ANALYSIS OF WHEAT PRICING POLICY

IN ZIMBABWE

by

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ABSTRACT

In Zimbabwe, wheat is the principal crop planted in winter occupying about 95 percent of winter planted acreage, it is also one of the most tightly regulated of the controlled crops. Even though Zimbabwe's wheat industry is well developed by regional standards, domestic production has not kept pace with demand making imports necessary, draining scarce foreign exchange and heightening concerns about national food security.

The study has reviewed how pricing policy has to date affected production and consumption trends of wheat. Three forms of policy intervention have been identified in the wheat industry in Zimbabwe:

- The producer price of wheat is consistently set below the world price.
- A subsidy on imported wheat to the millers is maintained in order to keep the consumer price of wheat and wheat products low.
- The government through foreign currency controls limit the amount of wheat that can be imported into the country.

Using a Nerlovian Dynamic Supply Response Model the price supply elasticity of wheat in Zimbabwe was estimated, and used to construct a model of the wheat industry. The results of the model were then used to evaluate the impact of different policy interventions on wheat production, through policy simulation.

Government policy in Zimbabwe taxes wheat producers while subsidising the consumers, thus current policy acts as a

disincentive to increased output supply on the one hand, while it encourages increased demand on the other. Although studies from other countries show that wheat production is responsive to price incentives, the results of this study however show a very low short run price responsiveness (0.11). Thus raising producer prices, without redressing all the other factors affecting wheat production such as cost and availability of irrigation facilities, prices of substitutes etc, would have limited impact on total production.

This study quantified the welfare effects and foreign exchange costs of current and alternative policy scenarios. Current policy in the wheat industry taxes the producers in excess of $39 million which is partly transferred to consumers and partly to government as revenue. Imports cost the country about $33 million in foreign currency in addition to a consumer subsidy of $4 million. The study also showed that uncompensated losses accounted for $1.08 million.

The question for Zimbabwe is how to create the necessary conditions to increase price responsiveness, i.e what policy changes are necessary to increase total supply of wheat. The overall conclusion is that there is not a simple low cost option to redress the situation in the wheat industry in Zimbabwe. The situation calls for a review of all the policy instruments currently in place, in addition to external factors such as the world price of wheat.

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I dedicate this thesis to the memory of my brother Kennedy Masawi, may he rest in peace.

In Almighty God we trust.

CHAPTER 1

1.0 INTRODUCTION

Rapidly increasing demand in Zimbabwe for wheat products, particularly bread, has generated interest in wheat production and consumption policies. Agricultural policymakers face the problem of how to bridge the gap between local production and demand of wheat as shown in figure 1. Zimbabwe now imports wheat, resulting in a drainage of scarce foreign currency thereby heightening concerns about national food security. An important question in the food security debate is whether or not wheat production should be expanded. Zimbabwe's population growth rate is estimated at 3.6 per cent per annum which is among the highest in Africa. The net effect is that the Zimbabwe population will double over the next twenty years. The average annual growth in volume of production in the 1980s was 2.6 percent for food compared to 3.8 percent for non-foods. Productivity gains in food production have therefore been more than offset by population growth.

The threat of food shortage is further compounded by the fact that since 1982 the economy of Zimbabwe has experienced a downward trend as a result of a combination of internal factors such as a high population growth rate, and the drought, besides external factors. The global recession and certain overseas policies have reduced the demand for Zimbabwe's exports, depressing foreign currency earnings, and increasing the country's balance of payments deficits leaving Zimbabwe with the need to limit its dependence on imports.

Similar to the situation in many tropical countries, wheat has become a staple food in Zimbabwe, especially for urban consumers. Wheat consumption has increased as a result of consumers' rising incomes and interest in convenience foods and the desire for a more diversified diet. Longmire and Byerlee[1] have estimated per capita consumption of wheat at 16 kilograms per year for Sub-Saharan Africa. More importantly, governments have encouraged the consumption of wheat and wheat products through favourable pricing policies for bread. Government supported large scale investments in capital intensive milling and baking industries, have also helped expand demand for wheat.

Wheat is mostly grown by large scale commercial farmers who are sensitive to profitability considerations. This feature of the commercial sector makes it especially important that policymakers get prices right in establishing agricultural production priorities. Studies on wheat production in Zimbabwe (Longmire et al 1986)[2], and studies on wheat production in the tropics, such as CIMMYT publication on "Wheat in More Tropical Environments"[3] put low profitability as the major constraint to wheat production, making pricing a major concern in considering the problems of increased wheat production.

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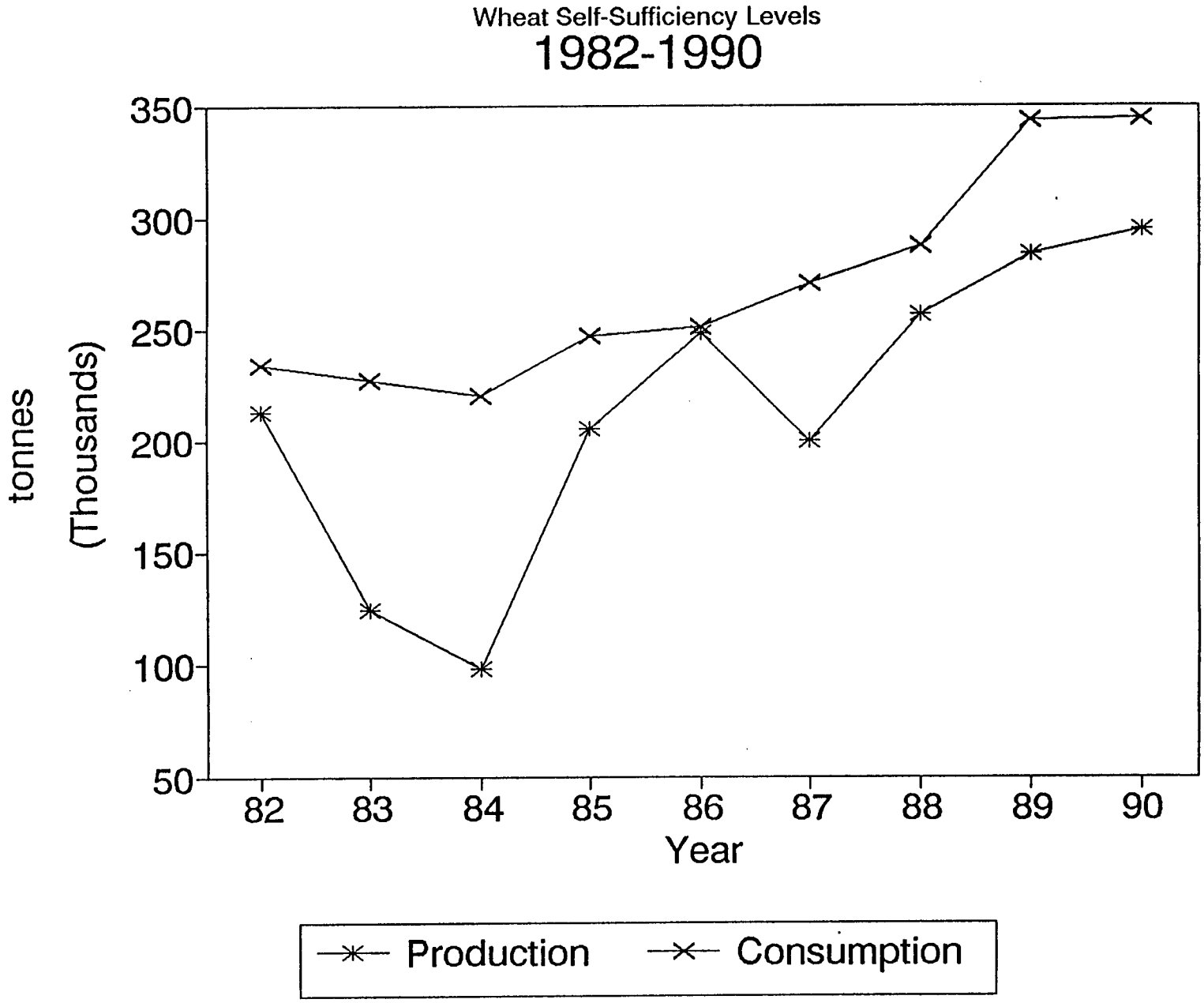
[1]Byerlee D.and J. Longmire "Wheat in the Tropics Whether and When" CIMMYT, Mexico (1985)

[2] Longmire P., P.Ngobese, S. Tembo "Wheat Policy Options in Zimbabwe and SADCC Countries" (1986)

[3] Byerlee D "Wheat in Tropical Environments" CIMMYT Economics Program, Mexico (1985)


Wheat Self-Sufficiency Levels
1982-1990
tonnes
(Thousands)
350
300
250
200
150
100
50
82
83
84
85
86
87
88
89
90
Year
Production
Consumption

1.1 Study Objective:

This study will therefore review how pricing has to date affected production trends in the wheat industry, how the same pricing policy if maintained will affect the industry in the future. Finally, the effects of alternative policy options facing the wheat industry in Zimbabwe, will be simulated for their impact on producers and consumers, government revenue and foreign currency.

The following questions will be addressed

- How does the agricultural pricing policy in Zimbabwe affect wheat production and consumption?
- What policy changes are necessary to resolve the "food policy dilemma" which stems from the conflict of interest between the producers and consumers?

1.2 Methodology:

In order to achieve the objective of this study, the price supply elasticity for wheat in Zimbabwe will be estimated, which will be used to construct a model of the wheat industry in Zimbabwe. The results of the model will be used to evaluate the impacts of different policy interventions on wheat production. I will not estimate the demand elasticity but I will use estimates from other studies. Sensitivity analysis will be used to explore the robustness of the policy analysis to elasticity values.

1.3 Research Procedure

Chapter 1 covers the introduction, the problem statement

and the objective of the study. Chapter 2 provides the background to the agricultural sector in Zimbabwe, the geo-physical and agro-ecological regions, the climate and the crop production.

Chapter 3 reviews agricultural pricing policy and price setting procedures. Land distribution and its policy implications will also be discussed in this chapter.

Chapter 4 deals with wheat production and the policy options for wheat in Zimbabwe. This is followed by a review of relevant literature on wheat in the tropics and more specifically on wheat production in Zimbabwe.

Chapter 5 provides the empirical model and the data used in this study. This is followed by the results of the estimation, and their implications.

Chapter 6 provides policy simulation based on the results of the study, provides conclusions and offers recommendations for future research.

CHAPTER 2

2.0 CROP PRODUCTION IN ZIMBABWE

2.1 The Role of Agriculture in Zimbabwe

Agriculture is the backbone of Zimbabwe's economy, with more than 70 percent of the population dwelling and deriving their livelihood in this sector. The growth of the economy is largely conditioned by the performance of the agricultural sector which, in addition to providing more than 90 percent of the food requirements of the society accounts for 41 percent of total merchandise exports and contributes more than 25 percent to the GDP, making it the largest contributor after manufacturing. It is also the largest employer of labour, providing about 30 percent of total formal employment.

The agricultural sector in Zimbabwe comprises three main sub-sectors, namely

Large Scale Commercial Sector (LSC)

Small Scale Commercial Sector (SSC)

Communal Farming Areas (CFA).

The LSC comprises about 5 400 farmers mostly white. This sector occupies 4.8 million of the 8.6 million hectares potential arable land. Land ownership in this area is under the free hold system. The SSC sector occupies the former African Purchase

areas[4] and comprises about 9 000 black farmers occupying 1.4 million hectares of which only 0.5 million hectares are potentially arable. The majority of this area is under free hold system with a small area still in the lease hold phase.

The CFAs cover 16.4 million hectares of land with only 3.3 million hectares arable. The area has the country's highest population density with 700 000 black families living here. Land is held under the traditional tenure, i.e occupants have the right to use but do not hold title deeds.

2.2 The Geo-Physical and Agro-Ecological Regions

Situated in tropical Southeastern Africa, Zimbabwe's principal geologic feature is a broad plateau that forms an elevated savanna region, or highveld through the centre of the country. Lower plateau regions on either side of it slope to three river basins: the Zambezi on the northern border, the Limpopo in the South, and the Sabi in the Southeast.

Zimbabwe as shown in the map (fig 2) is marked by four regions defined primarily in terms of relief or altitude but associated in varying degrees with bio-climatic zones. The first of these is the Highveld, land between 1 200-1 500 metres extending through the centre of the country from southwest to northeast. The second region, land between 900 and 1200 metres is the Middleveld. As the descending plateau approaches the

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[4]African Purchase Areas Land set aside for purchase by Africans who wished to own land

northern and southern borders marked by the Zambezi and the Limpopo rivers, it becomes the Lowveld, land under 900 metres. The most extensive area of Lowveld lies in the Limpopo and Sabi basins. The land here is gently undulating with areas of agricultural potential, limited mainly by the absence of water. The fourth region consists of the eastern highlands, which are mountainous in contrast to the plateau that characterises the rest of the country. These factors therefore are key influences on the availability of water, the types and patterns of vegetation and the spatial distribution of agro-ecological zones.

Zimbabwe is classified into five main "agro-ecological" or "natural regions", wherein agricultural development is conditioned by a variety of dominant natural characteristics. This agro-ecological classification provides a good guide to the natural factors governing agricultural production. Natural regions I, II and III are dominated by LSC farmers producing cereals such as maize, wheat, sorghum and barley in addition to tobacco,cotton,oilseeds (groundnuts, soybeans and sunflower). Most Communal farming is confined to natural regions IV and V, with maize, tobacco, cotton and groundnuts as the main crops.

