-surplus areas of Urungwe and Bushu which suggests that there is little local demand on a regular basis for additional grain in such areas.

Information on maize marketing from the 1983-84 crop in Urungwe and 1984-85 crop in Bushu is provided in Table 19. The main findings from both locations can be summarised as follows:

TABLE 19: Information on Maize Marketing for the 1983-84 Crop in Urungwe and the 1984-85 Crop in Bushu

Marketing Patterns for Maize Producers

Area	Households that Sold Maize (%)	Average Sale (Kg)	Proportion of households marketing (%)	
			once	twice
Urungwe 1984 harvest	77.7	5942 range=(91-33761)	96.7	3.3
Bushu 1985 harvest	66.7	2019 range=(182-10374)	100.0	0.0

Proportion of Households Selling Maize to Local Buyers or GMB (%)

Area	Local Farmer (%)	Grain Marketing Board (%)
Urungwe	6.3	93.7
Bushu	13.0	87.0

Type of Transport used for Maize (%)

Area	Type of Transport				
	Human	Donkey	Cart	Lorry	Tractor
	Proportion of Households				
Urungwe	3.2	1.6	4.8	77.7	12.7
Bushu	10.8	0.0	4.3	78.3	6.5

Mean Distance to Market and Transport Costs

Survey Area	Average distance to market (Km)	Transport Cost	
		\$/bag	\$/tonne/km
Urungwe	33.9 range(1-111)	1.16 range (0.50-3.00)	0.38
Bushu	19.37 range(1-26.0)	1.30 range (0.30-7.0)	0.74

Source: Data from author's Grain Marketing Study, Urungwe District (1983-84 season) and Bushu Communal Land (1984-85 season)

- a high proportion of farmers in both areas participated in the market.

- maize was generally marketed in a single transaction.

- most commercial exchange of maize passed through the GMB.

- 78 percent of households marketing maize transported their maize by lorry to the place of sale.

- the average distance to market is estimated at 34km for households marketing maize in Urungwe and around 19km for households in Bushu although there is considerable variation in the distance in Urungwe.

- Bushu farmers appear to be paying considerably more per tonne per kilometre to transport their maize than Urungwe producers even after allowance is made for a rise in transport costs between seasons.

The exact timing of maize sales will vary from year to year depending on seasonal rainfall patterns, conditions at harvest and particularly availability of transport. Since however there is no seasonal variation in the price GMB pays for maize there is no incentive for producers to store their surplus and we would expect farmers to market their maize fairly soon after harvest. Table 20 shows the timing of maize sales. Overall, there is a tendency for most maize to be sold within two to three months of harvest, in July and August and only a small porportion of maize was sold after September.

4.3.3 Grain Retentions

Grain retentions are dictated by farm household consumption and sales habits. In general, storing grain for household consumption receives priority. In addition, most farmers regard it as important to have in store more than they consume during the year in case of a 'bad harvest' and also to retain some grain for non-food purposes such as labour payment, exchange (particularly for cooking beef) and beer brewing.

TABLE 20: Timing of Sales - Proportion of Maize Sales Marketed in Each Quarter After Harvest (percentage)

Area (Season)	1st Quarter Month April	May	June	% Total	2nd Quarter Month Jul	Aug	Sept	% Total	3rd Quarter Month Oct	Nov	Dec	% Total	4th Quarter Month Jan	Feb	Mar	% Total	TOTAL
Urungwe	-	-	24.3		31.2	43.0	1.4		-	-	-	-	-	-	0.1		100
(1984 harvest)				24.3				75.6				-				0.1	100
Bushu	-	-	-	-	-	70.8	22.3		5.4	0.3	1.2		-	-	-	-	100
(1985 harvest)				-				93.1				6.9				-	100

SOURCE: Data from author's grain marketing study, Urungwe district (1983/84 season) Bushu Communal Land (1984/85 season)

Tables 21 and 22 show the frequency with which households retain grain for non-food uses and the proportion of families using each type of grain for various purposes. Maize is most commonly retained for non-food uses in Bushu and Urungwe whilst sorghum and mhunga are more likely to be retained for non-food purposes by Binga farmers. However, the latter households, owing to poor harvests, indicate that they generally have little opportunity to retain grain for other uses on a regular basis. For maize, the responses of Urungwe farmers support the hypothesis that the high level of grain retention in that area is associated with a greater use of maize for non-food purposes.

There is a distinct pattern of non-food uses identified for each type of grain in the areas under study. In Urungwe and Bushu, maize is used for a variety of purposes including poultry feed, brewing beer for spiritual ceremonies, security against a bad harvest, local sales and exchange. The one purpose for which grain is not frequently used is for feeding cattle. Beer-brewing is a common use for sorghum and rapoko. In Binga, the use of grain for exchange and beer-brewing is extremely common and households clearly identify a need to store grain in case of a 'bad season'. These findings are in keeping with the poor natural resource base of this environment and the limited level of monetisation amongst people in this region of Zimbabwe.

Actual grain retentions by households during the 1983-84 and 1984-85 seasons are illustrated in Table 17 and were also highlighted in Section 4.3.1. These findings suggest that on-farm retentions in grain deficit areas are positively related to the size of harvest and expand in good seasons. In grain-surplus areas there is probably little variation in on-farm retentions between seasons although the level of retentions may vary between regions, and be greater in locations where total grain output is higher.

TABLE 21: Proportion of Households which Retain Grains for Non-Food Purposes

Frequency of Grain Retention for Non-Food Use	Percentage of Households: Urungwe Maize	Urungwe Sorghum	Urungwe Mhunga	Urungwe Rapoko	Binga Maize	Binga Sorghum	Binga Mhunga	Binga Rapoko	Bushu Maize	Bushu Sorghum	Bushu Mhunga	Bushu Rapoko
Every year	50.0	6.4	-	19.2	-	18.8	12.5	-	4.5	-	-	-
Most years	42.3	6.4	-	12.8	-	6.3	12.5	-	32.8	1.5	-	3.0
Some years	2.6	5.1	-	7.7	25.0	68.8	68.8	-	61.2	-	-	11.9
Never	5.1	3.9	-	1.3	75.0	6.3	6.3	-	1.5	-	-	-
Not applicable	-	78.2	100.0	59.0	-	-	-	100.0	-	98.5	100.0	85.1

TABLE 22: Additional Purposes for which Stored Grain are used by Households in the Three Areas

Use of Stored Grain	Percentage of Households: Urungwe Maize	Urungwe Sorghum	Urungwe Mhunga	Urungwe Rapoko	Binga Maize	Binga Sorghum	Binga Mhunga	Binga Rapoko	Bushu Maize	Bushu Sorghum	Bushu Mhunga	Bushu Rapoko
Store in case of bad season	52.0	6.7	-	26.7	18.8	93.8	93.3	-	92.8	-	-	8.7
Sell locally	49.3	5.3	-	17.3	12.5	25.0	33.3	-	23.2	1.4	-	1.4
Exchange for labour	26.7	1.3	-	1.3	25.0	75.0	80.0	-	17.4	-	-	-
Exchange for other commodities	30.7	2.7	-	4.0	50.0	93.8	93.3	-	72.5	-	-	-
Feed cattle	1.3	1.3	-	-	-	-	-	-	1.4	-	-	-
Feed pigs	30.7	-	-	-	-	-	-	-	5.8	-	-	-
Feed poultry	68.0	6.7	-	-	-	6.3	-	-	33.3	1.4	-	-
Brew beer for labour payment	20.0	1.3	-	8.0	12.5	100.0	100.0	-	1.4	-	-	-
Brew beer for sale	37.3	14.7	-	25.3	18.8	100.0	100.0	-	2.9	1.4	-	2.9
Brew beer for spiritual ceremonies	52.0	13.3	-	22.7	25.0	100.0	100.0	-	75.4	1.4	-	10.1

SOURCE: Data from author's food grain study, 1985-86

4.3.4 Grain Acquisition

Tables 23 to 24 show farmers' own estimates of the frequency with which they run out of grain, the sources they are likely to use to obtain additional supplies and the primary and secondary sources of income that households are most likely to use if these grains are purchased.

Table 23: Frequency with which Households run out of Grain in Three Survey Areas

Frequency	Percentage of Households		
	Urungwe	Binga	Bushu
Every year	1.3	6.7	-
Most years	10.4	20.0	10.4
Some years	20.8	66.6	53.0
Never	67.5	6.7	36.6

More than two-thirds of Urungwe households stated that they never run out of grain compared to just over one-third of survey households in Bushu. In both areas, the proportion of households which run out of grain every year is minimal, and only around ten percent of households state that they use up their stored grain supplies before the next harvest in most years.

The situation in Binga contrasts with Urungwe and Bushu, although fewer households than expected state that they run out of grain every year. Twenty percent of households indicated that they run out of grain most years and another two-thirds state that they run out of grain some years. These figures probably understate the extent to which individual cultivators in the extended family run out of grain because Table 23 is based on the response of the head of the household.

Table 24: Supplementary Sources of Grain for Households in the Areas Surveyed

Method	Percentage of Households Urungwe	Binga	Bushu
Purchase	37.5	71.4	86.7
Labour exchange	16.7	-	6.7
Purchase & labour exchange	16.7	21.4	4.4
Relatives granary	16.7	7.2	2.4
Borrow	8.3	-	-
Miscellaneous	4.1	-	-

From Table 24 it can be seen that households which run out of grain either regularly or in some years generally obtain additional supplies through purchases or a combination of purchases and labour exchange.

The primary and secondary sources of income most likely to be used by deficit households to purchase additional grain are identified in Table 25. Remittances from family members working away from home are the dominant source amongst households in Bushu which is in keeping with the finding that this sample has the highest proportion of households with a family member in employment elsewhere. Households in Binga appear to rely mainly on money from smallstock, cattle sales and beer-brewing. Remittances are a moderate source of finance for grain purchases by Urungwe housheholds, which also make use of earnings from casual local employment and sale of non-grain crops.

Tables 26 to 28 provide details of the actual acquisition of grain by sample households over a 12-month period following the 1983-84 season (for Urungwe and Binga) and the 1984-85 season (for Bushu). Because data are available for different seasons this limits comparison between survey areas. Following the 1983-84 drought season, 90 percent of Binga households had insufficient grain to see them through the year and many households ran out of grain within 6 months of harvest (Table 26).

TABLE 25: Primary and Secondary Source of Income for Purchase of Additional Grain for Households in the Area

Primary Income Source			Source of Income to Purchase Grain	Secondary Income Source		
Urungwe	Binga	Bushu		Urungwe	Binga	Bushu
22.7	7.1	55.8	1. Remittances from family members	14.2	-	2.3
-	35.7	4.7	2. Cattle sales	-	-	2.3
9.0	50.0	4.7	3. Smallstock sales	19.0	28.6	23.3
22.7	-	16.3	4. Casual local employment	14.3	7.1	23.3
-	7.1	-	5. Beer-brewing	9.5	57.1	2.3
4.5	-	11.6	6. Handicraft(s)	-	-	16.3
13.6	-	6.9	7. Crop sales	4.8	-	-
-	-	-	8. Vegetable sales	4.8	7.1	2.3
-	-	-	9. Gold sales	-	-	14.0
-	-	-	10. Loans	-	-	11.6
-	-	-	11. Savings	-	-	2.3

SOURCE: Data from author's food grain study, 1985-86

TABLE 26: Proportion of Households which Exhausted Grain Reserves Before The Next Harvest and Frequency Distribution of Months in which Grain ran out

Survey Area (period)	Households Which Exhausted Grain Reserves	Month Grain Finished (% deficit households)											
		Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
	Percentage												
URUNGWE (April '84-March '85)	10	-	-	-	-	-	-	-	10	10	30	-	50
BINGA (April '84-March '85)	90	-	16	8	20	8	8	16	4	4	8	0	8
BUSHU (April '85-March '86)	4	-	-	-	-	33	-	-	33	-	-	-	33

TABLE 27: Proportion of Households Obtaining Additional Grain Supplies and Type of Grain Obtained

Survey Area (Period)	Households obtaining grain	Type of Grain Obtained (% Total Households)				
		Maize	Sorghum	Mhunga	Rapoko	Maize Meal
	Percentage		Percentage of Households			
URUNGWE (April '84 - March '85)	8.5	8.5	-	-	-	1.2
BINGA (April '84 - March '85)	90.0	62.0	10.3	17.2	-	82.2
BUSHU (April '85 - March '86)	4.0	4.0	-	-	-	-

SOURCE: Data from author's food grain study, 1985-86

TABLE 28: Pattern of Acquisition of Food Grains in the 1983-84 Season (Urungwe and Binga) and the 1984-85 Season (Bushu)

	Urungwe	Binga	Bushu
Total food grains acquired (kg)	1,445	21,441	910
Average per deficit household (kg)	206.4	824.7	303.3
Average per sample household (kg)	17.6	739.3	13.2
Average per capita per sample household (kg)	2.5	71.8	2.1
Type of grain acquired (% of total)			
Maize	94.5	14.6	100.0
Sorghum	-	1.7	-
Mhunga	-	-	-
Rapoko	-	-	-
Maize meal	5.5	83.7	-
Source of grain (% of Total)			
Purchased	69.2	84.6	40.0
Borrowed	-	-	60.0
Labour payment	23.1	1.6	-
Drought relief	-	12.0	-
Gift	7.7	0.8	-

SOURCE: Data from author's food grain study, Urungwe and Binga Districts (April '84 - March '85)
Bushu Communal Land (April '85 - March '86)

Only ten percent of Urungwe households reported that their grain supplies were exhausted before the next season's harvest and most of them ran short of grain between the ninth and twelth months after the harvest. The 1984-85 season was a relatively good one for Bushu farmers and very few had insufficient grain stored to last them through the year.

From Tables 27 and 28 it can be seen that maize was the main type of grain acquired by deficit households. In most instances, farmers purchased their requirements but some people borrowed from local farmers or acquired maize in exchange for labour. Binga households depended mainly on purchased maize meal since there was little surplus grain entering the local market. Drought relief accounted for the bulk of maize grain acquired by Binga households.

V SUMMARY OF FINDINGS AND PROPOSALS FOR FURTHER ANALYSIS

5.1 Summary of Provincial-level Findings

Regional patterns of grain production and officially recorded sales do exist. The main findings are:

1. Over the period 1980-85 Midlands was the dominant province in terms of share of total grain production. Manicaland and Masvingo were the next most important provinces, followed by Mashonaland West and East.

2. In all provinces except Matabeleland North and South, maize accounted for a higher proportion of grain output, over the period 1980-85, than sorghum and millets combined.

3. The Mashonaland Provinces made the highest mean contribution to total grain sales over the period 1980-85. Mashonaland East and West were the provinces accounting for the highest proportion of total marketed maize from the smallholder sub-sector in 1985.

4. A comparison of provincial maize sales in 1985 with per capita maize output levels in the same year demonstrates a significant positive correlation between these variables.

5. Manicaland and Masvingo provinces together market the bulk of GMB's sorghum intake from the smallholder sector. Masvingo is also the most important province in terms of official sales of mhunga, whilst Manicaland markets more than half of the rapoko purchased by the GMB from the smallholder sector.

5.2 Summary of Household-Level Findings from the Three Areas Surveyed

Some of the significant findings, which require further analysis are:

1. Households in Urungwe, which on average have more land than survey households in Bushu, put it into maize production rather than alternative cash crops such as cotton or oilseeds, which suggests that returns per unit of labour are greater in growing maize for sale than other options.

2. On-farm retention of grain is higher in higher producing areas. The question arises whether this is a function of the level of production alone or other factors as well. Bushu households have a much greater absenteeism of household heads in employment elsewhere which implies a greater access to non-farm cash incomes and less need to keep grains for other things such as labour payments. Wage employment may therefore be a factor affecting the level of on-farm retentions.

3. The primary reason given by virtually all households for growing grains is for food. This is despite the fact that grain surpluses are being produced on a regular basis by survey households in both Urungwe and Bushu.

4. Information on maize marketing from the 1983-84 crop in Urungwe and 1984-85 crop in Bushu demonstrates that some 78 percent and 67 percent of survey households in Urungwe and Bushu respectively participate in the market.

5. Around 90 percent of maize sales passed through the GMB. This suggests that official guaranteed prices less marketing costs provide a better remuneration to farmers in these survey areas than prevailing returns in the informal market.

Since there is no seasonal variation in official grain prices, there is no incentive for producers to store more grain than they require for their household needs. We would therefore expect farmers to market their surplus grain soon after harvest. Most surplus maize in Urungwe and Bushu is sold in a single transaction within two to three months of harvest.

In both Urungwe and Bushu, the proportion of households which stated that they usually exhaust their grain supplies before the next harvest, most or every year, is only around ten percent. Only 20 percent of survey households in Binga stated that they run out of grain most years but another two-thirds indicate that they run out of grain some years.

Remittances are likely to be the most common source of income used by deficit households in Bushu to purchase supplementary grain whereas households in Binga rely more on money from smallstock sales and beer-brewing.

In most instances, households, running out of grain in the seasons under study, purchased their additional grain requirements, although some people borrowed from local farmers or acquired grain in exchange for labour. Maize was the main type of grain acquired by deficit households in Urungwe and Bushu whilst Binga households depended mainly on purchased maize meal.

5.3 Discussion

Four key production, marketing and grain storage decisions facing small-scale farmers that require further analysis are:

- whether or not to grow grain for home use?
- whether or not to grow surplus grain for the market?
- how much grain to store or sell?
- when to sell grain and to whom?

The first decision, whether to grow grain for home use (rather than specialize in another activity), is based on consideration of what is the preferred method (taking into account both costs and risks) of meeting home food needs. Although grain can be grown or purchased, most farmers prefer to be self-sufficient and to consume home-grown grain.

The decision on whether to aim for the production of a surplus of grain is likely to depend on returns to labour in grains versus returns in other activities, other crops or wage employment. Bushu households are deciding that more household labour is better employed in wage earning than in growing more maize for sale - presumably because the use of additional labour on a more limited land area is giving diminishing returns to labour in maize production.

The decision on how much grain to retain or sell depends on household food needs plus the value of grains for other non-food uses. The value of grains for non-food uses is probably higher where the cost of producing a unit of grain in exchange for other goods, such as hired labour, remains low relative to other ways of procuring these goods (e.g. cash payments).

The timing of grain sales depends on the costs and returns to storage. Farmer behaviour in Urungwe and Bushu implies that the costs of storage (losses due to insects and rodents, outlays on buildings) outweigh the benefits of storage (price premiums received later in the year). An additional factor influencing the timing of sales is the need for cash. If other income sources are sufficiently large and regular, grain sales will not be directly dependent on the need for cash. But for many small farmers, crop sales are the main source of cash and therefore timing of sales is closely related to cash needs. The extreme case would be the 'distress sale' immediately after harvest. In the situation where a sizeable differential exists between grain prices in the informal and formal markets, such that the former is considerably lower than the latter, a likely hypothesis would be that local grain sales are mainly associated with households which have an immediate need for cash.

The types of relationships identified above can be tested using individual household data from the three survey areas. Some examples of the types of relationships that could be estimated include:

Relate : retentions per capita to grain output/per capita
: retentions per capita to wage income

Relate : proportion of grain sold to grain output/per capita
: proportion of grain sold to proportion of adults in non-farm employment
: proportion of grain sold to on-farm price
: proportion of grain sold locally to wage income

A further area of analysis which has not yet been mentioned is to analyse household data with respect to market-access according to sample stratification.

5.4 Conclusion

Some descriptive statistics have been presented to describe grain flows in the communal farming sub-sector at the provincial and household levels in the preceeding sections. This preliminary analysis has identified regional patterns in grain production and official marketings. It has also generated a number of hypotheses for testing, farmers' grain storage and marketing behaviour. Household data collected in the baseline and supplementary surveys can provide the initial basis for analysis but the monthly questionnaire, which represents a more accurate monitoring of grain flows and household income and expenditure, will provide a firmer data base to work with once this information has been processed.

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CHAPTER ELEVEN

OPTIMAL GRAIN PRICING AND STORAGE POLICY IN CONTROLLED AGRICULTURAL ECONOMIES: APPLICATION TO ZIMBABWE

Steve Buccola and Chrispen Sukume

INTRODUCTION

Increased emphasis on food security in developing countries has heightened attention to domestic pricing and grain stock policies. Analysts frequently have concluded that consumer and producer prices in controlled agricultural markets tend to be too low, although Jabara has argued this is not the case for producer prices in Kenya (Adoyade; Pollard and Graham). Governments of middle-income countries also have been blamed for holding excessively high food and cash crop stocks (Bale, pp. 32-4).

