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THE GROWTH OF SMALLHOLDER MAIZE PRODUCTION IN ZIMBABWE: CAUSES AND IMPLICATIONS FOR FOOD SECURITY

By

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ABSTRACT

THE GROWTH OF SMALLHOLDER MAIZE PRODUCTION IN ZIMBABWE:
CAUSES AND IMPLICATIONS FOR FOOD SECURITY

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This thesis identifies the factors explaining the tripling of smallholder maize production in Zimbabwe between 1979 and 1985. The analysis explores the effect of post-independence policy, institutional and technological interventions on smallholder production and market decision making through a combined analysis of aggregate small farm sector data and farm level survey data. The results of the analysis are used to evaluate the implications of the production growth for Zimbabwe's food security.

The growth of smallholder maize production can be attributed to five major factors. The ending of the independence war in late 1979 reestablished rural stability and fostered a major expansion in cultivated area. Yield growth was made possible by the availability of an improved set of production technologies arising from decades of investment in agricultural research. The adoption of technologies, and more importantly, higher rates of application were fostered by the establishment of a smallholder credit program. Input and product market infrastructure rapidly expanded through a complementary set

of public and private sector investments. Finally, smallholders faced a remunerative set of guaranteed prices which stood at particularly high levels immediately following the war.

The analysis compares the impact of these policy, institutional and technological changes in two high and low rainfall regions of the country. It finds the largest gains in smallholder maize production and sales were concentrated among farmers receiving greater rain and those owning greater production resources. While all smallholders benefited from the resultant aggregate increase in maize production and sales, further improvements in the food security of low resource farmers will require additional targeting of assistance to this constituency. The objectives of aggregate, national food security and household food security must be recognized as both complementary and distinct.

The smallholder maize production and market gains achieved over the 1979 to 1985 period provide strong evidence of the responsiveness of small farmers to shifting production and market incentives. This analysis of smallholder decision making underlying these gains provides information useful for the development of strategies necessary to extend and broaden future growth in the small farm economy.

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ABBREVIATIONS

AFC	Agricultural Finance Corporation
AGRITEX	Agricultural, Technical and Extension Services
AMA	Agricultural Marketing Authority
ARDA	Agricultural and Rural Development Authority
CSO	Central Statistical Office
DR&SS	Department of Research and Specialist Services (also R&SS)
FAO	United Nations Food and Agriculture Organization
FMRS	Farm Management Research Section, Economics and Markets Branch, Ministry of Agriculture, Lands and Rural Resettlement
FSRU	Farming Systems Research Unit, Department of Research and Specialist Services
GMB	Grain Marketing Board
GRZ	Government of the Republic of Zimbabwe
MEU	Monitoring and Evaluation Unit, Agricultural, Technical and Extension Services
MFEDP	Ministry of Finance, Economic Development and Planning
SADCC	Southern Africa Development Coordination Conference
UNFAO	Food and Agriculture Organization of the United Nations (also FAO)
USDA	United States Derpartment of Agriculture

CHAPTER 1

INTRODUCTION

In 1980, over 40 percent of the population of Sub-Saharan Africa suffered from calorie deficiencies.[1] Low consumption levels threatened one-quarter of all Africans with stunted growth and serious health problems[2] (World Bank, 1986:17). Yet per capita food production further declined in two-thirds of the Sub-Saharan countries over the next five years (FAO, 1985a). Cereal grain imports increased to record levels (FAO, 1985b). Three-quarters of the countries in Africa required concessionary food aid in 1987 (USDA, 1987).

Production shortfalls similarly characterize the circumstances of most of the nine Southern Africa Development Coordination Conference (SADCC) countries (FAO, 1985a). Between 1980 and 1985, per capita cereal production declined in five SADCC nations: Angola, Botswana, Lesotho, Mozambique, and Zambia. Total cereal production declined in three of

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[1] Consumption levels below 90 percent of FAO/WHO requirements.

[2] Consumption levels below 80 percent of FAO/WHO requirements.

these countries. Per capita production rose marginally in three other SADCC nations: Malawi, Swaziland and Tanzania. Nevertheless, following 1986 harvests, every SADCC country except Zimbabwe required net food imports (USDA, 1987).

Zimbabwe's recent cereal production record stands in sharp contrast to these African trends. Between 1979 and 1985, Zimbabwe registered an 80 percent increase in per capita cereal production. Harvests of maize, the country's basic staple, more than doubled.[3] By the end of 1986, Zimbabwe had amassed a record maize stock of roughly two million metric tons. Maize reserves had increased to almost four times the highest levels achieved during the 1970s, and stood 20 percent above the previous year's total level of domestic consumption. Though Zimbabwe had to mount a large domestic food aid program in response to widespread drought during the 1986/87 season, the country could still export 500,000 metric tons of maize. At the beginning of the 1986/87 cropping season, Zimbabwe still held 800,000 metric tons of maize in stock.

While Zimbabwe's maize subsector had historically been dominated by large-scale commercial producers, most post-independence maize production gains were contributed by

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[3] See Appendix A for a full listing of the principal data used in this dissertation. This includes a complete set of source citations.

smallholders.[4] Throughout the 1970s, commercial producers consistently harvested three-quarters of the nation's maize supplies. These farmers delivered over 95 percent of the maize entering formal sector markets. While planting only one-third of the total maize hectareage, extensive use of improved technologies maintained commercial yields at eight times the level of the average smallholder.

In contrast, smallholder or communal sector production could best be characterized as semi-subsistence.[5] During the 1970s, over 90 percent of smallholder harvests were retained for home consumption. Production levels stagnated. According to official estimates, area planted failed to keep pace with population growth. Smallholder maize yields are estimated to have remained unchanged. Less than ten percent of communal farmers sold maize in national markets. Most of these farmers were simply concerned with obtaining adequate quantities of food to meet household consumption requirements.

In 1980, the character of smallholder involvement in the

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[4] In 1983, the farm sector in Zimbabwe encompassed roughly 5,500 large-scale commercial producers, 8,600 small-scale commercial producers and 800,000 communal or smallholder producers (CSO, 1985a). Resettlement areas, established after independence, now hold approximately 31,600 households (MFEPD, 1986). In 1986, large-scale commercial and communal farmers produced over 90% of Zimbabwe's maize.

[5] In this study, the terms smallholder and communal farmer are used interchangeably.

national maize subsector changed dramatically. The newly independent Zimbabwe government aggressively promoted communal farm production and the integration the small farmers into the market economy. Market and development support services were expanded and redirected to assist the communal farmer. Producer prices were increased. As a result, between 1979 and 1981, smallholder maize production is estimated to have more than doubled. Most of this early gain resulted from an increase in area planted. Between 1981 and 1985, estimated yield gains lifted communal production levels another 50 percent. Smallholders now harvested over half of the nation's maize supplies. New found optimism about smallholder productivity prompted projections of a further 40 percent increase in communal maize production by 1990 (GRZ, 1986:25).

Roughly 60% of the increase in communal maize production was sold to the parastatal Grain Marketing Board (GMB). In five years (1980-85), smallholder maize deliveries to the GMB increased from less than five percent to over 30 percent of total intake. This increased the gross value of small farm formal sector market earnings by over 100 million Zimbabwe dollars.

The remaining 40 percent of maize production gains were consumed by smallholder households. Maize was substituted for sorghum and millet in daily diets. Widespread production growth also contributed to a net increase in per capita cereal consumption.[6]

Zimbabwe's growth in maize production has not fully resolved the nation's food security problems. Extreme variability in year-to-year production levels presents risks, particularly to households in low rainfall regions. Nevertheless, both aggregate food supplies levels and the distribution of these supplies have improved. The justification for these gains requires explanation.

1.1 Research Objectives

This dissertation sets out to explain why smallholder maize production and sales increased so dramatically since independence. The analysis of this problem is set out on two levels. First, aggregate, historical time-series data are used to examine the timing and distribution of the growth in smallholder maize production and sales. Evidence of crop

[6] Between 1979 and 1985, smallholder millet retentions are estimated to have increased by approximately 20,000 metric tons. Sorghum retentions increased by roughly 10,000 metric tons. Maize retentions increased an estimated 380,000 metric tons (Muir-Leresche, 1985; AMA, various years; CSO, various years). These data should be interpreted, however, as gross estimates of production and consumption trends. (See discussion of data reliability pp.24-26.

substitution and productivity gains is reviewed. Particular attention is directed toward analyzing the impact of government policy interventions designed to increase smallholder productivity. The aggregate analysis culminates in the construction of a smallholder supply response model quantifying the relative significance of the principal factors responsible for the production gains.

The review of aggregate trends is then extended with an examination of factors influencing maize production and market decision making at the household level. This cross-sectional investigation highlights the position of maize in the smallholder production system, the determinants of land allocation and decisions underlying technology use. The relationship between maize sales and retentions is evaluated. The impact of government policies and infrastructural investments on smallholder production and market strategies are consistently reviewed.

Two additional issues further guide the analysis. First the food security implications of maize production and market trends are considered. The inquiry seeks to identify what factors explain the distribution of smallholder participation in the maize economy. How broadly does responsibility for the recent production and market gains extend? What has been the distribution of benefits? Ultimately, how have household consumption levels been affected? In this context, the analysis stresses the important food security distinction between aggregate food production growth and household consumption sufficiency.

Second, the replicability of the maize production gains is questioned. To what extent can the advances be attributable to a unique set of circumstances following Zimbabwe's achievement of independence? Can the trends be expected to continue? What is necessary for them to be broadened to encompass additional crops?

1.2 Research Hypotheses

This study hypothesizes that the growth of smallholder maize production and sales was primarily stimulated by a complementary set of changes in agricultural policies, institutions and technologies. The combination of these adjustments brought a significant improvement in smallholder production opportunities and incentives. Increasing government administered producer prices probably most influenced the production decisions of the small subset of producers already selling to the GMB before 1980. However, the production decisions of most smallholders were more significantly affected by a broad series of institutional changes including the expansion of market infrastructure, the establishment of smallholder credit programs, improved extension support and the ready availability of new technologies. A further source of production growth was the termination of rural conflict associated with the end of the independence war.

The coordinated impact of government development strategies was important. In order to take advantage of producer price adjustments, producers required market access. This depended on the proximity of major market outlets and the severity of transport constraints. Technology adoption and rates of input application depended on input availability. This was contingent upon the distribution of input markets and ability to obtain credit. Similarly, the returns to input use depended on the quality of recommended practices and availability of extension support. Policy, institutional and technological constraints are interdependent. In some cases these may be independently binding.

A second major hypothesis relates to the distributional impact of government strategies to promote gains in smallholder productivity. It is hypothesized that the influence of government strategies is cumulative. Farmers with greater resources are better able to take advantage of associated shifts in production incentives. These resources include not only land, labor and capital, but also access to institutional services. Insofar as the distribution of these resources is skewed, the distribution of returns to broadly focused government investments or policy changes will be variable. This has particularly significant implications for the pursuit of food security. It suggests households facing the greatest food security constraints may benefit least from sector-wide development programs. Only special targeting of government assistance may offset critical barriers limiting production levels of the less advantaged.

A third major hypothesis proposes that the pursuit of farm and off-farm income is interdependent.[7] Most smallholders in Zimbabwe cannot be simply described as producers of crops and livestock or as farmers. Historically these have been part of an active labor reserve economy. Substantial income is derived from part-time involvement in rural small scale industry, farm based production of low cost consumption goods and labor migration to the formal sector. The level of investment in crop production depends on the relative returns to labor and capital in crop enterprises in comparison with the returns to investment in these

[7] Farm income encompasses earnings of household members who primarily live and work on their own family farm. This includes earnings from crop production, livestock production, minor inter-household trade and local short term labor hire. Off-farm income encompasses earnings of household members who primarily live or work off the family farm. This includes earnings from steady wages, business profits and remittances.

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alternative income generating activities. Further, diversification of investments across crop and non-crop production enterprises is stimulated by crop production risks, the seasonality of the cropping calender and the fact that the potential returns to the labor of various family members differs.

Before 1979, the low returns to investments in crop production encouraged farmers to produce only enough grain to meet their family food needs. Additional labor and capital were invested in off-farm activities or consumption expenditure. Maize returns then increased with the development of production infrastructure, application of improved technologies and increase in producer prices. Though the farm economy remained diversified, greater household resources were directed to maize production. Households facing the largest increase in net returns and those with the greatest access to investment resources increased their production most. Yet these gains are not necessarily permanent. In the future, investment priorities will still be influenced by the relative returns to alternative farm and non-farm investments.

A final hypothesis proposes that while the recent gains provide an important starting point for extending food security to most smallholders, many factors make the recent

Zimbabwe circumstances unique. The stimulus provided by the ending of the war for independence. The newly established multi-racial government was able to exploit an institutional base of agricultural infrastructure with a long history of efficient service to large-scale producers. This could be readily expanded or reoriented to serve the smallholder population. A large latent potential for increased smallholder productivity existed which could be tapped with relatively minor additional investment. Additional future gains will be more difficult. As the costs of future government investments mount, a more careful evaluation will be required of the trade-offs characterizing the pursuit of alternative development objectives. Instead of establishing programs for the smallholder sector as a whole, better targeting of assistance will be necessary.

1.3 Theoretical Framework

A broad range of theoretical models are relevant to the analysis of factors underlying the recent growth of communal maize production and sales. At the aggregate level, these encompass disciplinary models of supply response and subject matter theories about the relative importance of price incentives and institutional change. Questions of production growth are treated at the household level in theories of technology adoption, decision making under risk, household economics, farm management economics, and production efficiency. The implications of production and market growth can be traced through broad theories of agricultural development or policy specific assessments of issues such as food security. The following brief discussion of the theoretical framework guiding this study highlights some of the issues raised in this literature which appear particularly relevant in the Zimbabwe context.

Theoretical models of supply response in the international debate about agricultural development policy revolve around two perspectives. These can be broadly characterized in terms of the relative emphasis placed on price policy and market liberalization versus institutional and technological change encompassing the expansion of public goods and improved technology. The World Bank stands prominently as a major advocate of price and market reforms. In a 1981 strategy statement, the Bank identified four priorities for African agriculture. These included a focus on smallholder production, increasing prices and market incentives, expanded agricultural research and irrigation investments (World Bank, 1981:50). Three years later, the emphasis of a new Bank strategy statement was on market reform (World Bank, 1984). This cited price distortions and market inefficiency as the major constraints to agricultural production. A corresponding set of major policy reforms proposed the removal of administrative controls on input and product prices, the encouragement of private sector involvement in agricultural markets and the more 'businesslike' operation of parastatals. Agricultural research was now identified as a 'long term constraint'. No mention was made of irrigation investment.

The argument for market reform emphasizes the fact that significant production disincentives have been created by overvalued exchange rates, low producer prices and high marketing costs associated with government involvement in the market system. Agricultural production, it is suggested, can be strongly stimulated by resolving these constraints. This implies a high short-run elasticity of aggregate agricultural supply. It also assumes that technological and resource constraints are not immediately limiting. Rather, the capacity already exists to increase production substantially if price constraints can be resolved.

Advocates of institutional and technological change (eg. Eicher, 1982, 1985 and 1986; Delgado and Mellor, 1984) view aggregate supply to be relatively inelastic. This perspective emphasizes constraints embodied in inadequate infrastructure, the lack of improved location specific technology, low levels of human capital and poor institutional management. Adjustments in exchange rates and producer prices will not substantially affect production levels without the removal of these constraints. Relative prices are still viewed as important. However, the effectiveness of price incentives depends on their incidence at the farm level and the capacity of farmers to respond. These depend on the government's willingness to invest in public goods and the efficient application of these investments. Without institutional reforms, the impact of price policy will be limited. Institutional reforms on their own can have a potentially large impact on smallholder production and productivity even without major increases in administered prices.

The first study hypothesis supports the institutionalist perspective. Significant structural barriers were created by the lack of government support for communal agriculture before 1980. Credit, research and market institutions and infrastructure were built, with strong government support, primarily to serve the commercial agricultural sector. Extension programs designed for commercial agriculture stressed technology adoption and improved management practices. In the communal sector, extension efforts were periodically merged with programs of administrative control.[8] Major increases in communal productivity did not occur until institutions and infrastructure developed for the commercial sector were expanded to serve communal producers.

[8] See Wienrich (1978).

A broadly encompassing theoretical framework for the proposed cross-sectional analysis of farm level decision making falls under the category of 'agricultural household models'. (eg. Singh, Squire and Strauss, 1986; Barnum and Squire, 1979 and Nakajima, 1986.) These models have several major characteristics. They view the farm household as a holistic unit characterized by interdependence between production and consumption decisions. Such interdependence is particularly apparent in labor allocation decisions and an associated tradeoff between income generation and consumption. This tradeoff is influenced by the availability of non-labor inputs as well as the composition of the labor force. In their broader applications, household models can be used to trace the impact of any given policy or institutional change on production and consumption decisions. In the context of agricultural resource allocation, these models facilitate understanding of the wide range of socioeconomic variables influencing investment decisions.

One application of agricultural household models in the Southern Africa context (Low, 1986) seeks to explain the lack of supply responsiveness among smallholders in the region. Low argues that labor saving technology will be adopted in order to reduce family labor requirements for meeting household consumption needs and to allow freed resources to be committed to off-farm activities. No surplus will be produced because the returns to labor invested in non-farm activities are higher than those obtained from the production of a marketable surplus. The continuation of subsistence production implies the comparative advantage of nonmigratory labor in fulfilling the basic requirements of household maintenance. Zimbabwe is included as a case study.

Contrary to Low's expectations, maize production and sales in Zimbabwe have sharply increased. Two justifications for these gains are apparent. First, institutional changes encompassing the expansion of market infrastructure and establishment of a smallholder credit program have increased the returns to farm labor. Greater family labor resources have, accordingly, been allocated to crop production. These may be derived from labor previously allocated to enterprises other than crop production, leisure, or household maintenance. More importantly, higher returns to capital have justified larger investments in improved inputs than are required simply to maintain production at levels necessary to meet household consumption requirements. This improved the productivity of labor already committed to crop production, and ultimately could justify hiring additional workers.

Questions regarding the distributional impact of development strategies are broadly treated in debate regarding the relationship between economic growth and equity (eg. Lipton, 1977). A more specific, and in this case relevant, application of this debate examines historical patterns of adoption of high yielding varieties (HYVs).[9] Investigators have noted that large farmers, or those with better resource bases, adopted HYVs and associated inputs more quickly than those with poorer resources. Eventual adoption by the poor improved their welfare absolutely, though these farmers lost ground in terms of relative income. Many farmers in poorer agroecological zones failed to benefit except insofar as employment opportunities increased, wages rose and consumer prices declined.

These conclusions have largely been drawn from case studies in Asia. In the African context, greater variability exists in the availability of agricultural infrastructure and a larger proportion of producers face poor agroecological conditions (cf. Wanmali and Idachaba, 1987; Matlon, 1987). Accordingly, analysis of the impact of improved technologies or the broader set of production interventions needs to place greater emphasis on evaluating the combined impact of farm resource levels and institutional access. These further limit the applicability of improved technologies and the impact of policy changes. In addition, they increase the severity of

[9] A useful review of this literature can be found in Lipton and Longhurst, 1985. See also Timmer, 1987; Herdt, 1987.

resultant distributional disparity.

The issue of food security provides a framework linking the various components of the analysis. This provides a perspective guiding the choice of hypotheses and orientation of the analysis. This investigation concludes by placing particular emphasis on evaluating the food security implications of the findings. A growing conceptual literature on food security helps focus this perspective.