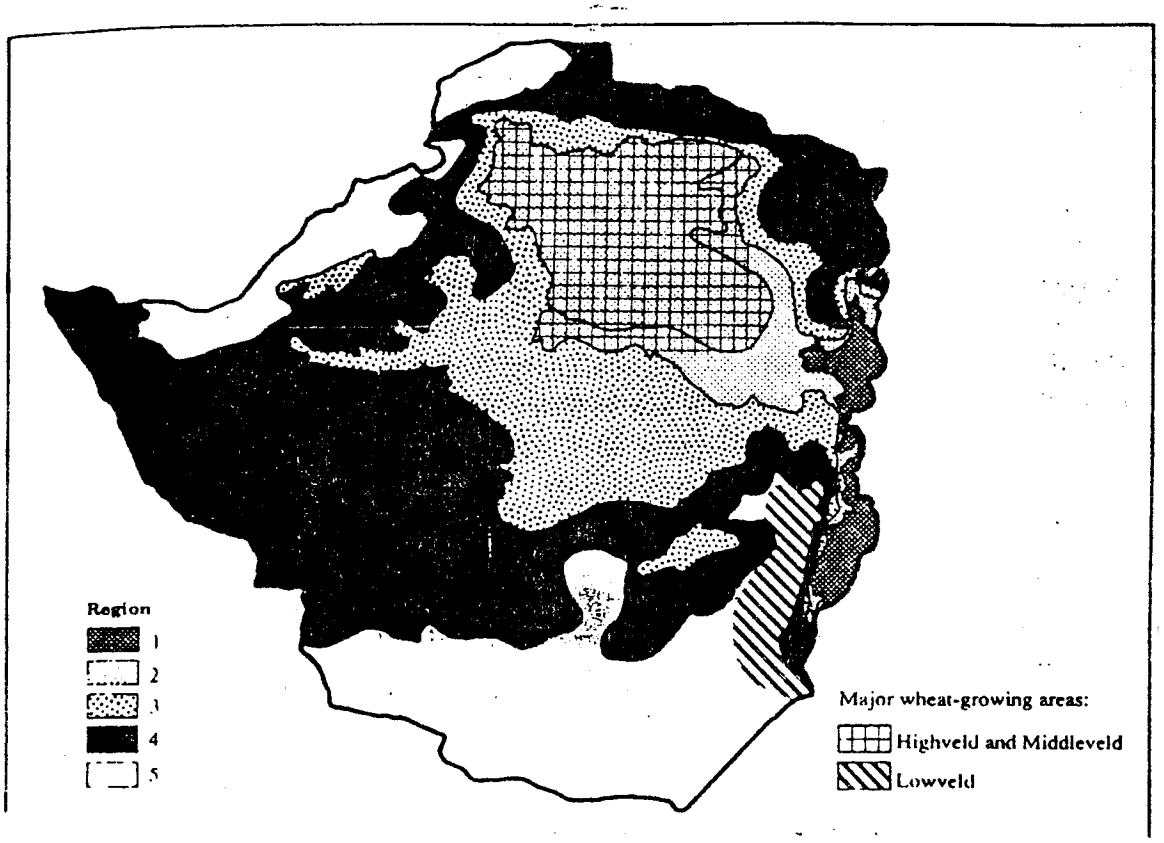
2.3 Climatic Conditions:

Although Zimbabwe lies within the tropics its altitude, relief and inland location modify the climate to create sub-tropical conditions over most of the country. The Highveld is cool while the Middle and Low velds are warm to hot during most

of the year. The Eastern Highlands experience cool humid conditions and good well dispersed rainfall. Agricultural conditions are controlled by seasons. The cool dry season late May to mid August is a period of dry weather. Wheat may be grown under irrigation during this period, but low night temperatures and an almost total absence of rainfall prevent dryland cropping. The warm dry season mid August to late October is marked by a rise in temperature. The rainy season late October to late March varies considerably in character over the country.

The type and distribution of rainfall is a major natural limitation to agricultural development. Much of Zimbabwe has a dry climate. The infrequent rainfall comes in heavy storms which cause severe erosion. The areas with the most fragile ecosystems suffer from both the drought and the rainfall variability, and only 8 percent of seasonal rainfall contributes to the annual stream flow. This small amount supplemented by limited amounts of groundwater provides the total national supply.

Fig 2 Agro-ecological Regions of Zimbabwe



Source: Morris M.L. "Comparative Advantage and Incentives for Wheat Production in Zimbabwe" CIMMYT Economics Programme, Working Paper

2.4 Crop Production in Zimbabwe:

Crop sales to the government marketing agencies from 1980 to 1990 are shown in Table I. Maize is produced by the majority of the commercial farmers and by all the communal farmers, except in the southernmost parts of the country where more drought tolerant millets are predominant. Production of maize has on several occasions approached 3 million tonnes, although production variability is high because most of the crop is grown under rain fed conditions. After maize the most important crops in quantitative terms are cotton, wheat, tobacco, soyabeans and groundnuts all of which are grown on both commercial and communal farms, except for wheat which can only be grown under irrigation and is grown only by the commercial farmers.

Despite the fact that communal farmers are entering the market in increasing numbers, most commercial agriculture in Zimbabwe is still in the hands of the Large Scale Commercial farmers featuring high levels of input use, extensive mechanisation and high levels of management.

Table I Production of Principal Commercial Crops

1980-1990

Year	Maize ('000t)	Wheat ('000t)	Cotton ('000t)	Tobacco ('000t	S/beans ('000t)	G/nuts ('000t)
1980	2 813.2	207.9	157.6	120.0	97.4	77.7
1981	2 728.6	228.2	170.6	69.4	72.9	118.8
1982	1 785.8	251.1	134.9	89.2	91.6	111.4
1983	844.0	204.7	146.5	94.0	80.6	32.8
1984	1 283.0	207.2	221.7	116.9	98.7	25.9
1985	2 952.0	176.6	274.2	107.0	87.2	66.7
1986	2 486.0	189.0	247.2	84.0	72.4	73.2
1987	958.0	241.9	237.0	84.0	94.8	75.7
1988	2 034.0	245.5	323.3	84.0	120.4	87.9
1989	1 196.8	262.5	261.4	101.0	121.0	65.6
1990	1 165.6	242.2	224.7	n.a	108.0	77.2
%growth rates	-41	16	42		9	-1

* g/nuts - groundnuts, s/beans - soybeans

Source: Agricultural Marketing Authority (various issues), Morris L.M. Comparative Advantage and Policy Incentives for Wheat Production in Zimbabwe CIMMYT working Paper

2.5 Agricultural Pricing Policy Objectives

In its Transitional National Development Plan (1981-1985) the government outlined the main objectives of the agricultural sector as;

- achievement and maintenance of food self-sufficiency to ensure food security,
- extension of the role of the agricultural sector as a major foreign currency earner,
- a greater degree of economic security and welfare for the majority of the population who live in the rural areas.

There is no formal statement of national objectives specific to the wheat industry but it is assumed that the objectives which relate to the wider issues of national food security, foreign currency earning and improved welfare also relate to the wheat industry. It is on the basis of these agricultural objectives that the pricing policy is designed. Agricultural pricing in Zimbabwe is highly interventionist, with the producer and consumer prices of most major products being administratively determined. Thus the government uses pricing mechanism to influence production, consumption and marketing trends in the agricultural sector.

At the heart of the pricing policy is the central role played by the price of maize, because of its weight in consumer expenditure and the high proportion of land and other productive resources dedicated to it by producers. To a considerable

extent the price levels of most other crops are determined in relation to the price of maize.

This interventionist policy framework dates to the 1930s, and was part of government effort to provide producers with a framework of predictable prices to facilitate investment and planting decisions. After independence 1980 the objectives of price policy were reviewed to include:

i) provision of food for consumers at moderate prices,

ii) promotion of the agricultural industry in the Communal areas,

iii) restraint of the growing budgetary cost of agricultural intervention,

Clearly there are conflicts within and among some of these objectives. For example the need to restrain the budgetary cost of agricultural intervention conflicts with the desire for food security stock holding and also with expansion of the rural network depots designed to encourage production by making marketing facilities accessible.

Because Zimbabwe's pricing policy is a holdover from the colonial era, in which it was designed to serve a small agricultural elite; present pricing policy is not necessarily optimal from an efficiency, equity or budgetary standpoint. The level of prices has had an important effect on resource allocation and has historically always favoured the LSC farmers. This problem is over shadowed by an even greater conflict. Providing producers with the necessary incentive to produce by raising the

level of their incomes conflicts with provision of food for consumers at moderate prices especially at a time when the economic situation in the country is forcing the government to reduce consumer subsidies. This is the core of the conflict of interests in agricultural policy in Zimbabwe.

2.6 Price Setting Procedures:

Producer and consumer prices for the commodities handled by the marketing boards are set annually by the Cabinet on the basis of submissions from the Ministry of Lands Agriculture and Rural Resettlement (MLARR) which is itself a result of a complex process of analysis and lobbying. The lobbying starts with the Agricultural Marketing Authority (AMA) perspective of the marketing boards, and the Joint Presidents Agricultural Committee (JPAC) of the three farming unions. MLARR reviews the submissions with particular attention being paid to likely stock levels at the close of the marketing year, expected intake, domestic demand, export opportunities, and in respect to wheat the price and quantity of imports. Cabinet makes the final decision and the prices are effective for a year starting April 1. The process of price negotiations is subject to restrictions of confidentiality. It is possible however, to make general observations on the interplay between the different interests. In the great majority of cases, the final prices announced are identical with or very close to the recommendations of the MLARR. It is therefore justifiable to say that the

pricing procedure is really based on the MLARR price analysis, which applies the following criteria[5]:

i) cost of production which is used to assess the likely effect of a given price on farm profitability, and the likely supply response in the following year,

ii) supply and demand conditions, and stock levels are taken into consideration with relative prices between crops being given considerable attention,

iii) year-to-year variability of producer prices is considered with the goal that producers' price levels be predictable to facilitate decisions on investment and cropping patterns.

Reviewing the criteria employed during the process of setting administered prices highlights some strengths and some weaknesses of the system. A strength of the system is that on a consistent basis it involves the main participants in the industry, allowing intensive discussion at both the technical and political levels. At its best it provides the mechanism for explicitly identifying conflicting objectives and enabling compromises to be arrived at. The continuity of the system also builds on institutional knowledge to a considerable extent. There are three principal weaknesses in the present analytical approach to price determination.[6]

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[5] Takavarasha T. and A. Rukovo "Food Security Issues and Challenges for the 1990s". In Mandivamba R., Mudimu G and Jayne T,eds. Food Security Policies in the SADCC Region (1990)

[6] Ibid

- First is the lack of well-based estimates of price elasticity for the main crops.
- Second, the food security and income implications of alternative price levels are not systematically drawn out. Price analysis tends to be based on crop specific budgets without sufficient attention being paid to the farm or household context.
- Thirdly, the MLARR do not have the means at their disposal to carry out research on the impact of alternative price levels on important variables such as supply and demand of the commodity, income distribution, public and private stocks levels and on the financial position of the marketing Boards.

In general, agricultural pricing policy since Independence has created an incentive structure for producers that is broadly consistent with the type of structural change in agriculture that government sought. Efforts by Government to promote diversification in production patterns towards higher value export crops appear to have been reasonably successful as far as the commercial farming sector is concerned.

Those prices controlled by government have not generally kept pace with inflation, with the result that the real value of output prices has been falling. Since many of the major commercial crops are close substitutes in production, commercial farmers are able to shift from one crop to another. Therefore, relative price ratios have a large impact on output decisions.

2.7 Land Distribution: Policy Implications

To be effective any agricultural policy in Zimbabwe has to take into account the political and economic implications of the historical perspective of land distribution, a factor which among other things explains why despite the fact that communal farmers have entered the market in increasing numbers since independence, most commercial agriculture in Zimbabwe is still in the hands of the Large Scale Commercial farmers. It also explains why alongside this highly successful commercial sector, featuring high levels of input use, extensive mechanisation and high levels of management, exists an impoverished peasant sector. The performance of Zimbabwean farmers is highly impressive even by international standards. During years of adequate rainfall, yields on commercial farms rival those achieved anywhere in the world, and Zimbabwe's two major export crops tobacco and cotton usually command quality premiums on world commodity markets.

The distribution of land in Zimbabwe is highly skewed in favour of the white minority and, therefore, has been an especially controversial issue throughout the country's history. Preferential land policies for white settlers were an integral part of colonial policy which persisted until independence. During the war for independence land redistribution was an effective rallying point for the Nationalist forces, so that at independence expectations for redistribution were very high.

The land policies before independence led to the European

area being expanded through appropriations[7], until it came to encompass a substantial portion of the granite based light sandy soils and a large portion of the more fertile loams in the country's Natural Regions I,II and III. The country's black population was pushed further into Natural Regions IV and V, marginal areas with the poorest soils,and prone to drought. In the late 1970s the whites in Zimbabwe held 62.6 percent of the land suitable for specialised farming and 73.8 percent of the land best suited for intensive crop and livestock production.

Policymakers face the dual objectives of attempting to redistribute the land and other resources equitably, while maintaining the high level of productivity needed to sustain development in the sector. The two major issues regarding land that policymakers face are:

i) the extent and pace of land redistribution,

ii) identifying the means for transferring land that minimises economic and social disruption.

To date only 162 000 families have been resettled compared to more than 666 000 families identified at independence in 1980[8].

In attempting an equitable distribution of economic resources the government has deliberately kept the prices of those crops grown by the LSC at lower prices than those grown by the peasant sector. So the price of wheat has been kept low

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[7] Auret D "A Decade of Development Zimbabwe 1980-1990" The Catholic Commission for Justice and Peace in Zimbabwe (1990)

[8] Thompson Publications Zimbabwe "Zimbabwe A Field for Investment 1989/90" Department of Information (1990)

because of government fears that a high price to the wheat producers may be seen to be a continuation of the colonial policy to favour the white farmers. Therefore, until the land question is resolved or the government has invested in irrigation in such a way that some peasant farmers can also grow wheat the pricing policy will continue to disadvantage wheat.