To argue that agricultural policies consistently are in error, one must hold either that policy makers optimize poorly, use biased supply and demand forecasts, or pursue objectives different from those the analyst thinks important. Of these three, it usually is most fruitful to consider the diverse objectives that governments and other economic groups pursue when setting or influencing policy. Producers' interest in high farm prices and consumers' interest in low retail prices are well known. Much less understood are the high risks and conflicting demands faced by those governments which have concentrated pricing, storage, and trade decisions in the public sector. Analysis of these risks and conflicts not only helps explain current policies but provides a better idea of desirable policy adjustments.

In this chapter we consider a government marketing board that dominates farm grain purchases, sales to commercial millers, and external grain trade. Government regulates or heavily influences most agricultural input and product prices at all levels of marketing chain. It also maintains most of the nation's grain reserve stocks. This institutional setting is found commonly in Africa and, to a slightly lesser extent, in Asia and Latin America (Ahmed and Rustagi, Aboyade). Since unexpected changes in net domestic supplies must be balanced by changes in the board's stocks or external trade, the arrangement imposes on government much of the food industry's financial risk.

Our objective is to outline a framework for identifying combinations of prices and storage policies that best promote government's -- and to some extent society's -- welfare. Unlike most past studies, we avoid equating welfare with just expected returns or risks of 'shortfalls' (Martin and McDonald, Reutlinger). Rather, welfare is taken in the broader sense of expected utility, which considers the entire probability distribution of returns associated with a given policy. Principal findings, applied to the Zimbabwe maize sector, are that optimal stock and price policies are interrelated. Present board stocks suggest an excessive willingness to gamble on future income. At approximately equilibrating exchange rates, full-cost pricing would reduce government utility and increase producer utility. This would create pressure for market decontrol.

DECISION MODEL

The approach taken is to specify a marketing board income equation and functions relating policy variable to domestic maize demands and supplies. Monte carlo methods then are used to estimate income probabilities and utilities of alternative policies.

(a) Marketing Board Income

The marketing board's annual maize income is determined by export revenue (or import cost), revenue from sales to domestic commercial millers, cost of farm maize purchases, storage costs, and handling and fixed expenses. Specifically, board income is

$$Y = \begin{bmatrix} (S + Q_{st} - Q_{dt})(P_{wt} - T_e)X_t/(1 + i) \\ \text{if } (S_{t-1} + Q_{st} - Q_{dt}) > 0 \\ (S_{t-1} + Q_{st} - Q_{dt})(P_{wt} + T_i)X_t/(1 + i) \\ \text{if } (S_{t-1} + Q_{st} - Q_{dt}) < 0 \end{bmatrix} \tag{1}$$

export revenues (import costs) net of

transport cost to (from) port, at time t

$$+ Q_{dt}P_d/[1 + (i/2)]$$

domestic revenues in t

$$- Q_{st}(P_s + H)/[1 + (i/4)]$$

farm maize purchase and handling costs in t

$$-(S_{t-1})(I) - F$$

storage insurance and fixed costs in t

$$- S_{t-1}(P_{w,t-1} - T_e)X_{t-1}$$

export value of stocks at t-1

where S_{t-1} = Quantity of maize carried from end of t-1 $\underline{th}$ to end of $t^{\underline{th}}$ fiscal year (tons);

Q_{st} = Quantity of maize supplied to the board by farmers in year t (tons);

Q_{dt} = Quantity of maize demanded of the board by commercial millers in year t (tons);

P_{wt}, $P_{w,t-1}$ = World maize price at port (US$/ton);

T_e (T_i) = Transfer cost to (from) port (US$/ton);

X_t, X_{t-1} = Zimbabwe - U.S. dollar exchange rate (Zimbabwe dollars per U.S. dollar: Z$/US$);

P_d = sale price charged commercial millers (Z$ per ton);

P_s = purchase price paid farmers (Z$/ton);

H, I = handling and storage insurance cost, respectively, (Z$/ton);

F = fixed cost allocated to maize account (Z$);

i = annual interest rate.

At end of the t-1 th fiscal year, when government selects price P_{st} to pay farmers, P_{dt} to charge millers, and strategic reserve stock S_{t-1} to carry into t, income Y is random.1/ Domestic supply response Q_{st}, domestic demand Q_{dt}, and hence net domestic supply $Q_{st} - Q_{dt}$, are yet unknown. And although current world price $P_{w,t-1}$ and exchange rate X_{t-1} are observable, those at future point t still are random.2/ Stocks carried forward from t-1 are assumed 'purchased' from the t-1 th fiscal year at current net world price and either are exported (or deducted from imports) at time t or 'sold' to the t+1 th fiscal year at net export price ($P_{wt} - T_e$). Thus, the board will export or import at t according as carryover plus net domestic supply, $S_{t-1} + Q_{st} - Q_{dt}$, is positive or negative. The distinction is important because to-port transfer cost T_e may not equal from-port cost T_i: imports may involve different per-ton freight rates than exports and deny policy makers the prestige of having achieved 'self sufficiency.'

Board income in (1) is expressed as a present value at decision point t-1. Interest rates are adjusted approximately to reflect the fact that domestic sales are nonseasonal while farm purchases peak early in the second quarter. External trades are assumed to occur near the end of the fiscal year and are discounted at the full annual rate. Variable storage cost consists principally of the time value of export revenues (or import costs) received at t rather than at t-1.

If government were risk averse and knew it would be an exporter at t, it never would hold other than working stocks at t-1 unless world price were expected to rise substantially in the ensuing year. Stocks sold immediately at t-1 avoid interest charge and risk of future price and exchange rate changes. Because few developing countries invest in the information needed for successful world price speculation, they only would hold strategic reserves in order to reduce the *ex ante* utility cost of future imports. *Ex post* import costs vary with per-ton transportation rates and the prestige loss of importing. *Ex ante* costs vary also with government's risk aversion and with the probability of requiring imports, which in turn depend not only on carryover stocks but on domestic prices influencing next year's domestic demand and supply.

It makes a difference in this regard whether exchange rates used are official ones or those reflecting true scarcity of foreign exchange. Many developing countries peg their unit of account to a market basket of foreign currency values, which vary randomly. Even so, the pegging formula typically is such as to chronically undervalue hard currencies in the sense that domestic demand permanently exceeds supply. In the latter situation, use of an official or pegged rate in (1) would understate the local currency value of exports and local currency cost of imports. It therefore would understate foreign earnings risks to which government is subject and fail adequately to explain developing governments' distaste for imports. For planning purposes, it is better to employ an estimate of the equilibrating rather than official exchange rate probability distribution, even though results will diverge from accounting returns based on official rates.

(b) Maize Demand and Supply

Nations with large peasant farming populations are in the unique position that the farm and retail price of a product each can affect both farm supply and retail demand. Peasant farmers often may choose between consuming their own grain or selling it and buying retail grain meal. Allocation between home-produced and purchased staple would depend upon relative producer and retail prices. In contrast, urban consumers respond only to retail and commercial farmers only to producer price. Data availability generally requires aggregating urban and peasant farm demand but commercial and peasant farm supplies may be specified separately. Letting P_r be retail price, Z_d (Z_s) a vector of other policies affecting demand (supply), W random weather conditions, and e_{dt}, e_{s1t}, e_{s2t} excluded random factors, demand and supply facing the board are

$$Q_{dt} = Q_d(P_r, P_s, P_d, Z_d, e_{dt}) \qquad (2)$$

$$Q_{st}^{pea} = Q_s^{pea}(P_r, P_s, Z_s, W, e_{s1t}) \qquad (3)$$

$$Q_{st}^{com} = Q_s^{com}(P_s, Z_s, W, e_{s2t}) \qquad (4)$$

where pea and com refer to peasant and commercial supply, respectively, and $Q_{st}^{pea} + Q_{st}^{com} = Q_{st}$.

Demand policy factors Z_d include urban wages which, together with price ratio P_r/P_s, affect meal orders placed by retailers with commercial millers. Z_d also includes (government controlled) wholesale wheat prices, which millers would compare with the board's maize selling price P_d in order to determine volume Q_{dt} of maize to purchase from the board. Random factor e_{dt} consists partly of unpredictable yield changes on peasant farms, since these affect demand for the retail substitute of home-produced maize meal. Supply policy vector Z_s includes fertilizer and cotton prices, while e_{s1t} and e_{s2t} represent random factors other than weather conditions. Grain producer prices in Zimbabwe are announced prior to planting. In absence of pre-planting announcements, price expectations would have to be modelled with appropriate lags.

Functional forms needed to fit (2) - (4) greatly affect policy implications derivable from the research (Turnovsky; Just, Hueth, and Schmitz, pp. 244-46; Reutlinger). This is because form determines the manner in which policy variables affect both the expectation and variance of demand and supply. Choice of form was guided partly by theoretical considerations, partly by goodness of fit. Doublelog version of (2),

$$Q_{dt} = AK_1{}^a e_{dt} \qquad E(e_{dt}) = 1 \qquad (2')$$

where K_1 is policy vector (P_r, P_s, P_d, Z_d) and $K_1{}^a$ represents $P_r{}^{a1}P_s{}^{a2}P_d{}^{a3}\ldots$, is the most widely recognized form of endogenous-quantity demand (Newbery and Stiglitz, pp. 120-1). Expectation and variance of demand in (2') are $AK_1{}^a$ and $A^2K_1{}^{2a}Var(e_{dt})$, respectively, so coefficient of variation is the constant $[Var(e_{dt})]^{1/2}$. Form (2') gave lower adjusted mean square error than did the linear and was employed in this study.3/

Supplies were specified with additive errors so that variance could partially be independent of mean. Letting K_2 be policy vector (P_r, P_s, Z_s), K_3 be (P_s, Z_s), and using the same notation as in (2'),

$$Q_{st}^{pea} = BK_2^{b}W^{g} + CK_2^{c}u \qquad (3')$$

$$Q_{st}^{com} = DK_3^{d}W^{g} + FK_3^{f}v \qquad (4')$$

where B, C, D, F are constants; $CK_2^{c}u = e_{s1t}$ and $FK_3^{f}v = e_{s2t}$; and $E(u) = E(v) = 0$, $Var(u) = Var(v) = 1$. Peasant farm supply (for example) has mean $BK_2^{b}E(W^{g})$ and variance $B^2K_2^{2b}Var(W^{g}) + C^2K_2^{2c}$, so its coefficient of variation is a nonconstant function of policy level. Forms (3'), (4') provided better fit than did doublelog versions, which, like (2'), have multiplicative errors.

Demand (2') was estimated with OLS and deflated 1968-85 time series; (3') and (4') were estimated with deflated 1953-85 data using the iterative nonlinear approach suggested by Buccola and McCarl. Elasticities of expected demand and supply with respect to stochastic and policy variables are shown in table 1. At first blush, a 0.81 wage income elasticity sounds high for a staple food. Actually, demand for commercially milled meal should be very wage-income-responsive since consumers tend to switch from home-produced to retail-purchased meal when moving from farms to wage employment. Producer price supply elasticity on commercial farms is very close to the (0.57) long-run wheat supply elasticity in developing countries estimated by Adams and Behrman (p.43). High response to fertilizer price underscores importance of fertilizer marketing policy in LDC's. Although we expected strong producer price response in the peasant sector, the large value estimated partly may result from the coincidence of rural security improvements, effective efforts at collective marketing, and

Table 1. Maize expected demand and supply elasticities facing marketing board, Zimbabwe

	Elasticity	t-Value
Wholesale Demand		
Wholesale Maize Price	-1.50	-3.13
Wholesale Wheat Price	0.90	1.06
Retail Maize Meal Price	-0.65 a/	a/
Producer Maize Price	0.65 a/	a/
Wage Income	0.81	2.43
Peasant Farm Supply		
Producer Maize Price	1.87 b/	7.97 b/
Producer Cotton Price	-1.87 b/	-7.97 b/
Retail Maize Meal Price	-1.75	-4.68
Tassling Season Rainfall c/	0.88	4.88
Commercial Farm Supply		
Producer Maize Price	0.55 b/	3.04 b/
Producer Tobacco Price c/	-0.55 b/	3.04 b/
Nitrogenous Fertilizer Price	-1.10	-3.07
Tassling Season Rainfall c/	0.62	4.21

a/ The ratio of producer to retail price was used in a doublelog model to forecast on-farm maize retentions, which is turn were used to forecast demand. Thus no direct t-values are available. On-farm retentions had elasticity -0.63 with standard error 0.20.

b/ These coefficients were constrained equal to overcome price collinearity.

c/ Indicates stochastic variable. All other variables were regarded as determined by government policy.

real price increases after the 1970's civil war (Bratton).4/ On the other hand, elasticities changed little when the time period of fit was varied from 1953-85 to 1968-85. Lower supply sensitivity to rainfall in commercial than in peasant areas is a consequence of supplemental irrigation on commercial farms.

(c) Simulation Procedure

Equations (2') - (4') make clear that government price policies affect the entire probability distribution of demand and supply. Through (1), policies also affect the probabilities of marketing board income. Because the board avowedly is operated on behalf of citizens and losses are charged to the public treasury, we argue that its income should be considered to accrue to all individuals in society. Thus board incomes should be evaluated in terms of a typical citizen's utility function.5/ Given widespread evidence of risk aversion in household decisions, it is appropriate further to cast effects of alternative policies in terms of expected utilities rather than expected profits. In this sense, we depart from the profit maximization approach taken by Pollard and Graham, who in other respects provide valuable insights into marketing board strategy and performance.

Analytical derivation of income probability moments and expected utilities would be unwieldy. Export income (import cost) alone involves the three-way product of random world price and random exchange rate with both random demand and random supply. Monte carlo simulation therefore is used instead. Two thousand random values of P_{wt}, X_t, e_{dt}, e_{s1t}, and e_{s2t} were drawn for each price and storage policy considered, and for each drawing a value of board income Y calculated. The latter then were used to compute income probability densities and expected utilities assuming citizens have exponential utility.6/ Absolute risk aversion employed for this purpose was derived from the modal or 'intermediate' partial risk aversion identified in Binswanger's study of Indian peasant farmers. Mean incomes in that study approximate average incomes in Zimbabwe. Details of utility derivations and other simulation parameter settings are available from the authors.7/

OPTIMAL PRICES AND RESERVE STOCKS

Domestic grain and meal prices that maximize the marketing board's expected utility depend upon reserve stock levels since stocks affect impacts of price changes on the board's expected income and risk. For the same reason, optimal stocks depend upon domestic prices in force. To demonstrate this, the board's expected utility is calculated for each of several producer prices at a given stockholding and the expected-utility-maximum price P_S^* recorded for alternative stock levels S. We indicate such a relationship by $[S, P_S^*]$. In similar fashion, the optimal reserve stock S^* is calculated at a number of alternative producer prices -- $[P_S, S^*]$.

Results are shown in figure 1, where prices other than for producer maize are held at 1986-87 positions. If the board holds no stocks, its privately optimal producer price is Z$130/ton; the optimum falls to Z$78/ton with a million-ton stock. At most producer prices, optimal reserves are zero; that is, the board is best off exporting any year-end excess over (or importing just to satisfy) working stocks. At prices below Z$90/ton, however, the probability distribution of net domestic supply $(Q_{st} - Q_{dt})$ is such that there is a substantial

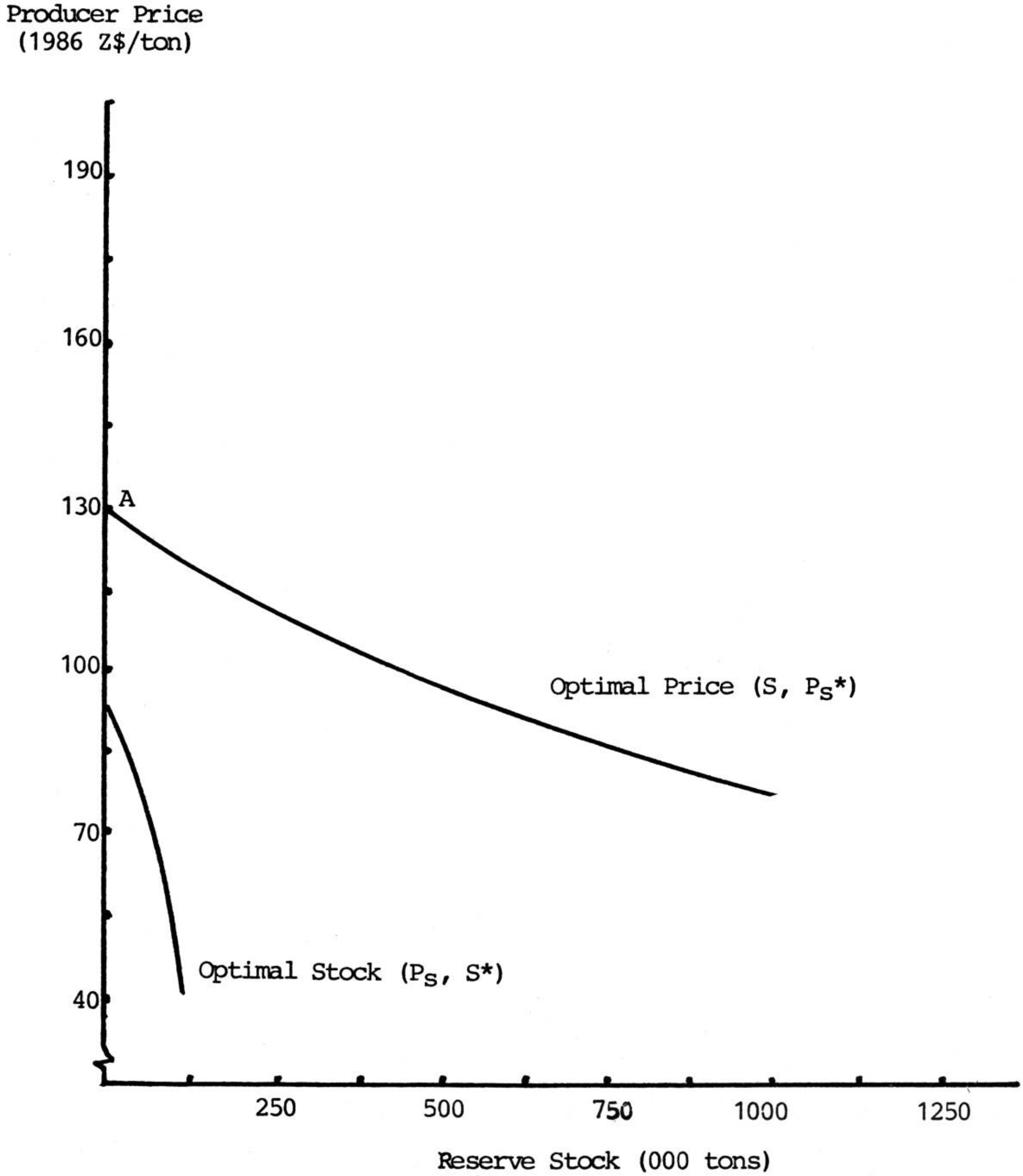


Figure 1. Board's optimal producer prices and reserve stocks given 1986-87 levels of other prices, Zimbabwe.

chance of requiring imports ($S_{t-1} + Q_{st} - Q_{dt} < 0$) if there were no reserves. For example, probability of imports rises from 8.7% to 15.1% as producer price falls from Z$100 to Z$80/ton when stocks are zero. This increases the desirability of holding stocks since stocks save round-trip transfer costs ($T_e + T_i$) to port and help insulate the board from import price risk.[8] Reaction functions [S, P_s*] and [P_s, S*] intersect at point A in figure 1, indicating that zero reserves and a Z$130 producer price are optimal overall.

Because the value of holding reserves increases with export and import transfer costs T_e, T_i, optimal reserve [P_s, S*] should rise as T_e or T_i increase in real terms. Viewed _ex ante_ at decision point t-1, real transfer cost is its certainty equivalent, which increases with the mean or variance of the cost probability distribution.[9] Unpredictable cost variance (cost risk) is especially important for a land-locked country like Zimbabwe, whose principal import supply routes through South Africa are threatened by sanctions. To reflect more fully the presently high risk component of import transfer costs, they were quadrupled over present values. Export transfer costs were only doubled since most exports would not be shipped through South Africa but would be affected by increased petrol and parts costs. Functions [S, P_s*] and [P_s, S*] then were re-estimated.