The Michigan State University Food Security Research Project defines food security as "the ability of a country or region to assure, on a continuous long term basis, that its food system provides total population access to a timely, reliable and nutritionally adequate supply of food (Staatz, 1985)." Adult nutritional adequacy, according to the United Nations Food and Agriculture Organization and the World Health Organization requires consumption of at least 2200 calories per day with associated access to protein and vitamins (Berg, 1981:6-7). Generally, if calories are available, both protein and vitamin requirements will be met. Continuous, timely and reliable access suggests the importance of consistent food availability throughout the year. Food may be either produced or purchased.

An important series of distinctions, discussed by

Reutlinger (World Bank, 1986) demarcate the range of government and household strategies for pursuing food security. These have been applied by Rukuni and Eicher (1987) in the southern Africa context. First, attention must be directed to both food supply and demand. The commonly cited statistic of per capita food production provides only the broadest proxy indication of potential nutrition levels. Per capita food supply, a measure excluding exports and including imports, is a more reasonable measure of aggregate food availability. Yet this tells us little about the distribution of food access. Ultimately, food security requires the ability of households to produce enough food to meet their nutritional requirements and purchase what they are unable to produce. Therefore, attention must be directed to both the distribution of production and income.

Food strategies must also cope with the distinction between chronic and transitory insecurity. Some households consistently lack the production capability or purchasing power to meet their basic nutritional requirements. Many more experience short-term production or purchasing shortfalls associated with drought, war or the loss of a job. Again, each sort of dislocation requires a unique program of assistance. In sum, the objective of attaining aggregate self-sufficiency or even self-reliance in the average year is not alone adequate. Policy makers must consider the distribution of calorie access across population groups and years with a coordinated set of responses to localized and changing needs. Production policy relating to Zimbabwe's principle staple, maize, must, ultimately, be evaluated for its correspondence with these objectives.

Finally, the breadth of this analysis ensures that consideration of many underlying issues will be incomplete. Johnson's (1986) distinction between disciplinary, subject matter and problem solving research offers justification for this stance. The effort to explain the rapid increase in smallholder maize production and associated food security implications represents a subject matter investigation. It aims to provide policy makers with information useful for identifying improved development strategies of relevance to a broader range of smallholder producers. The analysis does not seek to provide specific answers to particular policy problems. Nor does it present a disciplinary model aimed at advancing the theoretical debate. Rather, the analysis advances understanding of the range of factors influencing household production decision making and food security. In particular, the discussion provides an important case study of the complementary impact of policy, institutional and technological change on smallholder production and marketing. The broad focus of the investigation ensures the uncovering of numerous questions for future research.

1.4 Chapter Outline

Chapter Two reviews the study's methods of investigation. It describes the extensive set of household and market surveys conducted and reviews the range of secondary information employed.

Chapter Three begins the analysis with a brief review of Zimbabwe's smallholder agricultural economy. This encompasses a description of the fundamental characteristics of the agricultural sector, Zimbabwe's system of agricultural institutions, the relative position of smallholders and the post-independence agricultural sector development objectives.

Chapter Four begins the core analysis with an examination of aggregate maize production and market trends. The range of factors influencing smallholder production and market decisions are reviewed. A descriptive analysis evaluates the relative importance of alternative policy, institutional and technological variables. An aggregate supply response model attempts to quantify these relationships.

Chapter Five begins the micro-level analysis. This reviews the socio-economic circumstances of smallholder farmers, examines local evidence of maize production growth and identifies critical factors influencing small farm decision making which help explain these trends. The analysis emphasizes the explanation of area allocation strategies and factors determining maize yields. The variability of production levels draws particular attention. Regression equations are estimated for household maize area and maize plot yields.

Chapter Six continues this analysis with a review of the technology adoption and input expenditure patterns of survey participants. These investment decisions are related to historical trends in the returns to the maize enterprise in each survey region.

Chapter Seven looks more closely at maize marketing decisions. This clarifies the relationship between maize sales and retentions while identifying the major constraints to market involvement. The link between market institutional expansion and sales behavior draws particular attention. Regression equations employed to estimate the major determinants of household maize sales.

Chapter Eight concludes the investigation with a review of the implications of maize production gains for national food security. This summarizes the impact of policy, institutional and technological changes and reassesses the relative importance of the alternative development interventions. The most critical factors influencing future rates of maize production and market growth are cited. Factors affecting the extension of these gains are identified. The food security implications of the results are reviewed and an agenda for future research is proposed.

CHAPTER 2

DATA SOURCES AND COLLECTION PROCEDURES

The first broad compilation of aggregate agricultural, economic, physical and demographic data relating specifically to Zimbabwe's communal (and small-scale commercial) sector was published in 1978 (Whitsun Foundation, 1978). This collated information from the files of the various ministries and parastatals with responsibility for administration and development in the African farming regions. However, a prominent caveat appeared in the early pages of this report. This warned "some of the data series have to be treated with considerable caution. This is particularly true of the data for agricultural production (p. 9)." In effect, the limited aggregate data providing a basis for the construction of a new post-independence smallholder development strategy was of questionable accuracy.

Since 1980, Muir-Leresche (1985) updated and extended some of the crop production and sales data initially gathered by the Whitsun Foundation. The Central Statistical Office (CSO) (1985a) and Agricultural Marketing Authority (AMA) (eg. 1985, various years) have begun regularly reporting a limited series of smallholder production and market statistics. Greater efforts are being made to improve the quality of incoming aggregate production statistics. However, the range of published data on aggregate smallholder production trends remains small. Variables are frequently not clearly defined and questions about data accuracy continue to be raised.

The available base of household level survey data is also narrow. Shortly after independence, while planning a nationwide survey program to gather information on the smallholder economy, Zimbabwe's CSO noted "Zimbabwe is extraordinarily deficient in its information on...households in the rural areas...no reliable data are available on agriculture in the communal areas (CSO, NDa:1)." Since then, data collection efforts related to smallholder farming have proliferated. Localized case study investigations and baseline surveys have been conducted in many parts of the country.[1] The CSO program alone encompasses the collection of nationwide information on smallholder production levels and practices, agricultural resources, rural incomes and expenditure patterns, health indicators and demographic variables.

Most of the CSO data remains to be analyzed. While

[1] For example, ARDA, 1982; ARDA, 1983; PTA, 1982; CIMMYT, 1982; MEU, 1983; MEU, 1984; FMRS, 1984; Rukuni, 1985; Shumba, 1985.

important information has been obtained from the surveys of other researchers, consulting firms and government offices, knowledge of smallholder farming practices and production decisions is still limited. Much of the household level data is piecemeal, derived from one shot surveys or focused on a limited set of issues.

In view of the continuing questions about the quality of the aggregate data base, this chapter first includes a description of the principal sources of national data employed in the analysis of smallholder production trends. Questions about the accuracy of the aggregate data, particularly the production data, are reviewed.

Given the limited farm level data base, a thirteen month survey program was launched to collect information necessary for a detailed analysis of smallholder production decision making. The second part of this chapter describes the structure and content of the farm level survey program.[2]

2.1 Aggregate Data for the Communal Sector

Aggregate data for both national and communal

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[2] For a more complete description of the data collection effort see Rohrbach, 1987b.

agriculture were collected throughout the fieldwork period beginning in August 1985 and ending in March 1987. Several major problems were encountered in this endeavor. First, as noted above, little data on communal agriculture has been published. Only small quantities of information have been organized informally for policy analysis. Much information must be sought from government files. Many of these are not readily accessible to the researcher.

Second, the data obtained from different sources are frequently inconsistent. This results, in part, from the failure to clarify properly the farm sectors to which the data apply. The commercial sector data sometimes incorporate information for the large and small-scale commercial farmers. In other cases the term signifies the large-scale sector only. Data covering peasants or smallholders may include information on communal farmers, communal and small-scale commercial farmers or communal, small- scale commercial and resettlement farmers. In the CSO's <u>Statistical Yearbook</u> (1985), agricultural data are provided for commercial (generally large-scale and small-scale) and communal farmers. No data are provided for the resettlement sector.[3]

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[3] In this study, unless otherwise indicated, the term commercial applies to large and small-scale commercial farms. The terms smallholder and communal farmer are employed interchangeably. Resettlement farmers are distinguished.

A second possible reason for data inconsistencies, and a source of analytical problems, is the failure to clarify the meaning of variables. Crop area may represent area planted or area harvested. This has recently changed in the principal historical source of smallholder crop production data, extension worker estimates for the Agricultural, Technical and Extension Services (AGRITEX). However, the significance of this change has not been noted in published reports employing this information. The data is identified simply as crop area. Similarly, information on smallholder credit may represent loans allocated or disbursed.

Different estimates for certain variables may be available. In 1986, for example, two ministries offered three estimates of communal crop area and two estimates of crop yields. These were combined to form additional official production estimates by an inter-ministerial committee (CSO, various years). There are no firm figures for some variables such as seed and fertilizer deliveries to the smallholder sector. In such cases, different estimates may be provided by the representatives of different private sector firms supplying these inputs.

The problem of data quality remains omnipresent. The accuracy of the production data remains the most questionable. Ultimately, one might ask whether the tripling in smallholder maize production actually occurred. Much supporting evidence, including a relatively accurate set of formal market sales statistics, indicates aggregate production, in fact, sharply increased. Nevertheless, the timing and annual magnitude of area and yield growth since the late 1970s can still be debated. In addition, detailed analysis of this data below the provincial level is probably unwarranted. This investigation has accordingly placed greater emphasis on the explanation of sales trends and survey results. A listing of major aggregate statistics, with full source citations, appears in Appendix A. Here, a description of some of the most important data and data sources is provided.

2.1.1 Communal Sector Production Data

Over the last twenty years, the principal source of smallholder production data has been the estimates of agricultural extension agents. Fieldworkers and regionally based extension officers have compiled rough estimates of crop area, yield, production, expected sales and expected retentions. In recent years, these estimates have been made at least twice during the cropping season.[4] Until the 1984/85

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[4]During the later stages of the war (1977-79), local extension workers were withdrawn from communal areas subject to growing violence. Regional or provincial extension officers continued making rough estimates of production during this period. However, insofar as the estimates were not based on field visits, they may have been biased. Further, widespread changes in regional and local level

cropping season, crop area data represented the number of hectares expected to be harvested. If no harvests were expected, a zero area estimate was recorded. Thereafter, area estimates represent area planted. Since 1980, aggregate production data based on these extension worker estimates have been reviewed, and sometimes adjusted, by a national Crop Forecasting Committee chaired by the CSO.

Concern about the accuracy of the extension agent estimates prompted the introduction of two additional data collection efforts after independence. During the 1983/84 season, the CSO launched an annual survey to collect provincial data on smallholder crop area and yields (eg. CSO, 1985b). Area estimates, in these surveys are derived from sample plot measurement. Yield estimates are established with crop cuts.

During the 1984/85 cropping season, AGRITEX, the department of the Ministry of Agriculture responsible for administering the extension services, began gathering a third estimate of communal crop area. In addition to the traditional field staff estimates, random plot checks were performed based on the grid points drawn on aerial photos. The following year, yields at the grid plots were visually

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extension personnel after independence may have resulted in inconsistent estimation bias.

estimated. This survey provides information which can be disaggregated to the level of communal areas.

The justification for concern about the accuracy of the original extension agent estimates has become readily apparent as the new estimates have become available. Yet, the relative accuracy of the two new estimates also appears difficult to determine. Table 2.1 compares the three sets of smallholder production estimates for the 1984/85 season. The estimates of total smallholder maize area planted and yields differ by up to 25 percent. Since the divergence between area and yield estimates is offsetting, the two total production estimates are similar.

Table 2.1
Alternative Estimates of Communal Maize Production, 1984/85, Zimbabwe

	a/ AGRITEX Ext. Wrkr.	b/ AGRITEX Grid Survey	c/ CSO Hshld. Survey
Area Planted ('000 Ha.)	1176	1087	887
Yield (Mt/Ha)	1.42	N/A	1.92
Production ('000 Mt)	1666	N/A	1706

Sources: a/ calculated from original extension worker crop forecast forms (AGRITEX, various years)
b/ P. Johnson, AGRITEX, personal communication.
c/ CSO (1985b).

At the provincial level, the divergence between the three sets of estimates is substantially greater. Table 2.2 displays the same production data for one of the largest maize producing provinces, Midlands. This shows a difference in aggregate area estimates of over 50 percent. The estimates of total maize production differ by more than 25 percent. Production estimates for other crops display greater discrepancies.

Table 2.2
Alternative Estimates of Midlands Province Maize Production, 1984/85, Zimbabwe

	a/ AGRITEX Ext. Wrkr	b/ AGRITEX Grid Survey	c/ CSO Hshld Survey
Area Planted ('000 Ha.)	361	158	192
Yield (Mt/Ha)	1.29	N/A	1.78
Production ('000 Mt)	465	N/A	342

Sources: a/ calculated from original extension worker crop forecast forms (AGRITEX, various years).
b/ P. Johnson, AGRITEX, personal communication.
c/ CSO (1985b).

This study primarily employs the 1970-83 time-series data for production published in the CSO's Statistical Yearbook (1985). The most recent aggregate data comes from the Crop Forecasting Committee Estimates. Unless otherwise indicated, the provincial level data cited in the analysis is taken from the extension worker estimates upon which the CSO data has historically been based. The analysis takes account of the fact that these are gross approximations.[5]

[5] One further discrepancy in the historical AGRITEX extension worker estimates should be noted. These do not account for the production of green maize. This is maize harvested and eaten green, or before the crop is dry. This may encompass roughly five percent of the average household's crop.

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2.1.2 Communal Sector Sales Data

Data on communal sector crop sales are substantially more accurate than the production estimates. The principal outlet for smallholder crop sales has historically been the parastatal Grain Marketing Board (GMB). Legal restrictions are placed on the sale of registered crops outside of District boundaries. Farmers have always sold small quantities to local church-run schools and clinics. Farmers also sell small quantities to one another, particularly in drought years. However, the only buyer for larger surpluses has been the GMB. The GMB crop intake data for the smallholder sector employed in this study were extracted from the parastatal's computer files.

2.1.3 Other Major Secondary Data

Other aggregate data were pieced together from a variety of public and private sector sources. For example, crop price data were obtained from the Agricultural Marketing Authority (AMA) Economic Review of the Agricultural Industry of Zimbabwe bulletins (eg. AMA, 1985). Information on grain market infrastructure and operating procedures was obtained directly from the GMB. Data on input deliveries and prices were gathered from the major private sector input supply companies. Data on credit disbursement and repayment were obtained from the Agricultural Finance Corporation (AFC).

Again, the coverage and relative accuracy of these data were inconsistent. Official producer prices set a benchmark for farm gate price levels. The margin depends on transport costs, crop grade and the identity of the purchasing agent. Fertilizer delivery statistics have been roughly estimated from information about credit funded disbursements and sales locations. Smallholder seed deliveries have been derived from the difference between estimated commercial sector purchases and total seed sales. These procedures were employed because the companies themselves do not keep strict account of the portion of their sales to the communal farm sector. Therefore, these aggregate data only approximate true values.

2.2 The Field Survey Program

During the initial stages of the investigation, the coverage and available results of recently completed and on-going surveys of communal agriculture were reviewed.[6] Participants in this work were interviewed and copies of questionnaires were obtained. This information helped orient the focus of the planned survey program.

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[6] Bernsten and Rohrbach (1985) provide a brief description of this farm level survey work.

The broad objective of the micro-level data collection effort was to identify factors influencing household-level participation in the aggregate maize production and sales trends. This first required an assessment of the distribution of participation in these trends. Next, data were required showing why participation had occurred, and particularly, the influence of government policy or institutional interventions on the regional maize production and sales trends. Finally, information had to be collected to create a model of smallholder decision making identifying the most important factors influencing future production patterns.

Reliance on cross-sectional data limits the capacity to identify factors guiding production and marketing decisions over time. To the extent possible, survey participants were asked to estimate how their farming and marketing practices had changed over the past ten years. Assumptions had to be made about the relationship between the current distribution of production and sales levels and the growth of maize production and sales since 1979. These assumptions are highlighted in the analysis of the data. Once recognized these constraints were not insurmountable.

2.2.1. Survey Timing and Content

Two sets of surveys were planned. One series of four major questionnaires elicited information from a consistent sample of farm households on farm resource inventories, input purchases, production practices, product market activities, income and expenditure patterns and production decision making. A corresponding set of three minor surveys included a field measurement and soil sampling exercise, plot yield checks and a questionnaire gathering enterprise labor information. A brief summary of these surveys is provided in Table 2.3.

A second set of surveys collected information on the availability and practices of local agricultural support institutions. Formal interviews were conducted with local extension agents, input suppliers, product buying agents, and transporters. Informal discussions were held with community leaders, the heads of local farming groups, credit agency representatives and locally operating agricultural researchers. These surveys are outlined in Table 2.4. A detailed description of the entire survey program is provided in Rohrbach (1987b).

The household surveys were scheduled to coincide with major points in the agricultural calender. This was of critical importance given the priority attached to the collection of plot specific information. The institutional surveys were then scheduled as time was available.

Table 2.3
Schedule and Composition of Maize Study Household Surveys, Zimbabwe

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<u>First Cropping Practices Survey</u>
Date: January-February 1986
Sample: 204 Households
Information Collected: family composition; land use; crop sales; input purchases and adoption; credit use; plot data.

<u>Second Cropping Practices Survey</u>
Date: February-March 1986
Sample: 204 Households
Information Collected: production decisions; crop storage; cattle and implement ownership; plot data.

<u>Yield Data Collection Exercise</u>
Date: April-June 1986
Sample: 204 Households
Information Collected: plot yield data.

<u>Field Measurement and Soil Sampling Exercise</u>
Date: May 1986
Sample: 204 Households
Information Collected: plot size checks, soil samples.

<u>Enterprise Labor Survey</u>
Date: May 1986
Sample: 204 Households
Information Collected: enterprise labor information.

<u>Third Cropping Practices Survey</u>
Date: July-August 1986
Sample: 204 Households
Information Collected: harvest and planned utilization; crop storage; groundnut consumption; alternative income levels and sources.

<u>Fourth Cropping Practices Survey</u>
Date: January 1987
Sample: 204 Households
Information Collected: crop sales; acres planted; input purchases; credit use; food purchases and aid.

Table 2.4
Schedule and Composition of Maize Study Agricultural Support Institution Surveys, Zimbabwe

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<u>Input Sales Agent Survey</u>
Date: March-July 1986
Sample: all locally based retail outlets serving survey participants
Information Collected: period of operation; volume of business; prices; services offered; operational constraints.

<u>Crop Buying Agent Survey</u>
Date: March-July 1986
Sample: all formal market crop buying agents serving survey participants
Information Collected: period of operation; volume of business; crop prices; services offered; operational constraints.

<u>Transporter Survey</u>
Date: March-July 1986
Sample: all locally based transporters serving survey participants
Information Collected: period of operation, business volume; prices; services; constraints.

<u>Extension Worker Survey</u>
Date: January 1987
Sample: all extension workers serving survey respondents
Information Collected: recommendations; activities; views of local agricultural development; constraints.

Informal interviews were also conducted with credit agency representatives, farm community leaders, farmer group leaders, and locally operating agricultural researchers.