CHAPTER 3

3.0 THE WHEAT INDUSTRY IN ZIMBABWE:

3.1 Development of the Wheat Industry in Zimbabwe:

As in most of Africa, wheat is assuming greater importance in Zimbabwe because of rapidly increasing demand. However Zimbabwe is one of the few African countries that grows significant quantities of its needs. Wheat was introduced in Zimbabwe in the 19th century by the European missionaries. A sizeable industry only developed in 1965 as a result of Unilateral Declaration of Independence (UDI)[9] which reduced commercial grain imports and precipitated the need for self-sufficiency in basic cereals. In 1965[10] only 4 000 tonnes of wheat were grown in the country meeting only 4% of total requirements. The nation's 2000 commercial farmers responded to the challenge in remarkable fashion, creating a viable wheat industry within a short period.[11]

Wheat is the principal crop planted in winter, occupying about 95% of the winter planted acreage. Other crops grown on a smaller scale are barley, oats and winter legumes. The summer crops grown in rotation with wheat are maize, soyabeans and

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[9] UDI Unilateral Declaration of Independence

[10] Rukuni M. "The Development of Zimbabwe's Agriculture 1890-1990" Working Paper 7/90 Department of Agricultural Economics and Extension, University of Zimbabwe (1990)

[11] Grain Marketing Authority Report and Accounts : Year ending March, 31 1990, Harare, Zimbabwe

cotton. The study carried out by Longmire et al showed that maize was the principal summer crop grown in rotation to wheat.

Several factors made the development of a domestic wheat industry possible. First, climatic conditions, i.e the cool winters, in Zimbabwe are generally favourable for irrigated wheat. Irrigation also makes yields quite stable. The national average yields are among the world's highest[12] at 4.5 tonnes/ha in the Lowveld and between 5.5 and 5.7 tonnes /ha in the Highveld where temperatures are lower. Whereas much of Sub-Saharan Africa is too hot for wheat, the Middleveld and Highveld of Zimbabwe have temperatures ranging from 0-20°C, well within the limits tolerated by wheat. Rainfed wheat in the summer is constrained by excessive heat and disease. Small amounts of wheat are grown at Kairesi range in the Eastern Provinces where the Research and Specialist Services are experimenting with summer rain-fed wheat varieties.

Second, the similarity in production technologies between wheat and other crops grown in Zimbabwe made it relatively easy for commercial farmers to shift into wheat, while Government policies created strong incentives for commercial farmers to take up wheat production. In the later half of the 1960s, producer prices for wheat were maintained above import parity prices, and subsidised credit programs were introduced to promote wheat production. Zimbabwe's success in wheat is also

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[12] Agricultural Marketing Authority Economic Review of the Agricultural Indusrtry of Zimbabwe (1989)

attributable to excellent research. The varieties most suitable are the dwarfs and semi-dwarfs, all developed within the country. Continuing research is essential, because the threat of rust limits the use of each variety to a period of 3-5 years only.

Previous governments stimulated interest in wheat growing since 1965 by establishing high producer prices, well above import parity. At first most of the wheat was grown in the Lowveld on irrigated land developed by the Sabi-Limpopo Authority. However farmers in the highveld assisted by long term low interest loans from the government, invested in irrigation and highveld wheat production increased. Higher yields than in the Lowveld were achieved. Producer prices levelled off and decreased in the early 1970's as they became aligned to Highveld rather than Lowveld production costs. Production in the Lowveld decreased as more land was planted to crops such as sugar and cotton with higher returns. The government raised the producer price by the end of the 1970's to compensate for escalating input costs but it was kept below the border price.

Zimbabwe is a high cost producer relative to world prices.[13] Capital costs of establishing a new irrigation scheme for 1987 were estimated by the Commercial Grain Producers Association at $1 600/ha, 317 percent higher than in 1977. In the meantime operating costs have also risen steeply so that

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[13] Report of the Commission of Inquiry into the Agricultural Industry under the Chairmanship of Professor Gordon Chavunduka (p. 41)

some established wheat producers have chosen to cut back production. This implies that while demand for wheat will continue to grow as a result of increased urbanisation, domestic supply will decrease even further.

3.2 Wheat Production and Consumption Trends:

Consumption of wheat and wheat products has grown even more rapidly than domestic wheat production (Table 2). Total consumption tripled in the past two decades, and per capita consumption doubled. The forces underlying this rapid increase in consumption are similar to those found elsewhere in the Sub-Saharan region, and in much of the developing world, such as rising incomes, increasing urbanisation, changes in consumer tastes and preferences. More importantly is the relatively low prices of wheat compared to the prices of traditional staples.

In 1970 Zimbabwe reached self-sufficiency and even exported small quantities, but this was short lived. In the following year unprecedented increase in the demand for wheat products coupled with a bad rainy season resulted in total import requirements of upto 85 985 tonnes. Self-sufficiency has eluded the wheat industry with imports peaking at 121 495 tonnes during the drought in 1984.

The government controls consumption of wheat through rationing. The millers speculate that demand for wheat could be 25-30 percent more without rationing. The Grain Marketing Board (GMB) has predicted that consumption of wheat could easily

exceed 320 000 tonnes per year without rationing. This proved to be an under estimate since sales for 1987 with rationing were 333 319 tonnes. The Agricultural Marketing Authority (AMA) has predicted that by the end of this century Zimbabwe could be consuming as much as 500 000 tonnes of wheat per annum.[14]

The GMB has consistently run a deficit on its wheat account amounting to a peak of Z$95.52/t in 1988/89. The wheat trading deficit accounted for 21 percent of the Board's total trading loss between 1981-1989 marketing years.

There is a lot of support for Zimbabwe to continue growing wheat even from the influential Report of the Commission of Inquiry into the Agricultural Industry under the Chairmanship of Professor G.L.Chavunduka which has recommended that production of wheat in Zimbabwe makes a good deal of sense. The major considerations being the need to conserve foreign currency and the unreliability of external transport. Also of great importance is the complementary nature of wheat in farm operations, since it is produced in the winter, an otherwise slack period. Thus labour can be more fully utilised around the year and development of irrigation will improve crop production since the water can also be used to supplement for moisture in summer crops.

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[14] Agricultural Marketing Authority Grain Situation and Outlook Report , various issues 1970-1990

Table II Wheat Production and Consumption Trends

1977-1990

Year	Area (ha)	Prod'n (t)	Yield (t/ha)	Cons'n (t)	per cap Cons(t)	Imports (t)
1977	36 138	141 300	3.91	191 701	19.17	50 401
1978	37 881	161 752	4.27	221 655	21.43	59 903
1979	41 599	182 620	4.39	189 657	24.39	7 037
1980	41 834	207 915	4.97	221 681	28.79	13 766
1981	41 872	228 202	5.46	250 031	30.30	21 829
1982	44 132	251 111	5.70	272 111	30.97	21 000
1983	37 904	204 682	5.40	307 432	29.38	102 750
1984	36 042	207 242	5.79	328 737	27.57	121 495
1985	32 707	176 618	5.4	219 134	29.83	42 516
1986	32 878	189 049	5.75	210 702	29.69	21 653
1987	44 808	241 963	5.41	333 319	31.62	91 356
1988	43 067	245 482	5.71	309 514	32.86	64 032
1989	46 298	262 510	5.68	300 267	38.36	37 757
1990	49 321	242 166	4.92	295 916	37.39	53 750
	36.5	71	25	54	95	6

* - percentage growth rates period 1977-1990

Source: Agricultural Marketing Authority of Zimbabwe Grains Situation and Outlook Report various issues period 1970-1990

3.3 Policy Options for Wheat in Zimbabwe

Wheat along with soybeans, is among the most tightly regulated of the controlled crops in Zimbabwe. LSC farmers who are responsible for 95 percent of all production sell directly to the Board, and with milling being exclusively on a large industrial scale, wheat is almost wholly marketed through a single channel from the producer through the board to the millers and then to consumers through the wholesale and retail network.

Previous studies have concentrated on policy options for the wheat industry. The study by Jim Longmire et al[15] outlines three basic options to meet the growing demand for wheat in Zimbabwe, vis;

- expansion of wheat production,
- adoption of policies to slow down consumption growth,
- continue to import wheat.

Zimbabwe has learned from other developing countries the problems of allowing food imports to build up during the "good years" i.e the years of high export returns the author assumes that within the current economic situation of Zimbabwe the government will not adopt the policy to import unlimited quantities of wheat. Currently most wheat imports have been arranged as barter or triangular swap arrangements for maize

[15] Ibid

being sent as food aid to other African countries e.g Mozambique. In good rainfall years there is no problem in this arrangement because of the excess maize. The problem arises in drought years in which the government can not raise the necessary excess maize to barter and the scarce foreign currency has to be used to import maize which is the staple.

The adoption of policies to slow down growth of wheat consumption has political repercussions which may make governments reluctant to implement it. Bread has replaced the staple food maize for most of the urban population because of its convenience, its price and easy accessibility. The urban population represent a powerful electorate, and at a time when government has set a freeze on wage increases an increase in the price of bread is politically undesirable.[16]

However, such a policy could be effected if prices of other alternatives were simultaneously reviewed. Presently maize products are priced higher than wheat products. In their study Longmire et al draw the conclusion that if retail prices of bread and maize products were set to reflect the supply prices of these grains at the producer level, this would increase wheat to maize price ratios and slow the growth in consumption of wheat products, thereby increasing the relative demand for maize products.

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[16] Masters W.A. "The Value of Foreign Exchange in Zimbabwe: Concepts and Estimates" Working Paper AEE 2/90 Department of Agricultural Economics and Extension, University of Zimbabwe (1990)

Another factor affecting wheat production in aggregate is the relative profitability of alternative crops. Since wheat already occupies 95 percent of the winter irrigated area 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 supplementing summer crops to irrigating wheat. In addition, some farmers currently not growing wheat might be induced into its production if prices of export crops declined relative to wheat. Small holder farmers could be induced into wheat production if the government increased investment in irrigation.

There are a lot of inconsistencies in the way government has been setting prices in the wheat industry. On the one hand, producer prices, have been kept below import parity since the late 1970's: producers received an average of Z$460 compared with an estimated import parity of Z$620/tonne in 1990. On the other hand Zimbabwe has maintained a subsidy on wheat imports to the millers in order to maintain low consumer price of bread since 1965. In addition to which export crops have been priced above export parity, notably maize, cotton and tobacco thereby making export crops relatively more profitable than wheat. Thus government does not offer any incentives to domestic wheat producers while at the same time they encourage consumption of wheat by maintaining low consumer 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 and other incentives will the wheat industry be in the future. The adjustments of the industry to price changes in the late 1970s and in the early 1980s suggests there is significant 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 wheat production in Pakistan, India, and Egypt has responded by between 1 to 8 percent for every 10 percent increase in producer prices.

In summary, three important policy issues, relevant to the wheat industry have been identified

- the producer price of wheat is consistently kept below import parity,
- a subsidy on wheat to the millers has been maintained to keep consumer prices of wheat low,
- The government controls the quantities imported through rationing of foreign exchange made available to the industry.

3.4 Literature Review:

Derek Byerlee, of CIMMYT[17] has indicated that wheat has a special significance in the analysis of food policy and food imports in the Third World, because cereals constitute the bulk

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[17] Byerlee D. "The Political Economy of Third World Food Imports: The Case of Wheat" Economic Development and Cultural Change Vol 35 (2)

of Third World food imports, and among cereals wheat is by far the dominant food grain import. In 1986, wheat accounted for 86% of food grain imports by Third World countries. Most developing countries lie within the tropical belt in which the climate is unsuitable for wheat production, hence the basic inconsistency between the traditional food staple and the importation of wheat a non traditional staple with little immediate prospects for local production.

Byerlee's paper develops a framework to analyse the recent patterns in consumption and imports of wheat by developing countries, in light of both national food policies and the policies of the exporting countries. His study shows the biases in national and international food policies in favour of wheat products and he also discusses policy measures to arrest growing dependence on food imports. Fig 3 is a schematic representation of factors influencing consumption. On the right hand side are the factors which influence demand through their effects on incomes and food preferences, while the left shows those factors related to supply that influence the quantity and price of imported wheat relative to local food staples. A number of government policies, such as consumer subsidies, investments in the marketing and processing infrastructure influence the demand for wheat.

In Byerlee's study many of these factors were confirmed by cross-country regression analysis of per capita wheat consumption in 39 countries. The results of the regression analysis

show that the strongest determinant of per capita wheat consumption in the tropical developing countries is per capita income which is closely correlated with urbanisation. This phenomenon is also observable in the case of Zimbabwe. The upsurge in urbanisation since independence in 1980 there has resulted in an unprecedented increase in the consumption of wheat and wheat products particularly in the form of bread. Morris[18]in his paper "Comparative Advantage and Policy Incentives for Wheat Production in Zimbabwe" developed a framework for measuring comparative advantage of using local resources to produce a particular crop when measured against the possibilities of trade. He expressed comparative advantage by means of the resource cost ratio (RCR) which is a measure of the cost of domestic resource to a country of producing a particular commodity.