Results are shown in figure 2. Relation [S, P_s*] has shifted down an average Z$19/ton from its figure 1 level, reflecting the impact of lower net export prices on prices the board willingly would offer producers. More significant is the shift upward in the [P_s, S*] reaction function. The board now optimally would retain strategic maize reserves even with

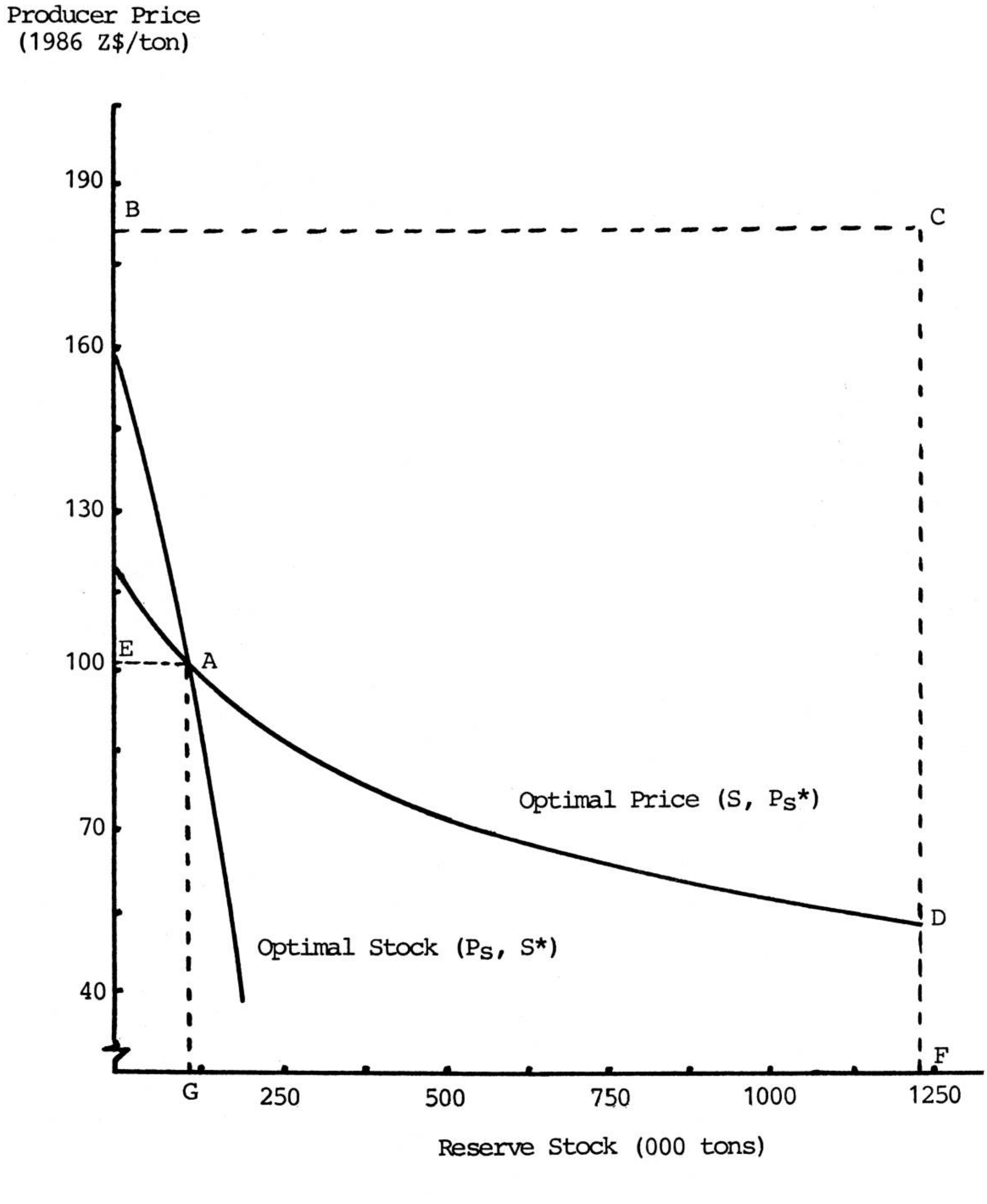


Figure 2. Board's optimal producer prices and reserve stocks given 1986-87 levels of other prices and import risk premium, Zimbabwe.

producer price as high as Z$150/ton. Reserves reduce the probability of requiring imports and thus have increased importance in the presence of a severe import penalty. At 1986-87 fertilizer, maize substitute, and retail maize meal prices, however, chances of imports still are not high and the overall optimum reserve is a modest 105,000 tons (point B in figure 2). Optimal producer price at this stock is Z$102/ton (point E), down Z$28 from the low-transport-cost (figure 1) scenario.

Many developing countries have designed price, input procurement, and extension policies to promote food staple self-sufficiency, that is to reduce probabilities of staple imports. It is useful to see how maize producer price and storage policies best would change if Zimbabwe departed from this practice by setting prices of demand substitutes so as to increase frequency of maize purchases from abroad. This is done in figure 3, where wheat price charged domestic millers is fixed two standard deviations above its 1968-85 mean, maize price charged millers is at 1968-85 mean, and all other prices are at 1986-87 levels. Export-import transfer costs also are returned to 1986-87 (figure 1) levels to represent end of South African sanctions.

With maize demand parameters so boosted, the effect of a producer price decrease in decreasing expected peasant sector demand in (2') is magnified. The [S, P_s*] function consequently is flatter than in figure 1, since the reduction in producer price called for by larger stock positions correspondingly has fallen. At a given producer price, the probability that domestic demand Q_{dt} will exceed domestic supply Q_{st} is greater than in figure 1, so there is greater incentive to insure against imports by holding a larger reserve

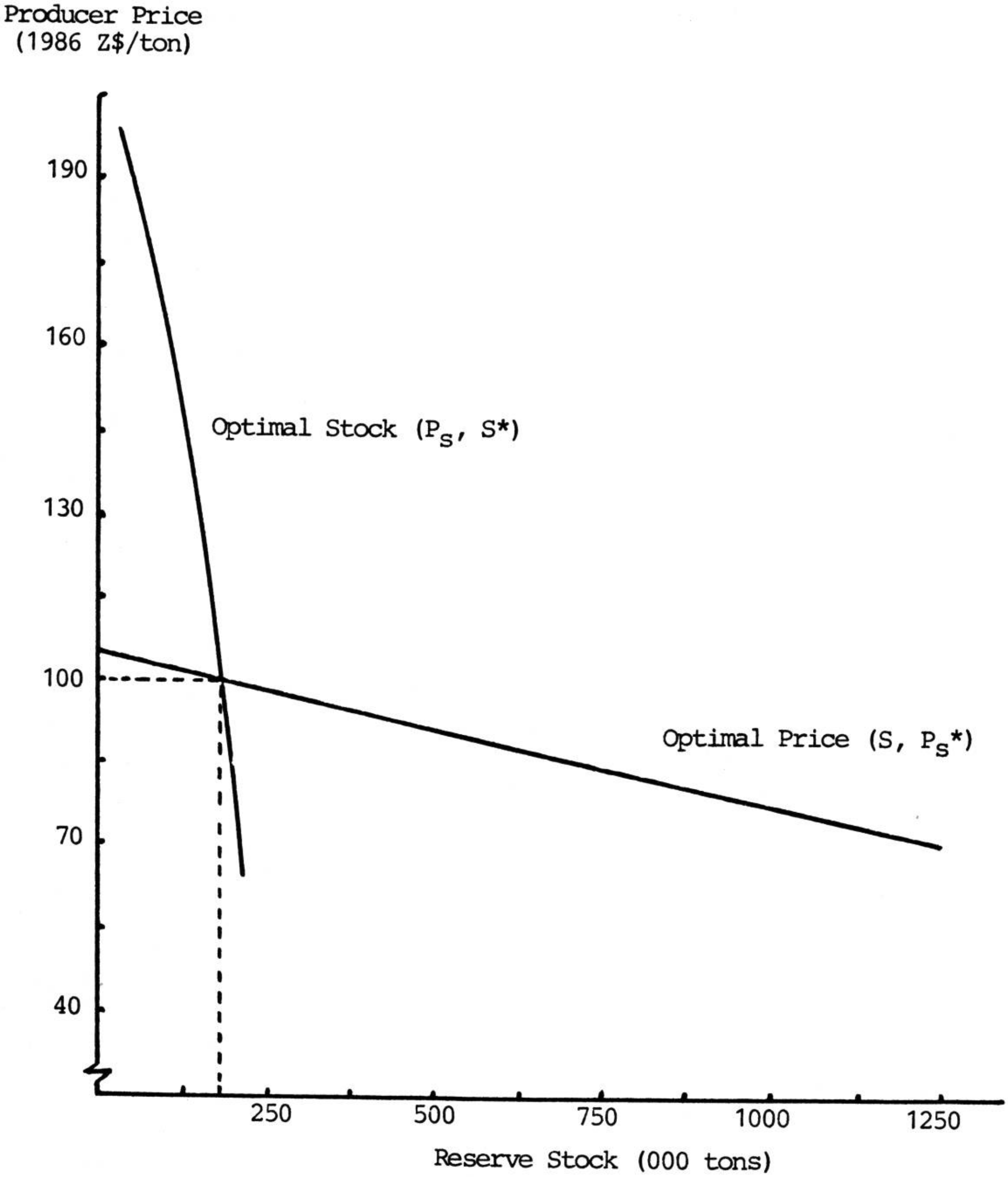


Figure 3. Board's optimal producer prices and reserve stocks given augmented wholesale wheat price, Zimbabwe.

stock. Locus [P_S, S*] thus shifts upward and to the right. Optimal reserve stock is S* = 175,000 tons, up from the zero reserve optimal when wheat price is at its 1986-87 level (figure 1). Optimal producer price is P_S^* = Z$100/ton, down from Z$130/ton in the 1986-87 wheat price scenario.

PRIVATE VERSUS SOCIALLY OPTIMAL POLICY

Zimbabwe Grain Marketing Board's actual maize reserves on March 31, 1986, adjusted for working stocks needed to compensate for farm supply seasonality, were 1,226,000 tons.[10] Producer price on that date was Z$180/ton. This stock-price combination is plotted at point C in figure 2, where it clearly differs from the point (A) considered most desirable on basis of the figure 2 analysis. Examination of the difference reveals the multiplicity of factors government takes into account when setting agricultural policy.

Deviation between actual producer price and the one determined in figure 2 as privately optimal to the board is vertical distance BE. The implied policy discrepancy is much greater than this, however, since if stocks are at 1,226,000 tons, optimal price is DF; true discrepancy between current and privately optimal price is distance CD. The board pays farmers a great deal more per ton than it would if it were acting as an expected utility maximizing monopsonist.

The most likely reason is that price policy has responded to a broader goal than maximization of the marketing board's welfare. Expected producer surplus always rises with producer price increases, and although variance of surplus rises as well (see analysis below equation 4'), producers' expected utility should improve with price increases given typical risk aversion levels. In their capacity as consumers, peasant farmers also gain from a higher producer price because it encourages them to sell maize and purchase retail maize meal, stimulating retail demand and increasing consumer surplus associated with a given retail price. Producers and peasant farm consumers thus form a natural lobbying front in favor of higher producer prices. Governments that have maintained low farm prices effectively have resisted this pressure in deference to the interests of their marketing board accounts. That is, they have imputed to the farming industry a low weight in the social welfare function (Pollard and Graham).[11]

The second form of discrepancy revealed by figure 2 is that if price is maintained at Z$180/ton, a reserve stock of 1,226,000 tons (length BC) is far higher than optimal given the intermediate risk aversion assumed. Optimum reserve in fact is zero, indicated by point B on figure 2's [P_S, S*] line. Difference BC is not likely explained by producer or consumer political pressure or by a welfare function that includes producer or consumer interests. Grain reserves immediately affect the mean and stability only of marketing board returns because domestic prices usually are fixed on an annual basis. Assuming policy makers are effective optimizers, a more plausible reason for the discrepancy is that risk aversion, mean exchange rate, or random variable probabilities we have employed differ from those policy makers actually have used.

These possibilities are examined in table 2 and figure 4a, which give estimated probability moments and cumulative frequency distributions of board income at 1986-87 domestic prices for a zero and 1,226,000-ton reserve stock. Income

Table 2. Prospects facing board with 1986-87 maize and other prices intact a/

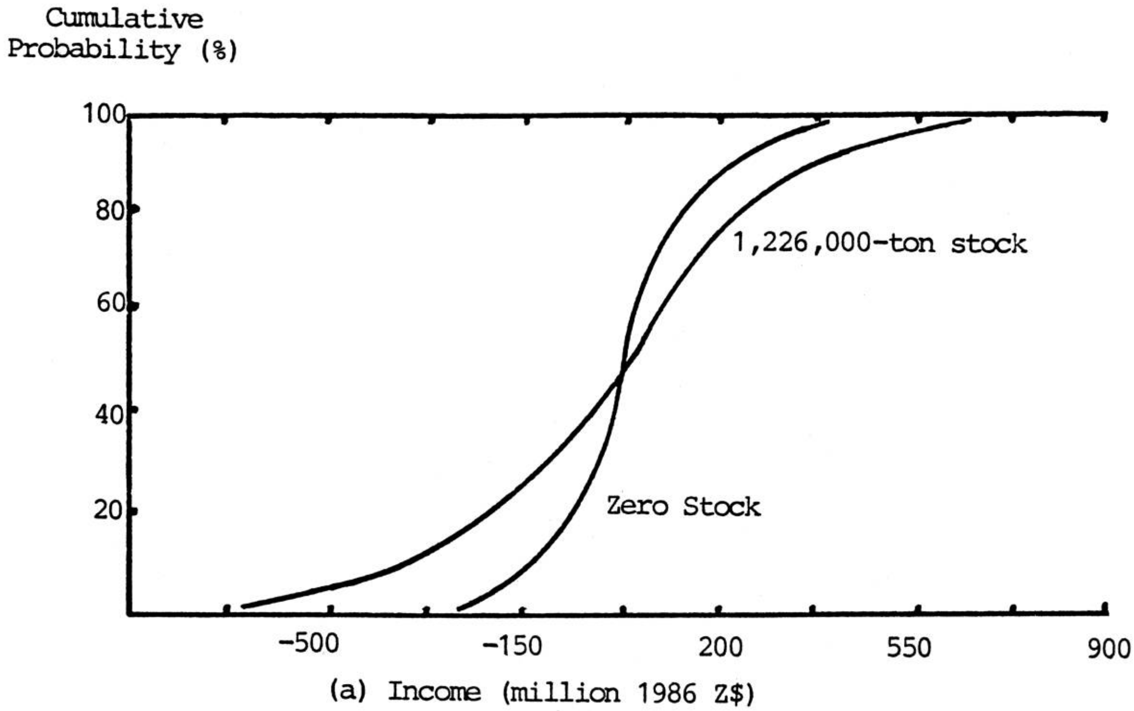
	Actual Reserve Stock, 3/31/86	Optimal Reserve Stock, 3/31/86 b/
Reserve Stock (000 tons)	1,226	0
Expected Net Domestic Supply (000 tons) c/	622.91	622.91
Chance of Imports (%)	4.4	8.1
Expected Income (000 Z$)	32,820	44,389
Standard Deviation of Income (000 Z$)	291,382	113,392
Income Skew d/	0.08	0.25

a/ Producer, wholesale (domestic selling), and retail meal prices are Z$180.00, 222.00, and 381.22/ton, respectively.

b/ Assumes government is intermediately risk averse on Binswanger's scale.

c/ Expected domestic supply less expected domestic demand.

d/ Skewness statistic is third central moment of income divided by the cube of the standard deviation.



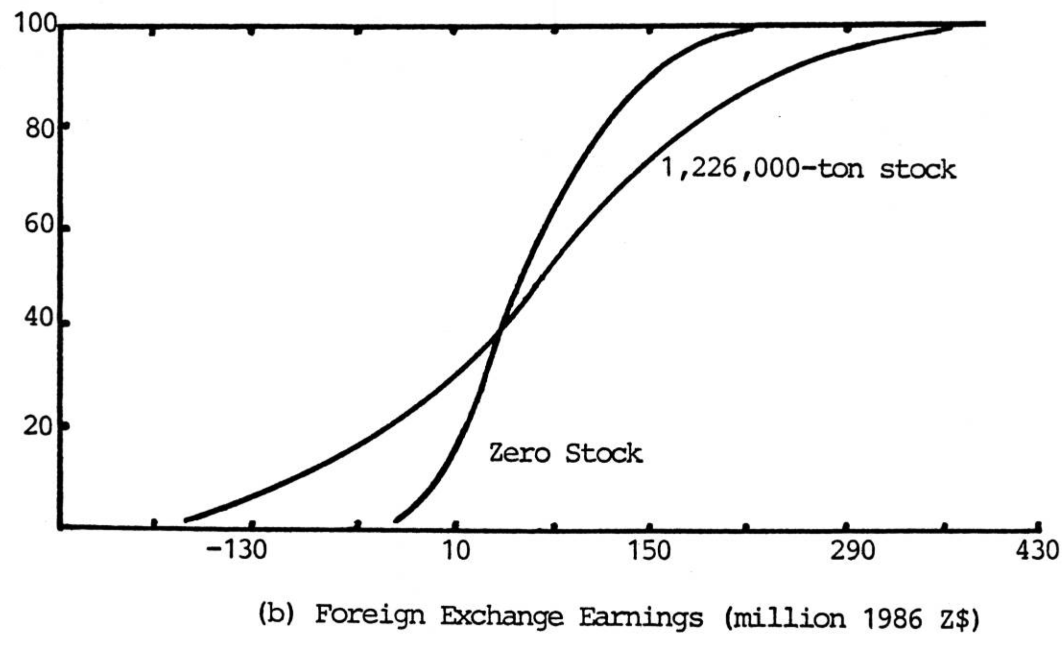


Figure 4. Cumulative probability distributions of marketing board income and foreign exchange earnings, zero-stock and large-stock policies, Zimbabwe. a/

a/ Figure assumes all prices are at 1986-87 levels.

associated with a zero stock has higher mean, lower variance, and more positive skew than does income with a 1,226,000-ton reserve. For risk averters with nonincreasingly risk averse utility functions, each of these differences favors the zero-stock policy (Tsaing, pp. 356-9).12/ More importantly, the zero-stock distribution's left tail in figure 4a lies well to the right of that of the 1,226,000-ton-stock distribution, indicating the zero stock is associated with lower probabilities of large losses. Because at any income level the area under the zero-stock cumulative probability distribution is smaller than that under the large-stock distribution, zero stock dominates the 1,226,000-ton stock in the second degree and is preferred to the latter by all risk averters (Anderson, Dillon, and Hardaker, pp. 284-88). If, then, our probability and exchange rate assumptions are correct, the board's large stockholdings imply policy makers are risk seekers, quite at odds with the risk aversion shared by most citizens.

The possibility that the foregoing conclusion results from undervaluing foreign exchange is dispelled by figure 4b, which gives cumulative distributions of foreign exchange earnings under the no-stock and large-stock scenarios. Figure 4b, rather than 4a, would interest policy makers if they infinitely valued hard over local currency, that is ignored local currency costs and revenues. Implications of figure 4b, however, are little different from those of 4a. Large maize reserves still are associated with the greater chance of a large loss. Maintaining the large stock reduces the probability of imports only from 8.1% to 4.4%, so the principal effect of the stock is to increase exposure to export price risk. Besides this, the stocks incur interest charges: mean present value of hard currency income is US$53,505,000 under the large-stock and US$56,693,000 under the zero-stock policy. Holding reserves would, of course, have reduced earnings risk if chances of imports had been higher.

Finally, policy makers may operate under probability assumptions different from those we have been using. Large carryover stocks at end of the 1982-83 fiscal year were, in hindsight, beneficial because they enabled Zimbabwe to weather two succeeding years of drought with minimal imports. But fixating on recent events obscures probabilities based on a wider range of experience. Chances of an early repetition of the 1983-85 yield depression in fact are quite small and serve as an inadequate basis for present policy.