2.2.2. Survey Sample Location

Several objectives guided the choice of locations for the survey work. The regions had to be major maize production areas. They had to be situated in distinct agroecological zones representative of major parts of the country. The survey locations had to have sufficient institutional development to be influenced by government development strategies. Maize needed to be viewed as a potential source of cash income. Farmers and community leaders had to be interested in participating in the surveys and willing to maintain involvement for the planned thirteen month period. Limited research funds allowed comprehensive work in two regions.

An additional factor influencing the choice of survey locations was the availability of recent information describing cropping practices and agronomic information evaluating available technologies. The information on cropping practices would help focus the planned surveys and extend the information base over a longer period. The agronomic information could supplement the collection of plot level data.

Two smallholder farming areas participating in Department of Research and Specialist Services farming systems research activities were chosen as survey sites:

Mangwende Communal Area in Mashonaland East Province and Chibi Communal Area in Masvingo Province. The two communal areas encompassed distinct agroecological zones broadly representative of Zimbabwe's maize growing regions (Figure 2.1). Both had reasonably good access to formal sector maize markets and associated development institutions. The farming systems teams provided access to baseline data collected in 1981 and 1982, the results of locally administered agronomic trials and interaction with crop and livestock scientists familiar with the farming problems and practices of local farmers.[7]

2.2.2.1. The Mangwende Survey Area

Mangwende Communal Area is situated 60-85 kilometers east of Harare in a high rainfall zone classified as Natural Region II.[8] This agroecological zone encompasses nine

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[7] The potential bias resulting from the farming systems activities in each region was considered. No new recommendations had been derived from the experimental trials in either area. No village participating in the farming systems activities was included in the sample. In such circumstances, the advantages of access to locally attuned expertise seemed to outweigh the limited extent of sample bias. In retrospect, this judgement still appears correct.

[8] Zimbabwe is divided into five Natural Regions according to rainfall and farming potential. Natural Region I, a specialized and diversified farming region, consistently receives at least 900 mm of annual precipitation. Natural Region II, an intensive farming region, generally receives 750 to 1000 mm of rainfall. Natural Region III, a semi-intensive farming region, receives 650-800 mm of rain. Much of this is in infrequent heavy falls and the area is subject to mid-season dry spells. Natural Region IV, a semi-extensive

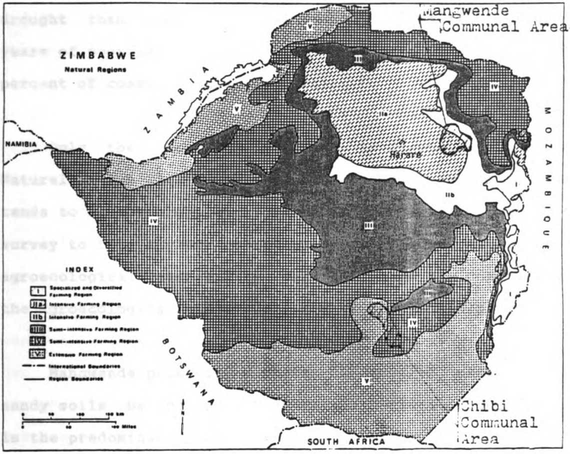

Figure 2.1 Mangwende and Chibi Survey Areas, Zimbabwe

percent of Zimbabwe's communal land and roughly 18 percent of the smallholder population (CSO, NDb). Available data indicates Natural Region II accounts for roughly 23 percent

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farming region, receives 450-650 mm of rainfall, but is subject to severe mid-season dry spells and drought. Natural Region V, an extensive farming region, generally receives less than 650 mm of rainfall too low and erratic for crop production. (See Appendix Table A.9 for a summary of the distribution of farmland by Natural Region.)

of total communal maize production when rains are good throughout the country. Since the region is less subject to drought than the larger semi-arid regions of Zimbabwe, in years of poor rainfall, the region may account for up to 60 percent of communal maize production.[9]

Only the southern part of Mangwende, encompassing Natural Region IIa, was included in the sample. Rainfall tends to be more consistent in this environment. Limiting the survey to this higher potential area reduced within-sample agroecological variability and increased the contrast with the agroecological characteristics of the second survey zone.

Mangwende primarily contains coarse to medium grained sandy soils belonging to the paraferrallitic group. Granite is the predominant parent material, with smaller areas of dolerite. The soils have a low content of clay, organic matter and weatherable minerals. They have a low pH and are deficient in nitrogen and phosphate. Potassium levels are generally considered adequate (Shumba, 1985: 12-14).

Market infrastructure in Mangwende is good by communal area standards. The region is divided by a major tarmac road leading from Harare to the Mozambique border. The area is

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[9] These calculations are derived from the Agritex extension worker estimates for district level production.

also served by several unpaved feeder roads. However, these tend to be poorly maintained during the rainy season. A major GMB depot is situated in the district center of Murewa. During the 1985/86 marketing season, four GMB collection points were also established as temporary buying locations. Several shopkeepers serve as GMB buying agents. A cooperative union operates two depots in the survey area which sell agricultural inputs. Two wholesalers in Murewa and numerous retailers throughout the communal area also sell inputs. Many locally based transporters serve the area.

Maize is the principal crop in Mangwende, as it is in most of the Zimbabwe communal sector (Table 2.5). It accounts for almost 70 percent of the average 2.2 hectares each household plants to summer crops.[10] Other minor crops include groundnuts (ten percent of area planted), finger millet (nine percent of area), sunflower (five percent of area) and bambara nuts (five percent of area). Average maize yields are roughly double the mean levels for the communal sector as a whole. The best farmers obtain yields comparable to average large-scale commercial farm levels.

Mangwende farmers are active participants in national maize markets. In 1985, three-quarters of local production was sold to the GMB, accounting for ten percent of total

[10] Vegetables are produced by some families in the winter.

Table 2.5
Major Characteristics of the Mangwende and Chibi Survey Areas
Zimbabwe

Characteristics:	Mangwende	Chibi	Communal Sector
Natural Region	IIa	IV	I-V
Ave. Rainfall (MM)	750-1000	450-650	N/A
Population Density Per Sq. Km. (1980)	52.7	41.2	25.2
Ave. Holding Size Ha. (1986)	2.8	2.4	2.4
Ave. Maize Ha. (1986)	1.5	1.3	a/ 1.3
Ave. Maize Yields MT/HA (1986)	2.2	0.5 (drought)	1.2
Ave. Maize Yields MT/ha (1985)	2.7	1.7	1.4
Ave. Maize Production Per Household MT (1985)	4.0	1.8	a/ 2.0
Ave. Maize Sales Per Household MT (1985)	3.0	0.6	a/ 0.8

a/ Derived from aggregate national data assuming there are 800,000 communal producers.

Sources: CSO (NDb), CSO (various years), CSO (1986), Mangwende and Chibi Surveys.

smallholder maize deliveries. Most farmers sold maize, though, as will be discussed in Chapter 5, relatively few sold large quantities.

2.2.2.2. The Chibi Survey Area

The Chibi survey area is situated 350 to 400 kilometers south of Harare and 50 to 100 kilometers south of Masvingo, the nearest urban center. While Chibi spreads across Natural Regions IV and V, only the southern area in Natural Region IV was included in the sample. This agroecological zone encompasses 47 percent of Zimbabwe's communal land and 42 percent of the population (CSO, NDb). The Natural Region's maize production accounts for 39 percent of the total communal supplies in high rainfall years (1984/85) and as little as 5 percent in drought years (1982/83).[11]

Southern Chibi soils are generally medium grain sands of the fersailltic group.[12] Soil pH tends to be low. Nitrogen and phosphate are extremely deficient, though potassium levels are adequate (Department of Research and Specialist Services, 1985: 29-30).

Market infrastructure in Chibi is satisfactory. A major

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[11] See footnote 6.

[12] Most communal area soils in Zimbabwe are kaolinitic and belong to either the fersaillitic group, as in Chibi, or the paraferrallitic group, as in Mangwende.

tarmac road intersects the communal area leading from Masvingo to Beitbridge at the South Africa Border. This also branches east from the center of the designated survey area toward Chiredzi. Unpaved feeder roads cross more populated parts of the region. The nearest GMB marketing depot is located in Masvingo, 90 kilometers north of the survey zone. However, in 1985, several GMB collection points were temporarily established in Chibi to reduce transport costs. Two local shopkeepers act as GMB authorized buying agents. One of these began operations in 1986. Seed and minor chemical inputs are locally available, though major input purchases have to be made in Masvingo. There are no major locally operated transport facilities for agricultural trade.

The cropping system in southern Chibi (Natural Region IV) is surprisingly similar to that of higher rainfall Mangwende (Table 2.5). Farmers plant an average of 2.2 hectares. Sixty percent of this is maize. Other important crops include groundnuts (13 percent of area planted), finger millet (12 percent of area) and bambara nuts (seven percent of area). Due to high rainfall variability and frequent drought, expansion of maize area is currently discouraged by local extension agents. Chibi has experienced drought or mid-season dry spells during five of the first seven seasons since independence.[13]

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[13] This pattern is unusually severe.

The recent variability in the level and timing of rainfall has strongly affected Chibi yields. In 1985, farmers experienced relatively high rainfall and average season length. Local maize yields averaged just above the official estimate of the communal farm sector mean. In 1986, a long mid-season dry spell sharply reduced harvests. A 70 percent yield decline dropped levels well below estimated average national levels. The subsequent 1987 harvests are expected to be even lower.

Chibi's maize production levels and market sales are correspondingly variable. Between 1985 and 1986, maize production declined by two-thirds. Sales declined even further. In 1985, a record 42 percent of Chibi farmers sold maize to the GMB. A year later less than 5 percent did so.

The two communal areas provide good case examples for the study of factors underlying smallholder maize production and market trends. Though Mangwende and Chibi have similar production systems, they have widely divergent production opportunities. Both regions have contributed to the growth of national maize production and sales. Both have been effected by newly designed national policies to stimulate communal sector production. Farmers have responded to these policies and associated institutional changes in similar ways. Yet both the potential impact of government interventions and the decision making environment of the two sets of producers are fundamentally distinct.

2.2.3. Survey Sample Selection

In each survey zone, household participants were chosen through a two stage process. First, sample villages, stratified on the basis of market access, were chosen. Ward-level[14] meetings were held with community leaders (ward councilors and village headmen) in the agroecological regions encompassed by the on-farm agronomic research programs. The research program was discussed and support solicited. Complete village lists were prepared distinguishing communities with better and poorer market access.[15] Two villages with differing market access were randomly chosen in each of three participating wards.

A series of village-level meetings opened the second stage of sample selection. The research program was again discussed and village support was solicited. Village

[14] Wards are administrative units encompassing a collection of villages. Communal areas encompass a series of wards. Districts contain one to ten communal areas. Provinces contain six to eight districts.

[15] The community leaders distinguished the villages with good and poor market access. The principal criterion was the proximity of the village to a primary or publicly maintained secondary road. This influenced the ease and costs of farm to market transport.

household lists were used to randomly choose seventeen participating farmers in each community.[16] The resulting 204 household sample breakdown is outlined in Table 2.6.

Table 2.6
Mangwende and Chibi Maize Study Household Survey Sample
Zimbabwe

Natural Region Stratification	Market Access Stratification	
	Good	Poor
Mangwende Natural Region IIa	3 villages 51 households	3 villages 51 households
Chibi Natural Region IV	3 villages 51 households	3 villages 51 households

The agricultural support institution surveys encompassed all local marketing agents serving participating households, all extension workers, representatives of the credit agency and a non-random sample of community leaders. The marketing agents were identified in the first household level survey.

[16]Originally, an attempt was made to use official census lists for the sampling. However, parliamentary restrictions strictly limited access to this data. An agreement allowing use could not be obtained before the starting date of the surveys. In retrospect, participation of community leaders and farmers themselves in the process of sample delineation probably enhanced local support and participation. Only two of the 204 households declined to participate after the first interview, though several others were lost when they moved out of the survey communities.

2.3 Summary

The data available describing smallholder agriculture in Zimbabwe is limited. Particular care is required when interpreting aggregate production statistics, though information on crop sales in the formal market sector is accurate. Rough estimates are available of aggregate smallholder input sales. Information on agricultural credit, infrastructural development and institutional support, though partially available, is not readily accessible. Farm sector categories are not always consistently defined and variable definitions are frequently unclear. Before employing this data to analyze the smallholder situation, it is necessary to carefully assess the relative accuracy and coverage.

Survey coverage of the smallholder sector is growing. While much of this work is limited in focus, ongoing CSO investigations offer the promise of a substantial set of national baseline information. The lack of immediately available detailed information on smallholder maize farming practices and decision making justified implementation of an additional thirteen month survey program.

Restricting the survey work to only two regions of the country limits the strength of generalizations which can be drawn from the data. Conclusions relating to the communal sector as a whole are strictly impossible. Nevertheless, the detailed perspective available with the smaller sample should strengthen the inferences regarding smallholder decision making which can be drawn. These inferences are critical for understanding why the major growth in smallholder production and sales suddenly occurred. The relevance of the results for the broader communal population must be subject to further testing and confirmation.

CHAPTER THREE

SMALLHOLDER CIRCUMSTANCES IN THE AGRICULTURAL ECONOMY

A common caveat posed in discussions of development strategy suggests the need to take account of the uniqueness of individual country circumstances (eg. World Bank, 1984:9). Similarly, when successful country-specific strategies are examined, an assessment of replicability requires consideration of the circumstances attending policy implementation. Factors distinguishing the country's physical, economic and institutional environment must be noted.

Several factors make the Zimbabwe case unusual. First, the growth of smallholder maize production immediately followed the resolution of an independence war and establishment of a multiracial government. Prior to this, debate over the country's development policy was largely concerned with economic growth in the white large-scale commercial farm sector and the industrial economy. The African farm sector was separately administered. Development programs emphasized land demarcation, resource conservation and the control of livestock numbers. An extensive system of rural roads and bridges were created with the help of a tax on African crop and livestock sales. Yet, the nation's agricultural market institutions were built primarily to serve the large-scale sector (cf. Weinrich, 1975; Johnson, 1964).

The ending of the war with the signing of the Lancaster House Accords in 1979, terminated rural instability. In 1980, the newly elected multiracial government inherited a well-managed public and private sector institutional base readily capable of serving a broader constituency. Zimbabwe's agricultural research service had developed the first locally adapted hybrid maize varieties outside the United States. The principal government marketing board boasted maize losses in storage of less than one percent. Agricultural credit granting institutions were well established and profitably run. Private sector suppliers offered commercial farmers ready access to most major agricultural inputs. Further, a strong commercial farmer's union provided consistent and substantial input into the creation of government agricultural policy. These institutions could be readily expanded to serve the smallholder sector.

In such circumstances, a post-independence increase in smallholder production was expected. However, no one projected the magnitude of the gain in maize production and market sales which occurred. This paper offers a broadly focussed analysis of the factors explaining the smallholder maize production and market growth. This chapter introduces the analysis with a brief overview of the physical, institutional and policy environment from which this growth was derived. It starts with a short description of Zimbabwe's physical environment and demography. Next, the structure of the economy is outlined, highlighting the characteristics of the agricultural sector. The array of public and private institutions serving the smallholder producer is described and the technological circumstances of small farmers are noted. Finally, the policy environment facing the smallholder producers is defined. This provides a contextual base for the analysis of smallholder maize production trends which follows.

3.1 Physical Environment

Zimbabwe is situated in southern Africa between latitude 15 degrees and 23 degrees south of the equator. The country contains 39,075,700 hectares of land. Eighty-five percent of this is allocated to farming. Agricultural potential is distributed according to average unimodal rainfall variations and temperature differences largely associated with altitude. The country's five Natural Regions roughly match this potential (see Figure 2.1). The two percent of Zimbabwe in

Natural Region I is located in the eastern highlands. This high rainfall region (at least 900 mm per year) is classified as specialized and diversified farmland. The 37 percent of the country in Natural Regions II and III lies in the northcentral part of the country. These receive moderate rainfall (650-1000mm) and is classified as suitable for intensive or semi-intensive farming. Most of Zimbabwe's maize is grown in these regions. Natural Regions IV and V cover 62 percent of the country. These low rainfall regions (less than 650 mm), primarily situated in the south and west, are frequently subject to mid-season dry spells and drought. They are categorized as semi-extensive and extensive farming areas. While maize is widely grown, particularly in Natural Region IV, local extension agents encourage farmers to grow more drought tolerant crops.

Zimbabwe has experienced extreme variability in rainfall in the years following independence (Figure 3.1). Rainfall was higher than normal through most of the country during the 1980/81 and 1984/85 cropping seasons. Widespread drought occurred between 1981/82 and 1983/84. This was particularly severe during the 1982/83 season. As a result, Zimbabwe experienced a sharper decline in cereal production than almost any country in Sub-Saharan Africa (FAO, 1985a). A similarly severe drought occurred during the 1986/87 cropping season.

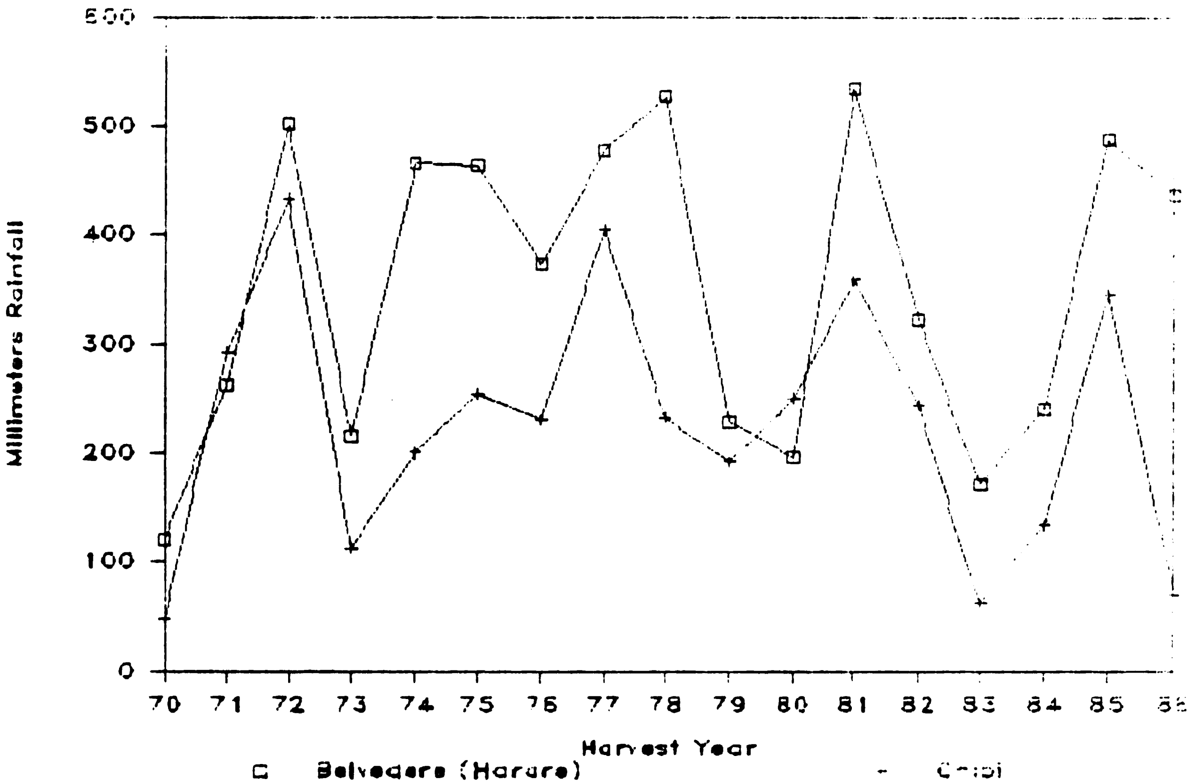

Figure 3.1 January and February Rainfall for Natural Regions II and V, Zimbabwe

3.2 Demographic Characteristics

Zimbabwe's population currently (1987) stands at about 8.6 million. The 1982 census estimated the annual population growth rate to be 2.9 percent. Roughly 23 percent of the population resides in urban areas. The annual urban population growth rate is about six percent. Almost one-half of all Zimbabweans are less than 15 years of age. The population density of the smallholder and small scale commercial farming areas averages 25 people per square kilometer. The density increases in rough correspondence with average annual rainfall levels (CSO, NDb; CSO, 1985a; MFEDP, 1986).