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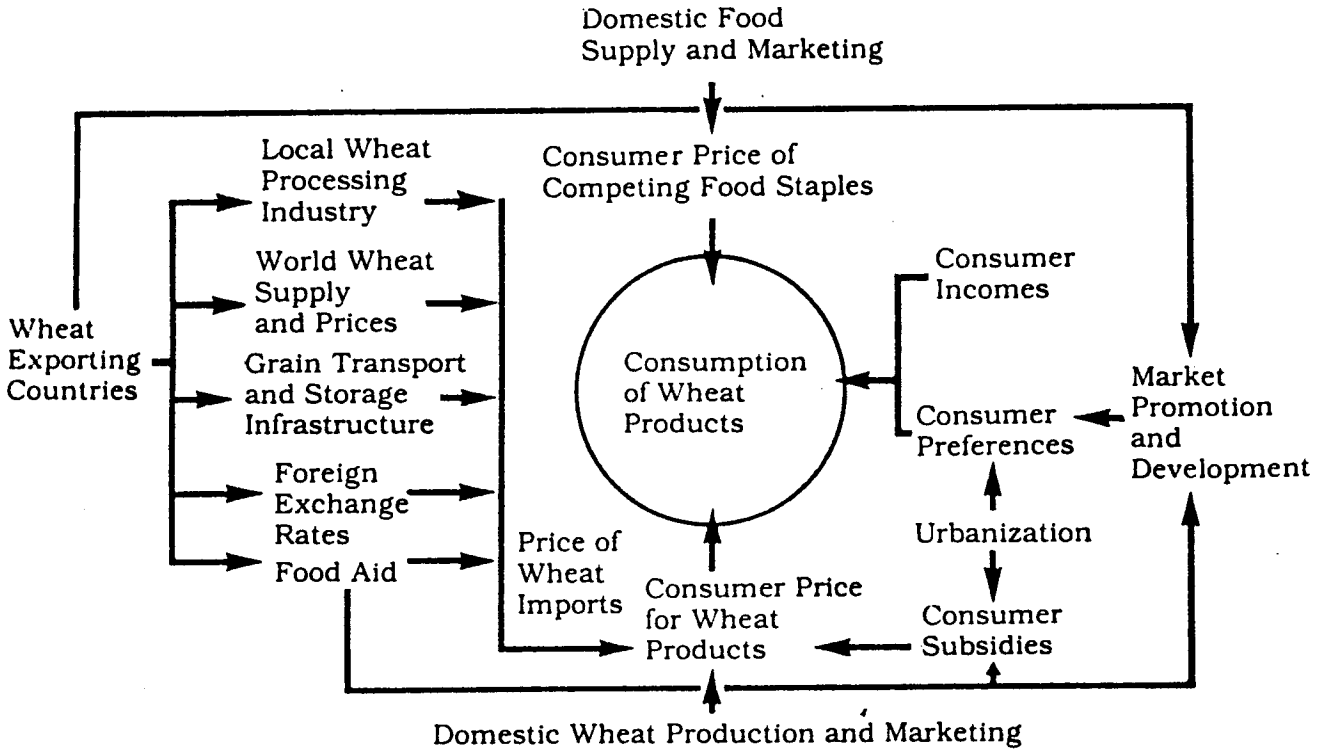
[18]Morris M.L. "Comparative Advantage and Policy Incentives for Wheat Production in Zimbabwe" CIMMYT Economics Working Paper 88/02 (1988)

Fig 3 Factors Influencing Production and Consumption of Wheat



Source: Byerlee D. "The Political Economy of Third Food Imports: The case of Wheat" 1989

From this study the author drew the conclusion that Zimbabwe enjoys comparative advantage in wheat production during periods when irrigation water is plentiful, but this comparative advantage is lost during times of drought when water becomes a limiting factor of production. An important issue raised in this study is that water is more valuable when used on crops other than wheat since farmers apply water inefficiently to wheat. There is growing evidence to show that the total amount of water applied to wheat can be reduced significantly without drastically affecting yields. Therefore Zimbabwe's future self-sufficiency in wheat depends critically on research designed to increase the efficiency of water use by the crop.

Bond [19]in her paper "Agricultural Responses to Prices in Sub-Saharan African Countries" reviews econometric evidence on supply responses to farm prices in sub-Saharan African countries in order to assess the quantitative significance of price in the agricultural sector. In view of the importance of the agricultural sector for growth and adjustment, governments need to determine what policies are best suited to stimulate agricultural production. In particular the crucial question is the extent to which pricing policy can be used to encourage agricultural growth. Many economists including those at the World Bank maintain that inadequate government-administered prices were a principal reason for the poor performance of

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[19]Bond M.E. "Agricultural Responses to Prices in Sub-Saharan African Countries". International Monetary Fund Vol 30 December 1983

agriculture in Africa.

Bond's paper is important because of her attempt to give the reasons for why it is difficult to econometrically assess the responsiveness of crop output to prices and other variables in developing countries. First the data are of poor quality or simply not available. Second a positive correlation between the producer price and marketed output indicates very little about the relationships underlying the choices of farmers between leisure and production, food crops and cash crops, and wage work and work on own farms.

In addition to relative prices, another important variable that affects a farmer's cropping decision is his perception of risk, particularly risks pertaining to weather patterns and dependency on markets. As Bond concludes, lack of reliable data and shortage of research tools such as computers make it difficult for most African countries to simulate all the factors to develop comprehensive models.

Berhman[20] discussed various a priori hypotheses about the supply responsiveness of underdeveloped agriculture to price changes. He divided the hypotheses into three major categories:

- The hypothesis that farmers in underdeveloped agriculture respond quickly, normally and efficiently to relative price changes
- The hypothesis that the marketed production of subsis-

[20]Behrman J.R "Supply Response in Underdeveloped Agriculture: A case study of Four Major Annual Crops in Thailand 1937-1963" North Holland Publishing Company (1968)

tence farmers is inversely related to price

- the hypothesis that institutional constraints are so limiting that any price response is insignificant.

A major proponent of the first hypothesis T.W.Schultz emphatically presented the following hypothesis:

> "The rate at which farmers who have settled into a traditional agriculture accept a new factor of production depends upon its profit, with due allowance for risk and uncertainty, and in this respect the response is similar to that observed in modern agriculture"[21]

That farmers in developing countries respond to price incentives can also be shown by the tremendous increase in wheat production between 1960 and 1970 in Zimbabwe. Good prices, kept above import parity, coupled with government support in the form of irrigation loans saw a boom in wheat production in less than a decade. The exact opposite happened when prices dropped below import parity.

The questions about supply response are basically quantitative, requiring quantitative estimates to answer them. However, there is little quantitative evidence to prove one or the other theory.

No satisfactory econometric study of Zimbabwean agricultural supply responsiveness has as yet been conducted. Studies for other low income areas, however, are increasing in number. Behrman[22] summarised the price responses which have

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[21] Schultz T.W. "Apathy on Hunger Assailed by Myrdal" Nov 23, 1965

[22] Ibid

been estimated for total production of various specific crops in low-income agriculture. Several general comments are suggested by the pattern of these estimates, the most important being:

- For annual crops there is a tendency to use area as the dependent variable because yields are often found to be unresponsive to price changes.
- The estimates being taken as a whole lend some support to the hypothesis that price responsiveness in underdeveloped agriculture is of an order of magnitude quite comparable to that observed in the agriculture of high-income areas.

Using Marc Nerlove's Dynamic Supply Response Model,[23] Behrman's[24] work was the first major study to estimate structural parameters for output of several crops cultivated in Thailand, with the aid of nonlinear statistical procedures. Behrman used a four equation version of Nerlove's model.

Behrman[25] discusses the advantages of using area planted to a crop as a proxy for planned total output since time series data for planned output is not available. Planted acreage is generally the best available method of gauging how cultivators translate their price expectations into action. The area

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[23]Nerlove M. "The Dynamics of Supply: Estimation of Farmers' Response to Price" Baltimore, The Johns Hopkins Press (1958)

[24]Behrman J.R. "Supply Response in Underdeveloped Agriculture: A case study of four major annual crops in Thailand, 1937- 1963" North Holland Publishing Company Amsterdam (1968)

[25]Ibid

actually planted to a particular crop is to a much greater degree than output, under farmers control and thus presumably a much better index of planned production.

All users of the Nerlovian model have included an expected price as a determinant of desired (actual) area planted in a crop, but Askari and Cummings[26] have raised concerns about which prices would be appropriate. In his analysis Behrman used the ratio of the price received by the farmers relative to alternative crops. The associated coefficient is expected to be positive, since an increase in the price should make production of the crop more desirable.

Nerlove did not include yield in his initial study because he did not see any "striking trends" in the yields of the crops under study. In some of his later analysis[27] for a later time period Nerlove did include an expected yield. Askari and Cummings outlined the following as the advantages of including the yield factor:

1) with the term $(Y^e_{t-1} - Y_{t-1})$ it is possible to account for unexpected variations in yield, and for how rapidly cultivators adjust their yield expectations.
2) a more fully specified model allows government officials to obtain evidence as to the effects of potential policies on crop yield.

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[26]Ibid

[27]Nerlove M, W. Addison "Statistical Estimation of Long-Run Elasticities of Supply and Demand" Journal of Farm Economics Vol 40 (1958)

CHAPTER 4

4.0 APPLICATION OF THE NERLOVIAN SUPPLY RESPONSE MODEL TO WHEAT PRODUCTION IN ZIMBABWE

This section presents the regression equation and the results of the model used to estimate the price responsiveness of wheat in Zimbabwe. The analysis is carried out for the period 1970-1990. The method most frequently used to analyse price responsiveness is to estimate price elasticities. The model most empirical studies apply is the Nerlovian Supply Response Model (Nerlove 1958, Behrman 1968, and Askari and Cummings, 1977; Bond 1983, Janssen and Perthel 1990).

4.1 Explanatory Variables:

A study by Longmire et al on wheat policy options in Zimbabwe and SADCC countries (1986)[28]carried out a survey in which farmers were asked to rank in order of importance the constraints to increased wheat production. The results are summarised as follows:

Low Profitability	56 %
Operation costs of irrigation	21 %
Variability of rainfall	18 %
Availability of certified seed	3 %
Others (e.g. accessibility to depots and extension services etc)	2%

[28] Longmire J.,P. Ngobese, S. Tembo "Wheat Policy Options for Zimbabwe and SADCC Countries:" Working Paper, Department of Agricultural Economics and Extension, University of Zimbabwe (1986)

Other studies on Zimbabwe (P. Ngobese) and including studies on wheat production in the tropics, such as CIMMYT publication on "Wheat in More Tropical Environments"[28]also put low profitability as the major constraint to wheat production. This and the data presented earlier in this thesis leads us to assume that the pricing of wheat is a major issue in considering the problems of wheat production in Zimbabwe.

The summer crops grown in rotation with wheat are maize, soyabeans and cotton. The study carried out by Longmire et al showed that maize was the principal summer crop grown in rotation to wheat. Although, summer crops are generally rainfed supplementary irrigation is necessary to improve the yields as it allows for more timely plantings and is also used to relieve moisture stress during dry spells which occur quite frequently during the rainy season. Farmers therefore face the choice of whether to irrigate their summer crops and thereby cut back on the acreage planted to wheat in the winter or hold their water in reserve and irrigate wheat.

Since maize is the most important alternative to wheat both the price of wheat and the price of maize deflated by the CPI will be included in the model. The use of a CPI deflator which may be of dubious value for subsistence farmers in other developing countries who buy only a very select basket of goods or none at all will be quite valid in the case of wheat in

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[28] Byerlee D. "Wheat in Tropical Environments:" CIMMYT Economics Programme, Mexico (1985)

Zimbabwe, since it is mostly grown by commercial farmers who use relatively large amounts of purchased inputs.

An important point to note is that current and not lagged prices of wheat and maize will be included, because wheat being a winter crop is the only commodity for which the price is known before planting. The producer prices for all agricultural commodities are announced in April and wheat plantings only begin at the end of May.

Another major constraint to increased production is the cost of establishing and operating irrigation schemes. Although the Ministry of Energy and Water Resources has estimated that upto 430 000 ha could be brought under irrigation, only 165 000 ha are currently being irrigated. Both Government and farmers are cutting down on investment in irrigation because of the operational costs. Cost of irrigation per unit of area ($/ha) will therefore be included as one of the explanatory variables.

Although the amount of rainfall is an important aspect of the weather conditions which affect agricultural production in Zimbabwe, many other factors such as the timing of the rainfall and the amount of sunshine are also important. Ideally the model should include a weather index to account for all such relevant factors, but the unavailability of data makes the construction of a more inclusive index impractical. The mean annual rainfall alone, is used as a partial index of the weather conditions. Rainfall also serves as a constraint to availability of irrigation water.

A non-market variable to take into account those factors not conveniently quantifiable such as accessibility to delivery depots, availability of certified seed and extension services should have been included but there was no reliable data to show how their effects change from year to year. However it is hoped that all these effects can be captured by the inclusion of a Time trend variable.

Wheat is the principal crop planted in winter, occupying about 95% of the winter planted acreage. Other crops grown on a smaller scale are barley, oats and winter legumes. The acreage planted to these crops is so insignificant compared to that planted to wheat, it was not considered necessary to include them in this model.

4.2 Model Specification:

The objective of this part of the thesis is to measure the response of total planned production of wheat to various variables such as its own price, the price of substitutes,input costs and rainfall. Because time series estimates of planned output are not available a proxy variable was utilised. Using actual output creates problems since it usually differs considerably from planned output because of factors such as the weather etc, factors beyond the direct control of the producer. Most econometric investigators of agricultural supply response have therefore tended to use the area planted as a proxy for planned output, since area planted to a crop is to a much greater extent under the farmers control than output. Area

planted to wheat is therefore the dependent variable in this study.

A three equation version of the Nerlovian supply response model was used. The structural model consists of a desired planted area relationship, a planted area adjustment relationship and an expected normal relative price relationship and the expected yield relationship. The following is the general form of the model:

$$A_t^d = \alpha_{11} + \alpha_{12} PWT_t^e + \alpha_{13} PMZ_t + \alpha_{14} YWT_t + \alpha_{15} PIR_t + \alpha_{16} RNF_t + \alpha_{17} T + U_{1t} \quad (1)$$

$$A_t = \alpha_{21} + A_{t-1} + \Gamma\left(A_t^d - A_{t-1}\right) + U_{2t} \quad (2)$$

$$PWT_t^e = PWT_t \quad (3)$$

A^d_t the desired area planted to wheat

A_t the actual area planted to wheat

PWT^e_t the expected normal producer price of wheat

PMZ_t the price of maize

YWT_t the expected yield per unit planted area

PIR_t cost of irrigation per unit planted area.

RNF mean annual rainfall

PWT_t current producer price of wheat

Γ area adjustment coefficient

T time trend

U_{it} disturbance term for the i-th relationship

α_{ij} the j-th structural parameter in the i-th structural equation

The dependent variable (A^d_t) and the first right hand side variable (PWT^e_t) are unobservable. Equations (2), (3) respectively relate the desired area planted, the expected normal relative price to observable variables. The area planted adjustment equation (2) states that the area actually planted in the current period (t) equals the area planted in the previous period, plus a term (Γ) proportional to the difference between the desired planted area in the t-th period and the actual planted area in the previous period, plus a constant and a disturbance term. **A priori,** the values of the area adjustment coefficient Γ should lie between zero and two. The adjustment may be characterised as an underadjustment, an exact adjustment, or an overadjustment, depending on whether the adjustment coefficient is between zero and one, not significantly different from one or between one and two respectively.

The expected normal relative price in production period (t) equation (3) equals the normal relative price in the current

period. At time of planting the price of wheat has already been announced and is therefore known by the farmers.