IMPACT OF REMOVING SUBSIDIES

A number of countries have begun reducing subsidies on consumer staples and, where applicable, taxes on producer prices in order to improve domestic resource allocation. Eliminating such interventions changes the probability distribution of net domestic supply, so marketing boards also must reassess reserve stock policy. Complete subsidy and tax removal was modelled in this study by setting domestic maize selling price equal to expected border price at t (world price less transfer cost to port) times expected exchange rate at t.[13/] Producer price was domestic maize selling price less board handling and storage cost, and consumer price was domestic selling price plus milling and distribution cost. Table 3 shows results assuming alternately that (a) the board maintains its present large reserve stock and (b) stocks are adjusted to maximize expected utility given intermediate risk

Table 3. Prospects facing board if maize price subsidies are removed a/

	Actual Reserve Stock, 3/31/86	Optimal Reserve Stock, 3/31/86 b/
Reserve Stock (000 tons)	1,226	0
Expected Net Domestic Supply (000 tons) c/	919.14	919.14
Chance of Imports (%)	4.3	5.3
Expected Income (000 Z$)	9,002	22,273
Standard Deviation of Income (000 Z$)	336,264	153,049
Income Skew d/	0.01	0.01

a/ Assuming an exchange rate of Z$2.25/US$, nonsubsidized producer, wholesale, and retail price are Z$227.22, 271.84, and 410.90/ton, respectively. At the official exchange rate of Z$1.66/US$, the prices are Z$156.66, 201.28, and 340.34/ton, respectively. A Z$2.25/US$ rate was used in this table.

b/ c/ d/ See footnotes under table 2.

aversion. The optimal adjustment again is to eliminate reserve stocks altogether.

At an approximately equilibrating exchange rate of z$2.25/US$, full-cost pricing would increase producer, wholesale, and retail prices. Thus, producers presently are taxed and consumers subsidized relative to border prices. The net effect of these price changes is to reduce the expectation, raise the variance, and reduce the skew of board income (compare tables 2 and 3). If the board had well-behaved (decreasingly risk averse) utility, it clearly would be worse off on all counts. Extent of the expected loss is about the same whether the large-stock or optimal (zero-stock) policy is maintained. One way, therefore, to cushion the impact on the Zimbabwe government of price policy reforms is to reduce reserve stocks.

The conclusion that the board would suffer from full-cost pricing seems counter to the usual notion that such pricing would help rid boards of chronic financial losses. Actually, there is no conflict between these two ideas. Accounting losses typically are based on official exchange rates that understate the social value of foreign exchange and therefore of exports. In export surplus years, the board's official net returns thus understate social returns. For the same reason, 'full-cost' producer prices based on official exchange rates typically would be too low relative to export value. Because they often also are lower than producer prices currently in force, switching to an official 'full-cost' price tends to improve a board's accounting returns.

To illustrate this, solutions in tables 2 and 3 were rerun using as a mean exchange rate the October 1986 average official rate of Z$1.66/US$. Expected board income with 1986-87 prices intact (corresponding to table 2) fell to -Z$6,029,000 given the 1,226,000-ton reserve and to Z$1,043,000 given a zero reserve. Standard deviations fell to Z$166,766,000 and Z$63,725,000, and skew coefficients to 0.02 and -0.12, respectively. 'Full cost' pricing at the official exchange reduced producer, wholesale, and retail prices below current levels (see footnote a of tables 2 and 3). Corresponding mean income, again using the official exchange rate, was only Z$6,793,000 given a 1,226,000-ton reserve (compared to the Z$9,002,000 in table 3) and only Z$10,270,000 given a zero reserve. Thus, whatever the stock level, mean accounting income at the official exchange rate rises when taxes and subsidies are removed. Reverting to an approximately equilibrating mean rate not only adjusts incomes to more accurate, higher levels but shows that producer prices actually rise and board incomes fall under full-cost pricing.[14] Net social welfare change depends upon the weight assigned producers' gains relative to government's losses.

CONCLUSIONS

A framework has been set out in this paper for evaluating the impact on a government marketing board of selected price and reserve stock policies. We have argued that impacts should be addressed *ex ante* in terms of the expected utilities of alternative policies. This involves assessing not just expected effects or likelihoods of arbitrarily defined disasters, but the entire probability distributions of random returns. Using this approach, optimal price and reserve stock levels were found to be interdependent. Producer price ideal from government's viewpoint depends upon the board's stockholdings and vice versa. At 1986-87 prices, Zimbabwe's optimal reserve (i.e. that net of working requirements) would be zero unless account were taken of the riskiness of import transfer cost. When the latter is considered, optimal reserve is only 105,000 tons. Larger reserves would be desirable if demand-stimulating wholesale prices were adopted.

Socially optimal prices are likely to be higher than those indicated in figures 1 through 3 because government must keep consumer and producer as well as marketing board interests in mind. However, with producer prices presently in force, the high reserve stocks maintained in Zimbabwe imply policy makers either are prone to take unusually large financial risks or dwell excessively on the recent drought experience. Given empirically validated risk aversion and import probability assumptions, the board's stocks are much too large to maximize expected utility. Allowing for differences in assumed objectives, this agrees with Pollard and Graham's conclusion (p. 1074) that Jamaican export marketing boards are 'inefficient both in terms of the maximization of their own profits and the maximization of foreign exchange earnings.'

The effect of removing subsidies or taxes from domestic prices depends crucially on the exchange rate used to convert world prices to a domestic equivalent. At official Zimbabwe dollar - U.S. dollar rates, producer prices are subsidized and wholesale and retail prices taxed relative to world prices.[15/] Removing these interventions would increase the expectation of the marketing board's accounting income. But official exchange rates do not reflect the true scarcity value of hard currency.

When a rate closer to equilibrating level is used, producer prices are taxed and wholesale and consumer prices subsidized relative to world price. Removing the latter interventions would reduce government's mean income and expected utility while improving producer welfare.

In the bleaker world in which government would find itself with full-cost pricing, there would be incentives to share grain marketing functions with other firms. Market sharing would shift to other equity-holders some of the enormous risks presently saddling government marketing efforts (see figure 4). Inter-firm competition also would help provide information on equilibrium prices necessary for determining true minimum costs, which in turn are needed for identifying the incidence of taxes and subsidies. Market decontrol thus is a natural consequent of, as well as requirement for, true full-cost pricing. Analysis of the likely impacts of decontrol would require additional information on the grain marketing costs that would be incurred by new firms.

NOTES

1. Strategic reserves are distinguished from working stocks held due to the seasonal nature of the board's domestic maize purchases. Terms 'reserve stock' or 'stock' in this chapter refer to such strategic reserves.

2. Because they tend to be stable in deflated terms, costs H, I, and F are assumed known at t-1.

3. To render comparable the mean square errors of doublelog and linear fits, the latter must be multiplied by the squared inverse of the dependent variable's geometric mean (Box and Cox).

4. We are indebted to Kay Leresche for pointing out the rural security effect on food supplies.

5. As Pollard and Graham point out (p. 1068), actual benefits to citizens depend upon how board losses are financed or how profits are distributed. We assume losses or profits are distributed broadly in some manner but do not venture to measure the effect of alternative distribution schemes.

6. Exponential utility is $U = -\exp(-mY)$, where Y is income and m is constant absolute risk aversion. Use of a decreasing absolute risk aversion function made little difference to the study's results and is not reported here.

7. Random variables e_{s1t}, e_{s2t} were assumed normally distributed with mean zero and variance derived from (3'), (4'). Variable e_{dt} was lognormally distributed with mean one and variance taken from (2'). World price P_{wt} was normally distributed with mean and variance derived from

its 1972-84 trend line. Variance of exchange rate X_t was derived from its 1980-85 trend but mean set at Z$2.25/US$. The latter is above official levels (Z$1.66/US$ in October 1986) but near what is commonly thought to be an equilibrating rate (Financial Gazette, p. 4.).

8. The additional argument that stocks 'save the foreign exchange cost of importing' assumes implicitly that hard currency is worth more than its official rate.

9. Certainty equivalent cost is expected cost plus risk premium, where the latter is a positive function of cost variance and the decision maker's risk aversion (Pratt, pp. 124-5).

10. Total fiscal-year-end stocks were 1,426,000 tons. The board's monthly net maize intake is negative until early July, when cumulative maize purchases begin to exceed cumulative domestic sales. We have assumed liberally that a four-month working stock is needed at 50,000 tons per month, so the effective strategic reserve on March 31 was 1,226,000 tons.

11. Pollard and Graham (p. 1068) note that when boards act as expected profit maximizers, this 'may reduce the potential benefits to society, depending on the state of the social welfare function.'

12. Increasing risk aversion is regarded by many as unreasonable because it implies an individual would be increasingly unwilling to bear a risk of fixed size as his income increased.

13. Deducting transfer cost from, rather than adding it to, world price assumes the board expects to export rather than import at time t. This is justified by subsequent results and by Zimbabwe's typically export position. If policy makers have rational expectations, disposition of transfer cost is endogenous because it must be consistent with the mean solution obtained.

14. Full-cost prices of imported farm inputs also would rise if the exchange rate employed to determine them were increased from official to equilibrating levels.

15. Also using official exchange rates, Jabara (pp. 616-17) found maize prices in Kenya to be roughly in line with world prices, hence neither taxed nor subsidized.

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PART IV

NEEDED RESEARCH ON INCOME GENERATING ACTIVITIES AND HOUSEHOLD FOOD SECURITY IN LOW RAINFALL AREAS IN SOUTHERN AFRICA

PART IV

INTRODUCTION

When the SADCC Heads of State met at their initial summit in Lusaka in 1980, they were concerned about drought and measures to rèduce the dependency on rainfall. And, in Southern Africa, a discussion of drought leads automatically to sorghum and millet. Both crops can be grown in lower rainfall zones (millet in 300 to 450 mm and sorghum in 400 to 600 mm of annual rainfall) than maize. When sorghum and millet were discussed at the Lusaka meeting in 1980, it was pointed out that the sorghum and millet technology shelf for small farmers was empty in the region and in other parts of Africa. For this reason the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) that is based in India was requested to establish and carry out a long term research programme on sorghum and millet in the SADCC region.

ICRISAT and SADCC joined forces in 1984 and established a regional research programmme on sorghum and millet. The premise of the ICRISAT/SADCC programme is that maize has slowly replaced sorghum in low rainfall areas in the SADCC region (e.g. in parts of Botswana, southern Zimbabwe, southern Zambia) because sorghum and millet research were historically underfunded in the colonial era relative to maize. The thrust of the ICRISAT/SADCC research programme is spelled out by the Project Director Dr. Lee House - an international authority on sorghum - in Chapter 12. House implicitely assumes that sorghum has as much genetic potential as maize and that, with a concentrated crop improvement programme, it will be possible for sorghum to regain its historical position in cropping systems of smallholders in low rainfall areas.

But, House, like other plant breeders in Africa, is pessimistic about millet improvement in the next 5 to 10 years. As a result the ICRISAT programme is giving higher priority to sorghum improvement.

Both red and white sorghum are grown in the region. Red sorghum is in surplus in Zimbabwe. The dominant red sorghum variety - Red Swazi, is robust and easily transferred across national boundaries. Red sorghum is grown by commercial farmers in Zimbabwe for the brewing industry. But white sorghum varieties for communal (smallholders) farmers for home consumption are low yielding and difficult and laborious to process by hand pounding.

Two questions for food security researchers are posed in the chapters in Part IV: (i) What can be done to increase the production of white sorghum for home consumption in low rainfall areas in the SADCC region and thereby increase family food security? (ii) What can be done to increase white sorghum production and the efficiency of farm and village processing to enable it to be blended with wheat flour to save foreign exchange on wheat imports?

These questions are explored by House in Chapter 12, Gomez, Mutambenengwe and Moyo in Chapter 13; Mbwanda in Chapter 14, and Muir-Leresche in Chapter 15.

CHAPTER TWELVE

SORGHUM AND FOOD SECURITY IN SOUTHERN AFRICA : PRESENT AND FUTURE RESEARCH PRIORITIES of TECHNICAL SCIENTISTS

L. R. House

INTRODUCTION

Maize, sorghum and pearl millet are important summer cereals in the SADCC region. Maize is by far the dominant crop. Generally, maize is grown in good farming environments, sorghum in drier areas and pearl millet in hot dry conditions. The yield potential of maize and sorghum is about the same, but that of pearl millet is less (50-60 percent) when all three crops are well managed and under conditions of no stress. Africa is a traditional sorghum - millet area but maize has encroached over the last 50-70 years and the process is still taking place. The reverse is true in Latin America, particularly Mexico, Argentina, and Brazil where sorghum has encroached into traditional maize growing areas. The Buenos Aires district of Argentina is an example where maize was the dominant crop and it was yielding 1750 kg/hectare. Over a period of years in the early-mid 1970s, the average yield of both sorghum and maize increased to 2250 kg/ha and sorghum replaced maize in the drier parts of the district.

Research on maize improvement in Zimbabwe is well established and has a long history; SR52, a commonly used hybrid, was released 27 years ago. High yielding hybrids have been developed, an efficient seed industry provides quality seed. By contrast, sorghum research has been more limited, with production coming from traditional varieties or imported hybrids. The picture is changing; scientists of Zimbabwe's Department of Agricultural Research and Specialist Services (R&SS) are developing and evaluating hybrids for farmer use. It is reasonable to expect that locally adapted high yielding hybrids will not only produce higher yields in traditional sorghum areas but will also provide an opportunity for farmers to plant some of their land to maize and some to sorghum in areas marginal for maize.

PRIORITIES FOR SORGHUM IMPROVEMENT

I believe that the exploitation of hybrid vigor is a powerful tool in the plant breeders' hands.A high priority for any crop improvement programme is the production of high yielding varieties and hybrids. These varieties and hybrids are invariably responsive to management inputs and, frequently are superior in yield under harsher growing conditions. Stability of yield is also an important consideration in a breeding programme. Stability of yield can be defined as a consistently good yield over locations and seasons. Stability of yield is an inherent characteristic identified by multilocation testing over seasons. Stability is also achieved from resistance to important biological (disease, insect, weed pests) and environmental stress factors (moisture, temperature, acidic toxic soils, etc.).

An effort has been made to identify and prioritize yield limiting traits in southern Africa (Table 1). We are currently verifying priorities. Progress has been made in developing procedures to screen for resistance to many of these traits. In some instances, ICRISAT's regional programme for SADCC states can adapt techniques developed outside of the region; and, in other cases it will be necessary to undertake developmental research within the SADCC Region.

The priorities for sorghum research at the ICRISAT Center in India for the SADCC Region are spelled out in Table 2.

Table 1: ICRISAT/SADCC Priorities for Sorghum Improvement in the SADCC Region

Trait	BOT	LES	MAL	MOZ	SWAZ	TAN	ZAM	ZIM	SADCC Mean
BREEDING									
Grain yield	10	10	10	10	5	10	5	5	8.1
Fodder yield	6	5	2	2	5	1	1	1	2.9
Crop maturity	7	7	3	3	3	3	3	3	4.0
Plant height	2	2	2	4	2	4	4	2	2.8
Grain quality food	8	8	8	8	8	10	8	5	7.9
Grain quality beer	5	5	5	5	8	5	8	8	6.1
AGRONOMY									
Soil fertility	3	5	4	4	4	4	4	4	4.0
Drought power	7	9	7	7	7	4	4	2	5.9
Weed control	5	5	7	7	5	7	7	7	6.3
Acid soils	3	1	2	2	3	3	4	2	2.5
Water logging	1	1	2	1	1	2	2	1	1.4
PHYSIOLOGY									
Cold tolerance	1	3	1	1	2	1	2	2	1.6
Drought	10	8	5	7	3	8	3	5	6.1
Stand establishment	6	6	2	2	2	4	2	3	3.4
Lodging	3	3	2	-	2	3	3	2	2.6
ENTOMOLOGY STEMBORERS									
Busseola	4	6	2	2	4	4	4	4	3.8
Chilo	6	1	6	6	6	6	6	4	5.0
Sesamia	4	1	2	2	4	2	4	2	2.5
Shoot fly	1	1	2	2	3	2	2	2	1.6
Aphids	5	5	3	3	3	2	4	4	3.6
Midge	1	1	3	3	1	3	3	2	2.1
Head bugs	1	1	1	2	1	2	2	2	1.5
Army worm	1	1	2	4	1	3	3	3	2.3
Locusts	9	2	4	4	2	4	5	5	4.4
Weevils	5	2	5	5	3	6	5	5	4.5
Mites	1	1	1	1	5	1	1	1	1.5
Termites	1	1	3	3	1	2	3	2	2.0
Birds	8	5	7	7	7	6	6	6	6.5
PATHOLOGY									
Grain mold	2	2	5	5	2	5	5	5	3.9
Downy mildew	2	1	4	4	3	3	4	4	3.1
Charcoalrot	3	3	1	1	1	3	2	2	2.0

1 = low priority; 10 = high priority

Table 1: (Continued)

Trait	BOT	LES	MAL	MOZ	SWAZ	TAN	ZAM	ZIM	SADCC Mean
LEAF DISEASES									
Leaf blight	2	1	3	2	3	3	4	4	2.8
Rust	1	1	3	2	2	4	3	2	2.3
Grey leaf spot	1	1	4	2	1	4	4	2	2.4
Anthracnose	1	2	2	2	1	2	2	2	1.8
Sooty stripe	2	1	4	2	1	3	4	3	2.5
Zonate leaf spot	1	1	2	2	1	2	2	2	1.6
Oval leaf spot	2	2	2	2	1	2	2	1	1.8
Bacteria	1	4	2	2	2	2	2	2	2.1
Ergot	2	1	2	2	3	2	2	3	2.1
SMUT									
Head smut	2	2	1	-	1	2	1	2	1.6
Long smut	2	1	1	-	1	2	1	1	1.3
Covered kernel	3	4	2	-	3	3	2	2	2.7
Loose smut	1	2	1	-	1	2	1	2	1.4
STRIGA	4	2	4	-	3	4	4	4	3.6

I feel it is important to have a multidisciplinary team focused on thse problems. It is important to ensure that new varieties and hybrids are not more susceptible to yield limiting traits than those currently in use, but, to cope with changes in the pest complex following use of new varieties, hybrids and management practices.

Quality of food made from the grain of new varieties and hybrids is an important factor in consumer acceptance and market value. Quality traits become important selection criteria. This area of crop improvement will be discussed in detail later in the paper.

Nutritional traits are also of concern both from a nutritional and antinutritional view point. The essential amino acid, lysine, is limiting in the storage protein of sorghum grain. High lysine has been found in some varieties from Ethiopia with shrunken seed, and from mutation studies at Purdue University, in an opaque seed.

Table 2: Sorghum Research Priorities at the ICRISAT Center in India for the SADCC Region

Trait	ICRISAT's Screening Capability at ICRISAT center in India	Research Priority	
		Development Research	Adaptive Research
Stem borer	0.7	0.5	0.5
Midge	0.8	0.2	0.8
Head bugs	0.1	Screening capability poor	
Shoot fly	0.8	0.3	0.7
Grain mold	1.0	0.2	0.8
Charcoal rot	0.2	Screening capability poor	
Downy mildew	1.0	0.3	0.7
Anthracnose	0.8	Very low priority	
Leaf blight	0.0	1.0	0.0
Rust	0.9	Very low priority	
Striga	0.5	0.6	0.4
Weeds		Establish priority	
Birds	0.0	1.0	0.0
Drought Resist.	0.3	Screening capability poor	
Stand est.	0.5	0.3	0.7
Soil fertility	0.8	0.7	0.3
Intercropping	0.5	0.7	0.3
Grain quality	0.8	0.6	0.4
Grain yield	0.9	0.8	0.2
Fodder yield		Establish priority	

* A value of 0.0 or 0.1 is no or poor capability and 1.0 is a very good capability, 0.4 is considered necessary for screening.

A 1.0 in the Development Research Column indicates a high priority for the SADCC Regional Programme.

A 0.8 in the Adaptive Research column implies a low development research requirement, but the adaptation of an existing technique.

The high lysine trait is not as stable in the opaque background as in the shrunken source. However, transfer of the trait to normal seed has been found difficult and expensive and interest still remains academic.

Tannin, is found primarily in brown seeded sorghum grains (with a testa) complex with protein reducing digestibility. There is also a lower carbohydrate digestibility compared to low tannin sorghums. The problem can be avoided by using very low tannin varieties or by detoxifying the tannin by alkali treatment or malting. The presence of tannin contributes to bird resistance and may have value in sorghum used for brewing. Almost all high tannin grains are soft, resulting in poor recovery following dehulling (pearling). Recently several high tannin lines with hard endosperm have been found in the world collection of sorghum germplasm at ICRISAT Center in India. We will evaluate these as pearling will also reduce the tannin containing testa.

The Tropical Development Research Institute in London is investigating a possible toxic effect from HCN in malts used for baby foods. HCN is a potential problem when sorghum is used for livestock feed. The problem is of particular concern in young sorghum plants - the HCN is basically gone once plants are 45-50 days old.