3.3 Agriculture in the National Economy

In 1985, Zimbabwe's GDP stood at Z$ 7.0 billion (US$4.2 billion).[1] GDP per capita was approximately Z$840 (US$504). The average annual real GDP growth rate was estimated at 3.7 percent between 1980 and 1985. Zimbabwe experienced two years of rapid economic growth during a period of reconstruction immediately after independence. These were followed, beginning in 1982, by two years of recession resulting from rising oil prices, declining world prices for Zimbabwe's major exports and drought. In 1984/85, international economic recovery and improved rainfall stimulated national economic growth once again. Per capita GDP rose during the 1980-85 period at a 0.8 percent annual rate (GRZ, 1986).

Roughly 15 percent of Zimbabwe's GDP is derived from agriculture. However, the health of the agricultural sector strongly influences the growth of the rest of the economy. Agricultural exports provide 40 percent of the nation's

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[1] These data are derived from CSO (1985a) and MFEDP (1986). The official exchange rate in 1985 averaged Z$1.00 = US$0.60. Foreign exchange controls, including rationing indicate the Zimbabwe dollar is overvalued.

foreign exchange earnings. These allow imports of essential importance to the industrial sectors, particularly manufacturing which accounts for 23 percent of GDP. In addition, the agricultural sector represents a primary source of demand for manufactured commodities. Income growth in the agricultural sector translates into rising demand for industrial products. Further, the farm sector accounts for approximately 26 percent of formal sector employment and 53 percent of the total work force. Roughly 70 percent of the nation's population derives its primary source of income from the agricultural economy.

The Land Apportionment Act of 1930 created a sharp division between the white, large-scale commercial farm sector and black, predominantly smallholder agriculture. A small number of specially trained Africans were allowed to own medium-scale commercial holdings. However, most blacks were required to live on communally owned reserves or Tribal Trust Lands. The division of land was determined on the basis of soil and rainfall surveys. Whites captured a disproportionate share of better land with higher rainfall.

Though racial restrictions ended shortly before independence, this original distribution still largely remains in place (Figure 3.2). The freehold commercial holdings provided blacks are now called Small Scale

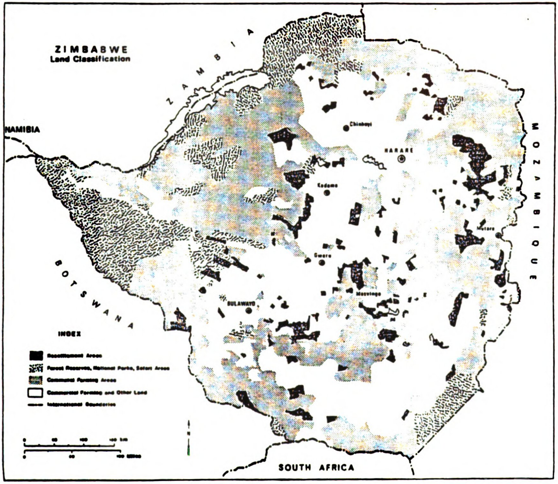

Figure 3.2 Zimbabwe Land Classification

Commercial land. The Tribal Trust Lands are now called Communal Areas.

Table 3.1 displays the distinguishing characteristics of the three principal farm sectors just after independence. The large-scale commercial sector accounted for almost one-half of all agricultural land, though less than one percent of the farmers. Most of this land is situated in regions generally receiving good rainfall. The small scale commercial sector encompassed four percent of arable land and about one percent of producers. While the communal sector held marginally more land than the large- scale commercial farmers, this had to support 98 percent of Zimbabwe's farmers. Three-quarters of this land was situated in low rainfall zones. Further, much of the communal land in high potential regions contained poorer, sandy soils.

Since independence, the government has promoted development of a nascent resettlement sector. A limited number of large scale commercial farms have been purchased and allocated to communal farmers and blacks found landless after the war. In 1986, this encompassed approximately 32,000 farmers on over 800,000 hectares. (MFEDP, 1986)

Table 3.1
Arable Land Distribution and Utilization
Zimbabwe

	Large Scale Commercial	Small Scale Commercial	Communal
Proportion of Total Area (%)	40	4	42
Number of Farms	6,000	8,500	800,000
Average Farm Size (Ha.)	2,200	125	20 a/
Ave. Area Under Crops (Ha.)	88.0	6.3	2.4(est)
Proportion of Land in: Natural Region I-III (%)	51	56	26
Natural Region IV-V (%)	49	44	74

a/ Individual farmers hold family rights to a limited area for cultivation and a small plot for dwellings. The average household holding size according to more recent CSO (1986) estimates is 2.4 hectares. Most remaining land is used communally for grazing.

Source: CSO (1985)

Maize is the principal crop, in terms of area planted, in each of the farm groupings. It accounts for approximately 40 percent of commercial area planted, and 55 percent of cultivated communal land.[2] The principal competing crops in the commercial sector are cotton (ten percent of area), tobacco (seven percent of area), soybeans (six percent of area), sugarcane (six percent of area) and sorghum (four percent of area). Winter wheat is planted on approximately six percent of commercial land. In the communal sector the principal maize substitutes are bulrush millet (nine percent

[2] Based on the 1985/86 season.

of crop area), sorghum (eight percent), groundnuts (seven percent), cotton (six percent), finger millet (six percent) and sunflower (two percent) (CSO, various years). Maize dominates the cropping patterns of roughly 80 percent of smallholder farmers. Though subject to greater drought stress than sorghum or millet, this crop has become the most important source of food and the dominant production enterprise in much of the low potential regions.

Livestock holdings are important to both sectors, though in the communal sector they primarily represent a production resource and means of savings. Commercial farmers own an average of 168 cattle, frequently in mixed crop-livestock operations (CSO, 1985a). Communal farmers own an average four cattle per household, but 40 percent of smallholders own no animals (CSO, 1986a). Poultry and goat production are widespread among communal farmers, but similar ownership data are not available for these animals. Livestock account for only five percent of the value of communal farm sales in formal markets. Livestock account for 20 percent of commercial farm sales (CSO, 1986b).

Zimbabwe has historically been self-sufficient in the production of its principal staple, maize.[3] The country has

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[3]Maize accounts for roughly 45% of total calories and 70% of cereal calories in the average Zimbabwe diet (FAO, 1981).

imported maize only four of the last 15 years. The imports followed seasons affected by severe drought. It has exported maize in all but one of the last 15 years. During the early 1980s, however, higher producer prices and low export parity prices created trading account losses (Murphy and Muchena, 1986).[4] Such losses were tolerated in view of high import parity prices resulting from the country's land-locked status. In addition, the government seeks self-sufficiency in maize production to avoid the risks of relying on South African transport routes.

3.4 Market Infrastructure

Product marketing in Zimbabwe is dominated by a system of government-sponsored parastatals responsible for bulking of farm deliveries, storage, international trade and delivery to private sector processors. The Grain Marketing Board (GMB), established in 1931, is responsible for marketing all major grain and oilseeds crops, including maize.[5] Structured prior to independence to serve the commercial farm sector, since 1980 the GMB has primarily invested in expanding facilities to serve the communal sector. This has entailed

[4] See also, Jansen, 1982.

[5] Other crops purchased by the GMB are sorghum, finger millet, bulrush millet, groundnuts, sunflower, soybeans, wheat and coffee.

the establishment of more than 13 permanent market depots and up to 135 temporary collection points. Communal farmers are allowed to sell crops to any consumers within their home District. The GMB or its approved agents (Approved Buyers and cooperatives) are the exclusive buyers of all major grain and oilseed crops moving across communal District boundaries and all sales by commercial farmers. The buying agents are required pay farmers administered prices minus a small handling charge, and ship the grain onward to a marketing board depot.

Zimbabwe has one of the most extensive road and rail systems in southern Africa. A system of primary or tarmac roads was built primarily to serve the large farm and industrial sectors. Yet, numerous secondary roads serve the smallholder sector. Agricultural road transport is largely provided by the private sector. This incorporates a wide range of large and small licensed and unlicensed truckers. Most transporters serving communal farmers are unlicensed local operators who frequently are also farmers. Transport prices are set through supply and demand through a combination of informal negotiations (for most farm-to-market transport), bids and tenders.

Agricultural inputs similarly are provided by the nation's private sector. Two firms hold principal responsibility for marketing fertilizer. A farmer-owned cooperative dominates seed production and supply in the country, though other agricultural input companies also participate in distribution. Most agro-chemicals and farm machinery are imported and distributed by 10-12 additional companies. Each of these firms sells directly to farmers but also relies on a broad system of wholesalers and localized retailers for input sales and delivery. The government regulates foreign exchange allocations for agricultural imports and input market prices.

3.5 Agricultural Prices

Producer prices for all registered commodities (those purchased by the marketing boards) are set by the government. Formal price requests are annually submitted to an inter-ministerial Economic Coordinating Committee by each of the three major farming sector unions[6], the Agricultural Marketing Authority (AMA) (a facility managing the borrowing and lending activities of the marketing boards) and Economics and Markets Branch of the Ministry of Agriculture. Producer prices, ultimately set by the Cabinet, take account of

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[6] The Commercial Farmers Union, representing the large-scale commercial farmers; the Zimbabwe National Farmers Union, representing the small-scale commercial farmers and the National Farmers Association of Zimbabwe, representing the communal farmer sector.

commercial production costs, stock levels, export opportunities, consumer prices and development goals. Administered prices are pan-seasonal and pan-territorial. They are guaranteed for deliveries to GMB depots.

Approved buyers and registered cooperatives are mandated to pay the guaranteed price minus a small charge for handling and delivery to the nearest depot. The actual level of Approved Buyer and cooperative deductions depends, in practice, on the purchaser. The Approved Buyers are frequently small shopkeepers, and many use their status as GMB agents to require payment for grain in purchases of goods from their stores. They also tend to price grain at the lowest grade, regardless of the quality (Whitsun, 1978).

During most years since 1975, the government announced preplanting prices. However, in 1986, the government stated its intention to establish producer prices during the pre-harvest period when estimates of production levels and potential stocks are available. Between 1975 and 1986, there was a 10 to 15 percent increase in real producer prices of most major agricultural commodities except cotton. Real maize producer prices[7] increased by 60 percent between 1979 and 1981. Similar increases were offered in the prices of most maize substitutes. Yet real maize prices then declined almost

[7] deflated with the GDP deflator.

20 percent over the following five years. The price of major maize substitutes similarly declined.

Consumer prices for major foodstuffs are set by Cabinet following the recommendations of the Ministry of Trade and Commerce. These take account of producer price levels, processing costs, distribution expenses and consumption objectives. Milling costs, and thereby retail maize meal prices, have been subsidized since 1979. These subsidies reached maximum levels in 1983, and since have declined (Table 3.2). Consumer prices are generally enforced in the urban areas, but are difficult to supervise in rural outlets.

Table 3.2
Maize Meal Subsidy Payments, 1979-84, (Z$ million)
Zimbabwe

Year	79/80	80/81	81/82	82/83	83/84	84/85
Subsidy	1.9	20.1	41.4	49.2	28.0	14.4

Source: MFEDP, 1986.

The government also administers prices for major agricultural inputs such as seed and fertilizer. These are set by the Ministry of Trade and Commerce on the basis of industry cost submissions and agricultural development objectives. The maize-to-fertilizer price ratio declined by 35 percent during the post-independence period.

3.6 Agricultural Research and Extension

Crop research in Zimbabwe is primarily conducted by the Department of Research and Specialist Services (R&SS) in the Ministry of Agriculture, Lands and Rural Resettlement. Formal crop research in Zimbabwe began in 1904. Extensive breeding work in the 1940s and 1950s adapted open pollinated varieties from South Africa to local conditions. In 1960, the first maize hybrid (SR52) was released. Short season hybrids, more appropriate to smallholder farming conditions, were first released in 1970 (Olver, 1986). The success of these efforts is indicated by the fact that roughly 80% of communal producers currently plant hybrid varieties (Seed Cooperative, 1987).[8]

Large investments were also historically made in research to identify optimal fertilizer rates, plant population, the timing of planting, tillage methods, and weed and insect control (Tattersfield, 1982). This research was primarily directed to serve the needs of large-scale commercial farmers. However, many results were also relevant to communal producers, particularly those operating in the higher rainfall zones.

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[8] The high adoption rate may, in part, result from the fact that improved open-pollinated seed is not widely available in input markets.

After independence, the government-run institute attached greater priority to the needs of the communal sector. Private sector research institutions expanded to maintain support for commercial farmers. Public research efforts have recently expanded on drought tolerant crops such as sorghum, millets and sunflower. A farming systems research unit has been established. On-farm trials have proliferated on communal farms with involvement among almost all major R&SS departments (DR&SS, 1986; DR&SS, 1987). However, between 1979/80 and 1985/86, the government allocated R&SS budget declined at an average annual rate of 2.9 percent (Table 3.3). Agricultural research expenditures averaged about 1 percent of the gross value of agricultural output.

Table 3.3
Government Investment in Agricultural Research and Extension (Constant Z$ '000), Zimbabwe a/

Fiscal Year	R&SS	Vet Services	AGRITEX	Other Agricul.	Total Agricul.	Percent of Total Budget
1977/78	6743	6266	4269	68383	85660	7.9%
1978/79	7322	7770	4602	64605	84300	7.1%
1979/80	7611	7807	4793	47879	68091	5.2%
1980/81	7968	8780	4083	34021	54852	4.6%
1981/82	7267	13852	8035	38514	67668	5.3%
1982/83	6036	14344	11298	63068	94746	6.2%
1983/84	6151	14269	11350	95632	127403	7.8%
1984/85	9966	14586	12276	98995	135824	10.4%
1985/86	6396	14790	11966	85280	118434	9.0%

a/ Deflated by 'implied deflator' for gross agricultural output (CSO, 1987)

Source: CSO, 1986a.

Responsibility for agricultural extension was divided, before independence, between two agencies: the Department of Conservation and Extension (CONEX), responsible for commercial sector extension, and the Department of Agricultural Development (DEVAG), responsible for communal sector extension. These were united in 1981 to form the Agricultural, Technical and Extension Services (AGRITEX). Again, the private sector took increasing responsibility for serving the extension needs of the commercial sector while the new government agency placed priority on the needs of smallholders. The government has sought to expand and improve communal extension programs with additional manpower, improved rural housing, subsidized loans for motor bikes and greater agent training. Extension worker to farmer ratios have declined since independence from 1:1000 to 1:800 (GRZ, 1986). The AGRITEX budget has increased, in real terms, by almost 150 percent between 1979/80 and 1985/6.

3.7 Agricultural Credit

Formal agricultural credit is provided to the farm sector by the parastatal Agricultural Finance Corporation (AFC), commercial banks, and savings and loan institutions. Small amounts of credit were available to the communal sector from localized church groups before independence. In addition, the government established a revolving loan fund for the African farm sector in 1958, though this primarily served the African Purchase Areas (small-scale commercial producers). There is no informal system of rural moneylenders serving the communal sector. The AFC began providing smallholder credit in 1979, initially on an experimental basis and a year later more broadly. This is currently the only major source of communal sector farm credit. Both the AFC and commercial banking institutions continue to serve most needs of the large-scale commercial farm sector.

3.8 National Agricultural Development Objectives

Zimbabwe's national agricultural development objectives have been identified in three major government planning documents. The first, titled Growth With Equity (GRZ, 1981), identified the following major agricultural development goals:

* fair distribution of land ownership,
* the reduction of poverty and increase in living standards,
* an increase in land and labor productivity,
* an increase in employment,
* food self-sufficiency and regional food security,
* promotion of agriculture's ability to generate foreign exchange and industrial inputs,
* integration of the peasant and commercial sectors,
* conservation,
* the promotion of regional balance in agricultural development
* human resource development.

These were to be pursued through land reform, the expansion of agricultural services including credit, marketing, research and extension, pricing policies geared toward promoting exports and the production of industrial inputs, resettlement, better use of underutilized land, research on alternative production systems including semi-arid land crops, and the promotion of cooperatives and small-scale industry (GRZ, 1981, pp.4-5).

These objectives were largely restated and extended in the Transitional National Development Plan (GRZ, 1982) covering the period 1982-1985 and the First Five Year National Development Plan (GRZ, 1986) for 1986-1990. Specific objectives of the Transitional Plan included the resettlement of 162,000 families on formerly large-scale commercial agricultural land within five years. The agricultural research establishment was called upon to expand research on finger and bulrush millet, edible dry beans and sunflower. A system of parastatal marketing institution collection points would be created to extend market access to most smallholder producers. These would be supplemented by the creation of rural service centers and growth points. Peasant producers would be organized into associations designed to facilitate improved production and marketing.

Progress was made in each of these areas. While only 36,000 families had been resettled by 1986, commitment to this program, despite high investment costs, was maintained in the following Five Year Plan. Parastatal credit facilities were dramatically expanded for communal producers; extension worker to farmer ratios were reduced; research efforts expanded for semi-arid land crops; the parastatal market system was expanded with the establishment of new depots and collection points; infrastructural investment was made in rural growth points. The formation of farmer groups and cooperatives was encouraged. While not all TNDP targets were achieved, the considered pursuit of plan objectives strongly contributed to the success of communal production efforts in the post-independence period.

The new Five Year Plan primarily aims to continue these programs. One possibly controversial, additional objective is "the reorganization of settlement patterns in the Communal Areas (GRZ, 1986:28)". This involves reestablishing historical boundaries between arable and grazing land[9], and village centralization. Many farmers who have settled or established fields in grazing areas will be forced to sacrifice investments in clearing fields and building

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[9] Smallholder farming areas were divided by government agents in a similar exercise during the 1930s and 1940s between grazing land and arable land. As population pressure has increased, this distinction has blurred. Much grazing land has been put under crops.

homesteads. Some may lose access to land altogether.[10]

3.9 Summary

The agricultural sector is of central importance to the Zimbabwe economy. While agriculture supplies a small proportion of the nation's GDP, it provides the dominant share of employment offering a livelihood for over three-quarters of the population. Maize represents the principal agricultural commodity in terms of area planted. A rapidly increasing share of maize supplies is produced by the smallholder or communal farm sector.

The smallholder agriculturalist was largely ignored before independence. Agricultural institutions were built to serve the large-scale commercial sector and government policy was predicated on the needs of these farmers. The communal regions were primarily viewed as a source of surplus labor, not of agricultural sales. While extension programs operated in the smallholder farming areas, research efforts were largely oriented to the needs of large-scale commercial producers. Smallholders obtained limited access to input and

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[10] This program was initiated in one of the villages included in the survey sample. Land holdings in grazing areas were measured following the 1986 harvests in preparation for resettlement. When the village was last visited in early 1987, the resettlement program had been delayed.

product markets. They had almost no access to farm credit.