Equations (1, 2, and 3,) are then manipulated by substituting equation 3 into 1 then 1 into 2 to obtain the equation (4) in which the unobservable variables, A^d_t, and P^e_t have been eliminated.

$$\begin{aligned} A_t = {} & \alpha_{21} + \Gamma\alpha_{11} + (1 - \Gamma)A_{t-1} + \Gamma\alpha_{12}PWT_t \\ & + \Gamma\alpha_{13}PMZ_t + \Gamma\alpha_{14}YWT_t + \Gamma\alpha_{15}PIR_t \\ & \Gamma\alpha_{16}RNF_t + \Gamma\alpha_{17}T + \Gamma U_{1t} + U_{2t} \end{aligned} \tag{4}$$

Equation (5) is the reduced form of equation (4)

$$\begin{aligned} A_t = {} & \pi_0 + \pi_1 A_{t-1} + \pi_2 4 PWT_t \\ & + \pi_3 PMZ_t + \pi_4 YWT_t + \pi_5 PIR_t \\ & + \pi_6 RNF_t + \pi_7 T_t + U_t \end{aligned} \tag{5}$$

where π_i's are reduced form parameters.

$\pi_0 = \alpha_{21} + \Gamma\alpha_{11}$, $\pi_1 = (1 - \Gamma)$, $\pi_2 = \Gamma\alpha_{12}$, $\pi_3 = \Gamma\ \alpha_{13}$

$\pi_4 = \Gamma\alpha_{14}$, $\pi_5 = \Gamma\alpha_{15}$, $\pi_6 = \Gamma\alpha_{16}$, $\pi_7 = \Gamma\ \alpha_{17}$

and $U_t = U_{1t} + U_{2t}$

The coefficient on variable A_{t-1}, π_1 is expected to have a positive sign and to be statistically significant since struc-

tural factors such as irrigation limit the ability of farmers to adjust to price changes in the short run. Price of wheat (PWT) is also expected to have a positive and significant coefficient. Price of maize (PMZ) is the price of a substitute and therefore expected to be negative, but significant since the price of maize plays a central role in agricultural price setting in Zimbabwe. The coefficient of the rainfall variable (RNF) is expected to have a positive sign. The coefficient of the irrigation costs variable is expected to be negative since it is inversely related to acreage planted to wheat. Both coefficients are expected to have significant t-ratios, since frequency of rainfall and availability of irrigation are two important factors of wheat production. The yield (YWT) factor is expected to have a positive sign but it may not be very significant, as it is influenced by irrigation and rainfall.

4.3 Estimation Procedures:

Equation (3) was estimated using the SHAZAM Econometric package. A linear functional form was regressed using ordinary least squares (OLS).

The simplest measure of model validation is the R^2. Four different regressions of the model were run (see Table 3) and in all four cases the R^2 were quite high ranging from 0.94-0.98. In all cases the R^2 adjusted were very close to the original R^2 from 0.92-0.97. Equations 1 and 3 are linear, with acreage planted to wheat as the dependent variable. Equation 1 was

regressed using ordinary least squares and the coefficients showed correct signs as expected but the yield variable had an insignificant t-ratio. The Durbin h statistic was 1.69 showing that autocorrelation did not exist. The second equation was regressed using ordinary least squares on a double log functional form. The results showed the expected signs, but since yield remained insignificant I decided to test for multicollinearity. An examination of the correlation matrix indicated that the pairwise correlation coefficient between yield and rain was high, and since yield showed a low t-ratio I decided to drop it.

Equation 3 is a repeat of equation 1 without the yield variable. The R squared in equations 1 and 3 remained the same showing that dropping the yield variable did not result in specification bias of the model. Likewise equation 4 was a repeat of equation 2 without the yield variable. The R squared remained the same as equation 2 but the price of wheat variable showed an insignificant t-ratio. The Durbin h statistic still showed no evidence of autocorrelation. I therefore decided to use the results of the equation (3) contained in Table IV for my analysis.

Table 3:

Summary of Regression Results

EQUATION	1 linear	2 loglog	3 linear	4 loglog
Constant	0.74	2.25	0.32	2.22
	(0.88)	(1.05)	(0.38)	(0.77)
#	0.22	2.25	0.91	2.22
T trend	0.29	0.61	0.25	0.62
	(1.67)		(1.41)	(3.18)
#	1.11	0.61	0.94	0.62
Lag Acre	0.69	0.95	0.53	0.94
	(13.5)	(11.44)	(5.71)	(11.92)
#	0.94	0.95	0.91	0.94
YWT	0.78	0.11	--	---
	(0.46)	(0.56)		
#	0.34	0.11		
PWT	0.25	0.11	0.58	0.15
	(2.34)*	(2.40)	(2.03)	(1.18)
#	0.16	0.11	0.11	0.15
PMZ	-0.75	-0.49	-0.12	-0.47
	-(2.98)	-(3.25)	-(2.07)	-(3.28)
#	-0.53	-0.49	-0.41	-0.47
RNF	1.29	0.27	1.47	0.31
	(4.76)	(5.11)	(2.83)	(2.87)
#	0.21	0.27	0.27	0.31
PIR	-0.15	-0.15	-0.19	-0.15
	-(2.48)	-(2.51)	-(2.58)	-(1.99)
#	-0.21	-0.15	-0.25	-0.15
R squared	0.98	0.98	0.94	0.98
R sqd adj	0.97	0.97	0.92	0.97
Durbin H statistic	1.69	1.97	1.57	1.73

Notes: YWT-Yield of wheat Wheat
PWT- Price of wheat
PMZ- Price of maize
RNF- Rainfall
PIR-Irrigation price
elasticity at means
*significant t-ratio

Table 4:

Model Results
(n=22)

Dependent variable Acreage planted to wheat

Variables	Estimated Coefficient	t-ratio at 5% level	Elasticity at means
A_{t-1}	0.53	5.71	0.91
PWT_t	0.58	2.03	0.11
PMZ_t	-0.12	-2.07	-0.41
RNF_t	1.47	2.83	0.27
PIR_t	-0.19	-2.58	-0.25
T	0.25	1.41	0.94
constant	0.32	0.38	0.91

R^2 = 0.94 R^2 adj = 0.92 * Durbin H statistic =1.57

A_{t-1} - lagged acreage

PWT - price of wheat

PMZ - price of maize

PIR - Irrigation costs

T - Time trend variable

Durbin H statistic decision rule:

If h lies between -1.96 and 1.96 do not reject the null hypothesis that there is no first-order autocorrelation.[29]

[29]Gujarati D.N "Basic Econometrics" Second Edition (1988)

In order to further check the accuracy of my model I plotted the observed and predicted acreage and this showed a fairly reasonable correlation between observed and predicted values (Fig 4). A plot of the error terms also showed that they were randomly distributed (Fig 5). By using the root mean squared error we can calculate the deviations of the predicted from the observed values. The smaller the deviation the better the model. The value calculated is 0.05891. In the terms of this model this level of deviation is judged to be acceptable. Given all the results of the tests, the model has proved to be a robust and well specified model.

In summary, all the explanatory variables showed significant t-ratios, and the coefficients had the expected signs, the Durbin h statistic was 1.57 showing that there was no autocorrelation. The R^2 was 0.94 and R squared adjusted was 0.92. Therefore the model can be assumed to be valid as specified.

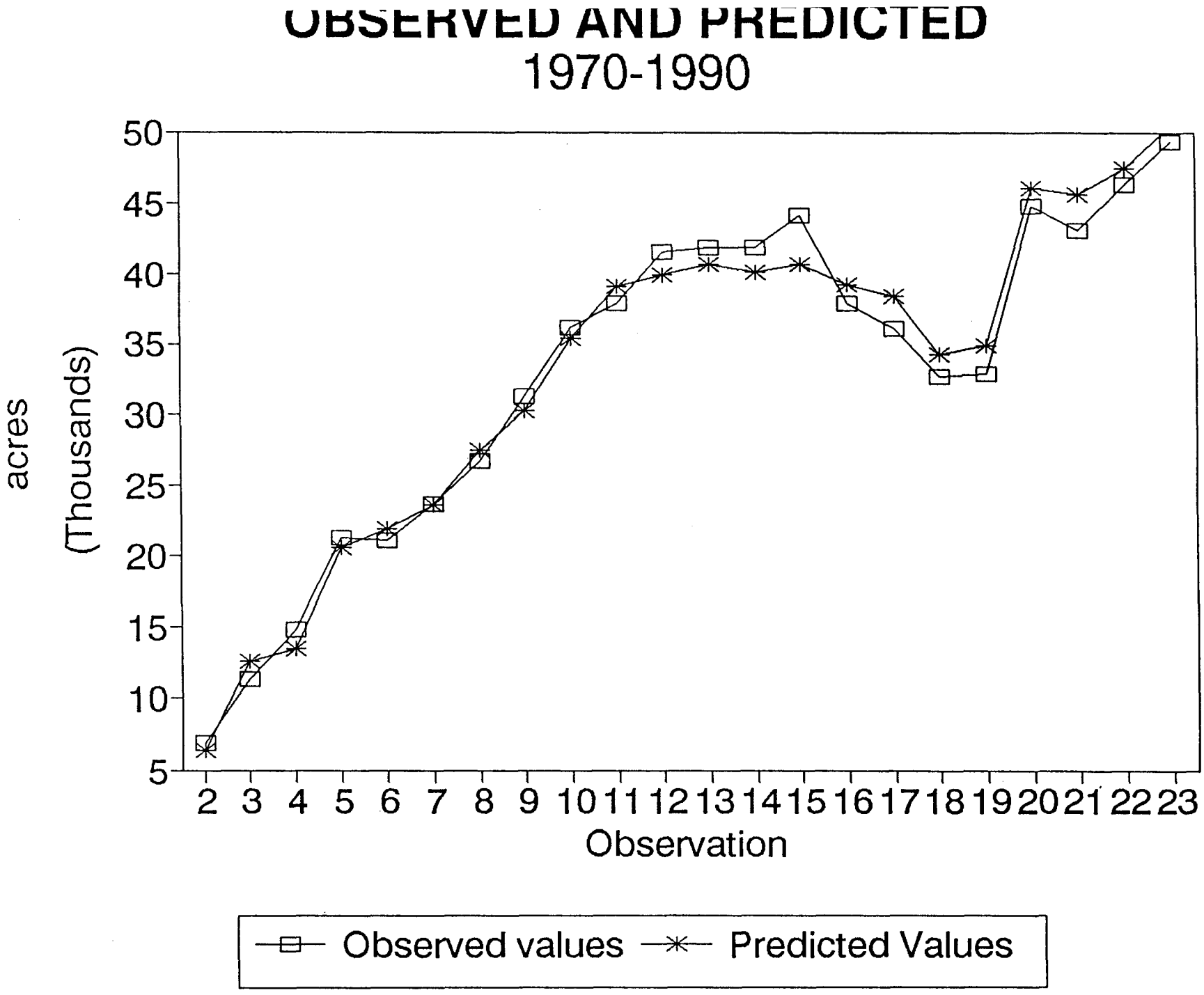
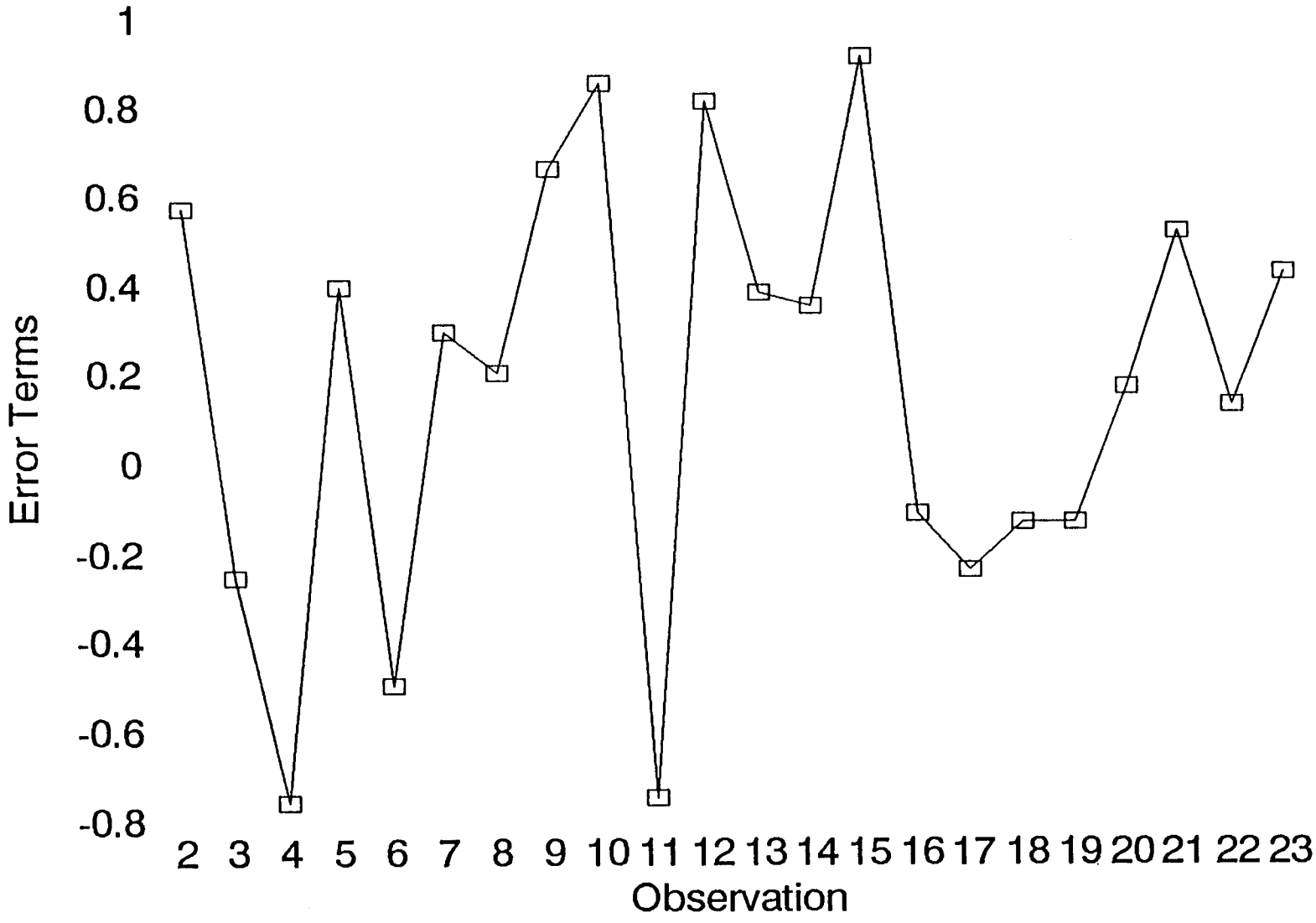

OBSERVED AND PREDICTED
1970-1990
acres
(Thousands)
50
45
40
35
30
25
20
15
10
5
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Observation
Observed values
Predicted Values

Fig 4
Plot of Residual Errors



4.5 Assessment of Data used: (Appendix I)

Before discussing the conclusions that can be drawn from the results of this model it is important to give an assessment of the data used. The most important data sources are the Ministry of Lands Agriculture and Rural Resettlement(MLARR), Agricultural Marketing Authority (AMA), The Department of Agricultural Economics, University of Zimbabwe and The Commercial Grain Growers Association of Zimbabwe. Other possible sources are FAO and World Bank publications. CIMMYT, Mexico has commissioned research into the Zimbabwe wheat industry and I have access to their publications.