VARIABILITY - ITS GENERATION AND EXPLOITATION

Except for identical twins, no two people look alike. Differences represent variations among people. Variation exists for all traits in plants and animals. Because of variation a breeder can apply a selection pressure, for traits that he wants in a plant variety. As selection proceeds variability is reduced. It is therefore important for a breeder to both select for and generate variability for traits in which he has interest.

Several steps are important to maintain variability. One is the collection and use of traditional varieties (both local and introduced) and breeding stocks from other breeders.

The ICRISAT/SADCC regional sorghum programme was launched in the 1983-84 season at the MATOPOS research station outside Bulawayo in Zimbabwe. A sorghum breeding nursery was established at the MATOPOS station. Some 5300 sorghum collections (varieties) from southern Africa and from breeders' lines from 25 breeders around the world were planted at the nursery. The ICRISAT/SADCC nursery is providing a diverse base for crop improvement activities. Introduction of new varieties is a constant process. Recently we have been introducing lines with specific food quality or resistance traits.

Variability is also increased by crossing; selection is applied in generations following the cross. Intermating populations are also genetically manipulated to maintain variability while selection proceeds.

The existence of variability is an important point of this paper. Many overlook this important aspect and undertake research with sorghum - any sorghum. But one variety may differ greatly from another and the value of research can be greatly reduced if this fact is not appreciated. But, of greater importance, is the opportunity for the breeder to select for a desired trait; say a sorghum that makes a good sadza (thick porridge), or produces a flour that blends well with wheat flour, or a sorghum with good malting traits. The opportunity to select for desired traits has been largely overlooked by the food technologist. As mentioned, all to frequently, sorghum is sorghum - all the same.

SURPLUSES

Surplus grain of any kind is expensive to store and to manage. Today grain surpluses exist in Zimbabwe, India, China, USA, Canada, Argentina and Australia. Other countries, such as Malawi and Zambia periodically have surpluses in some crops and/or in some areas. The Sudan currently has a surplus of sorghum.

As crop improvement people we recognize a traditional use of the crop which is important and which can be modified and non traditional uses that might have market opportunity. A sorghum surplus generates a need for scientists to identify market opportunities that might absorb the surplus. In Zimbabwe, an array of uses of cereals exists, including sorghum. Some ventures using sorghum flour have not succeeded; grain colour has been a factor. ICRISAT's sorghum breeders are in the process of identifying new end uses for sorghum, learning what is known about their quality requirements, and incorporating these traits in our regional breeding programme.

TRADITIONAL USES OF SORGHUM

Traditionally sorghum is used in an array of products:

1. Flat breads, leavened and unleavened, from fermented or nonfermented dough.
2. Porridges, thick and thin, fermented or unfermented, acidic, neutral, or basic.
3. Pasta products.
4. Boiled rice-like products.
5. Pop, parched, snack foods.
6. Fermented and unfermented beverages.

The priority that ICRISAT researchers have assigned to these food types for the SADCC Region is presented in Table 3. The table also lays out a series of quality traits and our capability to evaluate them. The desired nature of each trait is presented for each food type. There are basic traits across food types and traits specific to each food type. Traits of importance in evaluating a grain for a thick porridge are presented in Table 4.

The relationship of grain hardness (texture) and pericarp thickness to various traditional foods is as follows:

> "The specific acceptability of the cultivars was related to endosperm texture and pericarp thickness. Grains with a hard endosperm texture and a thick pericarp had the best hand milling properties while the floury grains exhibited poor milling qualtiy. The thin pericarp pearly endosperm types were not readily accepted by consumers using hand milling, but, they can be mechanically milled to produce excellent products.

Table 3: Basic Series of Tests for Routine Evaluation of Types of Foods from Sorghum and Millets

Grain Trait	Flat Breads	Porridges	Composite Flour	Boiled rice-type Prod.	Pasta	Baby Inst.	Malt	Evaluation Capability
Priority in Southern Africa (1)	1	5	4	3	1	3	5	
GRAIN								
Texture	Inter	hard	soft	inter	?	?	not imp	4
Colour	wh	wh	wh	wh	wh	?	not imp	5
TESTA								
(Tannin)	Abs.	abs. present	abs.	abs.	abs.	abs.	absent present	3
Density	Inter	high	low	high	low	?	not imp	5
DEHULLING-MILLING								
Extraction rate	high	high	inter	not imp	inter	high	not imp	4
Dehulling time	short not imp	short	short	short	short	short	not imp	4
Kernel shape	round flat	round	round	round	round	round	not imp	5
Pericarp thickness	thick/ thin			thick/ thin	thick/ thin	thick thin	not imp	5
1000 grain wt.	inter	low inter	inter high	low inter	?	?	not imp	5
Grinding work	inter	inter high	inter low	high	?	?	not imp	4
Particle size dust	fine	course	very fine	not imp	?	?	not imp	4
MALT								
Diastatic power	not imp	?	not imp	not imp	not imp	?	high	4

5 = very high priority; 1 = very low priority

Grains with 60 to 100 percent corneous endosperm were preferred for the preparation of stiff porridges like tû, ugali, bogobe and sangati (sadza), and for rice like products. Soft endosperm (0 to 40 percent corneous) types produced the best quality kisra and injera (flat breads from fermented dough). Kernels with intermediate texture (40 to 60 percent corneous)

Table 4: Additional Tests for Routine Evaluation of Traits Relevant to Production of Porridge (Sadza)

Trait	Evaluation Capability
Gel Spread	3
Water Retention	5
Amylographic properties	4
Starch damage	4
Gelatinization temperature	5
Taste	3
Texture (finger and mouth)	3
Keeping quality	3

were the most suited for producing unleavened breads like roti and tortilla. In general, brown sorghums with a testa were unacceptable or least preferred for all the products evaluated. The presence of a red or yellow pericarp did not adversely affect acceptability of most of the products as long as their taste, texture, and keeping quality were satisfactory. The preferred colour of porridges is either white or yellow; but porridges made from red sorghums were also acceptable. Some sorghums with a sub coat made good leavened breads. Thus, colour is not of critical importance in many of the food systems. However, colour is critical for unleavened breads, particularly tortillas[1/]."

These data and comments clearly indicate that traditional foods can be categorized and that tests for several quality parameters have been identified. These tests are still to be systematically applied in crop improvement programmes.

Lars Hultgren, Biotechnic Lab of the Carlsberg Research Center in Copenhagen has shown that more than one product may be possible following various treatments of the grain; for example, finer flours going to one use and course to another. It is also possible to develop various uses of the stem resulting in total plant use. An increase in the

1/ Murty, D.S., L.W. Rooney, H.D. Patil and L.R. House. A Report on the International Sorghum Food Quality Trials (ISFQT) ICRISAT page 16.

number of marketable products would increase the value of the crop. A range of products has been mentioned, many more could be identified. Multiple end uses of sorghum are a real possibility. A range of quality traits have been identified that can be evaluated. Products from sorghum have ranged from successful (Chibuku opaque beer) to moderately or poorly successful (composite flours). The question why can be asked.

Food technologists and industrialists have generally looked at sorghum as sorghum; i.e., all sorghum grains are the same. But if the food technologist works with the plant breeder to develop varieties and hybrids for specific end uses, there might be an expanded market for sorghum for human and industrial consumption. The array of possible new sorghum products is very great, all of them cannot be dealt with. Prioritization is required. To approach this question, ICRISAT/SADCC has commissioned four sorghum study papers on the following topics:

1. Food technology research on sorghum from traditional to industrial.
2. Non food industrial uses of sorghum.
3. Sorghum in livestock feed.
4. Sorghum marketing and trade policy.

These study papers will describe the state of the art, and what can be done to improve short run market opportunities for sorghum and long range market development. These papers should assist in helping ICRISAT scientists establish research priorities. However it is becoming increasingly apparent that some exploratory research and development activities will be necessary to establish ICRISAT's final sorghum breeding priorities for the SADCC region. Once established, it will be possible to derive tests to measure important quality parameters.

One can only hope that the development of sorghum varieties and hybrids for specific end uses will result in expanded market opportunities for red sorghum in Zimbabwe and expanded use of white sorghum by smallholders in low rainfall areas in the SADCC region. The availability of better market opportunities will encourage production and the availability of sorghum in processed form.

CHAPTER THIRTEEN

RESEARCH ON SORGHUM AND WHEAT FLOUR COMPOSITES

M.I. Gomez, M. Mutambenengwe and H. Moyo

BACKGROUND

The development of improved maize varieties and processing technology has gradually enabled maize to replace sorghum in low rain areas of Zimbabwe and other SADCC states. Sorghum and millet production and utilization technologies have remained at traditional levels of low efficiency and productivity. The increased dependence on maize has been coupled with a concurrent increase in the demand for wheat and wheat products. With the exception of Malawi and Zimbabwe, the rest of the SADCC states are net importers of maize. Currently every SADCC state is an importer of wheat.

Apart from the shift from traditional cereals of sorghum and millet to maize, wheat and rice, the SADCC countries face common problems arising from drought. The dryland regions (400 to 600mm rainfall) which collectively account for about 17% of the total SADCC land area (Table 1). The unimodal rainfall pattern limits production to one growing season for rainfed crops. The erratic distribution of rainfall, is a critical determinant of agricultural productivity of the region. Increasingly, agricultural policies are being geared to address the problems of recurrent drought and low rainfall.

In Zimbabwe, in an effort to improve and expand sorghum and millet production, the government raised producer prices about 80 percent since independence in 1980. The combination of higher producer prices and favourable weather in 1985 and 1986 has led to a large increase in the marketed surplus of sorghum as shown in Table 2.

Table 1: SADCC States: Percent of Land Area in the 400 to 600 mm Rainfall Zone, 1980).

Country	Percent of Land Area in 400-600 mm rainfall zone
Angola	5
Botswana	65
Lesotho	14
Malawi	3
Mozambique	13
Swaziland	15
Tanzania	19
Zambia	1
Zimbabwe	23
Average	17.6

Source: World Bank, (1981).

Table 2: Zimbabwe: Sorghum Marketed by Type of Farm, 1981-86

Harvest Year	Large-scale Farmers	Small Scale Communal and Resettlements	Total Marketed
	(000 tonnes)		
1981	24.5	7.9	32.4
1982	16.9	2.2	19.1
1983	4.9	0.5	14.0
1984	15.5	5.2	20.7
1985	51.9	29.6	81.5
1986 *	66.0	66.6	132.6

Source: Grain Marketing Board
* CSO, First Official Crop Estimate, 1986-87

However, the bulk of the sorghum in GMB warehouses in Zimbabwe is red sorghum that is used in the brewing industry. White sorghum is preferred by communal households and it has a potential for blending with wheat to make composite flour.

The traditional uses of sorghum are two-fold: the malting of sorghum grain for brewing of opaque beer and the use of sorghum meal in the traditional staple 'sadza'. The breeding, selection and agronomic research have been hitherto directed almost entirely to the brewing-type of red sorghums which are produced primarily by large scale commercial farmers. But the malting and brewing demand was only about 20 - 30 000 tonnes out of the 84 000 tonnes of red sorghum purchased by the Grain Marketing Board (GMB) in 1986.

Since the bulk of sorghum is produced in semi-arid and drier regions of the country which are most prone to drought and maize crop failure, it is desirable in terms of long-term food security to increase the production and of white sorghum for rural consumption. However, such a decision pre-supposes the availability of technologies for expanded utilization of the crop both for 'food' and possibly industrial applications. A logical approach to product development and diversification would be to direct research and development to the substitution of sorghum for imported cereals such as wheat, rice or maize.

WHEAT SUPPLY AND DEMAND

Zimbabwe currently imports about 40 - 50 000 tonnes of wheat per annum representing about 15 to 20 percent of normal domestic consumption of 250,000 tonnes. If the current rationing of flour to millers were lifted in Zimbabwe, the annual wheat consumption would increase from 250,000 to 350 000 tonnes. Since wheat is essentially an irrigated crop in Zimbabwe, the expansion of area is limited by the availability of water resources and investment in new or expanded irrigation schemes. Despite an increase in yields to a national average of 4.5 metric tons/hectare, the prospect of increasing wheat production seems remote, although research is being carried out on summer wheat production.

Studies on bread consumption patterns in urban and communal areas indicate that Wedza communal lands consumers buy at least one loaf a month. In Chiweshe more than half the households sampled consumed bread more than once a day (Berg, 1982). In high density suburbs, low income families were found to spend 7.2 percent of their total food expenditure on bread (CSO, 1980). The demand for wheat is expected to continue to rise to double the present level by the end of the century.

SORGHUM UTILIZATION

The sorghum research programme of the Food Science group at the University of Zimbabwe was initiated in 1985 in response to a demand for solutions to reducing the mounting sorghum surplus. The research objectives and agenda on sorghum utilization were designed to:

- improve and increase sorghum consumption as partial replacement of wheat imports and eventually to develop technologies capable of producing bread or bread alternatives from non-wheat flour.
- substitute sorghum for maize in traditional diets in low rainfall areas.

Current research by UZ food scientists is based on a two pronged approach to increasing sorghum utilization:

- Development of small mechanical dehulling and milling technologies to replace the traditional processing techniques.
- Development of industrial technologies for the large-scale utilisation of sorghum in commercial food products such as bread and bread substitutes.

DEHULLING OF SORGHUM

A major constraint on sorghum consumption is the tedious, labour-intensive nature of the traditional dehulling and grinding operations. Studies in Sengal showed that it takes two women about 1.5 hours to decorticate the daily household requirements of sorghum grain (2.5 kg) and a further 2-2.5 hours to process the grain to flour (Chinsman, 1984).

The Department of Agricultural Research and Specialist Services and some non-governmental organisations became interested in rural sorghum dehulling technologies in 1984-85 . Although pilot dehulling units were operating at several rural sites, inadequate information was available on the techical performance of the machines. In collaboration with one of the field projects, a study was undertaken to evaluate the PRI/IDRC models of mechanical mini-dehullers.

The dehullers were evaluated to determine the optimum batch size and processing time in relation to optimum level of extraction, the effects of dehulling on removal of tanins and the acceptability of sorghum porridge. The optimum batch size was 8-10kg and a residence time of 8 minutes was required to obtain sufficient extraction (82 - 85 percent) for removal of bran and tanins and to produce a flour of good consumer acceptance in 'sadza' preparation. Mechanical dehulling under these conditions removed 33 - 46 percent of the tanins and significantly improved the acceptability of sadza for both red and white grain types relative to traditionally hulled and milled flour. The white grain was preferred over red in sadza preparations while the reverse was true for the thin porridge 'Bota'. The high level of acceptability of these traditional food products prepared from dehulled and hammer-milled flour indicates there is a market potential for a dehulled milled and packaged sorghum flour from both red and white types.

COMPOSITE FLOUR TECHNOLOGY

Composite flour technology (CFT) is based on the blending of various cereal flours or cereal and non-cereal flours (legumes, root crops) for economic, nutritional or functional advantage. Since gluten starch interactions are responsible for most of the functional properties of wheat in bread making, the replacement of wheat at whatever level with non-gluten materials such as sorghum or cassava starch results in a reduction of the functional and organoleptic properties. Sorghum-wheat composite flour technology has been developed in several countries, including Ethopia, Sudan and Senegal and applied to a range of food products (Zewide 1984; Bach, 1979 and Perten, 1984). The extent to which sorghum varieties could be incorporated into bread flour mixtures in Zimbabwe without a significant effect on baking properties and acceptability had to be investigated using local varieties. For the purposes of this study, a PRL/IDRC minidehuller of 8-10 kg capacity was used in conjunction with a hammer mill and laboratory sifter. Four sorghum varieties were blended with wheat flour to make bread:

Variety		Type
SV_1 and SV_2	-	White improved
Nyamidzi	-	White traditional
Red Swazi	-	Red improved

These varieties were incorporated at 5, 10, 15, 20 and 25 percent levels in white wheat flour/sorghum composites in a straight dough bread formulation. The dough characteristics and baking properties were evaluated by objective mixograph and specific volume measurements. Acceptability of the bread samples was carried out by sensory evaluation using laboratory and consumer panels. Acceptability scores of composite flour bread were comparable to those of the 100 percent wheat flour controls in sorghum:wheat composites up to 15 percent level of replacement. SV_1 composites were as acceptabile as the controls up to 20 percent levels of replacement.

The red sorghums were unacceptable due to a purplish-pink discoloration of the loaf in white wheat flour composites at all levels though it had comparative acceptability as the 100 percent whole wheat bread at 15 percent level in whole wheat flour composites. The specific volumes supported the sensory results, showing no significant reduction in loaf volume up to 15 percent level. Similarly tests of dough strength demonstrated signficant differences from the control only at higher levels of 20 and 25 percent.

The SV_1 and Nyamidzi white sorghum breads were subjected to shelf-life studies based on sensory evaluation and objective measurements of moisture content and compressibility. Sequential tests using a trained panel of consumers were carried out on composite and control (100 percent wheat flour) bread samples from Day 1 through Day 5. The 15 percent composites were indistinguishable from the controls and acceptable up to Day 5 when stored in plastic bags at room temperature even though moisture content and compressibility values decreased over this period. The sorghum breads were resistant to mould growth for a larger period (10 days) than wheat flour controls which started moulding at day 7.

PRACTICAL IMPLICATIONS FOR TECHNOLOGY DEVELOPMENT

Laboratory and pilot scale trials clearly demonstrate that the mechanical mini-dehuller coupled with a hammer mill and sieving system are capable of producing a white sorghum flour of adequate extraction (80-85 percent) and quality for incorporation in composite flour up to a level of 15 percent. Some varieties such as SV_1 showed higher extraction (90 percent) and are capable of incorporation up to 20 percent. The extraction rates obtained using the mechanical dehulling/milling systems as compared to the traditional system show an increase of about 20 percent and reflect not only higher energy efficiency but also lower processing losses.

However, the small-scale dehullers have a limited capacity (1-4 tonnes/month) and are capable of servicing only household or village needs when coupled with a hammer mill. The straight run flour from a mini dehuller-hammer mill unit is only suitable for 'sadza' or as brewing grits in combination with sorghum malt. The viability of the mini dehullers is therefore very limited.

Large-scale utilisation of sorghum as a milled product of varying granularities for a variety of end-uses ranging from sadza flour to bread flour, semolina and confectionary flour is constrained by the lack of industrial-commercial hulling and milling capacity. Sorghum and millets have very different milling properties from those of wheat (Perten, 1976). Semi-commercial scale milling systems for sorghum have been developed in Sudan and Senegal (Perten, 1983) and several commercial models of dehullers (Schulle, Buhler) are now on the market. <u>However, an integrated commercial scale hulling and milling technolgoy capable of producing a range of milled products for varied end-user is yet to be developed</u>.

The identification of possible and potential end-user and market testing of sorghum products is a process that generates a chain reaction of development activity. These tests should stimulate the further development of industrial processing technologies. These tests should also provide sorghum breeders with a shopping list of desirable functional and quality factors of grain to match the specific end-uses of sorghum. The work on DVT and the pressures to increase sorghum utilization have stimulated sufficient interest among local millers in Zimbabwe to generate a modest level of investment in dehulling equipment. However, it will take further investment of capital and experimentation before the whole hulling-milling system for sorghum could be developed to a commercially viable level. At the same time, the viability of CFT would have to be convincingly demonstrated to millers through "scale-up" of pilot-scale trials to industrial test-baking and test-marketing in conjunction with one of the medium scale bakeries.

Provided industrial processing technology could be developed even at the current selling price of GMB sorghum (Z$230 per tonne) and the price differential between sorghum and wheat ($340 per tonne) composite flour technology offers the millers a substantial annual savings of about Z$3.9 million if sorghum were to be incorporated at 15 percent level in composite flour. The use of sorghum in bread which is price-controlled also gives the bakers a financial advantage in being able to reserve rationed wheat flour for higher-priced confectionary products. Over and above the domestic savings, the annual foreign exchange savings in reducing current wheat imports by 15 percent would amount to nearly Z$12 million.

In the major sorghum producing countries of Africa such as Sudan and Ethiopia, sorghum and millet have remained as subsistence crops. Processing technologies have also remained at the traditional or at an intermediate level of mechanization. The transition of these crops from subsistence to cash crop status has not been accompanied by the corresponding advances in large-scale processing technology. The development of technologies for serving both rural and urban needs are of strategic significance for Food Security in low rainfall areas in Africa. This discussion of sorghum illustrates the void that presently exists in post-production technologies. Unless, improved technologes are rapidly developed in conjunction with breeding programs, rural households in low rainfall areas will become increasingly dependent on maize - a higher yielding but more unstable crop.