These conditions changed radically after independence in 1980. Research efforts focussed more directly on smallholder needs and constraints. Extension programs grew. Input and product markets expanded. Credit became newly available to large numbers of smallholders. Public and private sector institutions in existence before 1980 were reoriented to provide greater support for communal sector development. In response, there was a sharp rise in smallholder maize production and market sales.

CHAPTER 4

ANALYSIS OF THE AGGREGATE GROWTH OF SMALLHOLDER MAIZE PRODUCTION AND SALES

This chapter examines evidence regarding the aggregate growth of smallholder maize production and sales. First, the post-1970 smallholder maize production and sales trends are reviewed and compared with the similar trends for the commercial farm sector. The differences between the two sets of trends are highlighted. Next, the analysis examines the 1985 distribution of smallholder maize production and sales to assess the breadth of participation in the respective trends. Evidence of crop substitution is then explored to determine whether the growth of maize production has resulted from a shift in hectareage from other crops or represents a net increase in cereal plantings. Finally, the sources of aggregate growth in maize production and sales are identified, initially in descriptive terms and then in a supply response model. This analysis continues with an analysis of cross-sectional household data in the following two chapters.

4.1 A Comparison of Smallholder and Commercial Farm Maize Production and Sales Trends

4.1.1. Smallholder Maize Production Trends

During the 1970s, communal maize production remained essentially stagnant. Harvests declined sharply in years of poor rainfall, but otherwise remained remarkably constant (Figure 4.1). No growth occurred in smallholder maize area, despite an approximately three percent annual rate of population growth (Figure 4.2). Area harvested fluctuated with rainfall. Area planted seems to have remained largely unchanged.[1] Smallholder maize yields, according to locally based extension workers, consistently averaged around 700 kilograms per hectare (Figure 4.3).[2]

Between 1979 and 1981, communal maize production more than doubled. Rainfall was below normal during the 1979/80 season. Yet maize area harvested increased by one-third. The increase in area planted was likely greater. During the high rainfall 1980/81 season, area harvested rose an additional 25 percent. In two years, smallholder maize area almost doubled. In comparison, the estimated growth in maize yields was marginal. Between 1981 and 1985, despite three intervening years of drought, production increased another 66 percent, primarily as a result of yield gains. Average smallholder maize yields now stood at 1.4 metric tons per hectare, or twice pre-independence levels.

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[1] Extension worker crop area estimates were for area harvested before 1984. The trend in area planted can be inferred from the area harvested in better rainfall years.

[2] The relative consistency of smallholder maize area, yield and production levels prior to 1980 could, in part, be an artifact of imprecise data collection procedures. The production trends are consistent, however, with the more reliable smallholder maize sales data.

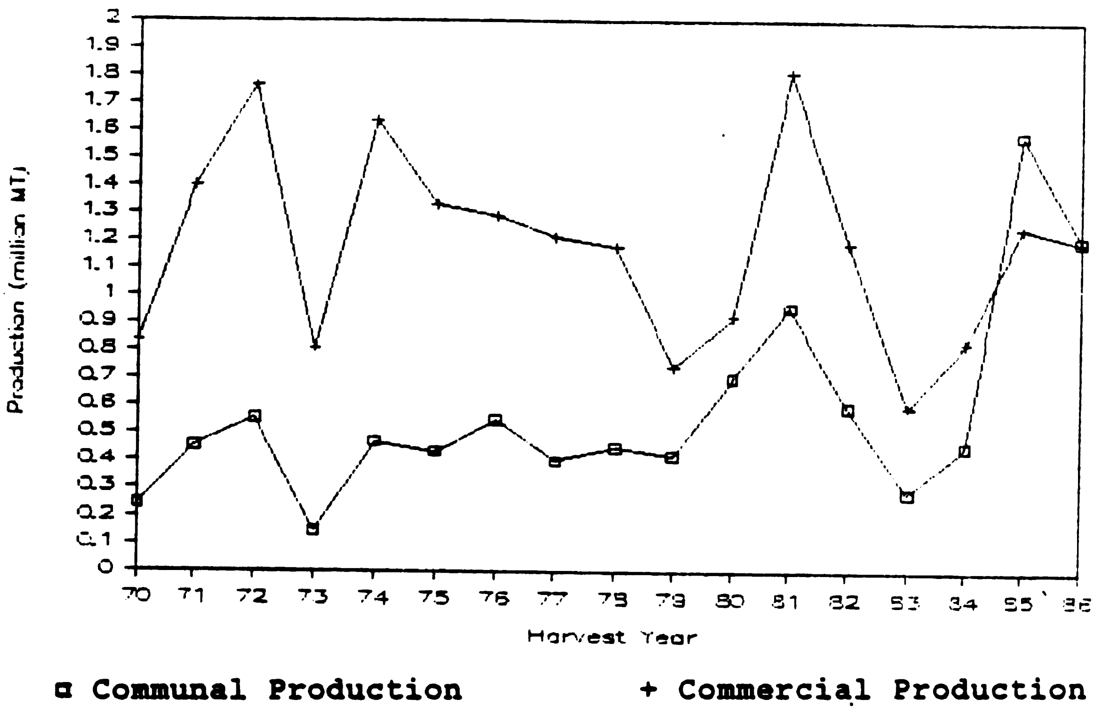

Figure 4.1 Communal and Commercial Sector Maize Production, 1970-1986, Zimbabwe

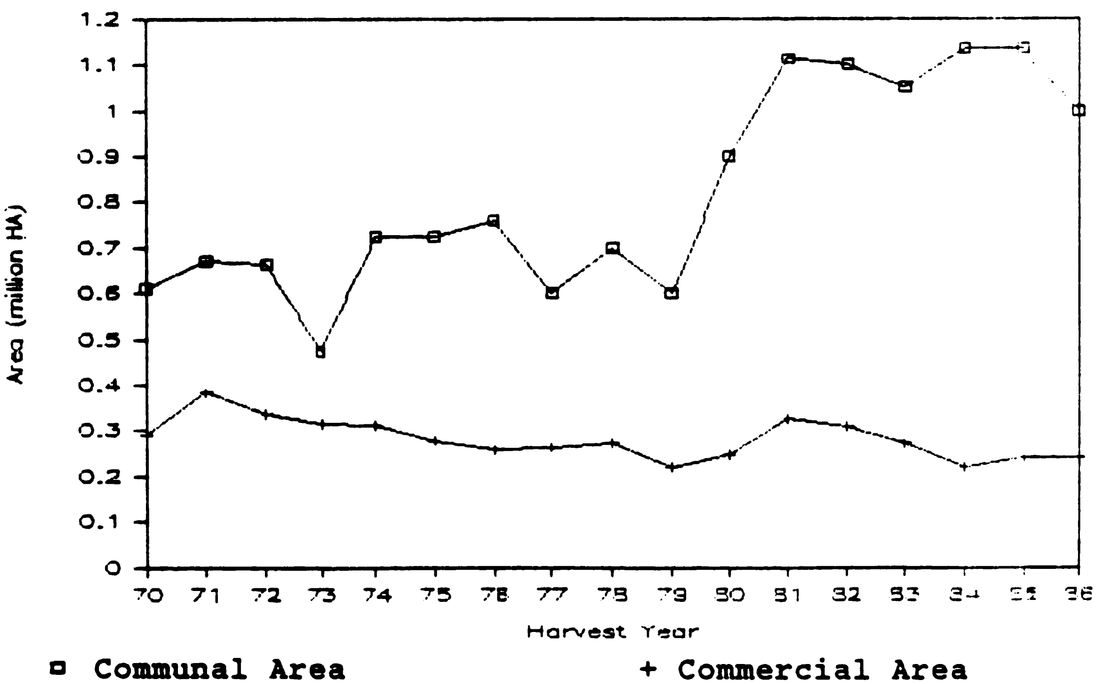

Figure 4.2 Communal and Commercial Sector Maize Area, 1970-1986, Zimbabwe

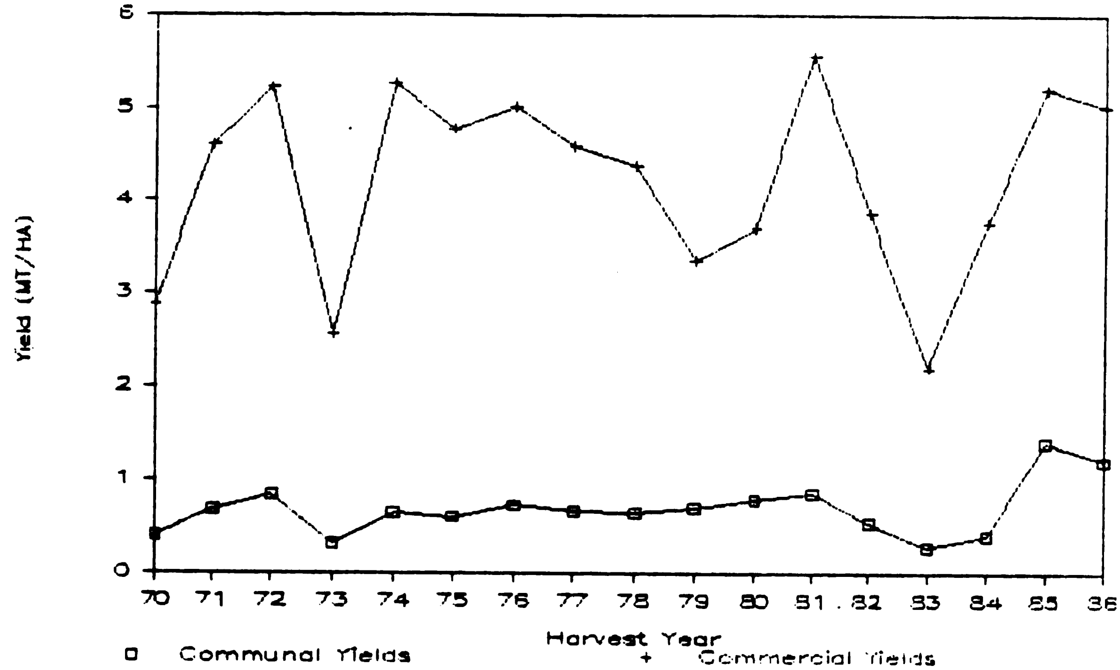

Figure 4.3 Communal and Commercial Sector Maize Yield, 1970 - 1986, Zimbabwe

4.1.2. Commercial Maize Production Trends

Maize production trends of the large and small-scale commercial farm sector display a different historical pattern.[3] Although rainfall fluctuations had a similarly large impact on aggregate production, once the losses associated with drought are accounted for, commercial production shows a consistent decline through much of the 1970s (Figure 4.1). Maize harvests reached record levels in 1972. By 1979, production had fallen by 60 percent. Both area

[3] Large-scale farms account for 85-90% of commercial sector maize area and roughly 95% of commercial production.

planted (Figure 4.2) and average yields (Figure 4.3) had declined by one-third.

During the two year period between 1979 and 1981, commercial maize production, in correspondence to communal trends, rose sharply to new record levels. Much of the post-1974 loss in maize area and yields was fully recovered. However, in contrast to smallholder production trends, this growth then ended. While smallholder maize production continued to rise, commercial production again declined.

4.1.3. Smallholder and Commercial Sector Maize Sales Trends

These production trends are reflected in the historical pattern of commercial and communal sector maize sales to the GMB (See Figure 4.4). Commercial maize sales simply fluctuated with production levels, with retentions declining when real maize prices increased. On average, 15 to 20 percent of maize harvests were retained.[4] Until 1980, smallholder deliveries to the Marketing Board were negligible. Few farmers sold grain on national markets. Roughly 90-95 percent of communal production was retained for home consumption. However, in 1981, smallholder maize sales suddenly rose to more than ten times their average pre-independence levels. By 1985, smallholder maize sales had again more than doubled, rising even during years of poor

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[4] To provide food for farm laborers and for animal feed.

rainfall. The large production gains also increased smallholder maize retentions to record levels.

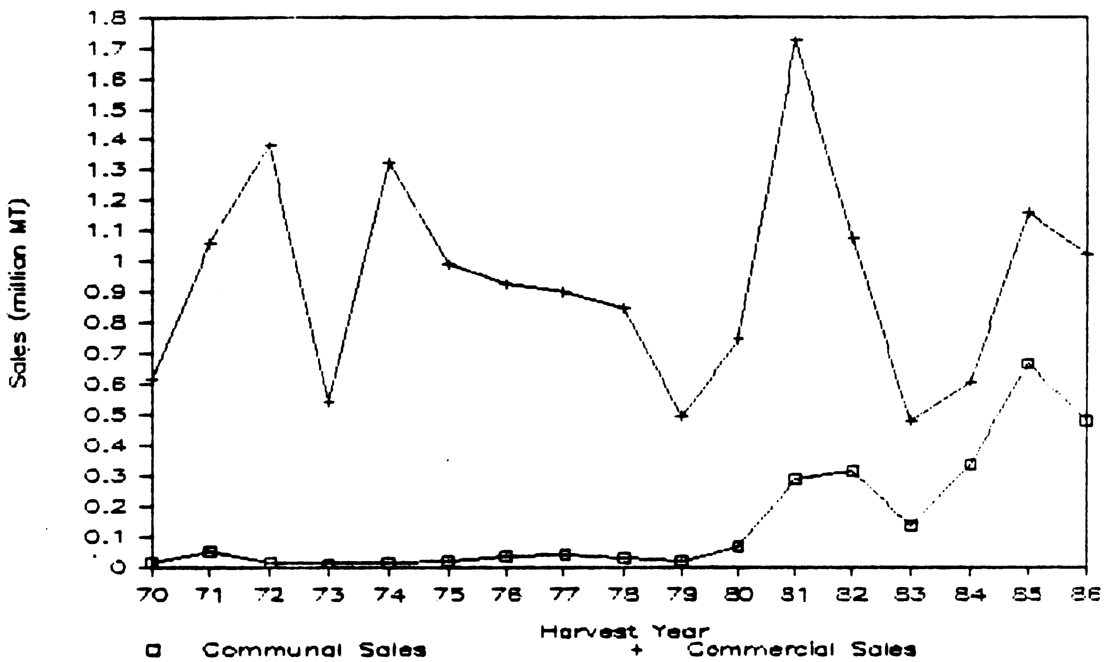

Figure 4.4 Communal and Commercial Sector Maize Sales to the Grain Marketing Board, 1970-1986; Zimbabwe

4.1.4. The Rising Smallholder Contribution to National Maize Supplies

Despite harvesting 60 to 70 percent of Zimbabwe's maize area during the 1970s, communal farmers produced only one-quarter of the country's maize supply. Communal sales accounted for only about three percent of GMB intake. By 1985, smallholders produced over 50 percent of Zimbabwe's maize supplies. Smallholder maize deliveries increased to over one-third of the parastatal's intake. In the new Five Year Plan prepared in 1986, smallholder production was projected to continue increasing at a 6.7 percent annual rate (GRZ, 1986).

The growth in communal maize sales corresponded with a substantial increase in national maize stocks (Figure 4.5). During the 1970s, the GMB's end of year holdings averaged around 300 thousand metric tons or 2/3 the average level of domestic GMB sales. Stocks peaked at 530 thousand metric tons in 1976. In 1986, the quantity of maize in GMB storage stood at almost two million metric tons - almost three times the average level of domestic sales over the previous three years. Despite severe drought during the 1986/87 cropping season, Zimbabwe was able to mount a large domestic food aid program and still export maize.

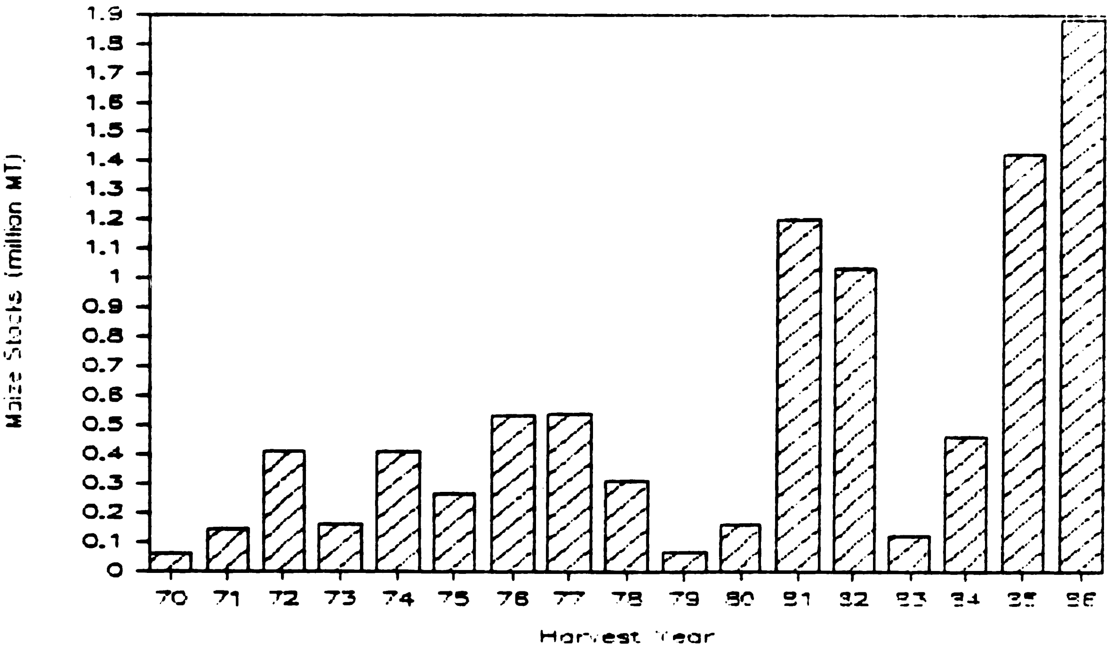

Figure 4.5 End of Year Maize Stocks, 1970-1986; Zimbabwe

The sudden rise in stocks provoked a reassessment of producer price levels in 1986. A discriminatory pricing policy was established prior to the 1986/87 cropping season that strongly favored smallholders. Commercial farmers obtained the guaranteed price of Z$180 per metric ton for their first 91 metric tons plus one-half the level of their previous year's marketings. Any additional maize received only Z$80. Communal farmers received the full guaranteed price.[5] In effect, smallholders were granted primary responsibility for the production of the nation's main staple.

4.2 <u>The Distribution of Smallholder Maize Production and Sales</u>

An examination of aggregate smallholder production and market trends first requires an understanding of the distribution of production and sales across different segments of the communal population. In Sub-Saharan Africa, smallholders are often discussed as if they are a homogeneous group facing identical production opportunities and incentives.[6] In Zimbabwe, the government has targeted

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[5] This discount was dropped after the reappearance of severe nationwide drought during the 1986/87 cropping season.

[6] A classic argument against this perspective is provided in Hill (1968).

communal sector development programs indiscriminantly at the entire smallholder population. Yet communal producers are clearly a heterogenous grouping. Agroecological differences are substantial. Further, these farmers face widely varying access to production resources and market infrastructure. These factors strongly affect the impact of development policies.

The current distribution of maize production and sales among Zimbabwe's communal regions is first examined. Following this, the analysis assesses how this distribution evolved; did all regions participate equally in the recent maize production and market trends or has the growth been dominated by a particular group of farmers? The analysis then seeks evidence of crop substitution.[7]

4.2.1. The Distribution of Maize Production and Sales

The provincial distribution of communal sector maize production and sales is shown in Table 4.1. Multiple production estimates for the 1984/85 cropping season allow data averaging to compensate for the questionable accuracy of

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[7] Again, it should be noted that the questionable accuracy of the communal production statistics limits the reliability of analysis employing disaggregated data. At best, it is possible to identify gross relationships and trends which support rough inferences. Insofar as the relationships and trends appear consistent with each other and with additional information about communal sector agriculture, the inferences can be judged reasonable.