The data on prices is very reliable since most of the agricultural commodity prices are set by the Ministry of Agriculture and I used their publications and consulted with them to confirm the data. I am also confident that the production data I am using is quite reliable since large scale commercial farmers usually give comparatively accurate information.

The only data that could not be confirmed was the war period 1974-1979. I did not however, observe any significant divergence in the data to warrant the inclusion of dummy variables to take account of that period.

4.6 Discussion of Regression Results:

1). Lagged Acreage

Quite significant with a t-ratio 5.71, the lagged acreage

variable had a positive sign showing a positive correlation with the area planted to wheat. The estimated coefficient of the lagged acreage (1-Γ) was 0.53, therefore the area adjustment coefficient Γ was 0.47. An area adjustment coefficient between zero and one implies underadjustment of planted acreage[30]. This variable was very stable throughout the 4 equations, showing high t-ratios in all cases.

2). Price of Wheat:

The t-ratio for this variable was 2.03 and the calculated elasticity at means was 0.11, showing that the price supply elasticity of wheat is very low. The results were also very stable throughout the equations.

The low elasticity at means of the price of wheat variable shows that the price of wheat is not highly significant in determining producer response in wheat production. Raising the price of wheat is therefore not sufficient incentive to increase wheat output in Zimbabwe.

3). Price of Maize

Maize is the major substitute crop to wheat competing for water rather than land since wheat is grown in the winter and maize in the summer. This variable showed a negative sign which is to be expected since the acreage planted to a crop is inversely

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[30]Behrman "Supply Response in Underdeveloped Agriculture: A Case Study of Four Major Annual Crops in Thailand, 1937-1963" (1968)

related to the price of a substitute. It showed a significant t-ratio -2.07 and a calculated elasticity at means of -0.41. The coefficient sign was correct in all 4 equations.

These results imply that the producer price of maize has a more significant influence on the acreage planted to wheat than the price of wheat. This is as true for wheat as it is for other agricultural commodities in Zimbabwe. The price of maize is used as a barometer for setting prices, because of its weight in consumer expenditure and the high proportion of land and other productive resources dedicated to it by producers.

4). Yield:

Since the yield variable showed a consistently insignificant t-ratio, it was dropped from the final equation. As yield improvement is mostly a result of technological innovations over time, the T trend was expected to pick up the effects of yield on the area planted to wheat. The yield variable also showed high pairwise correlation with the cost of irrigation variable. This was to be expected since yield improvement is constrained by the availability of water.

5). Rain

Intuitively, I expected the rain to have a high elasticity at means since it is a major factor in agricultural production in a drought prone country like Zimbabwe. One would expect that in a year with good rainfall there would be more water available

for irrigation and therefore more land planted. Thus the elasticity 0.27, which implies a 27 percent increase in planted area as a result of a 100 percent increase in rainfall seems reasonable.

6). Cost of Irrigation:

The cost of irrigation should be inversely related to the acreage planted so we expect the estimated coefficient to be negative. The cost of irrigation variable showed a significant t-ratio at -2.58 and an elasticity at means -0.25.

7). Time

A priori, it would be hard to predict the sign on the estimated coefficient since the time trend is expected to pick up the trends in all the variables such as the yield factor, input prices, etc. which have not been included in the model. The time trend had a significant t-ratio at 1.41 and the elasticity is 0.91.

4.7 Price Supply Elasticities:

One of the objectives of this study is to estimate the price supply elasticity of wheat in Zimbabwe. Using the results of the regression we can calculate the values of the reduced form coefficients, which are then used to calculate the short run and long run supply elasticities. From the estimated coefficient of lagged acreage we calculated Γ (p 55).

The calculated elasticities were long run elasticity $E_{lr} = 0.43$, calculated as follows:

$$E_{lr} = (\sigma A_t / \sigma P_t) * (P_t / A_t) + \alpha_{11}\{(A_t - \alpha_0/\alpha_1) * (1/A_t)\}$$
$$= (\alpha_1 A_t - \alpha_1\alpha_0) / \alpha_1 A_t = 1 - (\alpha_0 / A_t)$$
$$= 1 - (18925/32895) = \underline{0.43}$$

where:
E_{lr} - longrun elasticity
σA_t - change in acreage
A_t - acreage
σP_t - change in price
P_t - price

and short run elasticity $E_{sr} = 0.11$. To date none of the studies on the wheat industry in Zimbabwe have attempted to estimate the short and long run supply elasticities. Longmire (1986) estimated the demand elasticity, and Bond (1983)[31] carried out a study on nine Sub-Saharan African countries and gave the average elasticities of wheat as supply 0.18 and demand 0.21. Table 6 is a comparison of the elasticities from other countries with my own results.

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[31] Bond M.E. "Agricultural Responses to Prices in Sub-Saharan African Countries" International Monetary Fund Vol 30 (1983)

Table 6 Comparison of Supply and Demand Elasticities of Wheat

Author	Country	Es	Ed
Longmire et al	Zimbabwe	---	0.20
Askari & Cummings	Punjab	0.10	0.50
- " -	West Pakistan	0.33	0.67
Bond	Ghana	0.20	0.42
- " -	Kenya	0.10	0.37
Own results	Zimbabwe	0.17	

4.8 Conclusions

four equations of the specified model were regressed, and each of these showed consistent estimated coefficients, with expected signs. The R-squared and t-ratios were also stable in all the equations. Graphing the residual errors of the chosen model did not exhibit distinct patterns, thus showing lack of specification bias. A plot of the observed and predicted acreage showed the existence of close correlation between the two. It can be concluded therefore, that the model was valid and robust as specified.

The calculated price supply elasticity 0.11 is well within the average elasticities estimated by earlier research on other developing countries (Behrman 1968, Askari and Cummings 1976) and in other Sub-Saharan African countries (Bond 1983).

Chapter 5

5.0 POLICY SIMULATION:

In this section supply and demand elasticities will be used to model the impact of current policy interventions and three alternative scenarios on the wheat industry. Three important policies relevant to the wheat industry have been identified; the producer price of wheat is consistently kept below import parity while that of export commodities are kept above export parity, and a subsidy on wheat to the millers has been maintained to keep consumer prices of wheat and wheat products low, while rationing of foreign currency limits the amount of wheat that can be imported into the country. Changes in these policies will be simulated in the original model to determine the impact of these changes.

5.1 Price Policy Analysis: Theoretical Perspectives

Government economic policies influence rural urban terms of trade, which are in turn a major factor in determining incentives to increase agricultural output while simultaneously signalling about the relative costs of food. Producer incentives can be raised in two ways: higher output prices or lower input costs.

The rural-urban terms of trade are influenced by two sets of policies;

i) macro-economic policies such as foreign exchange rates, interest rates and wage rates

ii) sectoral policies such as subsidies and/or taxes and other trade policies that drive a wedge between the world price of a product and its domestic price.

Three forms of policy intervention are used in the wheat sector in Zimbabwe; the producer price of wheat is consistently kept below the world price, and a subsidy on imported wheat is maintained to keep the consumer price of wheat products low, while rationing of foreign currency limits the quantities available in the country.

This study is concerned with how these policies affect the wheat industry. The government of Zimbabwe has always used the pricing mechanism to influence the production and consumption patterns in the agricultural industry. Price policy intervention affects the four food policy objectives in the following ways:

1) it affects economic growth by the extent of efficiency losses;
2) income distribution by the direction of income transfers;
3) food security by increases or decreases in quantities traded internationally;
4) and nutritional status by the income transfers price policies effect to or from consumers.

5.2 Effects of Policy Intervention:

This section will analyse the current situation in the wheat industry in Zimbabwe i.e how current pricing policy affects the industry. This will be followed by an analysis of the industry in a free trade situation which will be used as a base case to highlight the effects of policy intervention.

In 1990 the producer price of wheat i.e the price at which the government through the Grain Marketing Board buys from producers was set at $460/tonne while the consumer price i.e the price at which the government again through the Grain Marketing Board sells to the millers was set at $550/tonne. Production and consumption quantities in the same year were 242 166 tonnes and 295 916 tonnes respectively. It is important to note that whereas production output is a result of producer price control, consumption is a result of a combination of two different policies: 1) consumer subsidy

2) government rationing

The government imposes a limit on the quantity of wheat imported into the country by restricting the foreign currency allocated[32], imposing a limit therefore on the amount of wheat available in the country. This makes wheat products particularly bread affordable but not easily available, a factor which explains the persistent shortages of bread and other wheat

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[32]Agricultural Marketing Authority "Economic Review of the Agricultural Industry in Zimbabwe" (1988)

products clearly observable in the urban areas of Zimbabwe[33].

In the same year 53 750 tonnes were imported at a price of $620.37/tonne, the border price. Fig 6[34] illustrates the combined effects of the policy interventions on the wheat industry in Zimbabwe. We assume that without government intervention the producer price of wheat would equal the border price at $620.37-/t. In a free trade situation the domestic supply is Q_1 while domestic demand is Q_2. The difference between Q_2 and Q_1 represents the import requirements under free trade i.e in the absence of policy intervention.

The control on producer price of wheat results in a reduction of supply to Q_3. At the subsidised consumer price, without rationing we assume the demand for wheat should be Q_4 at which the import requirement would be the difference between $Q_4 - Q_3$. Rationing effectively reduces consumption of wheat from Q_4 to Q_5, thereby reducing import requirements from Q_4-Q_3 to Q_5-Q_3, respectively. The total subsidy paid by government is:

$$(P_w - C_p) \times (Q_5 - Q_3)$$

Relative to free trade, producers lose ACKL which is partly transferred to consumers and to government. The government gains FGKL by paying producers less ($460/t) than the consumer price ($550/t), and ACFH which is transferred to con-

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[33]Longmire J.,P. Ngobese and S. Tembo " Wheat Policy Options in Zimbabwe and SADCC Countries" Working Paper Department of Agricultural Economics and Extension, University of Zimbabwe (1988)

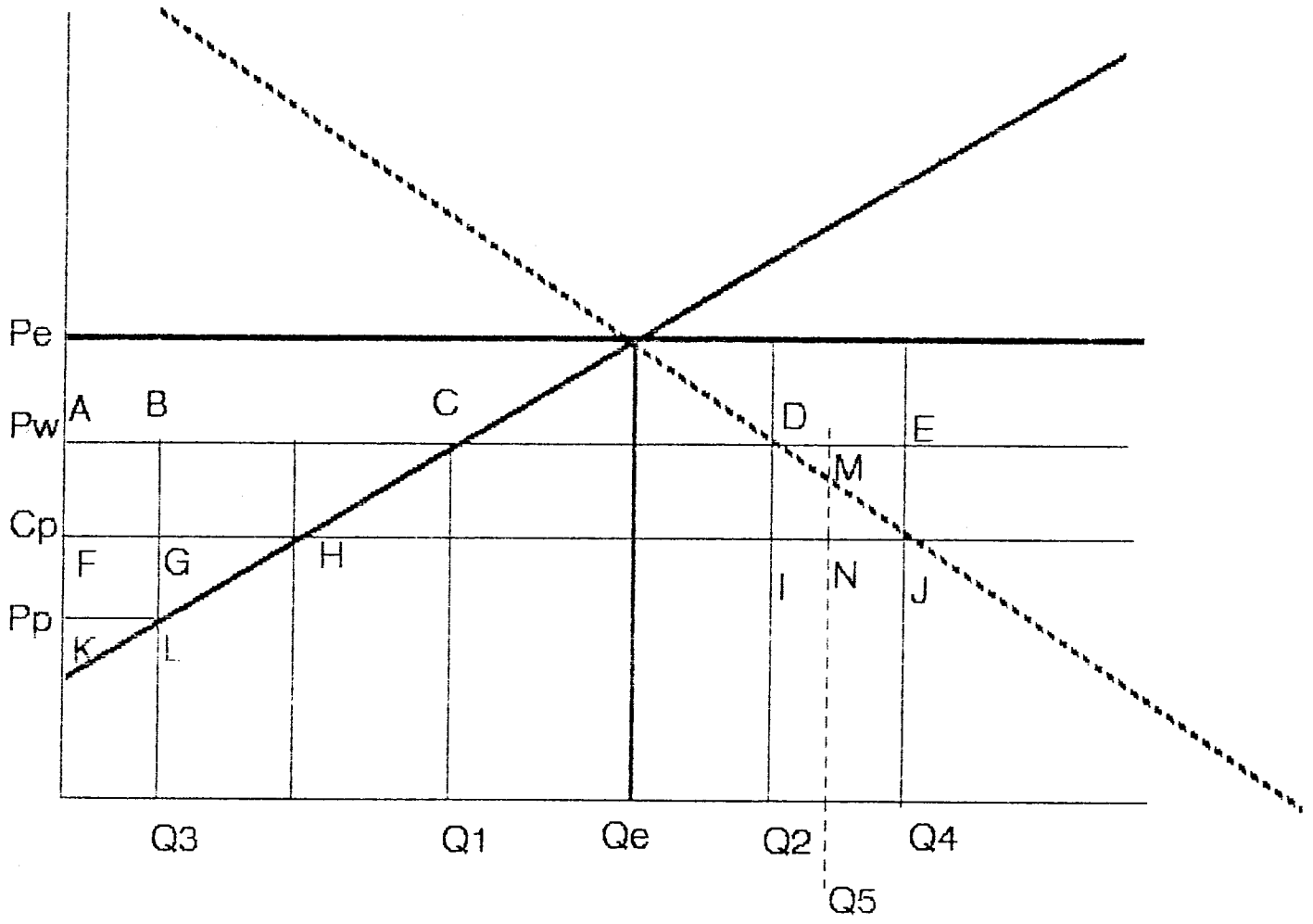
[34]Fig 6 is not drawn to scale

sumers. The total deadweight loss equals triangle GHL, which represents the profits lost by producers through output reduction plus area BCGH, part of the government subsidy which benefits no one.