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CHAPTER FOURTEEN

SORGHUM AND HOUSEHOLD FOOD SECURITY IN LOW RAINFALL AREAS OF ZIMBABWE : A RESEARCH PROPOSAL

C.B. Mbwanda

BACKGROUND

At the initial SADCC meeting in Lusaka in April of 1980, the Heads of State identified the lack of research on sorghum and millet as a critical problem and they agreed to seek external assistance for this task. In 1984 with financial assistance from USAID and the Federal Republic of Germany, the International Crops Research Institute for the Semi- Arid Tropics (ICRISAT) launched a long term (20 year) research programme on sorghum and millet for the SADCC region. Presently a team of seven internationally-recruited scientists is working at the Matopos research station outside Bulawayo in Zimbabwe. The ICRISAT/SADCC research programme is headed by Lee House.

PROBLEM STATEMENT AND RATIONALE

Sorghum is more drought resistant than maize and for this reason it is the most assured crop for the low rainfall (200-600 mm), Natural Regions IV and V of Zimbabwe, most of Botswana, the southern region of Zambia and parts of other SADCC states. However, with the gradual development and dissemination of short season hybrid maize varieties, many rural households are slowly replacing sorghum with maize in local diets. Moreover, maize processing technology is well developed and small maize mills are conveniently located in villages throughout the maize belt. By contrast, sorghum has suffered from a lack of research on high yielding varieties and small-scale home processing machines. In short, the combination of favourable maize prices, relatively higher yields of maize in normal rainfall years, and the difficulty in home processing of sorghum flour have induced communal (smallholder) farmers to produce maize for family food security needs as well as for the market. However, because of inadequate and variable rainfall, maize crop yields are poor in drought years. The result is food shortages, household food insecurity, and the need for SADCC states to provide food aid and food for work for programmes in these low rainfall areas.

Lee House has already provided the rationale for ICRISAT's long term (20 year) research programme. In Zimbabwe, a small group of researchers in the Department of Research and Specialist Services (R&SS), Environmental Development Agency (ENDA) and the University of Zimbabwe's Food Science group are starting to exchange ideas on how to improve sorghum production and processing technology. It is hoped that the research will enable sorghum to become more competitive with maize in low rainfall areas and that improved small scale processing technology will reduce the cost and drudgery of home processing and increase household food security. It is also hoped that the research will develop new end uses for sorghum, including blending sorghum with wheat flour, developing new convenience foods (e.g. sorghum chips), and expanding the use of sorghum in livestock feed and industrial uses (e.g. paint, plastics).

To my knowledge, no one has ever carried out an economic study of any aspect of sorghum production, processing, marketing and consumption in communal (smallholder) farming areas of Zimbabwe. The purpose of this brief proposal is to lay out my preliminary ideas of a study of sorghum and household food security in low rainfall areas of Zimbabwe. The proposal will be further developed in cooperation with Mike Weber, Rick Bernstein and John Staatz when I am in residence at Michigan State University from January-March 1987. I plan to initiate field research in mid 1987 and to carry out various studies on sorghum and household food security over the 1987-1990 period as part of my D.Phil programme at the University of Zimbabwe.

SORGHUM AREA PLANTED, PRICES AND CONSUMER DEMAND

Tables I and II show that from 1965 to the present, communal and commercial farmers in Zimbabwe planted an average of 200 000 ha and 10 000 ha of sorghum, respectively. Area planted and yields have increased in response to higher prices and declined during drought years. There is no information available on the extent to which maize has replaced sorghum for home consumption but it is well known that this process has been underway for at least four decades.

Table 1 shows that the government has increased the nominal producer prices of sorghum from Z$ 80 per ton in 1979/1980 to Z$ 180 in 1985/86, an increase of 125 percent in six years. Both communal and commercial farmers responded to the dramatic price increases by increasing marketed output. As a result, the Grain Marketing Board (GMB) has accumulated a sorghum stock equivalent to three years' normal GMB domestic sales in early 1987. Presently most of the sorghum surplus in Zimbabwe is the Red Swazi variety that is produced by comercial farmers for the brewing industry. Red sorghum cannot be blended with wheat to make composite flour because of the purplish-pink discoloration of bread. White sorghum is primarily produced by communal farmers for home consumption. However, because of low yields and the lack of cost effective home processing technology, maize has gradually replaced white sorghum in rural diets in low rainfall areas.

The amount of sorghum available to the household is a function of the cost of production and processing sorghum

Table 1: Zimbabwe: Sorghum Production Statistics, 1965-87

	National Output (000 mt)	Commercial Output (000 mt)	Communal Output (000 mt)	GMB Intake (000 mt)	GMB Sales (000 mt)	Domestic Retention (000 mt)	Producer Price Z$ (mt)	GMB Selling Z$ (mt)	Area Planned (000 ha)	
									Commercial	Communal (Small-holder)
1965-66	n/a	3	n/a	1	10	n/a	34.48	39.01	13	n/a
1966-67	n/a	26.4	n/a	32	10	n/a	28.66	38.92	19	n/a
1967-68	n/a	26.4	19.5	32	10	n/a	32.88	55.77	17	246
1968-69*	n/a	8.4	38	6	11	n/a	35.16	55.60	13	93
1969-70	147	16	131	11	12	136	55.58	55.60	15	394
1970-71*	69	7	63	3	12	66	37.25	55.60	16	196
1971-72	76	7	69	4	13	72	38.74	54.95	12	239
1972-73	140	20	120	23	15	117	41.65	54.67	14	240
1973-74*	50	28	22	26	21	24	41.81	54.84	21	n/a
1974-75	164	14	150	13	17	151	41.54	54.56	7	n/a
1975-76	136	6	130	6	18	131	41.54	54.56	5	200
1976-77	121	16	105	15	14	106	64.27	71.75	7	210
1977-78	64	17	47	14	14	50	75.00	71.75	11	95
1978-79	73	14	57	17	15	56	75.00	90.00	8	120
1979-80*	50	20	30	22	17	13	80.00	98.00	10	76
1980-81*	83	17	66	23	20	65	105.00	117.00	8	120
1981-82	125	25	100	34.4	18	94.4	115.00	117.00	9	200
1982-83*	17	50	35	26	49	115	117.00	117.00	8	200
1983-84*	52	8	44	23	18	38	120.00	147.00	8	200
1984-85	155	18	37	25	14	34	140.00	165.00	11	156
1985-86	133	52	81	97	29	96	180.00	239.00	19	215
1986-87	-	-	-	84	25	-	180.00 1/	239.00	-	-

Source: Grain Marketing Board (GMB) and Agriculture Marketing Authority (AMA)
* Drought years
1/ 1 Z$ = .60 US$ in January, 1987

Table 2: Zimbabwe: Sorghum Trade Statistics, 1965-87

	National Output (000 mt)	GMB In-take in-cluding Stocks (000 mt)	Imports (000 mt)	GMB Sales (000 mt)	Export	GMB Closing Stock (000 mt)	GMB Producer Prices Z$ (mt)	GMB Selling Price Z$ (mt)	World Price US $ (mt)	GMB Maize Selling Price Z$ (mt)	GMB Wheat Selling Price (z$ mt)
1965-66	n/a	1	10	10	9	1	34.48	39.01	61	43.24	62.45
1966-67	n/a	33	-	10	0.34	14	28.66	38.92	67	43.24	62.14
1967-68	n/a	46	-	10	-	2	32.88	55.71	64	43.24	70.16
1968-69*	n/a	8	5	11	-	3	35.16	55.59	64	43.24	71.00
1969-70	147	15	-	12	-	2	55.58	55.60	56	43.24	71.00
1970-71*	69	5	7	12	-	-	37.25	55.60	54	43.24	69.45
1971-72	76	4	9	13	-	1	38.74	54.45	61	43.24	69.29
1972-73	140	24	-	15	-	9	41.65	54.67	62	43.24	69.01
1973-74*	50	35	-	21	8	6	41.81	54.84	174	43.24	65.18
1974-75	164	19	3	17	2	3	41.54	54.56	170	43.24	79.80
1975-76	136	8	12	18	4	2	41.54	54.56	160	51.54	110.00
1976-77	121	17	-	14	-	2	64.27	77.75	142	51.54	121.00
1977-78	64	16	-	14	-	3	75.00	71.25	96	51.54	128.00
1978-79	73	34	-	15	-	6	75.00	90.00	129	57.07	110.00
1979-80*	50	42	-	17	-	4	80.00	98.00	173	63.00	115.00
1980-81*	83	41	-	20	-	16	105.00	117.00	175	89.00	135.00
1981-82	125	64.4	-	18	-	9	115.00	117.00	173	137.00	165.00
1982-83*	67	54	-	26	2.5	4	115.00	117.00	155	137.00	190.00
1983-84*	52	28	9	18	-	11	120.00	147.00	154	157.00	220.00
1984-85	55	46	-	14	-	45	140.00	165.00	153	177.00	250.00
1985-86	133	97	-	29	20	94	180.00 1/	239.00	154	222.00	-
1986-87	-	-	-	-	-	-	-	-	-	-	-

Source: Grain Marketing Board and Agriculture Marketing Authority (AMA)
* Drought years
1/ 1 Z$ = .60 US$ in January, 1987

and the availability of substitutes such as maize. Although taste differences do exist between maize and sorghum flours, rural households in the communal areas attribute the substitution of maize for sorghum to time-consuming hand pounding of sorghum to make sorghum flour.

OBJECTIVES

The specific objectives of the proposed study are;

1) To describe the evolution of the sorghum subsector with respect to the role of sorghum in meeting rural food security objectives in Zimbabwe.

2) To describe the food security situation among households in low rainfall areas.

3) To analyse the relative cost and returns of sorghum and maize enterprises among communal farmers in selected low rainfall areas.

4) To analyse the constraints on expanding white sorghum production among communal farmers in the three communal areas.

5) To analyse the technical, economic and social impact of traditional and improved processing technologies for white sorghum in communal households.

6) To assess alternative policy options for the support of sorghum production and processing to increase food security in low rainfall areas.

HYPOTHESES

In this study, it is assumed that with present sorghum varieties and processing technology, the production and consumption of sorghum in the low rainfall areas will continue their historical decline relative to maize.

The following hypotheses will be tested:

1. Improved Production Technology for Food Security in Low Rainfall Areas

   a) Given the present white sorghum and maize varieties, the returns to maize are higher but more risky than sorghum on communal farms.

   b) With improved white sorghum varieties, returns will be higher and more stable than maize and farmers will be willing to invest more land, labour and other inputs into sorghum production to improve family income and food security .

2. Improved Mechanical Processing and Food Security

   a) Improved sorghum processing technology will reduce household labour requirements in processing sorghum flour and increase the supply of sorghum flour available for household consumption. Reduced sorghum processing costs relative to maize will reduce household dependency on maize.

RESEARCH METHODOLOGY

A subsector framework will be used to gain a preliminary understanding of the evolution of the Zimbabwe's sorghum subsector, (Shaffer, 1973). The vertical system has a linked production sequence in which the output of one production stage becomes an input in the next. The performance of each stage is influenced by various factors like technology, institutions, economic policy, and producer and consumer responses.

This study will be confined to two stages in the system: sorghum production and processing. Interlinkages between these and other stages will be studied in order to understand the historical role of sorghum in food security. Over the next 3 to 6 months various informal (Colson, 1984 and formal agricultural household models will be analyzed to determine how to develop a model to help explain household production, storage, consumption and marketing decisions (Singh *et al* 1986). This phase of the research will be developed in conjunction with John Staatz at MSU over the January-March 1987 period.

The cost and returns of the sorghum and maize enterprises will be collected from farm surveys. The allocation of resources between the two enterprises will be analysed to investigate the current and potential role of sorghum in meeting family goals. Budget comparisons will be made between maize and sorghum crops.

The researcher will work closely with agricultural engineers in ENDA, R&SS, IDR and the SADCC Post Harvest Technology group in comparing the technical, financial, and economic coefficients of hand pounding with improved processing technology for farm families and villages. Data from the IDRC pilot processing machines in Botswana will be evaluated. The processing part of this study should probably be carried out by an M. Phil or D. Phil student in agricultural engineering.

PROPOSED OUTLINE OF FINAL REPORT

1. Introduction

   a) Problem Statement
   b) Background of sorghum subsector in Zimbabwe
   c) Objectives of Study
   d) Hypotheses
   e) Literature review.

2. Research Methodology

   a) Data sources available
   b) Survey approach (i.e. sample design, questionnaires
   c) Methods of data analysis.

3. Presentation and Analysis of Research Results

4. Policy Recommendations

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CHAPTER FIFTEEN

COMMENTS ON THE SORGHUM PAPERS

Kay Muir-Leresche

It is most gratifying that the authors of these papers recognise the importance of a market for sorghum. For many years extension officers in Zimbabwe have tried to persuade farmers to grow the more drought resistant sorghums and millets but it was only when the government increased the price dramatically that farmers responded. This resulted in large, unsaleable stocks, a situation which replicated that in Tanzania in the early 1970s[1/]. In most of the SADCC region, maize is the preferred staple and whilst this may have arisen because maize is easier to process, it would seem that it has become a taste preference. Sorghum is important as a household security crop in the more marginal regions but if it is to gain national or regional significance, product development is essential. The R&D work on small-scale dehulling machines for villages and rural households is of major significance to household food security in semi-arid land. But it is also essential that we introduce higher value commodities which can increase incomes in the semi-arid zones. Much of the SADCC region receives less than 700mm annually; most of those areas which receive more rainfall are prone to mid-season droughts which can seriously affect maize yields. Increasing sorghum yields under favourable moisture conditions will only be valuable if demand is greatly increased. Research on sorghum as a wheat substitute is significant and has particular value as a foreign currency saver and in increasing the value of a low-rainfall commodity.

1/ Kay Muir-Leresche (1984). "Crop Price and Wage Policy in the Light of Zimbabwe's Development Goals", Unpublished D. Phil. dissertation, Harare, Department of Land Management, University of Zimbabwe.

Turning to Lee House's paper, it was most interesting to note the wide range of characteristics that can be incorporated in a breeding program. I endorse his emphasis on the importance of a multidisciplinary approach to establish the most desirable traits for the plant breeder's agenda. In this regard, it is also important to establish exactly what the farmers' constraints are and to help overcome these in addition to selecting for particular end products.

My most serious reservation with the paper is in how the priorities are established. Whilst it may be difficult for a breeder to select for drought resistant qualities, it is important to have the priorities established by a multidisciplinary team which includes local knowledge. It would appear to me that the scientists have given drought resistance too little emphasis, given that maize is the preferred staple in most of the region. Unless there is a very marked change in demand patterns, it is not important to improve sorghum yields in the higher rainfall zones. Whilst it is difficult to select for drought resistance, it may be possible to develop shorter season varieties or varieties which flower later and longer. In addition there may be various agronomic methods of increasing drought tolerance.

Dr. Gomez's paper described some exciting work, important to the household, the nation and the region. This is of particular interest at the moment when several countries in the region are facing grain surpluses. The work on utilising sorghum in bread has important implications for all countries in the region as the demand for convenience foods and particularly bread is increasing with urbanistion and wheat imports are increasing in the SADCC region Even if wheat can be grown locally, its production tends to be capital intensive with much of the equipment imported. The background and rationale for the study appears to present several untested hypotheses as statements of fact e.g. that the Grain Marketing Board deliveries come from the semi-arid areas. In addition, there are some important policy implications from some of the data given e.g. the high percentage of deliveries by the large-scale commercial sector. Many of these issues will no doubt be studied by Mr. Mbwanda.

Mr. Mbwanda's research will complement the former studies and it is important for researchers in other countries in the region to carry out similar studies. Some of the assumptions appear to be untested hypotheses. The study appears to assume that demand will increase simply because newer technologies are available. In addition, it does not question whether soghum-based food security is in fact desirable. It would seem that the proposed research programme should be split into several distinct projects.

CHAPTER SIXTEEN

THE OILSEEDS SUBSECTOR AND HOUSEHOLD FOOD SECURITY IN THE COMMUNAL FARMING AREAS OF ZIMBABWE : A PRELIMINARY RESEARCH PROPOSAL

Godfrey D. Mudimu

BACKGROUND

The oilseeds sub-sector is composed of cottonseed, soyabeans, groundnuts, and sunflowers. The subsector is targeted for expansion following recent government measures aimed at discouraging maize and sorghum production. The aim is to reduce maize production by at least 50 percent in the 1986-87 season. The reason for the new policy of agricultural diversification is the high cost of storing the 2.1 million tonne maize stockpile (January, 1987) which is equivalent to three years' domestic sales of the Grain Marketing Board (GMB). The annual average storage cost of maize is approximately Z$24 million in 1986-87 alone. Consequently farmers are being encouraged to diversify into alternative non-grain crops such as oilseeds.

Commercial farmers, plan to reduce maize area for the 1986/87 crop year by diversifying into soyabeans, sunflowers, groundnuts and to some extent cottonseed. The greatest expansion is expected in sunflowers in the 1986-87 season (Table 1).

Table 1: Zimbabwe - Estimated Area Expansion of Oilseed Crops for the 1986-87 Season

Crop	Area (ha) 1985-86 (Actual)	Area (ha) 1986-87 (Estimated)	Percent Expansion
Soyabeans	42 000	50 000 - 55 000	19 - 31
Sunflowers	1 000	6 000	600
Groundnuts	2 200	3 500	59

Source: <u>Financial Gazette</u>, Harare, 16 September, 1986

Trend in Oilseeds Production and Marketing

The oilseeds sub-sector is important for the production of edible oils and fats, and oilmeals for livestock feeds. Total deliveries of oilseeds to official marketing channels increased by approximately 95 percent between 1971-72 and 1984-85 (Table 2). Prior to 1974-75 cottonseed and groundnuts accounted for up to 95 percent of total oilseed deliveries. Currently, cottonseed and soyabeans contributed 90-95 percent of total oilseeds supply. Since 1974-75 soyabean deliveries have increased by over 300 percent while cotton has increased by about 50 percent. Groundnut deliveries to the Grain Marketing Board (GMB) declined from 46 000 tonnes in 1976-77 to 11 000 tonnes in 1980-81 and 6 000 tonnes in 1984-85. Sunflower production is largely by communal and small-scale commercial farming sub-sectors and production has fallen since the late 1970s (Table 2). The fall in groundnuts and sunflower production has been attributed to low yields and producer prices, compared to grain crops, soyabean and cotton. Low groundnuts yields are attributed to a lack of appropriate production technologies, partly due to low priority in agricultural research in Zimbabwe.

The expansion in soyabean and cotton production since the early 1970s is attributed to favourable producer prices for the two crops relative to other crops, and improvement in production technologies that resulted in substantial yield increases (Tattersfield, 1982). Commercial farmers supply the bulk of the marketed oiseeds crops with the exception of sunflowers as shown in Table 3.

Trend in Edible Vegetable Oils Supply and Demand

Edible oils in Zimbabwe are expressed from cottonseed, soyabeans, sunflower seed, groundnuts and maize germ.

Table 2: Zimbabwe: Trends in Oiseeds Marketing, 1965-66 - 1985-86

Marketing (Intake) YEAR	Cottonseed	Soyabeans	Groundnuts	Sunflower	TOTAL
	('000 tonnes)				
1965-66	18.2	0.2	17.0	-	35.4
1966-67	26.6	0.2	32.1	-	58.9
1967-68	45.8	0.4	33.1	-	79.3
1968-69	57.2	1.7	11.5	-	70.4
1969-70	160.5	7.7	26.0	-	194.2
1970-71	99.0	7.4	11.6	-	118.0
1971-72	140.4	8.1	31.6	1.4	181.5
1972-73	170.7	8.5	81.2	1.3	261.7
1973-74	135.8	8.0	26.5	1.2	171.5
1974-75	164.7	19.1	44.4	3.4	231.6
1975-76	163.1	27.9	44.7	8.7	244.4
1976-77	131.6	44.8	46.6	23.4	246.4
1977-78	148.0	44.1	13.5	21.4	227.0
1978-79	173.9	69.7	17.7	5.6	266.9
1979-80	166.8	81.0	12.7	3.5	264.0
1980-81	182.0	93.6	17.4	8.1	301.1
1981-82	200.8	65.3	20.0	4.0	290.1
1982-83	157.7	84.3	15.9	3.8	261.7
1983-84	167.3	74.4	9.3	12.0	263.0
1984-85	250.1	89.8	5.7	9.0	354.6
1985-86	295.0	86.0	7.9	6.5	395.4

Source: 1) CSO (1986) and Muir-Leresche (1984).