Table 4.1
Provincial Distribution of Communal Maize Production and Sales
1984/85 Harvest, Zimbabwe

	a/ Population		b/ Area HA.		c/ Production MT.		d/ Sales MT.	
Province	(000)	(%)	(000)	(%)	(000)	(%)	(000)	(%)
Midlands	761	18	242	23	404	24	142	17
Manicaland	770	18	179	17	282	17	70	8
Masvingo	811	19	170	16	256	15	110	13
Mashonaland West	282	7	140	14	212	13	162	20
Mashonaland East	485	12	135	13	204	12	170	21
Mashonaland Central	333	8	66	6	195	12	134	16
Matabeleland North	341	8	58	6	61	4	34	4
Matabeleland South	403	10	47	5	71	4	6	1
Total	4186	100	1037	100	1685	101	828	100

Sources: a/ CSO (NDb).
b/ Average of AGRITEX (various years), Johnson (personal communication) [AGRITEX areal photo estimates] and CSO (1985b).
c/ Average of AGRITEX (various years) and CSO (1985b).
d/ Stanning (1987a). Note these sales figures include small scale commercial and resettlement sector sales. These account for almost 20% of the total.

production estimates.

The distribution of smallholder maize sales is more highly skewed. According to Table 4.1, roughly one-quarter of communal farmers, deliver 57 percent of the sector's GMB intake. This includes Mashonaland East, Central and West. However, the 1985 harvest was good throughout the country. A year earlier, when rains were below normal throughout the country, the three Mashonalands accounted for over 80% of communal sector sales.

A further indication of the limited participation in national maize markets can be found in data showing the proportion of farmers registered to sell produce to the GMB.[8] Between 1979 and 1985, the number of registered producers increased in rough proportion with the quantity of smallholder grain sales (Table 4.2). At independence, only three percent of communal farmers could sell crops to Marketing Board depots. At the beginning of the 1985 harvest, roughly one-quarter of communal farmers held GMB grower cards (GMB, various years). While unregistered farmers could still sell through Approved Buyers, these offered lower crop

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[8] Registration cards are readily obtainable through local extension agents. Farmers must obtain registration numbers in order to sell directly to a GMB depot or collection point.

prices.[9] Household survey data indicates major maize sellers generally deliver most of their grain directly to a GMB depot or collection point.

Table 4.2
Number of Communal Farmers Registered to Sell Crops to the Grain Marketing Board, 1979-86
Zimbabwe

Year	Farmers Registered	Percent Registered
1979	21,372	3
1980	23,914	3
1981	60,806	8
1982	121,508	15
1983	155,917	19
1984	176,311	22
1985	217,189	27
1986	295,981	37

Source: GMB Producer Registry, various years.

4.2.2 Regional Production Trends and Crop Substitution

The sharp post-independence increase in smallholder land under maize cultivation raises questions about the substitution of maize for other crops, particularly for more drought tolerant crops in the country's semi-arid zones. Recent recognition of the magnitude of maize production growth in the communal sector has been accompanied by concern

[9] Approved buyers are legally required to provide the guaranteed producer price minus a small charge for handling. Yet many offer lower prices through unnecessary quality discounts, weight mismeasurement and payment in kind (Whitsun, 1978; Mangwende and Chibi Surveys).

regarding an apparent decline in groundnut harvests. Groundnuts provide an important source of concentrated energy and protein for young children and lactating mothers and historically provided a major source of Zimbabwe's vegetable oil (Makombe, Bernsten and Rohrbach, 1987; AMA, various years). Concern about maize replacing sorghum and millets has led extension workers to discourage maize area expansion in drought-prone regions.[10]

Extension worker production estimates reveal that the sharp increase in maize area harvested between 1978 and 1981 has not corresponded with a major decline in plantings of alternative crops (Table 4.3). Instead, maize area gains appear associated with a 25 percent increase in total crop area. At this time, plantings of sorghum, groundnuts and cotton were also rising. The cultivated area for bulrush and finger millet declined, and a limited portion of this land may have been reallocated to maize production. Yet given the assumption that farmers choose to grow these crops because of their drought tolerance, most of the land shifted out of millet may have been allocated to similarly drought tolerant sorghum.

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[10] Extension workers were discouraging maize production in the Chibi survey area in 1987.

Table 4.3
Smallholder Crop Area Trends 1977-1984 ('000 Hectares)
Zimbabwe

	1977/78	1980/81	1984/85
maize	660	1086	1160
bulrush millet	497(a)	401	303
groundnuts	224	243	149
finger millet	141(a)	118	154
sorghum	129	214	247
cotton	41	62	146
sunflower	35(a)	24	31
other	35(a)	61	28
TOTAL	1762	2209	2218

(a) Estimates based on data from Whitsun Foundation (1978) for 1976/77. Sunflower estimate does not include Manicaland Province.

Sources: AGRITEX, various years; Whitsun Foundation, 1978.

The extension worker estimates reveal maize area increased in all provinces, and increased most in those regions with the largest initial plantings. In the four provinces for which complete disaggregated information is available[11], no consistent pattern of crop substitution is evident. The combination of area gains and widespread increases in extension worker estimates of maize yields led to at least a doubling of estimated maize production in every province between 1978 and 1985 (Table 4.4). In five of the eight provinces, smallholder maize production is estimated to have tripled.

[11] Mashonaland East, Mashonaland West, Mashonaland Central and Masvingo.

Table 4.4
Smallholder Maize Production Trends 1978-1985 ('000 Metric Tons); Zimbabwe

	1977/78	1980/81	1984/85
Midlands	109	277	482
Manicaland	93	182	214
Masvingo	82	233	202
Mashonaland East	69	212	239
Mashonaland West	61	117	201
Mashonaland Central	46	59	158
Matabeleland South	19	53	42
Matabeleland North	13	20	46

Source: AGRITEX, various years.

These trends are reflected in the more accurate data on smallholder sales to the GMB. Table 4.5 shows a provincial breakdown of communal sector maize deliveries over a period similar to that for which production data is available. The concentration of sales in Mashonaland after the 1984 harvest reflects the incidence of drought in other semi-arid regions of the country. During the following season, rains were generally good nationwide.

In summary, smallholders throughout the country contributed to the growth of maize production. Area and yield gains occurred in all farming regions. Only limited crop substitution appears to have taken place. Instead, more land was placed under cultivation. The specific factors responsible for these gains are explored next.

Table 4.5
Smallholder Maize Sales Trends 1976-1985 ('000 Metric Tons)
Zimbabwe

	a/ 1975/76	b/ 1983/84	b/ 1984/85
Mashonaland West	12.2	90.4	129.8
Midlands	11.3	35.8	113.4
Mashonaland Central	10.5	80.9	107.2
Mashonaland East	7.0	89.7	136.2
Manicaland	6.0	22.4	55.9
Masvingo	1.3	3.1	88.2
Matabeleland South	0.2	1.7	4.7
Matabeleland North	0.1	0.8	27.1

Sources: a/ Whitsun (1978) b/ GMB (various years)

4.3 Factors Explaining Aggregate Increases in Smallholder Maize Production and Sales

The Zimbabwe government faced three major concerns at independence. First, there was the immediate and pressing need to resettle large numbers of refugees after the war. Second, the government needed to rebuild agricultural infrastructure damaged during the conflict. In many communal areas dip tanks and government housing had been destroyed and extension workers had been forced to withdraw. Third, the government sought to create a stable environment for agricultural growth and to expand smallholder participation in the agricultural economy. This required maintaining favorable production incentives and improving smallholder production and market opportunities. Administered producer prices were increased. In addition, major investments were made to expand agricultural support services available to communal farmers.

The analysis of the relative impact of these policy, institutional and technological interventions is difficult, because all were instituted over the same period. The changes were interdependent. By the same token, they affected various parts of the country differently depending on the quality and quantity of local resources and the strength and timing of exogenous investment. In this chapter, the aggregate incidence of major interventions will be described and quantitatively modelled.

4.3.1. Population Growth and Post-War Resettlement

Maize area planted in the communal sector appears strongly influenced by growth in the number of farmers over the 1970 to 1985 period, and by fluctuation in these numbers associated with the independence struggle. Between 1971 and 1976, the smallholder population was growing at approximately a 2.7 percent annual rate (CSO, NDb).[12] Maize area increased at roughly a 2.5 percent average annual rate. Between 1976 and 1979, maize cultivation declined as rural instability increased with the expansion of the war. Growing numbers of

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[12] This rate applies to the full 1969 to 1982 period.

male household heads and older sons left to take part in the armed struggle. Some families left their farms altogether, migrating to urban areas, plantation estates and other communal areas affording relative calm. In regions inflicted with the greatest violence, farm households were rounded up by government troops and moved into guarded camps.

Only rough estimates are available of the actual magnitude of dislocation caused by the war. Data compiled for a refugee resettlement program run by AGRITEX in 1980 indicate almost one-third of communal families required post-war resettlement assistance (AGRITEX, 1980). However, the results of household surveys conducted during the course of this research suggest this estimate is too high.[13] As the war wound down in late 1979, families began to return to farming and to expand their holdings. Young families, in particular, took advantage of this period of flux to move away from their parents and establish independent farms. Fields abandoned during the war were reclaimed. Farmers expanded cultivation into lands previously designated as grazing areas. The household survey data indicate voluntary resettlement was substantially greater than that made necessary by the war.

[13] For example refugee program estimates indicate over one-half of all Chibi households had to be resettled after the war. Chibi farmers in the survey zone claimed refugee resettlement was limited.

Much of the increase in maize production between 1979 and 1981 can be associated with this transition from war to peace time conditions. The latent population pressure entailed in a wartime lag in new family settlement could account for at least 30 percent of the area gain.[14] The de facto lowering of restrictions against settlement and cultivation of designated grazing lands also stimulated area expansion. In addition, crop land abandoned during the conflict was replanted. Together, these factors offer the major justification for the substantial and sudden increase in total smallholder crop area after the war. Yet maize area increased substantially more than the area allocated to alternative crops. The factors justifying this inordinate gain are discussed below.

4.3.2. Rainfall

Another factor strongly influencing communal production is rainfall. The variability in rainfall during the post-independence period has been extreme. The sharp increases in production and market sales in 1981 and 1985 were associated with unusually good seasons. In contrast, the 1982-84 drought was uncommonly severe.

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[14] This gain would have occurred between 1976 and 1981 as a result of population growth. Instead, new families waited until 1979 and 1980 to establish their own holdings.

It is difficult to assess the relative impact of rainfall fluctuations on aggregate communal production because annual changes differ widely across agroecological zones. Rains may be normal in Zimbabwe's high potential regions while long mid-season droughts limit production in low potential zones. Yields depend not simply on the aggregate quantity of a season's rainfall, but also on the timing. Productivity will decline if rains begin late, end early or occur inconsistently.

Under the assumption that rainfall during the period of maize pollination is most critical to crop yields, an index of January and February rainfall levels was created. This averages the rainfall of natural regions II and V, weighted by the proportion of 1985 maize production derived from the high and low rainfall communal regions.[15] Figure 4.6 reveals a close correspondence between smallholder maize production and rainfall, except during the later stages of the war. The Figure also suggests, however, that the sharp post-independence gains in production must be attributed to additional factors.

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[15] [(Natural region II January-February rainfall)*(% total 1985 maize production derived from natural regions I-III)] + [(natural region IV rainfall)*(% of total 1985 maize production derived from natural regions IV and V)].

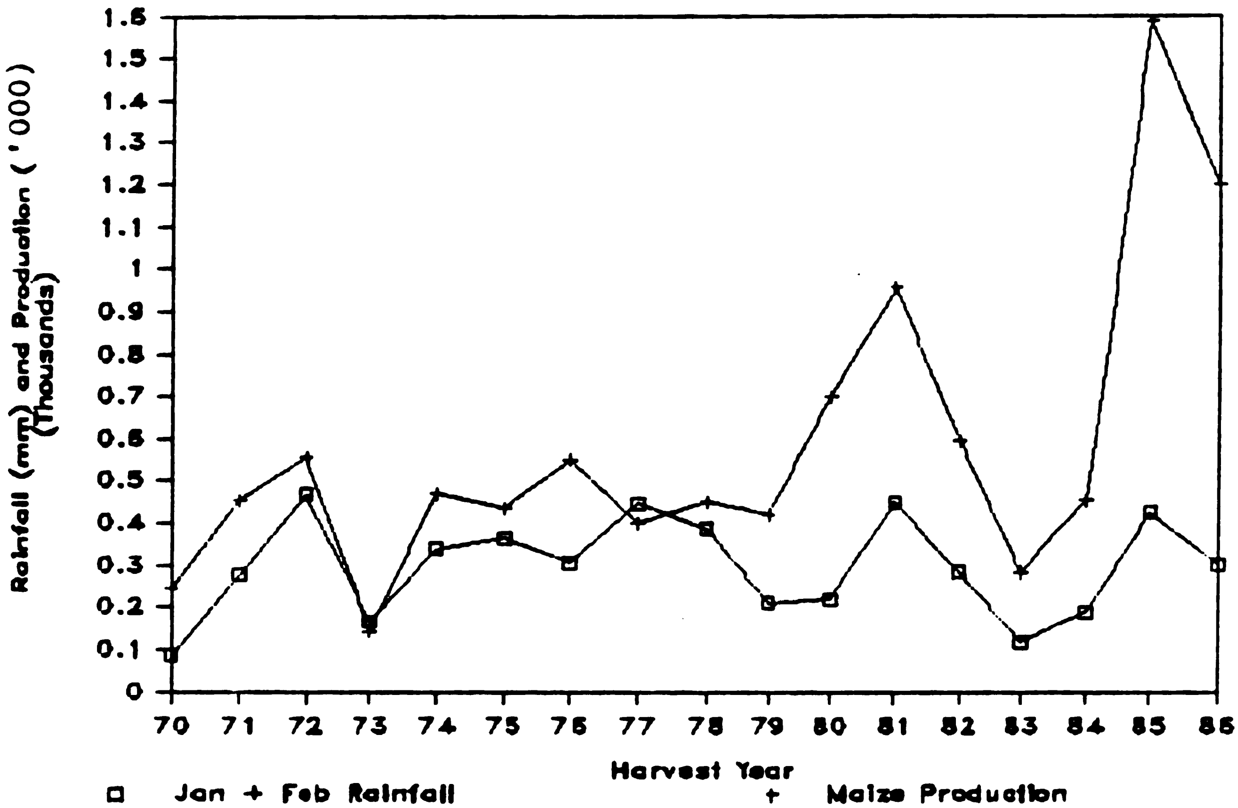

Figure 4.6 Relation Between Communal Maize Production and Rainfall, 1970-1986; Zimbabwe

4.3.3. Relative Maize Prices

There is consistent evidence throughout Africa that smallholders respond to economic incentives and relative crop prices (Eicher and Baker, 1982). The administration of guaranteed producer prices provides a major policy tool employed by the government to guide farm investment decisions. According to a recent study, the establishment of pre-planting prices increases price responsiveness in the commercial sector. (Jayne and Thompson, 1987).

In estimating the magnitude of communal price responsiveness, however, one must consider what prices farmers most take into account. The principal crop substitutes for maize are groundnuts, sorghum, finger millet, bulrush millet and in some regions, cotton. The GMB only began purchasing finger millet and bulrush millet in 1983. Prior to this, markets for this commodity were highly localized. Cotton is purchased by the Cotton Marketing Board.

According to AGRITEX estimates, only bulrush millet experienced an area decline during the principal period in which maize area sharply increased (1979 to 1981). Plantings of groundnuts, sorghum and cotton were all rising. The lack of a national market for bulrush millet may have stimulated maize substitution for this crop. An increase in the ratio of the price of maize to the price of groundnut, sorghum and cotton may have stimulated relatively greater investment in the maize enterprise. The maize-to-cotton price ratio increased sharply between 1978 and 1981[16] (Figure 4.7). Yet both maize and cotton production rapidly increased during this period. Communal cotton area almost tripled. Relative maize-to-groundnut and maize-to-sorghum prices increased

[16] Buccola and Sukume(1986) estimate a strong positive cross price elasticity for the combined communal and small scale commercial farm sector maize sales based on a maize-cotton producer price ratio. However, the maize-cotton price ratio is highly correlated with the incidence if institutional changes in the post-independence period. These are discussed below.

marginally over this period. Smallholder groundnut area increased by 25 percent and smallholder sorghum production area increased by almost 175 percent. Insofar as these numbers are correct, no widespread substitution took place.

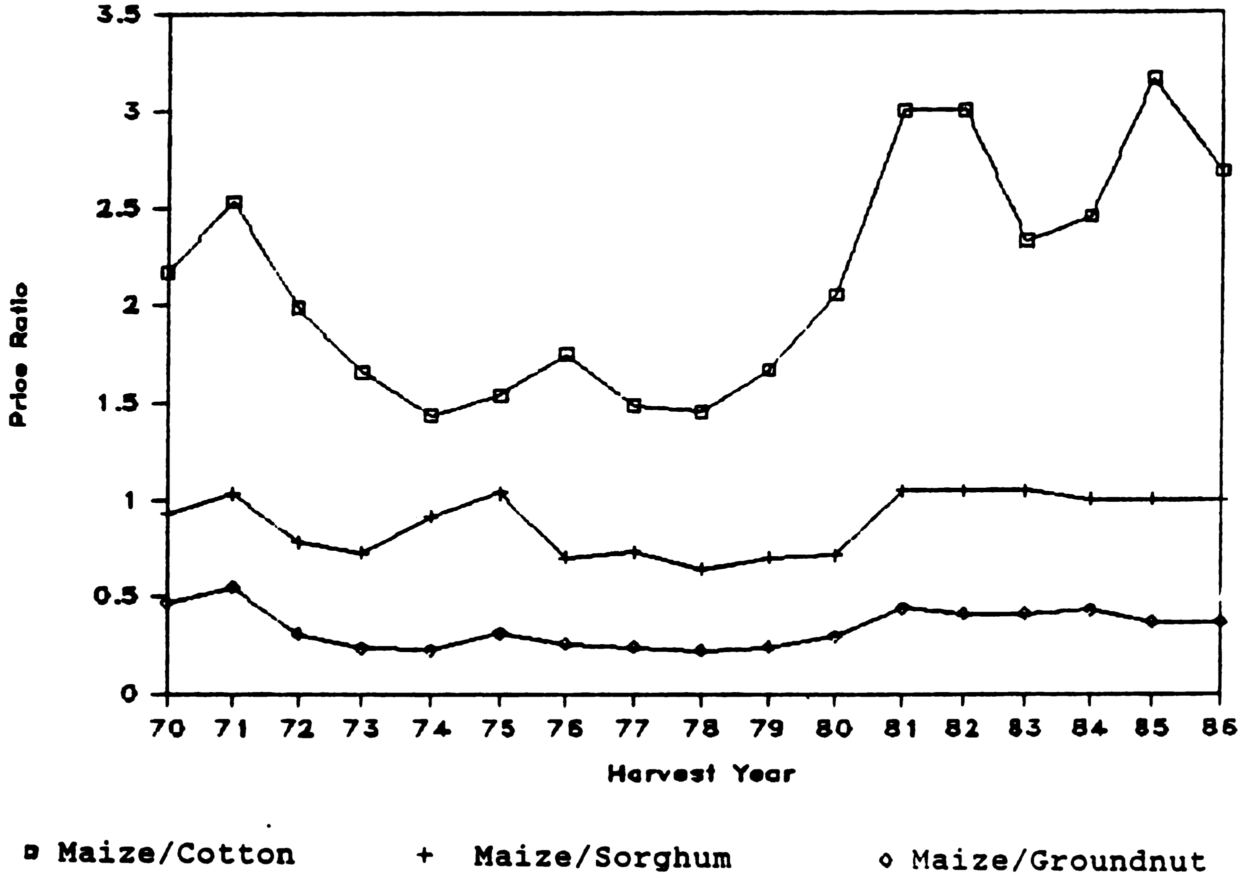

Figure 4.7 Maize-to-Substitute Crop Producer Price Ratios, 1970-86, Zimbabwe

Smallholders may also simply respond to real maize prices. The production investment patterns identified in the household surveys indicate maize is generally viewed as the most profitable enterprise.[17] The only other crop grown specifically for cash markets was sunflower.[18] Yet most farmers planting sunflower only grew small quantities. Further, little fertilizer was applied to crops other than maize, and such applications were uncommon.[19] This suggests farmers currently primarily perceive their investment options in terms of the relationship between the returns to maize and the returns to enterprises other than crop production. An assessment of the response to the real price of maize alone may best capture this relationship.