There are other economic costs besides the cost of the budget subsidy. Although consumers clearly benefit by this price subsidy their total gain is less than the sum of the budget subsidy and implicit transfer from farmers. The difference is due to the efficiency losses, caused by the price distortions introduced by the wedge between domestic and international prices, and are experienced by both producers and consumers.

On the consumer side, the demand curve represents the price consumers are willing to pay for each quantity, so a lower price produces benefits for consumers who were willing to pay a higher price but no longer have to. The consumer surplus is reflected by the area under the demand curve but above the consumer price. In fig 6 the change in consumer surplus as a result of subsidised imports is measured by the area ADJF. Rationing however, reduces consumer surplus by the triangle MJN to ADMNF.

Fig 6 The Effects of Policy Intervention:



5.3 Policy Simulation Exercise:

The basic model applied shows linear supply and demand curves and how the prices and quantities are related. The general formula for a linear demand curve with quantity as the dependent variable:

$$Q = b + m(P)$$

However, in economics the inverse of this formula is used i.e

$$P = (Q-b)/m$$

Using the calculated supply elasticity 0.11 and the demand elasticity calculated by Longmire et al 0.20 changes in policy will be simulated into this basic model to show their effects on various factors in the industry. Using data from various publications of the Grain Marketing Board, the Agricultural Marketing Authority on producer and consumer prices, production and consumption levels and import requirements, and Ministry of Trade and Commerce on government revenue gains and losses and foreign currency allocations, the effects of policy intervention on the most important factors were considered.

Table 7 shows the results of the policy simulation exercise.

Base Case - This scenario assumes a free trade situation i.e a situation in which the domestic price of wheat equals the border price. At that price domestic supply equals 255 766 tonnes and consumption is 288 916 tonnes and imports are 33 150 tonnes. The foreign currency spent on wheat imports is about $20.553 million. In this scenario the government does not incur any additional costs in terms

of efficiency losses or subsidies.

Scenario I -shows the current situation in Zimbabwe. At the controlled producer price domestic production is 242 166 tonnes while consumption at the subsidised consumer price, but restricted foreign currency allocations is 295 916 tonnes increasing import requirements relative to the base case to 53 750 tonnes at a cost of $33.325 million.

In the current situation producer loss as a result of the difference between the world price and the domestic set price, in addition to output reduction is $42.010 million while the consumers gain by the amount equivalent to the subsidy and part of the producer loss $26.632 million. The government subsidy equals $3.762 million while the government gains upto $21.794 million, the difference between the set producer price and the consumer price. Current policy intervention in the wheat industry, while creating profit of upto $18.032 million for the government taxes producers and does not create incentives to increase supply. Uncompensated losses i.e part of producer loss GHL and BCGH part of the government subsidy which benefits no one equal $1.088 million.

Scenario II - shows the effect of imposing self-sufficiency on the industry i.e quantity demanded equals the quantity

supplied, assuming government adopts a policy of no imports. Relative to the base case producer gain is P_ePCA ($46.382 million) while consumer surplus decreases to $2.917 million. The higher price will result in an increase in the production of wheat, while decreasing the domestic demand of wheat. The likely consumer resistance to the high price increases of wheat products make this an unlikely policy.

Scenario III - shows the effects of maintaining producer price control but removing both the consumer subsidy, and the rationing on foreign currency i.e the producer price will remain at $460/t while the consumer price increases to $620/t. Relative to the free trade scenario domestic output decreases to 242 166 tonnes while consumption equals 288 916 tonnes. The import requirements are 46 750 tonnes costing $28.985 million in foreign currency.

There does not seem to be an easy low-cost means to expand wheat production in the short run. Table 6 summarises the welfare effects of policy intervention in Zimbabwe, followed by the effects in the event of policy changes.

An immediate transition to self-sufficiency would be desirable from the producers' point of view but this would definitely result in consumer resistance. Moving towards free trade through decontrol of both the producer and consumer prices

followed by a gradual build up towards self sufficiency, through gradual price increases seems the most viable option in the long run.

Table 6 (1) EFFECTS OF CHANGES IN PRICING POLICY

Variables	Base Case	Scenario I	Scenario II	Scenario III
Acreage (ha)	52091	49321	55256	49321
Producer price ($/t)	620	460	796	460
Import price ($/t)	620	620	--	620
Consumer price ($/t)	620	550	796	620
domestic prod'n (t)	255766	242166	271310	242166
domestic cons'n(t)	288916	295916	271310	288916
Imports(exports)(t)	33150	53750	0	46750
Cost of imports($mln)	20.553	33.325	0	28.985
Subsidy($mln)	0	3.762	0	0

Base case assumes free trade,i.e no policy intervention
Scenario I presents current situation: producer and consumer price control and rationing of foreign currency
Scenario II imposes self sufficiency i.e demand =supply
Scenario III maintains producer price control, but removes consumer subsidy

Table 6 (2) Welfare Effects of Pricing Policy ($mln)

	Base Case	Scenario I	Scenario II	Scenario III
Producer gain (loss) (ACKL)	39.834	(39.834)	88.548	(39.834)
Consumer gain (loss) (AEIF)	(20.224)	20.469	(94.117)	(20.469)
Consumer Subsidy (Pw-Cp)*(Q5-Q3)	0	3.762	--	---
Govt gains (F6KL)	0	21.794	--	38.746
Uncompensated losses (GHL + BCGH)	0	1.088	--	
Cost of imports (Pw*(Q5-Q3)	20.553	33.325	--	28.985

Pw-Border price
Cp- Consumer price
Q5- Domestic consumption
Q3- Domestic production

5.3 Sensitivity Analysis

Sensitivity analysis was used to test the robustness of results by simulating elasticities from other studies. Various levels of elasticities based on the study by Bond on Sub-Saharan African countries[34] were tried on both the demand and supply parameters. In the base case my own calculated supply elasticity of 0.11 and Bond's demand elasticity -0.20 were used. I then proceeded to use higher demand elasticities of -0.54 and -1.1 while holding the supply elasticity constant. Higher supply elasticities 0.37, 0.54 and 1.00 were also simulated while holding the demand elasticity constant. These elasticities were chosen because they were the results of studies based on Sub-Saharan African countries which I perceived to have similar economic and agricultural conditions as those prevailing in Zimbabwe.

A priori, higher supply elasticities i.e higher price responsiveness by producers should result in an increase in output as the producer price of wheat increases, while higher demand elasticities should result in a decrease in the demand as prices go up. Table 8 shows the result of the sensitivity analysis.

Relative to the base case, changing the demand elasticity from -0.20 to -0.54 while holding the supply elasticity constant decreased the demand for wheat, which in turn reduced import

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[34] Bond M.E. "Agricultural Responses to Prices in Sub-Saharan African Countries" International Monetary Fund Vol 30 Dec (1983)

requirements from 33 150 tonnes to 21 250. Based on the import price of $620/t for 1990 this cost the government $7.738 million in foreign currency compared to $20.553 million in the base case. A demand elasticity of -1.1 resulted in import requirements of only 1 650 tonnes which would cost only $1.023 million in foreign currency, compared to the base case.

Changing the supply elasticity from 0.11 to 0.37 while holding the demand elasticity constant resulted in an increase in output from 255 766 tonnes in the base case to 271 766 tonnes. Import requirements therefore decreased to 17 150 tonnes and a savings of $10.612 million in foreign currency. A supply elasticity of 0.58 almost brings the country to a situation of self-sufficiency, with domestic supply almost satisfying domestic demand. Unitary supply elasticity resulted in surplus of upto 33 250 tonnes. The sensitivity analysis showed that the results of this model were quite sensitive to changes in elasticity assumptions.

Table 8 Results of Sensitivity Analysis:

Es=0.11 Ed= -0.20

Variables	B Case	Scen I	Scen II	Scen III
Acreage (ha)	52091	49321	55138	49321
Producer price ($/t)	620	460	796	460
Import price ($/t)	620	620	0	620
Consumer price ($/t)	620	550	796	620
domestic prod'n (t)	255766	242166	270726	242166
domestic cons'n(t)	288916	295916	270726	288916
Imports(exports)(t)	33150	53750	0	46750

Ed=-0.20 Es=0.37

Variables	B Case	Scen I	Scen II
Acreage (ha)	55349	49321	61981
Producer price ($/t	620	460	796
Import price ($/t)	620	620	0
Consumer price ($/t	620	550	796
domestic prod'n (t)	271766	242166	304326
domestic cons'n(t)	288916	295916	270726
Imports(exports)(t)	17150	53750	(33010)

Es=0.11 Ed = -0.54

Variables	B Case	Scen I	Scen II	Scen III
Acreage (ha)	52091	49321	55138	49321
Producer price ($/t)	620	460	796	460
Import price ($/t)	620	620		
Consumer price ($/t)	620	550	796	620
domestic prod'n (t)	255766	242166	270726	242166
domestic cons'n(t)	277016	295916	229496	320216
Imports(exports)(t)	21250	53750	(41230)	78050

Ed=-0.20 Es=0.58

Variables	B Case	Scen I	Scen II
Acreage (ha)	58771	49321	69166
Producer price ($/t	620	460	796
Import price ($/t)	620	620	0
Consumer price ($/t	620	550	796
domestic prod'n (t)	288566	242166	339606
domestic cons'n(t)	288916	295916	270726
Imports(exports)(t)	350	53750	(68880)

Es=0.11 Ed = -1.1

Variables	B Case	Scen I	Scen II	Scen III
Acreage (ha)	52091	49321	55138	49321
Producer price ($/t)	620	460	796	460
Import price ($/t)	620	620		
Consumer price ($/t)	620	550	796	460
domestic prod'n (t)	255766	242166	270726	242166
domestic cons'n(t)	257416	295916	160616	345416
Imports(exports)(t)	1650	53750	(110110)	103250

Ed=-0.20 Es=1

Variables	B Case	Scen I	Scen II
Acreage (ha)	65614	49321	83537
Producer price ($/t	620	460	796
Import price ($/t)	620	620	
Consumer price ($/t	620	550	796
domestic prod'n (t)	322166	242166	410166
domestic cons'n(t)	288916	295916	270726
Imports(exports)(t)	(33250)	53750	(139440)

CHAPTER 6

6.1 Conclusions:

Agricultural policy makers in Zimbabwe today face the difficult question of what to do about the widening gap between supply and demand of wheat. Even though Zimbabwe's wheat industry is well developed by regional standards, domestic production has not kept pace with demand making imports necessary, draining scarce foreign exchange and heightening concerns about national food security. Government policy in Zimbabwe taxes wheat producers while subsidising the consumers, thus current policy acts as a disincentive to increased output supply on the one hand, while it encourages increased demand on the other. This study quantified the welfare effects and foreign exchange costs of current and alternative policy scenarios.

Although studies from other countries show that wheat production is responsive to price incentives, the results of this study however show a very low short run price responsiveness (0.11). Thus raising producer prices, without redressing all the other factors affecting wheat production such as cost and availability of irrigation facilities, prices of substitutes etc, would have limited impact on total production.

The calculated elasticity at means for the price of maize variable which was included in the model to account for the price of substitutes was -0.41, showing that for every 10 percent increase in the price of maize the production of wheat

decreases by about 4 percent.

The question for Zimbabwe is how to create the necessary conditions to increase price responsiveness, i.e what policy changes are necessary to increase total supply of wheat. The overall conclusion is that there is not a simple low cost option to redress the situation in the wheat industry in Zimbabwe. The situation calls for a review of all the policy instruments currently in place, in addition to external factors such as the world price of wheat.

Current policy in the wheat industry taxes the producers in excess of $39 million which is partly transferred to consumers and partly to government as revenue. Imports cost the country about $33 million in foreign currency. In essence the government does not really make a profit in the wheat industry because $33 million in foreign currency at current bank exchange rates far outweighs the profit made on the domestic market. The government pays out nearly $4 million as consumer subsidy while losing out $1.08 million in uncompensated losses.

The first base case scenario in the last chapter assumes a situation of free trade i.e decontrol of both producer and consumer prices, in addition to removal of the subsidy. This scenario resulted in a decrease in import requirements which in turn results in a decrease of about $13 million in foreign currency. Imposing self sufficiency in scenario II does away with the need to import. The government loses a source of revenue but make saves on the foreign currency in addition to

the subsidy. The third scenario, maintaining control on the producer price, while removing the subsidy on consumer prices and selling at the border price would not resolve the problem as there continues to be high import requirements and continued drainage of scarce foreign currency. Policy implications of some of the conclusions drawn from the results of the study are made in the following section.