Table 3: Zimbabwe: Commercial and Communal Farming Deliveries of oilseeds to the Grain Marketing Board, 1980-85.

Oilseed	Farming Sub-sector	Intake Year 80-81	81-82	82-83	83-84	84-85
		('000 tonnes)				
Soyabeans	Commercial	88.5	61.5	83.7	73.7	89.0
	Communal	5.2	3.8	0.7	0.7	0.8
Groundnuts	Commercial	6.5	9.9	8.8	5.0	2.6
	Communal	5.0	3.1	1.6	0.6	0.8
Sunflower	Commercial	-	-	0.9	1.1	1.3
	Communal	-	-	3.8	10.6	7.7
Cotton	Commercial	117.4	99.3	105.3	107.9	138.7
	Communal	32.9	74.7	49.2	60.5	111.5

Source: Agricultural Marketing Authority (1986).

Prior to 1965, groundnuts contributed up to 90 percent of national oil expressing requirements. In 1983-84, cottonseed and soyabeans jointly accounted for 94 percent of the total oil extracted from oilseeds. Oil palm production in the Lowveld is expected to contribute up to ten percent of total edible oil supply at full production of the plantation in eight to ten years.

Domestic demand for edible oils increased from 21,000 tonnes in 1975-76 to 45,000 tonnes in 1982-83 and is currently estimated at 42,000 tonnes (COPA News, 1985). The rapid expansion in demand led to a five percent shortfall in supply in 1981-82, a 25 percent shortfall in 1982-83 and an estimated two to five percent shortfall in 1984-85 (COPA News, 1985). The shortfalls were met by imports and reduction in exports as well as oil extraction from maize.

The oilseed sub-sector presents a unique challenge to policy makers. Cottonseed has three joint products - lint, cottonseed meal and oil. Cotton lint is a valuable foreign exchange earner and a raw material for the textile industry. Cotton production, being labour intensive at harvesting, has employment, resource use and income distribution consequences. Groundnuts have the highest oil content and are a valuable protein source for human consumption. An increase in communal groundnuts production for oil extraction may have negative consequences for nutrition, particularly in the communal areas where groundnuts are an important source of protein for children. Soyabeans are a preferred raw material for oil extraction because of its high protein content. The protein content of soyabean meal is 46 percent compared to 40 percent for cotton, 33 percent for sunflower and 45 percent for groundnuts. Soyabean meal is valued more than groundnut meal because of its high oilmeal extraction rate which is 77 percent compared to 52 percent for groundnuts.

Currently, the oil expressing industry is giving higher priority to oilseed meal production and marketing, compared to edible oils. This is because the retail or consumer prices for edible oils are considered too low for a profitable return to investment in edible oil production and marketing (communication from a CFU meeting, Harare, May 1986).

The above discussion has highlighted the importance of substitution among crops in the oilseeds sub-sector and the need to understand the dynamics of the subsector rather than pursuing isolated studies of each commodity. Domestic demand for oilseeds crops depends on the demand for and production of vegetable oils, oilseed meals and cotton lint.

POLICY ISSUES FOR OILSEEDS

There are several key questions facing the oilseeds subsector. The prime question is how can the oilseeds sub-sector avoid over production after three to four seasons of expansion? To answer this question, an economic analysis is required of the short- and long-term impact of diversification on:

i) farm profitability,
ii) domestic resource use,
iii) income distribution, and
iv) food security.

Farm Profitability Effect

Farmers - commercial and communal - are concerned with the impact of diversification on farm profitability because of the risks involved in shifting resources to oilseeds. These arise from:

a) lack of familiarity with oiseeds production practices because some farmers have not grown some of these crops before such as sunflowers and groundnuts,

b) low returns associated with groundnuts and sunflowers because of low yields, and

c) Uncertain future government policy with regard to crop prices, production quotas, etc.

Domestic Resource Use Effect

Since a number of joint products are obtained from oilseed crops, it is important to determine which crop or crop combination yields the best domestic resource use for production of each crop.

Income Distribution Effect

Income distribution effects of diversification need to be assessed to determine the relative impact of alternative policies on the different farming sub-sectors. It is hypothesized that government's perception of the relative impact of diversification on the different producer sub-sectors will influence government's policy formulation for the oilseeds sub-sector.

How the communal and commercial farming sub-sectors will benefit relative to each other will be determined by the contribution of each sub-sector to total output of each oilseeds crop. The ability of each farming sub-sector to expand production is a function of:

a) farmers' resource endowments and

b) availability of production technologies,

c) institutional support (credit, extension, commodity pricing, transport services, etc.).

d) policy environment

Food Security Effect

In the communal areas, the concern is, how will expansion of oilseeds influence household food security? Household food security is defined as the ability of a household to maintain adequate, quantitatively and nutritionally, food supplies at all times. This can be achieved in two ways; 1) household food production and storage; and/or 2) purchasing from the market. Committing production resources to oilseeds may influence household food security as follows:

a) A shift from grains - especially the staple food maize - may reduce household food availability.

b) Diversifying resources to oilseeds which are essentially grown for cash may enhance cash availability for purchasing food.

The food security impact of diversification depends on (1) the capacity of communal farmers to expand oilseeds production and (2) the extent to which oilseeds crops contribute to household food security . These impacts will vary from area to area according to each area's comparative advantage in producing alternative oilseed crops. The governing factors are:

i) land resource availability,
ii) availability of appropriate production technologies for agro-ecological conditions,
iii) institutional support and,
iv) policy environment

Food security issues also differ with respect to each oilseeds crop. Groundnuts are an important protein source in the household diet in the communal areas. Therefore increased production may contribute to improved nutrition. However, production of groundnuts for sale may have a negative effect on nutrition at the farm household.

Cotton is an important cash crop for communal farmers who currently produce 40 to 50 percent of the total marketed output. Cotton expansion would increase communal farm income and the income of cotton pickers.

Sunflowers are an ideal insurance crop for (i) farming areas with short growing seasons; and (ii) when the onset of rainfall is late for major crops and a substitution crop is needed.

It is therefore essential that the new oilseed diversitifation policy take account of household food security issues in the communal areas.

Technological Change Issues

Technology plays a central role in all the issues outlined above. Groundnuts and sunflower yield levels in communal areas could be increased by an improvement in production technologies and extension service directed at these two crops (Makombe, Bernsten and Rohrbach, 1986)[1]/. The policy issue is therefore what new technical packages are needed for oilseeds? There is a need to assess how technological improvements will affect oilseed production patterns in the short- and long-run; and what will be the impact on (i) farm profitability; (ii) household food availability; (iii) income distribution and (iv) level of aggregate oilseed output.

Export Market Potential

Zimbabwe's domestic market may not be able to absorb the output of the proposed expansion programme. Therefore, export markets for oilseeds products need to be investigated. The task is to assess Zimbabwe's comparative advantage in oilseed production and trade vis-a-vis other countries in the Preferential Trade Area (PTA) and the SADCC regions. The study should determine whether the strategy should concentrate on exporting raw materials or processed products.

1/ Editor's note: See Chapter 8.

STUDY FOCUS AND OBJECTIVES

The study will focus on oilseed production in communal farming areas. The general objective is to analyse the economics of oilseed production in the communal areas in order to identify the linkages between policies, institutions and technology, and how they can be modified to influence oilseed production, income generation and food security among communal farmers. Four alternative oilseeds crops will be studied in order to determine the comparative advantage of each crop and which has the most favourable impact on income generation, employment and food security.

The specific objectives of this study are:

1. To describe past trends and the present state of the oilseeds subsector in SADCC with special emphasis on Zimbabwe.
2. To analyse the present role of oilseeds in meeting income and food security objectives of communal farmers.
3. To identify technical and institutional constraints on expanding oilseed production in the communal sub-sector.
4. To assess the potential of introducing new technical packages for the expansion of oilseeds in the communal areas.
5. To analyse needed policy changes to increase oilseed production income and household food security among communal farmers.

RESEARCH METHODOLOGY AND ANALYTICAL APPROACHES

A variety of analytical frameworks and research methods will be employed to meet the objectives. These are outlined below:

Overview of Oilseeds Subsector

The first objective will be met by a descriptive overview of the oilseeds subsector using the subsector analytical framework. A subsector is defined as the vertical set of activities in the production and distribution of a closely related set of commodities (Shaffer, 1973). For the oilseed subsector, the vertical system would be made up of producers; extension and research services; marketing structures; transport, storage and processing services; input supply activities; and consumers of oilseed products as well as well as the technical, economic, social and political environment in which production and consumption take place. This part of the study is interested in understanding the vertical and horizontal linkages that influence the performance of the oilseeds subsector.

Production Constraints, Technology and Food Security Assessment

For objectives two, three and four, both primary and secondary micro-level data will be collected on production, current technologies and household food security needs. Primary data will be obtained through a cross sectional survey. The sample for the survey will be drawn to represent communal farmers in all agro-ecological zones of the country, taking into account cost-effectiveness in data generation. Farm surveys in conjunction with formal discussions with extension and research personnel will be used to assess current production technologies and anticipated technological changes and their impact on food security and household income.

Different analytical techniques such as linear programming (LP), production functions, input-output analysis, and simulation can be used to address questions related to constraints and how they influence the farm system and implications of removing these constraints. The LP technique can be used to determine the optimum mix of production activities that will maximise household income and food security. The following LP model is proposed:

Max Z $= f(x) = C^{\bullet}X$
Subject to $X > 0$
$A^{\bullet}\ X > S$
Where Z = objective function to be maximized
C = mx 1 vector of net returns (over variable costs)
X = n x 1 vector of activity levels
A = m x n matrix of input-output coefficients
S = m x 1 vector of constraints.

Household food security and income would be incorporated in the objective function. Activities would include oilseed crops, grain crops, production, storage, marketing, food purchasing and consumption levels and other income generating activities. Resource constraints to be incorporated are land, household storage working capital, family and non-family labour, etc. Food security constraints would be minimum protein and calorie requirement, timing of production, harvesting, storage/ marketing and purchasing. Input-output coefficients would be obtained from secondary and primary data. The LP technique can provide guidelines to identifying: (i) production constraints; (ii) effects of innovation; (iii) critical resources and their opportunity cost; (iv) income distribtuion; and (v) constraints on achieving household food security needs.

Studies by Stanning, Makombe and Rohrbach will be utilized as secondary data sources. Special attention will be paid to Makombe's ongoing M.Phil. study on the economics of groundnut production by communal farmers. Makombe's findings, including recommendations and issues for further research will be used to formulate specific research hypotheses.

Policy Issues

Policy implications for agricultural research, extension, commodity pricing and other policies will be drawn from the results obtained above.

STUDY DURATION

It is anticipated that the study will take about three to four years to complete. The crucial components of the study are (i) problem definition, literature review and specification of the analystical frameworks; (ii) analysis of constraints on oilseed production in the communal areas (iii) assessment of new technology; and (iv) analysis of policy options. A report on preliminary findings will be produced for each annual UZ Food Security Conference.

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PART V

NEEDED RESEARCH ON EFFECTS OF MARKET LIBERALISATION ON FOOD SECURITY OF THE POOR

PART V

INTRODUCTION

In the past few years, non-project or policy-based lending has increased dramatically in most development assistance agencies, especially in the World Bank (Helleiner, 1986). The premise of policy-based lending is that financing projects in an unfavourable policy environment is like chasing the rainbow. The seeds of policy-based lending were planted in the Berg report for the World Bank - Accelerated Development in sub-Saharan Africa (World Bank, 1981), by former Commissioner Pisani of the EEC in Brussels in 1982 (Pisani, 1982) and later by the Nordic Delegation (1984) at SADCC's 1984 annual meeting with donors. One of the contentious issues in policy-based lending is the role of the state in food and agricultural production, marketing, storage, fertilizer distribution, etc. Advocates of policy-based lending or what is now commonly known as Structural Adjustment Loans (SALs) generally argue for a reduced role of the state and increased reliance on market forces or market liberalisation, including the reduction of fertilizer and food subsidies, taxes and overvalued exchange rates. But recent food battles in Liberia, Sudan and Zambia point out that the impact of policy reforms can have severe repercussions on the food security of the poor.

To date, there has been little research on the effects of market liberalisation on the food security of the poor. Robert Bates' influential book Markets and States in Tropical Africa (1981) presents a political scientist's view of government decision-making based mainly on historical data on government marketing boards in English-speaking Africa in the 1960s and 1970s. In a recent critical assessment of structural adjustment lending, Elliot Berg and Alan Batcheler contend that "the underlying (implicit) theory of policy-based lending in general, and, SALs in particular, inadequately treats many of the basic questions. The question of "why governments need money from outside to do things that are good for them and their people requires closer analysis" (Berg and Batchelder 1985, pp. 46-47). Moreover, Shlomo Reutlinger of the World Bank recently pointed out that both the short and long run impact of SALs on the food security of the poor is far from obvious. (Reutliner, 1986).

Since market liberalisation programmes are underway in Malawi, Tanzania and Zambia, the UZ/MSU food security project is in the early stages of developing a research proposal on this problem area in cooperation with local scholars in these three SADCC countries. Chapter 17 is a preliminary report on market liberalisation in Zambia by Muntanga and Mwiinga. Chapter 18 presents a preliminary research proposal by Martin Muchero on the GMB of Zimbabwe. The UZ/MSU research team would like to exchange ideas with scholars working on this problem area in other parts of Africa.

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CHAPTER SEVENTEEN

AGRICULTURAL POLICY REFORMS IN ZAMBIA

C. Muntanga and F. Mwiinga

BACKGROUND

The real output of the Zambian economy has been declining for the last decade. Various factors have contributed to this prolonged contraction including:

1. The heavy import dependency of the existing economic structure. The productive structure in the economy depends on imports for raw materials and essential production inputs like oil, fertilizers, pesticides and other agricultural and industrial chemicals. In addition, the production structure in the parastatal sector is strongly biased towards the production of consumer commodities rather than intermediate goods. This lop-sided development of the manufacturing sector with its import dependency is exacerbated by the shortage of foreign exchange over the past decade. These problems have led to the under-utilization of capacity in most industries and have inhibited the smooth operation of the manufacturing sector, whose output is subject to wide fluctuations depending on the availability of imported inputs.

2. The export sector has not been sufficiently diversified despite the fact that this has been one of the major objectives of all the three medium-term plans that the country has so far implemented. Over 90 percent of export earnings are still derived from mineral exports of which copper is the dominant commodity. The copper mining industry is itself highly dependent on imports and absorbs almost a third of the foreign exchange earnings for imported inputs.

3. Sharp deterioration in Zambia's terms of trade during the last decade; has greatly reduced Zambia's capacity to import. The result is that investment in the domestic economy has fallen sharply from 22 percent of real GDP in 1980 to 11 percent in 1985. The bulk of this investment expenditure is directed towards the rehabilitation of the existing industries, structures and institutions. There is very little investment in diversification of the domestic economy.

4. The deterioriation in Zambia's balance of payments position worsened in 1982 and led the country to suspend external debt service payments. In early 1983, the country had to go to the Paris Club to ask for re-scheduling of some of its debt service liabilities. The process has since been repeated for the third successive year in 1985.

5. Agricultural output remains heavily dependent on rain-fed cultivation. Hence, a shortfall in food production is always experienced when there is a drought and the country has to import food, especially maize, to meet its requirements. Buffer stocks are not available to shield the nation against adverse weather conditions. Other problems in this sector include: lack of regionally self-sufficient agricultural processing facilities and capacity at provincial and district levels, to process agricultural raw materials such as leather, oil seeds, wood etc. to produce finished goods.

6. The interaction of the various factors outlined above has contributed to Zambia's current economic crisis and to its external indebtedness. There is an urgent need to restructure the economy.

AGRICULTURAL REFORMS

Agricultural Pricing Policy

Zambia's agricultural pricing policy has been focused on price stabilization to ensure that farmers recover their production costs when their produce is sold. The government uses a cost of production method in determining crop producer prices and producer prices are reviewed annually to reflect inflation and other changes in the economy.

In 1984 the government introduced floor prices for all controlled agricultural commodities except maize. Under the floor price regime, the farmer is free to negotiate for a price higher than the government set price. This move is an attempt to bring the crop producer prices in line with the decontrolled prices of their end products. Prior to the introduction of the floor prices, there was an outcry by the farming community that government controls on producer prices were taxing farmers in the sense that the crop prices were artificially depressed. This was viewed as a disincentive to investment in the agricultural sector. This outcry won sympathy from the government and a floor price scheme was adopted to ensure reasonable returns to farmers irrespective of the prevailing market situation. In this way, capital flows into agriculture would continue thereby enhancing overall agricultural development.

Although the floor price system is in effect, most crops have not benefitted from this policy decision. The floor price in most cases has remained "the selling price". This is principally due to lack of a strong organisation to fight for high prices on behalf of the farmers - particularly small scale farmers. However, crops such as wheat, soyabeans and tobacco that are dominated by commercial farmers have been able to realize higher prices through their organization - the Commercial Farmers Bureau.

Liberalization of the Agricultural Marketing

Since 1968, the National Agricultural Marketing Board (NAM Board) was the only organization with statutory power to market agricultural crops except specialized crops such as cotton, tobacco, tea and coffee. It also had the responsibility of importing any shortfalls and/or exporting any surplus. However, NAMBoard's performance has never been very satisfactory. It could not reach some of the areas thereby denying farmers in such areas access to the formal market. It could not move all the crops to safe storage on time to avoid losses through rains. It was generally highly inefficient and depended on government subsidy for their day-to-day operations.

In 1982, the government allowed provincial co-operative unions to market agricultural crops in their respective provinces. NAMBoard's operations were restricted to inter-provincial marketing of maize and exporting any surplus and/or importing any shortfall. Under this new arrangement, the situation seemed to worsen and subsidies to NAMBoard and Provincial Unions more than doubled.

In 1985, the government made another attempt to try to improve the marketing situation. This time, instead of allowing NAMBoard and Co-operative Unions operating independently, they had to work with Unions acting as agents of NAMBoard in the marketing of maize. However, Unions retained the portfolio of marketing other crops such as sunflowers, groundnuts, soyabeans, cassava, sorghum millet, etc. This new arrangement also did not solve the marketing problems. Apparently, Unions did not accept this arrangement and as a result, they never took the responsibility seriously. The whole arrangement ended up as a total failure. It was, however, believed that no one instituion had the capacity to effectively market maize throughout the country.

In view of the problems outlined above, in April of 1986 the government passed a policy decision to liberalise the marketing of crops which were marketed by NAMBoard. Under this new arrangement, NAMBoard ceased to enjoy statutory monopooly power in the marketing of agricultural crops especially maize. Today all interested parties including NAMBoard, Unions, Millers and indeed private traders are free to participate in the marketing of agricultural crops. However, NAMBoard is charged with the following responsibility for maize:

(1) the buyer of last resort,

(2) importing and exporting maize,

(3) maintaining a strategic reserve of 2.5 million 90kg bags at all time, and

(4) facilitating inter-provincial trade i.e. supplying maize to deficit provinces from surplus provinces.

Moreover, NAMBoard has to compete with provincial unions, millers and other private traders in the marketing of maize in surplus provinces.

It is hoped that under the new marketing arrangement, a more efficient marketing system will emerge.

It is assumed that allowing wider participation in the trade, competition will emerge among participating institutions/persons thereby promoting efficiency. More importantly is the belief that by freeing the marketing system all parts of the country will be serviced. Also by allowing direct sales of maize to millers by farmers both the transport and handling costs will be reduced.

Though it is too early to assess the performance of the new marketing arrangement, it is probably worthwhile to note that the marketing of maize in 1986 has been much better co-ordinated than the previous years. Payment to farmers for their produce has been fairly prompt and also almost 90 percent of the marketed maize has already been moved to safe storage. This is not to say that the new system has no problems. To the contrary, the system experienced some operational problems initially.

NAMBoard could not supply empty grain bags to Unions on credit as has been the tradition. This is because they were no longer associates but competitors. This caused considerable delays in the distribtuion of empty grain bags particularly in the remote areas where NAMBoard has no distributional outlets. Also, because the government had to pay a maize subsity to NAMBoard and Unions and not to other potential traders, the marketing activity remained restricted to NAMBoard and Unions. This problem has however, been resolved by ensuring that subsidy is only paid to Millers on the basis of their mealie meal production figures. This means that agricultural marketing institutions will not receive subsidy, instead they will charge economic prices for maize sold to millers. It is hoped that this arrangement will permit all interested parties to participate in the marketing of maize. And indeed, any other agricultural commodity.