Real maize prices increased by 60 percent between 1979 and 1981 (Figure 4.8)[20]. Smallholder maize area increased by 85 percent and sales rose fifteen-fold. Between 1981 and 1986, real maize prices declined by 30 percent. While official estimates of area remained essentially unchanged, formal market sales continued to increase. While real maize price increases may have stimulated smallholder maize sales between 1979 and 1981, thereafter, alternative causal factors

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[17] This judgement is supported by AGRITEX's smallholder crop budgets (1985) and enterprise budgets derived from data in this investigation (see Chapter Six).

[18] Respondents were asked whether individual fields were grown for sale, for family consumption or for sales and consumption.

[19] A few applied small quantities of fertilizer to finger millet and groundnuts.

[20] Current producer prices were deflated with the GDP deflator (1980=100).

were prominent. Increased maize profitability associated with rising maize yields may have offset the effect of the real price decline.

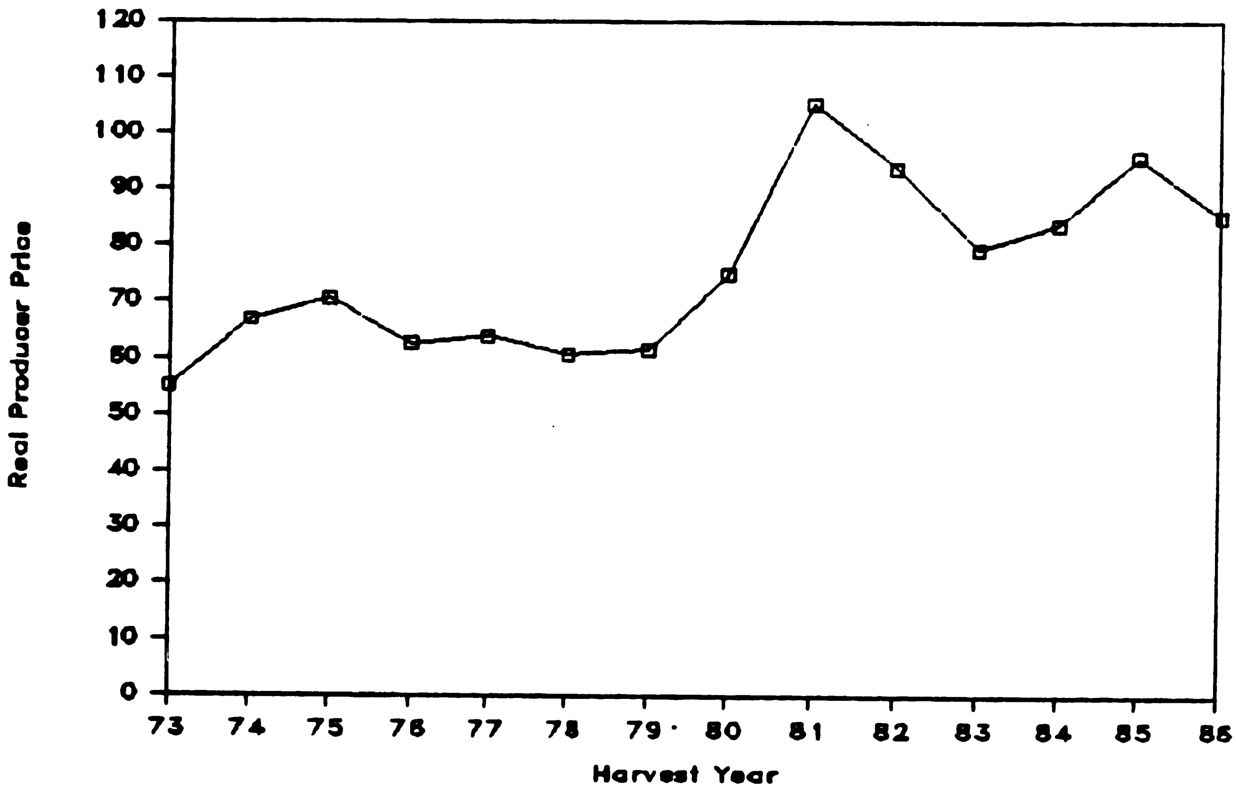

Figure 4.8 Real Maize Prices, 1970-1986; Zimbabwe

A principal indicator of maize production profitability is the ratio of the producer price of maize to the price of maize fertilizer compounds. While most communal farmers still do not use fertilizer, the majority of those selling maize to the GMB probably do.[21] This input represents the largest cash

[21] In the low potential region covered in the household level surveys entailed in this research, only 12% of farmers had tried fertilizer. Fewer consistently used it. In the high potential zone virtually all farmers had tried fertilizer and most consistently used the input. Similar differences, based on agroecological zone; were found in AGRITEX's recent studies in Wedza (Monitoring and Evaluation Unit, 1985).

production cost for these producers. But the correspondence between maize production growth and the maize-fertilizer price ratio is limited (Figure 4.9). In fact, fertilizer use trends appear largely independent of the price ratio. Fertilizer use increased when the relative producer price increased. However, much of this gain, as will be discussed below, can be attributed to government purchases under a post-war resettlement program and to the improvement of smallholder access to credit. While the maize-to-fertilizer price ratio fell, after 1981, fertilizer use continued to climb. During the immediate post-war period, access to fertilizer (and the credit to purchase this input) probably influenced usage more than relative fertilizer prices.

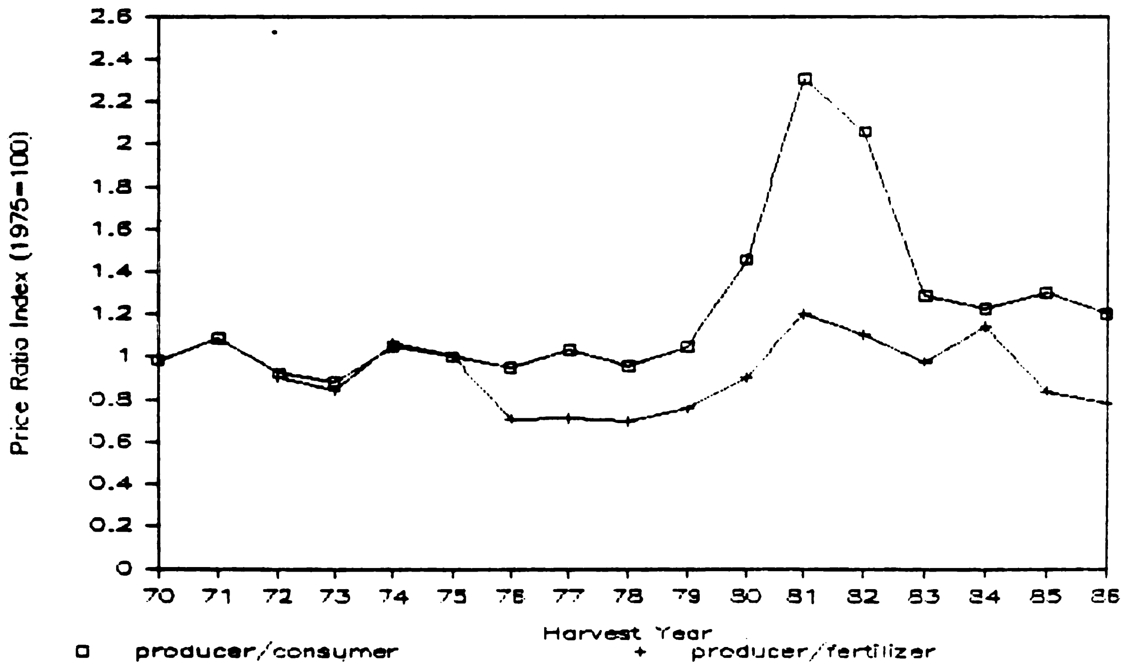

Figure 4.9 Maize Producer-to-Consumer and Producer-to-Fertilizer Price Ratios, 1070-1986; Zimbabwe

Maize sales can vary independently of production levels in response to the ratio of producer and consumer prices. When relative consumer prices are low, farmers may decide to sell production normally retained and later purchase maize meal as required for consumption. Figure 4.9 also displays this price index. Again, the relative producer price increased significantly in 1979 and 1981, a situation reflected in the growth of maize meal subsidies (Table 3.2) Thereafter, however, contrasting trends appear. As maize meal subsidies were reduced and relative consumer prices sharply increased, sector deliveries to the GMB continued to grow. The sharp increase in smallholder maize sales in 1981 may have been partly stimulated by the establishment of maize meal subsidies. Jansen (1982) reported, at this time, that rural maize mills were closing as farmers began purchasing larger quantities of manufactured meal. However, in 1981, national maize meal sales declined.[22]

In this study's household level surveys, a consistent relationship between production and sales is evident. Following the 1984, 1985 and 1986 harvests, farmers in Mangwende consistently retained maize required for home consumption and sold the remainder. This same pattern occurred in low rainfall Chibi when rains were good in

[22] Jansen provided no data supporting her claims beyond a partial analysis of comparative advantage.

1984/85. During the next two years, in which harvests were poor, Chibi farmers with surpluses saved additional grain for local sales. Farmers in both regions suggested this was their standard operating strategy.[23] Stanning (1987) found a similar pattern in the two maize growing regions she surveyed.[24]

In summary, while the sharp increase in maize producer prices may have helped stimulate market sales immediately after independence, their later impact is more ambiguous. Further increases in net maize returns associated with additional institutional reforms may have offset the real price decline.

4.3.4 The Expansion of Market Infrastructure

The Grain Marketing Board legally acts as the sole buyer of all maize sold in the commercial sector and all maize sold beyond district borders in the communal sector. The guaranteed producer price set by Cabinet applies to maize, as graded, at each GMB delivery depot. Transport to the depot is provided, except under unusual circumstances, by the private sector at competitive prices.[25]

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[23] This issue is discussed further in Chapter Six.

[24] Hurungwe and Bushu.

[25] The government provided communal farmers limited additional transport assistance late in the 1985 and 1986 marketing seasons.

Prior to independence, the GMB infrastructure of delivery and storage depots was positioned primarily to serve large-scale commercial farmers. For example, in 1975, only one depot was located in the communal areas. However, the number of communal area depots increased steadily after independence (Table 4.6). The new depots were situated in regions with the largest prospective maize sales.

Table 4.6
Expansion of Grain Marketing Board Buying Points 1975-86
Zimbabwe

	1975	1980	1981	1982	1983	1984	1985	1986
Total Depots	32	34	37	41	43	44	45	51
Communal Depots	1	3	6	10	12	13	14	20
Collection Points	0	0	0	0	0	0	135	57

Source: GMB (various years).

Before 1980, communal producers could also sell grain through cooperatives and GMB Approved Buyers. These buyers are required to pay government set prices after deducting a small charge for handling and transport to the nearest depot. The actual level of this discount depends on the purchaser. The Approved Buyers are generally local shopkeepers. Many use their status as GMB agents to require payment for grain in purchases of goods from their stores. They also tend to price the grain they purchase at the lowest grade, regardless of quality (Whitsun, 1978). This increases their profit margin and offsets the risks of spoilage during the limited holding period before delivery to the GMB depot. Complaints about high cooperative handling and transport cost deductions were also reported by farmers during the regional survey work. Yet the number of cooperative and Approved Buyer outlets similarly expanded rapidly after independence.

In 1985, to expand market access further, the GMB established a system of 135 collection points. Producers were then charged a nominal amount for transport from the collection point to the nearest depot. Ultimately, the Board's stated policy was to locate buying facilities within 20 kilometers of most farmers. However, the strong response to this infrastructure, particularly in regions more distant from major depots, created a concern that maize required for local consumption could be extracted from regions subject to drought. In addition, the operation of collection points was costly. Accordingly, only 56 of these temporary facilities were opened in 1986. Only 17 were opened in 1987.

The net effect of the expansion of GMB infrastructure into the communal areas was probably an increase in farm gate prices. Farm to market transport costs declined as market outlets were established in closer proximity to producers and the number of transporters serving smallholders expanded.

Approved Buyers and cooperatives faced greater competition as producers obtained access to an additional major outlet for their grain.[26] Despite this competition the number of approved buyers and marketing cooperatives continued to increase.

The causal relationship between the expansion of market infrastructure and production of maize surpluses probably worked in both directions. As markets expanded, increasing numbers of farmers began to view production of a surplus as profitable. This stimulated an expansion in production area and greater investment in improved technology. On the other hand, the growth in market surplus prompted further expansion of market infrastructure. Additional depots were established in regions with larger sales. Greater demand for market services also stimulated an increase in the number of private transporters and buying agents. Overall, between 1980 and 1985, the expansion of market infrastructure may have had a greater impact on maize production and sales than the increase in administered producer prices. As will be discussed in Chapter Seven, the correspondence between market institutional growth and sales is substantially closer than between guaranteed prices and sales.

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[26] During the 1986 marketing season, Mangwende farmers were offered 15 to 20 percent more for their maize by the GMB depot than from nearby Approved Buyers. The price offered by Approved Buyers was about the same as the price offered for farm-to-farm sales.

4.3.5. Credit

Agricultural credit was initially made available to communal farmers in 1958 (Johnson, 1964; Weinrich, 1975). However, the restrictive terms of this scheme (including participation in a land survey program allocating individual land rights) limited smallholder participation. Small amounts of credit were also available to a limited number of producers through localized church groups. Virtually no credit was available from the private banking and trade sectors and there were no rural moneylenders. Major cash constraints (eg. bridewealth) were resolved through long payment periods and migration to cash paying jobs.

A major new government-sponsored credit scheme for communal producers was established on a pilot basis in 1978. This expanded rapidly after independence (Table 4.7). By 1985, credit reached roughly ten percent of communal producers. The majority these were likely major market participants. In order to participate in the smallholder credit programs, each farmer had to prove his or her ability to produce a surplus. This could be done by showing a history of previous marketings or by being recommended by extension agents as a better than average producer. Accordingly, the significance of the expansion of credit facilities for aggregate maize production and sales is probably greater than the limited number of loans suggests.

Table 4.7
Smallholder Credit Offered by the Agricultural Finance Corporation, 1979-1987; Zimbabwe

Cropping Season	Number of Loans	Value of Loans ($ million)
1979/80	2,850	0.48
1980/81	18,000	4.80
1981/82	30,150	9.05
1982/83	38,912	13.24
1983/84	50,000	25.29
1984/85	65,793	32.00
1985/86	77,526	38.90
1986/87	77,384	60.00

Source: AFC, various years

4.3.6. Fertilizer and Seed Deliveries

The growth of communal maize production and sales can also be linked with an increase in fertilizer and seed deliveries (Table 4.8). While purchases of these inputs were relatively constant in the years just prior to independence, sales increased sharply in 1980. Roughly 60% of this one year gain can be attributed to the implementation of the post-war refugee resettlement program. A major component of this called for the delivery of free input packages and associated training in the use of these inputs to farmers returning to the land (AGRITEX, 1980).[27] Though this was a one year program, fertilizer and seed deliveries continued to rise in

[27] Inquiries in Mangwende and Chibi revealed, however, that many of these packages were distributed to households farming consistently during the war years.

following years.

Table 4.8
Hybrid Maize Seed and Fertilizer Deliveries
to the Smallholder Sector 1974-85
Zimbabwe

Cropping Season	Fertilizer Deliveries (mt)	Seed Deliveries (mt)
1974/75	24,000	2,350
1975/76	19,000	3,950
1976/77	20,000	2,700
1977/78	25,000	3,700
1978/79	25,000	4,250
1979/80	27,000	4,300
1980/81	90,000	9,650
1981/82	96,000	13,950
1982/83	98,000	16,900
1983/84	106,000	17,300
1984/85	127,664	19,500
1985/86	130,000 (est)	20,250 (est)

Sources: Windmill, 1987; Seed Cooperative, 1987.

Since 1981, a major part of the increase in input sales has resulted from the expansion of credit. AFC packages require farmers to purchase specified input packages incorporating seed and fertilizer. While smallholders have also invested more of their own cash resources, survey results from Mangwende and Chibi reveal that many of those farmers purchasing the largest quantities of fertilizer are substituting credit for their own resources. At the same time, an increasing proportion of fertilizer purchased in each region was bought with credit. The implications of this trend will be discussed in Chapter 5.

4.3.7. Extension and Research Support

The adoption of improved technologies was made possible by large historical investments in agricultural research and extension. While research efforts were largely directed toward the needs of large-scale commercial farmers, a portion of results were directly relevant to smallholders. New maize hybrids were developed for both high and low rainfall agroecological zones. These increased farm yields even without fertilizer. While roughly 30 percent of smallholder maize area was planted to hybrids in 1979, this increased to approximately 80 percent of plantings by 1986. Fertilizer recommendations were also developed for producers in high and low rainfall zones. As maize prices increased, credit became available and input markets expanded, smallholder fertilizer use also expanded. Research on herbicides and insecticides also allowed the development of recommendations governing the use of these inputs, though the adoption of agrochemicals was more limited. The growth of smallholder maize yields corresponds with the adoption of hybrid seed, and particularly with increased rates of fertilizer application.

The relevance and adaptability of technologies developed for commercial sector crops other than maize and cotton was more limited. Recognizing this, after independence, the research service attached increased priority to research geared directly to the requirements of the communal sector (DR&SS and AGRITEX, 1987). This included the substantial expansion of on-farm trials in the smallholder farming areas and greater work on the more drought tolerant crops such as sorghum and sunflower. The returns to this investment can be expected in the future.

The adoption of improved technologies and production practices was likely aided by strong extension support. Agents withdrawn during the later stages of the war were replaced. Field staff were provided improved housing and loans for motor bikes. This improved incentives to work in the rural areas and increased extension worker mobility. Staff training programs expanded, and in 1986, regional extension officers initiated a broadly focussed program of on-farm verification and demonstration trials.

The impact of these investments can only be indirectly measured in terms of rates of adoption of improved technology and the associated increase in farm yields. In this aggregate analysis, the rapid growth in input deliveries offers a limited proxy for this relationship. The pattern of technological change will be examined more closely in the household level analysis.