6.2 Policy Implications:

1) The Macro Economy and Macro Policies:

Comprehending the relationship between the food system and the macro economy helps identify the policy issues and the range of choices available to policy makers. Currently policymakers operate within an atmosphere of distorted macro policies, which typically include rapid inflation, an overvalued exchange rate, minimum wages for an urban working elite, and depressed rural incentives. This set of policies make rapid growth in agricultural output extremely difficult, while it simultaneously skews the distribution of earned income. The only justification for these policies is that they protect the short-run interests of poor people by keeping food prices low[35]. Schfer describes the effects of these policies as follows:

When macro policies are badly distorted, their cumulative

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[35]Mlambo K. "Exchange Rate Overvaluation and Agricultural Performance in Zimbabwe: 1965-1985", in Mudimu G.and Bernsten R, eds.,Household and National Food Security in Southern Africa UZ/MSU Food Security Research Project, University of Zimbabwe (1989)

> impact puts pressure on the economy for major policy reforms. As this pressure builds up, the options open to policymakers are extremely limited: more investment in irrigation, a better agricultural research and extension program, subsidies on fertiliser and certified seed. These contribute to agricultural growth, but in the constraining environment of distorted macro policies, such programs do not provide the basis for long run dynamic growth of rural output and incomes, which is the essential base for a food policy that simultaneously increases food production while reducing hunger.[36]

A combination of factors, notably sluggish growth in Zimbabwe's major agricultural and mineral exports along with depressed world prices, has in recent years reduced the nation's export earnings and precipitated a severe foreign exchange shortage. The government has responded to this crisis by instituting a set of foreign exchange controls, including a system of rationing foreign exchange to essential industries[37]. One effect of this policy has been to allow the government to maintain an overvalued currency. Currently the official exchange rate does not fully reflect the real value of a unit of foreign currency to the Zimbabwean economy[38]. Economists in government and at the University of Zimbabwe estimate that the Zimbabwean dollar is overvalued by as much as 30 % in relation to the US dollar, based on differential rates of inflation

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[36] Schafer, H. "Real Exchange Rates and Economic Performance:The Case of Sub-Saharan Africa". Unpublished Ph.D. Dissertation, Department of Economics and Business, North Carolina State University at Raleigh (1989)

[37] World Bank "Zimbabwe: An Industrial Sector Memorandum". Industrial Development and Finance Division, Eastern and Southern Africa Region. Washington D.C: 1987

[38] Ibid

between Zimbabwe and its major trading partners (O'Driscoll 1987). Consequently if adjustments are not made to correct for domestic currency overvaluation, efficiency will be biased in favour of import-intensive activities.

2) Price Decontrol:

The Government of Zimbabwe should review if the reasons for which the policy to control agricultural pricing apply to the wheat industry. Certain agricultural commodities such as tobacco, tea, coffee and sugar are not controlled. Whereas controlling the producer prices of staple foods such as maize, millets, and groundnuts might have been necessary, firstly as a means to ensure income transfers to the peasant sector and secondly to ensure that food remains affordable to the majority of the poor people, both these reasons do not apply in the case of wheat. Wheat is produced by the large scale commercial farmers who have proved to be economically viable, and do not need Government to guarantee their incomes. Furthermore, the policy as it stands currently taxes the farmers and has acted as a disincentive to increased output.

The base case scenario, free trade and the self-sufficiency scenario have both shown that an increase in the producer price of wheat would result in increased output, compared to scenario II and four in which producer price control is maintained.

3) Producer Price Increase

Increasing the producer price in the current situation would result in increased income transfers to the large scale farmers, which would be against government desired policy. What seems viable, however is to expand wheat production base by making it possible for small scale and peasant farmers to enter into wheat production through equitable distribution of the fertile granite based light sandy and loam soils which are currently dominated by white commercial farmers as a result of the pre-independence land policies.

Since wheat already occupies upto 95 % of the winter irrigated area on wheat farms, there is little potential for further substitution of land to wheat from other winter crops on existing wheat farms. There is scope however for substituting water away from supplementing summer crops to wheat. In addition some farmers currently not growing wheat may be induced to its production if the prices of export crops declined relative to wheat. This however may go against government policy to maintain equitable income distribution within and among the sectors.

4) Expansion of Wheat Production Base:

Presently, wheat is produced by the large scale commercial farmers only because producers in the other sectors do not have the capital to invest in irrigation facilities. With regard to expansion of irrigation water supplies, there appear to be no

easy low-cost options. The increasing real cost of dam construction in the future will mean that irrigation will be increasingly expensive, and other demands for water will tend to reinforce this. In addition to the high cost of irrigation, irrigation equipment costs and pumping costs are very high in Zimbabwe. The government has two possible options,

1) set the producer price of wheat very high to get farmers to invest in irrigation facilities.
2) Maintain current producer price control, but invest in irrigation facilities

The results of my study showed that the difference between the producer and consumer price on the domestic market represents a source of revenue for the government. After paying the consumer subsidy the government still made a profit of upto $16 million. (see Table 6)

This profit could be invested in irrigation facilities in the rural areas to enable peasant farmers to grow wheat. Although the model cannot directly evaluate the effectiveness of investing in irrigation facilities relative to producer transfers it is assumed that this would have the added advantage of increasing the viability of rural farmers by lessening their dependence on rainfall, even for summer crops.

5) Irrigation Fund Policy:

Irrigation costs can be broadly divided into two categories: the cost of water storage (e.g dam construction)and the

cost of installing an irrigation system (pipes, fittings and system assembly). The cost to farmers of irrigation is directly affected by several government policies. Although most irrigation pumps are locally manufactured, those that are imported are assessed a tariff of 20 percent. In addition all pumps, locally manufactured or imported are subject to a 20 percent sales tax[39]

Since 1965 the government has put in place a subsidised government credit program targeted specifically at wheat producers to cover irrigation investment costs. First established in 1965 then reintroduced in 1985 after having been suspended for several years, the National Farm Irrigation Fund (NFIF) extends low cost finance to finance irrigation development, with the condition that any area developed using NFIF funds be used for wheat production for the duration of the loan. This condition was set to ensure that farmers would not use NFIF loans at subsidised interest rates to plant crops other than wheat. The NFIF loan rate currently stands at 9.7% per annum compared to commercial lending rates at 16-18 percent.

Investment in irrigation might increase if farmers could use the area irrigated with NFIF loans to grow other crops, especially high value export crops such as tobacco and cotton. Farmers are then able to rotate summer and winter crops thereby increasing the returns per dollar invested in irrigation. The

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[39] National Planning Agency, Ministry of Finance, Economic Planning and Development, Government of Zimbabwe "Minute on Economic Appraisal of Irrigation Projects" Government Printers (1988)

farmers then could base their ability to pay back loans on the performance of two or three alternative crops, rather than on wheat only.

6) Increased Imports:

Increasing wheat imports may be a viable option to increase availability of wheat. Irrigation could be used to increase the production of export crops such as maize, cotton and tobacco. The foreign currency earned through export commodities could be used to pay for commercial wheat imports. To date most of the wheat imports have been arranged as barter deals especially for maize exports sent to Mozambique by international organisations as food aid.

The general decline in commodity prices on the international market has made this option less attractive, and this is exacerbated by the high costs of transport and the dependency on neighbouring countries (South Africa, Mozambique) for inland transportation. The recurrent droughts also make this a risky option as there is not enough maize to use for barter during the drought.

6.3 Issues for Future Research:

The prices of many agricultural inputs in Zimbabwe are influenced directly or indirectly by government policies, such as taxes, subsidies, import tariffs, export controls, quotas, marketing regulations, minimum wage legislation and exchange rate controls. The following section reviews selected government

policies on the fertiliser and crop chemical industries in addition to varietal and yield improvement of wheat.

Fertiliser:

The fertiliser industry in Zimbabwe consists of four private companies (two importer/manufacturers and two distributors). Because fertiliser is classified as an "essential commodity", its pricing structure is subject to government regulation. Pricing of fertiliser is determined at cabinet level, based on recommendations developed through negotiations involving government ministries and industry representatives. The policy of cross-subsidising fertilisers was removed in 1975, resulting in a substantial increase in the prices of fertiliser. Fertiliser prices have risen more rapidly than crop prices. The nitrogen:wheat price ratios has since been maintained at 4:1[40].

Since 1986 retail fertiliser sales were exempted from sales tax, however fertiliser imports and imports of materials used in manufacturing fertilisers are subject to an import tariff of 20 %.[41]

Crop Chemicals

Crop chemicals (such as herbicides, fungicides, and insecticides) are imported into Zimbabwe by one of several

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[40] Reserve Bank of Zimbabwe Quarterly Economic and Statistical Review 9(4) December 1988

[41] Ibid

authorised chemical distributors, who distribute them to farmers at government regulated prices. The official pricing structure for chemicals is quite similar to that for fertilisers. Retail sales are exempted from sales tax, while all imports are subjected to a 20 percent import tariff[42].

The price controls, on the prices of fertilisers and crop chemicals coupled with the import tariff make it unprofitable for manufacturers with the result that there are very few operators in these two industries. A lot of times there are shortages of fertilisers and chemicals at a time when farmers need them, because of the limit on the foreign currency made available to fertiliser companies to import chemicals.

Varietal Improvements

On-going varietal improvement is probably one of the least expensive methods of expanding wheat production. The estimated increase associated with varietal improvement and related crop management has been sizable, close to 100 kg/ha per year. With regard to research on new varieties the criterion should be water efficiency and for summer varieties resistance to diseases.

Yield Improvement

The scope for yield increase through additional fertilisers and chemicals or through further adoption of new crop management

[42] Ibid

methods seems limited since farmers are already applying close to the economically optimal levels of these inputs.[43]

Given that water is the principal limiting factor, a high priority area for research is analysing the response of wheat to different amounts of water applied, and to different timings of irrigation. Related research should be undertaken to evaluate alternative irrigation technologies and how they affect the yields. It is quite common in Zimbabwe to have on average 13 irrigations which seems excessive compared to countries like Mexico, Pakistan and India with irrigations[44]

Product Development:

Present trends such as increased urbanisation indicate that the demand for wheat will continue to grow in Zimbabwe. There is need therefore to control the rate of growth of the demand for wheat products particularly for bread through correct pricing policies and food product development. By eliminating the subsidy on wheat, and increasing its price to the same level as maize products or other staples, it may be possible to slow the growth in consumption of bread in the long run.

Similarly, new maize product development and further blending of flour, e.g with maize and\or sorghum, would help

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[43] Whingwiri E.E. "A Survey of Commercial Wheat Production Practices in 4 Provinces of Zimbabwe". Zimbabwe Agricultural Journal Vol 82 (4)(1985)

[44] Longmire J., P. Ngobese and S. Tembo "Wheat Policy Options in Zimbabwe and SADCC Countries" (1988)

slow down the demand for wheat. Research on new maize and sorghum products which might substitute for wheat should be undertaken. A number of maize products in the Americas have convenience properties and offer attractive alternatives to wheat products. Research into production of other cereals such as triticale[45] which is more disease-tolerant than wheat, and its flour can readily be blended with wheat flour should be given priority.

[45] Anfrae G., B. Beckman "The Wheat Trap: Bread and Underdevelopment in Nigeria" London, Zed Press (1986)

Appendix I

Statistics on Wheat in Zimbabwe

Year	Area (ha)	WPN (t)	YWT (t/ha)	WCN (t)	IMP (t)	PWT ($/t)	CPW ($/t)	CPI 80=100	RNF (mm)	PIR $/ha	PMZ ($/t)
1970	11361	41695	3.67	41695	0	69	80	0.484	403	115	20
1971	14788	54716	3.70	85985	31269	69	80	0.499	600	204	30
1972	21322	72068	3.38	100827	28759	69	80	0.513	765	235	26
1973	21151	80374	3.80	124252	43878	69	80	0.529	480	200	36
1974	23680	79328	3.35	130402	51074	80	100	0.564	540	120	40
1975	26745	106713	3.99	122545	15832	110	100	0.621	500	2000	37
1976	31250	134063	4.29	161228	27165	121	112	0.689	510	540	44
1977	36138	141300	3.91	191701	50401	123	113	0.76	498	414	52
1978	37881	161752	4.27	221655	59903	110	113	0.803	476	643	53
1979	41599	182620	4.39	189657	7037	115	121	0.949	560	989	61
1980	41834	207915	4.97	221681	13766	135	134	1	678	1222	85
1981	41872	228202	5.45	250031	21829	165	157	1.131	650	1289	120
1982	44132	251111	5.69	272111	21000	190	169	1.252	403	1380	120
1983	37904	204682	5.40	307432	102750	220	239	1.541	464	1369	120
1984	36042	207242	5.75	328737	121495	250	285	1.852	746	1598	140
1985	32707	176618	5.40	219134	42516	285	323	2.009	695	2200	180
1986	32878	189049	5.75	210702	21653	300	358	2.241	422	1660	180
1987	44808	241963	5.40	333319	91356	330	378	2.344	744	1660	180
1988	43067	245482	5.70	309514	64032	365	426	2.609	460	1750	195
1989	46298	262510	5.67	300267	37757	400	480	2.944	600	1864	215
1990	49321	242166	4.91	295916	53750	460	550	3.004	685	3600	225

Notes:

Area- Acreage planted to wheat
YWT- Yield of wheat
WCN- Wheat consumption
IMP- Wheat import
PWT- Producer price of wheat
CPW- Consumer price of wheat
CPI- Consumer price index
RNF- Mean annual rainfall
PIR-Price of irrigation
PMZ- Price of maize

Source: Agricultural Marketing Authority (various isues)

Central Statistical Office (various issues)

Appendix II Statistics on Maize in Zimbabwe

Year	Maize Prod'n (t)	Maize Cons'n (t)	Producer Price ($/t)	Selling Price ($/t)	CPI 80=100
1970	980000	610686	20	4.1	0.484
1971	1809148	1113709	30.05	4.17	0.499
1972	2266523	1420725	25.88	4.19	0.513
1973	967395	550363	36.37	4.19	0.529
1974	2124774	1336856	40.11	43.24	0.564
1975	1746683	1006922	37	51.54	0.621
1976	1786123	958532	44	51.54	0.689
1977	1655222	941065	52	51.54	0.76
1978	1618395	877026	53	57.07	0.803
1979	1149842	802465	60.5	63.89	0.949
1980	2813150	969965	85	89	1
1981	2728640	1538168	120	137	1.131
1982	1785800	1525545	120	137	1.252
1983	844000	860000	120	157	1.541
1984	1283000	845000	140	177	1.852
1985	2952000	1130000	180	222	2.009
1986	1828000	1480393	180	222	2.241
1987	1677600	990327	180	222	2.344
1988	402537	933073	195	245	2.609
1989	1959870	933073	215	285	2.944
1990	2115657	1062500	225	305	3.004

Source: Agricultural Marketing Authority
Report and Accounts Year Ending 31 March
(various issues)

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