Input Procurement and Distribution

The government has also made some policy changes with regard to the procurement and distribtuion of inputs particularly fertilizer and grain bags. The procurement and distribution of other inputs has aleady been decontrolled.

Under the new policy measure, NAMBoard will no longer be obligated to procure and distribute these inputs. Instead, it will compete with other interested traders. The idea is to spread the financial burden of procuring fertilizer and empty grain bags. It was also felt that those farmers or group of farmers should be allowed to import inputs instead of waiting for NAMBoard fertilizer which, in most cases, is either in short supply or distributed late.

Incentives

The government has also introduced the following incentives to enhace agricultural development:

(i) attractive producer prices,
(ii) a flat tax rate of 15 percent on income from agriculture,
(iii) development allowance for growers of tea, coffee and citrus fruits,
(iv) two years write-off period for farm machinery and equipment,
(v) withdraw of selective employment tax on incomes of expatriates engaged in agriculture,
(vi) exemption of customs duty on imported agricultural machinery,
(vii) foreign exchange retention scheme for exporters of agricultural commodities.

RESEARCH AND EXTENSION

A recognised critical input in the development of agriculture is the supply of the appropriate messages from research extension.

The Department of Agriculture has re-organised its research department where research has historically been carried out by disciplines. Under the new system research is carried out by Commodity Research Teams (CRT), Specialist Research Teams (SRT) and Adaptive Research Planning Teams (ARPT). Commodity Research Teams conduct applied agricultural research on a given commodity in order to generate new technology and build up a pool of knowledge (and expertise) on that commodity. Specialist Research Teams focus on the production and constraints of a given locality or farming system drawing on the pool of knowledge by the respective Commodity and Specialist Teams. The Adaptive Research Planning Teams are charged with developing a two way communication link between the Commodity and Specialist Research Team and the farmers or specific target groups with the involvement of extension staff at all levels.

Formal links between Research and Extension exist through various committees such as annual commodity research meetings which are attended by Extension Subject Matter Specialists. Besides these annual meetings, there are also a number of co-ordination meetings. The establishment of the post of Research-Extension Liaison Officer at the Headquarters of Agricultural Research and in all Adaptive Research Planning Teams based at the provincial level is aimed at strengthening this linkage and getting information following between the branches and farmers.

The Extension Services has also re-orientated its approach towards technology transfer. In the past progressive farmers were given priority. Now it is obliged to serve all types of farmers. However, due to the limited resources (both in terms of staff and infrastructure) emphasis is now directed towards the small scale grower because these are the majority of the farming population and lag behind in improved knowledge and technolgy. Because of this emphasis, the Department of Agriculture decided to introduce an intensive method of extension popularly known as the Training and Visit System (the T and V System). The Extension Branch has since been restructured, especially at the lower levels, in order to implement this new extension approach. Basically, the T and V System involves regular scheduled visits to contact farmer or farmer groups on pre-arranged days. These visits are also extended to the field staff group discussion, mobile courses, and demonstrations. Regular supervisory visits are made by senior staff to assist in solving farmers' problems and conducting courses or demonstrations.

CONCLUSION

All these reform measures mentioned above are intended to enhance the development of the agricultural sector. There is a firm conviction that given Zambia's endowments and level of technological development, the only logical path to a meaningful development is to start with agriculture.

CHAPTER EIGHTEEN

THE ROLE OF THE GRAIN MARKETING BOARD IN SERVING COMMUNAL FARMERS IN ZIMBABWE: A RESEARCH PROPOSAL

M.T. Muchero

INTRODUCTION

In the "managed" economies of today Government intervention in the field of agriculture is a recognised, if not entirely acceptable feature. Successive governments have intervened in a number of ways to assist agricultural producers in marketing their commodities. This intervention has assumed various forms, such as direct control on the marketing of commodities, the registration of producers, the licensing of farmers and other more indirect forms such as, import and export control on commodities. (GMB, 1959).

Government intervention in agricultural marketing is widespread in both developed and developing countries and public sector marketing agencies are accepted as a political imperative in most African countries (Child, Muir-Leresche and Blackie, 1985). This view is shared by Todaro (1977) in his discussion on agricultural and rural development when he states that the full benefits of small-scale agricultural development cannot be realised unless government support systems are created which provide the necessary incentives, economic opportunities and access to needed imputs to enable small cultivators to expand their output and raise their productivity. Zimbabwe is no exception to this generalization. Reacting to the needs and requests of large-scale farmers when world prices fell below production costs in the early 1930s, the Maize Control Act came into being, thereby, laying the foundations of the present Grain Maketing Board (GMB, 1959). The extent to which the benefits of marketing efficiences are achieved and passed on to farmers in the form of higher prices or reduced marketing costs depends in large part on the competitive structure of the marketing agencies (Mellor, 1974).

The development of efficient, low cost marketing systems is fundamental to successful agricultural development (Child, Muir-Leresche and Blackie, 1985). Through the provision of economic incentives and the stimulation of innovation (Mittendorf, 1981), such systems can be achieved. Some of the major issues that dominate any discussion of strategies for the development of more effective marketing systems include: the need to design marketing systems that are able to deal satisfactorily with the increased food supplies required to feed rapidly growing urban populations, the means by which the subsistence and semi-subsistence producers can be integrated into the marketing systems; and the effective use of pricing policies as an important stimulant of agricultural production (Mittendorf, 1981).

With respect to the first two issues described above, the research programme for my D. Phil dissertation at the University of Zimbabwe will concentrate on how the GMB can deal satisfactorily with purchasing surplus food from communal farmers and the integration of the communal sector, into the commercial economy. The third regarding pricing will be discussed only in the limited aspect of marketing costs incurred by producers. This brings me to my hypothesis which states that:

> The current structure of the Grain Marketing Board is not well adapted to service the demands imposed on it by the communal sector. This dissertation will examine options available for adoption by the Grain Marketing Board in its efforts to expand its marketing services to the communal agricultural sector.

ASSUMPTIONS

There are two main underlying assumptions in this dissertation:

First, controlled marketing answers a real political and economic need in Zimbabwe. The uncertainty of food production and the difficulties of trade in food in Southern Africa are such that governments are unlikely to gamble on private trading to supply the market. Governments of such different political persuasions and economic strengths as some developed western countries rely extensively on private sector investment in food marketing. Gsaenger and Schmidt have shown that, with low income and price elasticities of demand for maize, consumer welfare (particularly of low income groups) will fluctuate widely under free market conditions - an undesirable and politically destabilizing situation. Their analysis of the welfare effects of various stabilization schemes indicates that price stabilization are due to random shifts in supply. This is the case in Zimbabwe where maize production is highly influenced by annual variations in rainfall (Child, Muir-Leresche and Blackie, 1985).

Second, existing public food marketing agencies are not inherently inefficient. They have, however, been designed primarily to serve large farmers. It is the simple expansion of such agencies to serve small-scale farmers in recent years that underlies their poor performance in many countries. The efficiency of such agencies can be significantly improved if their design is altered in accordance with their functions. (Child, Muir-Leresche and Blackie, 1985).

It is noted that it is very difficult to change marketing systems that are well established, tried and trusted. It is not the intention of this dissertation to generate information on how to replace the GMB but to figure out how to help place more emphasis on communal producers and at the same time, operate at low cost.

The GMB is a producer initiated, single channel marketing system, which, in most years, has fulfilled its objectives of maintinaing national food self-sufficiency (Child, Muir-Leresche and Blackie, 1985). The Grain Marketing Board has effectively serviced the needs of the large-scale commercial farmers who were the founding force of the GMB system. Its whole structure has been built around and for use mainly by commercial farmers. The large concentration of GMB marketing facilites, or depots in these areas is evidence of its emphasis in that sector.

The second assumption refers to the simple expansion of existing government marketing agencies to cater for small farmer requirements as the main cause of poor performance by those agencies. Examples can be cited in a number of African countries which, on attaining independence, have simply expanded existing marketing systems to cater for small-scale farmers without making corresponding adjustments in the nature and structure of the marketing systems. The result has been poor performance.

Zimbabwe appears to be falling into the same trap as other African countries as experience in the first five years since independence appears to indicate. The purpose of this dissertation is to analyse the GMB marketing system and suggest changes in order to prevent the collapse of the system as has happened in many African countries.

Since independence in 1980, the government of Zimbabwe has concentrated on the preivously neglected communal sector. It places greater emphasis on the provision of adequate marketing facilities to service the communal sector. A number of senior government officials have stated during public addresses that GMB depots should be sited in such a manner that they service farmers within a small radius. This new policy aims at improving the standard of living in communal areas by way of, among other things, reducing the cost of marketing surplus produce. The current GMB marketing system is looked upon to provide such expanded serivce by simply extending further afield. Its present structure is not well adapted to service the new demands imposed on it by the communal agricultural sector. This is evidenced by the large increases in operating costs as more small depots are established. It is therefore necessary to examine the options available that can be adopted in expanding marketing services to the communal agricultural sector.

OBJECTIVES

The objectives of this study are to examine:

1. whether the present GMB marketing system can be sustained, firstly in the communal sector and secondly, in the large- and small-scale commerical sectors and communal sector, in view of its rapidly changing clientele.

2. whether the provision of marketing systems which are complimentary to the GMB system is a viable proposition

3. whether the provision of marketing systems which compete with the GMB are a practical solution to meeting the added demands.

To tackle the above issues it is necessary :-

a) to determine how much further the GMB can expand its facilities to service the increasing demands of the communal sector without losing efficiency in carrying out its duties and functions.

b) to condider what options exist which would allow for the expansion of existing facilities or the creation of alternative facilities to service the communal sector.

c) to determine the impact of economically feasible options on government objectives.

d) to determine which of these options are most acceptable politically

LITERATURE REVIEW

During the early part of the century colonial policies, as related to African grain production, changed in order to suit the settlers' requirements. In times of drought or war, African production was encouraged to augment shortfalls in settler production. In good times, government policies tended to suppress the African producer. The African producer was therefore viewed as an emergency supplier, otherwise considered not important in agricultural expansion and development in general. This view is explained by Tickner (1979) when he reports that as a result of food shortages during the Second World War, restrictive policies towards Afican farmers were relaxed and African agriculture received some encouragement. He goes on to say that, although some individuals in government service and some private white farmers continued to give suppport to African producers to remain in the market, the nature of structures that existed meant that African farmers were being steadily squeezed out of the market. Tickner (1979) records that whereas in 1955 Africans sold 30 percent of their agricultural produce, by 1970 this proportion had dropped to 19 percent.

Since independence, the government has placed greater emphasis on African, or communal agriculture. This was expressed clearly in its First Five Year Plan 1986-1990. In direct contrast to suppressive government policies of the first half of the century, this government views communal production as being the pivotal point around which the country's true development revolves. Tickner (1979) says that African producers need to be viewed not just as subsistence producers with peripheral interests in the market economy but more as producers who, if given the opportunity, can and would become more market orientated producers.

Tickner (1979) went on to say that communal producers often found it (and still do) in the majority of cases, uneconomic to compete in the market as they are limited by their own productive capacity, their consumption requirements, their proverty their inability to obtain finance and to benefit from economies of scale and technological developments as well as restrictive structures in marketing and transport. Uma Lele (1974) states that the goal of the marketing system must be to minimize costs of distribution, to reduce spatial and seasonal price flucutations and to handle efficiently the increased marketable surpluses emanating from expanding production. To be effective Lele (1974) continues, a market system must also reach a large number of farmers. A market organization that fails to do so, however well conceived, would not serve the purpsoe, either of reducing overall marketing margins or of providing an incentive price to boast agricultural production generally. Lele (1974) goes on to say that the effeciency of any market system, whether private, public or co-operative, cannot be increased unless the risk and uncertainty in marketing can be reduced by removing basic constraints such as poor transport, storage and processing facilites, poor market information systems, lack of standardisation of weights and measures and inadequate and/or poorly administered credit facilities. Given the production problems faced by communal products this dissertation is confined to market facilities constraint.

The policy of the Agricultural Marketing Authority (AMA) and its four constituent Boards prior to Independence was clearly stated that:

> "The Agricultural Marketing Authority recognises the key role which the provision of marketing services can play in the development of agriculture in areas remote from the main centres of development. However, its prime function is not to act as a development agency, but to ensure that farm produce is handled efficiently and at the least cost to the country, while ensuring that returns from sales are maximised. Our marketing institutions have played a key role in the development of Agriculture in Rhodesia, by pursuing this objective with single minded determination. It is the Authority's intention that this should remain its prime concern" (Tickner, 1979).

In practice, this policy has meant that African producers in remote (and hence expensive) areas have usually been poorly helped by the marketing authorities. The transportation system of roads and rail that exist predominantly in European areas, along with a payment structure to farmers that is based on the principle of farmers meeting their primary marketing costs to points of sale (which are mainly located at processing plants and points accessible to the transportation system) have meant that many African farmers have been disadvantaged in marketing their produce (Tickner, 1979).

THE ESTABLISHMENT OF THE GRAIN MARKETING BOARD

The first embryonic stage in orderly marketing was when a small group of maize farmers negotiated with the mines of Mazowe in 1909. Controlled marketing of maize and the provision of guaranteed markets and prices were taken more seriously beginning in 1931, a period of acute depression when world prices of maize fell below production costs. In 1936, the Maize Control Board was established in an effort to stabilize farm incomes and continued farm settlement. In 1957, the Maize Control Act was repealed and replaced by the Grain marketing act which promulgated the establishment of the GMB.

Functions and Duties of the Grain Marketing Board

The GMB has since evolved to perform the following functions:

a) to ensure the orderly marketing of controlled products;
b) to buy and sell any controlled product which is delivered to or acquired by it;
c) to provide storage, handling and processing facilities for controlled products;
d) to maintain stocks of controlled products as it may consider necessary;
e) to import and export contolled products as it may consider necessary.
f) to do such things whether in relation to a controlled product or not as may be required by the Minister of Lands, Agriculture and Rural Resettlement.

This dissertation will examine the structure of the Board in respect of its first three functions mentioned above as they relate to communal producers. In its early stages GMB facilities were situated on line of rail with the producer price payable at these centres to any producer. European producers were responsible for actual costs of transport, from the farm gate to line of rail, whereas African producers were called upon to bear an equalised transport deduction irrespective of their points of production. It is stated that this arose from the fact that the majority of African producers were unable to bulk and transport their products to line of rail and that arrangements had to be made for some organisation to undertake this task on their behalf (GMB, 1963). This gave rise to what are now known as Approved Buyers. The equalised transport levy was deducted from the producer price. In addition, an agricultural levy and handling charge were deducted. The levy, a form of agricultural taxation was employed for use in African development (GMB, 1963).

It its written evidence to the Commission of Inquiry into the Agricultural Industry in April 1981, the Agricultural Marketing Authority went into some detail describing the development of primary marketing services in Zimbabwe. The following is a brief account of the major issues raised.

THE DEVELOPMENT OF PRIMARY MARKETING SERVICES

a) Primary Marketing

The term primary marketing has been used in Zimbabwe to describe that marketing process from farm gate to central marketing depots. The term includes those other stages of marketing such as central storage, processing and distribution. Within the diverse structure of Zimbabwe's agricultural base there exists a disparity in the ability of primary agricultural producers to overcome the probleming of this primary marketing stage (i.e. bulking up of produce, identification of product, transport to central marketing depots). For many years debate has ensued as to where the responsibility to the GMB commences, the issue hinges upon the question as to whether the Board itself should fulfil a greater development role in conjunction with its marketing role. In recent years the option has favoured the board's assuming a greater level of responsibility at the developmental stage. As a result, policies have been established which envisage a far greater spread of market intake points throughout the country for certain categories of controlled products.

b) <u>"Line of Rail" Intake</u>

An elementary concept in the theory of comparative advantage lays stress on the significance of distance from the market in the level of remuneration to the producer of any pocket. The importance of this concept was not lost to the earlier policy màkers. The crucial importance of transport (which in earlier years was synonimous with the railways) in the marketing system, no doubt led to the adoption of the "line of rail" price fixing system for controlled products. Whilst this policy may have been satisfacotry in the initial stages of transportation development it probably presupposed that the rail network would have been enlarged to a far greater extent than has been the case.

c) <u>"Off Line of Rail" Intake</u>

In recent times, with the sharp increase in grain output, particularly in Mashonaland, certain areas have been confronted with major transportation and storage problems. This has led to a gradual erosion of the "line of rail" policy and several marketing depots have been established "off the line of rail". Initially the cost of transporting this grain to the line of rail was met by a direct government subsidy. From 1977 onwards those costs have been a direct handling charge to the Board.

With this development it was a short step to extend the marketing strategy. Accordingly in 1970 the government agreed to the adoption of a policy which has the long term objective of providing marketing depots throughout the country on an intensive scale. The concept of this policy is that ultimately no producer should have to travel more than sixty kilometres in order to deliver his product. This move would obviously lead to pressure from various producer interests for the establishment of depots within their area of interest. Therefore it has been necessary to devise certain criteria for determining relative priorities. Such criteria require that a locality should already be a significant producer of particular controlled products and have the potential to increase its output.

MARKETING IN MALAWI

The marketing system of commodities in Malawi is similar in some ways to that of the GMB of Zimbabwe. In Malawi the Agricultural Development and Marketing Corporation (ADMARC), is charged solely with the responsibility of purchasing agricultural produce from smallholders. Other organizations in the private sector particpate in the trade of commodities produced by commercial farmers. There are four agricultural produce marketing channels in Malawi.

a) ADMARC, as a public enterprise buying from smallholders;
b) estates or commercial producers selling directly to mills and export markets;
c) private traders or middlemen, who are licensed by ADMARC to buy and sell to ADMARC; and
d) the farmer himself disposing his produce through the local markets in small lots (Paper 2, 1985).

In 1984, ADMARC had 74 main storage depots/markets for the various crops, supplemented by over 1020 seasonal produce-buying centres. These systems of buying centres and buying agents or private traders are in use by these countries so far considered, Kenya, Malawi and Zimbabwe. But Malawi's use of the buying centres is much more pronounced. Therefore a system deserving greater scrutiny as a method of expanding market outlets. Malawi's two tier agricultural marketing system, namely the estate sub-sector which operates under the framework of free marketing and price determination and the smallholder sub-sector which operates through ADMARC, is unique (Paper 3, 1985) and very valuable to this dissertation.

MARKETING IN KENYA

The marketing system for agricultural commodities in Kenya is similar to that of the GMB. The Kenyan marketing system in Zimbabwe was set up in the 1930's to serve both domestic and Second World War requirements. With the passage of time this system expanded, and modified to handle a wide range of commodities (Paper 1, 1985). One of the government objectives is to ensure socio-economic and political stability. In order to achieve these goals, certain control measures were applied on essential foodstuffs and export crops. As in Zimbabwe, these include the provision of secure outlets for specified farm produce (Paper 2, 1985). In Kenya, the National Cereals and Produce Board (NCPB) is charged with the responsibility of purchasing and selling maize through its own buying centres as well as through agents. The only difference between the NCPB and the GMB is that the former is a buyer of last resort whereas the latter is the sole buyer of surplus produce. The NCPB, however, controls maize purchases by issuing movement permits to traders (Paper 1, 1935). All in all, therefore the NCPB deals in direct competition with traders.

In my research, I shall study Kenya's experience in food marketing and its relevance to the GMB of Zimbabwe.

MARKETING IN TANZANIA

The marketing system in Tanzania is somewhat different to those briefly described above. In Tanzania, Cooperative Unions play a major role in purchasing buy crops from the farmers through primary cooperative societies. The crops are then resold to other institutions, but principally to the National Milling Corporation (NMC) (Paper 4, 1985).

MARKETING IN ZAMBIA

In Zambia the National Agricultural Marketing Board (NAMBOARD) operates side by side with Cooperative Unions and its own registed traders. In deficit provinces, Cooperative Unions have a monopoly in terms of purchases of grains from farmers. Each NAMBOARD depot serves producers in a 25 kilimetre radius. Produce is bought and collected from the farm gate. Should the farmer opt to deliver for himself he gets paid for the transpoort at government fixed rates for the distance travelled up to a maximum of 25 kilometres.

SUMMARY

This paper presents a preliminary statement of my proposed research programme. I shall be grateful for comments from readers at this early stage of my D. Phil dissertation research in the Department of Agricultural Economics of the University of Zimbabwe.

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