4.3.8. Additional Factors Influencing Smallholder Productivity

A number of additional factors indirectly affected smallholder production and market trends. The establishment of majority rule heightened general government interest in promoting smallholder production. Politicians, speaking directly to communal farmers, encouraged the formation of farmer groups, the use of credit, the adoption of improved technology and the expansion of market deliveries. Agricultural infrastructure, including rural roads, dip tanks, extension worker housing and meeting halls, damaged during the war, were rebuilt. Investment in schools and local health programs substantially increased. Private sector fertilizer and agrochemical companies also expanded their activities in smallholder farming areas by sending larger numbers of salesmen out to promote stocking and purchase of their products. In some areas, the companies established demonstration trials to show farmers the benefits of using these technologies.

The independent effect of these interventions is difficult to gauge, particularly in the context of an analysis of aggregate supply response. They can be modeled with an indicator variable distinguishing the pre and post-independence period. However, the true meaning of this would be difficult to interpret. The possible impact of some of these variables is, again, best considered in the analysis of micro-level data.

4.4 Aggregate Supply Response Analysis

The limited accuracy of the communal sector production data constrains its use in regression analysis. While the broad trends indicated by the data are probably reasonable, the actual area, yield or production for any given year may greatly differ from those officially recorded. The more accurate data for smallholder maize sales offers a better basis for estimating the impact of policy, institutional and technological changes, at least among farmers significantly involved in product markets.

Nevertheless, the significance of the distinction between a production and a sales model should not be underestimated. A sales response function for communal farmers measures the influence of policy and institutional changes on farmers involved in the maize market, primarily farmers from the higher rainfall regions of the country. In contrast, a production response function incorporates consideration of the decision patterns of producers in semi-arid zones or those facing severe market access constraints. At best, the sales response equation indicates the possible existence of a similar potential responsiveness among this larger group of producers. This relationship, however, requires testing.[28]

The specification of the smallholder maize sales response model was derived from economic theory and the results of the descriptive analysis of theoretically expected relationships reviewed above. This takes the following general form:

Qs = f(Pp, Ps, Pc, Pi, I, R)

where: Qs = quantity of maize sold to the GMB
Pp = producer price of maize
Ps = producer price of maize substitutes
Pc = consumer price of maize
Pi = price of maize production inputs
I = institutional factors affecting maize production profitability not adequately reflected in price variables (eg. credit rationing)
R = rainfall

The limited availability of time series data for several key variables restricts the historical coverage of the time-series model. Data for the dependent variable, communal maize sales (deliveries to the GMB), is only consistently available since 1974. While data on 1972 communal sales are also available, the records for 1973 have been lost. Muir-Leresche (1985) gathered statistics for combined communal and small scale commercial sales to the marketing board dating back to

[28] The relation between production and sales behavior is explored in Chapter 6.

1950. These were used to estimate communal sales following the 1970, 1971 and 1973 harvests.[29]

The only historical data available for major maize input prices were for the price of maize fertilizer. Yet the descriptive analysis identified a strong relationship between fertilizer demand and institutional factors such as the post-independence refugee resettlement program, the establishment of a smallholder credit program and the expansion in the number of rural retail outlets selling inputs. While credit data and information about the size of resettlement program deliveries are available, information identifying the expansion of rural input markets is not. Given, the limited time period covered by the equation, it is necessary to restrict the number of variables in the equation. Therefore, these factors are best modelled with a single variable accounting for the level of fertilizer deliveries to the smallholder sector.

The effective incidence of producer prices similarly depends on the level of access to GMB market outlets. Accordingly, a second institutional variable measures the expansion in the number of depots and collection points in the communal areas.

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[29] Communal sales were estimated on the basis of the sector's relative contribution to combined communal and small scale commercial sales in 1972 and 1974.

Data for a third key institutional variable, the fluctuation in the number of smallholder farmers during and just after the war, are simply unavailable. While national censuses were conducted in 1969 and 1982, these provide no basis for estimating the magnitude of migration during the war. If resettlement program figures are correct, there would have been a substantial decline in the smallholder population during the later stages of the war, and a sharp increase thereafter. There is no way, however, to assess the timing and speed of these trends.

The high likelihood of multicollinearity among independent explanatory variables, presents a further problem. As can be seen in Figure 4.4, the historical trend in communal maize sales is highlighted by the post-independence transition. Before 1979, sales remained at consistently low levels. Sales only began increasing in 1980, and increased most sharply in 1981 and 1985. Accordingly, the explanatory power of the regression equation is likely to be strongly influenced by the broad range of factors correlated with the achievement of independence. The independent impact of the numerous post-independence interventions is expected to be difficult to distinguish.

A series of regression equations were estimated with

Ordinary Least Squares in the attempt to sort out the relative importance of the various factors influencing communal market response. A double log functional form was employed. This is one of the most common functional forms used for supply response analysis, and allows direct observation of supply elasticities. (Buccola and Sukume, 1987). This equation fits the data reasonable well.

In the final base equation, to reduce the number of variables, commodity prices were generally transformed into price ratios. The producer prices of maize substitutes were omitted. The maize-to-cotton price ratio was highly correlated with the ratio of the maize producer-to-consumer price. Further, there was no consistent evidence of crop substitution at either the aggregate national level or provincial level. While the maize-to-groundnuts price ratio was tested, as expected, this proved insignificant and was not included in the final model. The producer and consumer prices of maize and the price of fertilizer were included. The fertilizer price variable reflects the farmer's decision to gauge fertilizer purchases in terms of a measure of input profitability. A fertilizer quantity variable accounts for the effective rationing of this commodity. The base equation, accordingly, appears as follows:

MZSALES = f(PCRATIO, MFRATIO, FERTDEL, DEPOTS, RAIN, RLMPR)

where: MZSALES = GMB maize intake from communal farmers (000 MT)
[mean=145.9, standard deviation=199.6]

PCRATIO = maize producer price ($ per MT)/retail price of maize meal (c per KG)
[mean=1.23, standard deviation=0.4]

MFRATIO = maize producer price ($ per metric ton)/maize fertilizer price ($ per MT basal dressing)
[mean=1.75, standard deviation=0.3]

FERTDEL = fertilizer deliveries to communal farmers (MT maize compounds)
[mean=65638.7, standard deviation=45695.5]

DEPOTS = number of GMB depots situated in the communal areas
[mean=4.1, standard deviation=4.9]

RAIN = weighted average of natural region II and natural region V January and February rainfall (mm)
[mean=354.6, standard deviation=141.3]

RLMPR = real producer price of maize ($ per MT deflated by the GDP deflator)
[mean=81.0, standard deviation=17.4]

The results of this analysis are listed in Table 4.9 as equations one through five. In equation one, two of the variables appear to explain a large portion of the growth in maize sales. These are the ratio of producer to consumer maize prices and the expansion of GMB market infrastructure. The elasticities on both variables are high. The coefficient for the ratio of maize to fertilizer prices is negative, though this was expected given government involvement in fertilizer distribution and the impact of credit programs. The negative coefficient on the fertilizer deliveries variable, however, was not expected, but neither of these coefficients are significant. The price and institutional characteristics of the product market seem to dominate the

Table 4.9
Maize Sales Response Regression Results, 1970-86
Zimbabwe

Equation	1	2	3	4	5
PCRATIO	2.73**	1.82**	0.51		
	(1.05)	(0.50)	(0.61)		
MFRATIO	-1.21				
	(0.96)				
DEPOTS	1.45*	0.92**		0.83**	
	(0.74)	(0.12)		(0.23)	
FERTDEL	-0.89		1.45**		1.56**
	(1.24)		(0.22)		(0.17)
RAIN	0.50	0.40	0.33	0.67	0.33
	(0.33)	(0.26)	(0.35)	(0.43)	(0.34)
RLMPR				3.09**	
				(1.24)	
$\bar{R}^2$	.92	.89	.87	.83	.88
DW	1.99	1.77	2.14	1.50	2.30

* = significant at 10% level
** = significant at 5% level
(numbers in parentheses are standard errors)

model. However, the potential incidence of multicollinearity requires further investigation.

This equation was re-estimated after excluding the fertilizer price and quantity variables (Equation 2). While the coefficient of determination remains essentially unchanged, the coefficients on the key product market variables decline sharply. This adjustment can be attributed to multicollinearity between the variables remaining in the equation and at least one of the fertilizer variables removed, most likely, the fertilizer deliveries variable.

A third equation was accordingly estimated substituting the fertilizer deliveries variable for that measuring market expansion (Equation 3). Here the multicollinearity problem is confirmed. The coefficient of determination remains, again, unaffected. The price variable coefficient becomes statistically insignificant. Now, communal maize sales appear closely related with production growth resulting from increasing fertilizer usage alone.

If the maize producer-to-consumer price ratio variable is replaced with a variable for real maize producer prices alone (RLMPR), the same result occurs (Equation 4). The elasticity of the real price variable is very high indicating a one dollar increase in the real maize price increases smallholder maize deliveries to the GMB by 3000 MT. Both the price and market expansion coefficients are statistically significant. However, the price coefficient becomes insignificant when the market expansion proxy is again replaced with the structural variable for fertilizer deliveries. The simple correlation between the two price variables (PCRATIO and RLMPR) is .92. On the basis of the descriptive analysis, both the producer and consumer price probably ought to be in the equation. However, this relationship requires further investigation.

Lastly the price variable is dropped from the equation altogether, leaving variables for fertilizer deliveries and rainfall (equation 5). These results again suggest that increased fertilizer use alone explains most of the increase in communal maize sales. While fertilizer use was undoubtedly important, this result cannot be accepted. Instead, one can infer that fertilizer use, and several factors correlated with fertilizer use, including market expansion, explain the gain. Unfortunately, this result is not very useful.

In sum, the regression analysis indicates both price and structural variables influenced the growth in communal maize sales. The results do not, however, provide a basis for judging the relative importance of these factors. Multicollinearity increases the standard errors, in effect, hiding the significance of certain coefficients. Further, dropping explanatory variables to offset this problem biases the coefficients of those remaining in the equation. These coefficients cannot, therefore, be explicitly interpreted. In addition, data is unavailable for some variables which ought to be in the equation such as producer numbers and farm wage rates. The sharp increase in maize producer prices between 1979 and 1981 coincides with the resolution of rural violence and an increase in the number of maize producers. In effect, one is left to rely upon the weight of descriptive evidence in evaluating the relative importance of policy and institutional interventions.

4.5 Summary

The weight of the descriptive analysis falls on the explanatory power of structural variables. The sharp growth in maize sales in 1980 and 1981 corresponds with both the unusually high real producer price and associated producer to consumer price ratio. However, this also corresponds with the ending of the independence war, an large increase in producer numbers and the implementation of a refugee resettlement program. The increase in producer numbers can be linked to the sudden jump in total cultivated area, and maize area in particular. The resettlement program brought greater use of fertilizer and higher maize yields.

Though real maize producer prices and the producer to consumer price ratio declined after 1981, communal sector maize production and sales both continued to increase. This record stands in sharp contrast to the decline in production and sales occurring in the large scale commercial farm sector. Similarly, the limited evidence of crop substitution suggests smallholder farmers were relatively unresponsive to changes in alternative producer prices.

This is not to suggest that prices are unimportant to communal farmers. The ultimate impact of institutional changes, such as expanding market infrastructure, providing access to credit, improving extension support and the like, is to lower the costs of production and increase production returns. Once production and market opportunities are expanded, smallholders can be expected to become increasingly responsive to producer price levels. The government must then judge the relative costs and returns associated with further investment in structural change versus simply increasing product prices. In so doing, it must consider the distributive effect of each possible intervention.

The limited explanatory power of the aggregate model prevents the identification of any but the most general policy implications. This can be supplemented significantly, however, with a review of farmer decision patterns at the household level. Such a review is carried out in the next three chapters which examine smallholder investment and marketing decisions. The results of the above analysis of aggregate data are then reconsidered in a summary chapter.

CHAPTER 5

HOUSEHOLD PRODUCTION DECISIONS: FACTORS INFLUENCING THE GROWTH OF MAIZE AREA AND YIELDS

This chapter analyzes factors influencing the growth of smallholder maize production at the household level. The review of nationwide production trends reveals the increase in aggregate smallholder production was associated with a rise in producer numbers, an improvement in production incentives, and an expansion of institutional support improving access to markets and new technologies. Yet this analysis does not provide a firm basis for judging the relative importance of the various policy interventions, nor for tracing their actual impact on producer decision making. Also, the assessment of aggregate trends assumes the associated policy and institutional interventions affected all smallholders equally. The agroecological diversity of the communal farm sector alone contradicts this supposition. Most likely, high and low resource farmers within and across agroecological regions responded differently to government interventions. The factors underlying the maize area and yield trends of these subgroups of smallholders is traced in the micro-level analysis which follows.

As identified in Chapter 2, the two survey regions were selected to represent high and low potential agroecological zones. Mangwende Communal Area, in Mashonaland East, represents a high rainfall region with better than average maize yields. These farmers generally sell 70 to 80 percent of their maize to the GMB. Mangwende accounts for roughly four percent of the total smallholder maize area. In 1985, a year of good rainfall throughout the country, these farmers provided over ten percent of smallholder maize deliveries to the Grain Marketing Board. Chibi Communal Area, in Masvingo, represents a low rainfall region with lower than average maize yields. These farmers plant a similar proportion of total smallholder maize area, but sell less than 20 percent their harvest. In frequent poor rainfall years, the majority of Chibi households experience food production shortfalls.

The analysis is introduced with a brief review of the socioeconomic circumstances of Mangwende and Chibi households. This identifies the farm resources available to smallholder households and relative significance of alternative income sources. Second, the maize based cropping system is briefly described, highlighting the dominance of maize in both the Mangwende and Chibi cropping systems. Third, the analysis begins examining factors affecting the expansion of maize production by assessing the relative severity of resource constraints and opportunities for expanding farm investment. Fourth, the institutional support available to smallholder agriculture is described. The major policy and institutional interventions influencing maize investment decisions are cited. Fifth, the variability of maize production levels across and within the two farming regions is briefly reviewed. This provides an important reference point for evaluating the distributional impact of government policy. The principal factors influencing production levels are then reviewed and hypotheses regarding the relative importance of these factors are examined. A series of regression equations for maize area allocation and yield levels offer a basis for testing the relative strength relationships prominent in the descriptive analysis of decision patterns. Finally, the results of the analysis are reviewed in the context of the original hypotheses regarding the relative impact of price and structural change and the objectives of national food security.

5.1 Economic Circumstances of Mangwende and Chibi Farmers

The maize enterprise cannot be examined independently of the smallholder production system as a whole. In general, the farm household allocates its resources to meet consumption objectives most efficiently. The structure of resource allocation reflects the level of resources available, the perception of returns to alternative enterprises and the relative values attached to complementary and conflicting consumption goals. These vary by household and ultimately by household member. Nevertheless, a roughly similar set of circumstances characterize Mangwende and Chibi farmers.

5.1.1 Labor Availability

Family size, in the two regions, averages about seven members (Table 5.1). This includes all individuals who normally reside and eat meals at a given homestead, plus the male household head who may live and work elsewhere. In Mangwende, almost 45 percent of male household heads live off the farm. This high migration rate results from the region's proximity to Harare. However, most migrant household heads contribute capital and labor to farming activities and participate in farm decision making. About 13 percent of the households are female headed. These are led by women who are divorced, widowed or unmarried. In Chibi, 36 percent of households have male heads working elsewhere, while seven percent are female headed.

Family labor availability was measured in two ways. Family members were first asked to identify their major occupation (whether in school, working on the farm, working off the farm, etc.). Second, they were asked whether they worked, at least part-time, on crop or livestock production. The first question measured full-time labor availability. The second provided a basis for estimating the availability part-time labor.

In Chibi, the average household has almost three full-time farm workers and more than two part-time laborers. Higher rates of off-farm migration in Mangwende leave fewer than two full-time laborers. This loss is offset by the greater availability of part-time family workers in this region. Women make up almost two-thirds of full-time household farm workers in each region. Part-time workers include male heads of household primarily working elsewhere and older school children.

Table 5.1
Labor Resources of Mangwende and Chibi Households, 1986
Zimbabwe

	Mangwende	Chibi
Ave. Family Size (No.)a/	7.0	7.3
Households with Female Head (%) b/	12.7	6.9
Households with Male Head Working Off Farm (%) c/	44.1	36.3
Ave. Full-Time Farm Labor (No.) d/	1.8	2.7
Ave. Part-Time Farm Labor (No.) d/	3.3	2.3

a/All individuals residing and eating together plus the male head of household if he works elsewhere.
b/Households headed by divorced, widowed or unmarried women.
c/Most of these men also contribute farm labor and help make farm decisions.
d/Child labor was not converted into adult equivalents.

Source: Mangwende and Chibi Surveys

Over half of family members in each area are under the age of 16, resulting in a high farm worker to dependency ratio. Almost all primary and secondary school age children in each region are in school. The increase in rural educational opportunities, since independence, has reduced the availability of labor for crop production. As a result, children provide less than ten percent of maize production labor.

5.1.2 Land Availability

Land holdings in Mangwende are marginally larger than those in Chibi, though similar areas fall under cultivation (Table 5.2). These holdings are normally distributed.[1] Roughly two-thirds of the households in each region own one to three hectares. Less than ten percent own more than five hectares. The larger land owners tend to be households led by community leaders, or better farmers who have obtained supplementary land allocations.[2]

Ward Councilors and village Headmen take primary responsibility for the allocation of usufructuary land rights. If families do not plant their full holdings, fields may be reallocated to new households or to families seeking

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[1] Unimodal and roughly bell-shaped.

[2] Many farmers in both Mangwende and Chibi seem to be able to obtain additional land if they can prove it will be fully planted.

to enlarge their plantings. Accordingly, few households have more than ten percent of their land in fallow, many have none. While the sale of land is illegal, fields are occasionally rented or loaned in exchange for clearing and ploughing services.

Table 5.2
Land Resources of Mangwende and Chibi Households, 1986
Zimbabwe

	Mangwende	Chibi
Land Holding (mean Ha.)	2.77	2.35
Land Cropped, 1985/86 (mean Ha.) a/	2.15	2.15

a/ summer season only

Source: Mangwende and Chibi Surveys

During the 1930s and 1940s, the Rhodesian government centralized small farm holdings by demarcating separate arable and grazing areas for individual villages. As population pressure increased, community leaders responsible for land allocation faced increasing pressure to reallocate grazing land to crop production. Much encroachment on grazing land occurred during the instability in settlement patterns associated with the war and post-war resettlement. This provided the principal source of new holdings and new fields for established farms. In effect, the availability of grazing land allowed continuing expansion of crop production and partially offset what national leaders perceived as a severe land constraint.[3]

5.1.3 Draft and Equipment Ownership

The distribution of ownership of fixed production capital resources in both regions is skewed (Table 5.3). In Mangwende, 38 percent of farm households do not own enough cattle (oxen or cows) to field a minimum two animal draft team. Almost 60 percent do not own enough cattle to field a preferred team of four animals. In Chibi, the draft problem is even more severe. Fifty-four percent of the households, in this drier region, own fewer than two draft animals (oxen or cows or donkeys). Almost 80 percent own fewer than four. This deficiency has resulted, in part, because many animals died or had to be sold during the 1982-84 drought.

Farm equipment ownership corresponds with draft ownership. The first major piece of equipment purchased by farm households is a plough. Over two-thirds the of farmers in each area own ploughs (Table 5.3). The high proportion of plough owners in Chibi, relative to the proportion holding adequate draft resources, shows the impact of recent drought

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[3] The poor quality of most communal area soils still represents a major problem. Also, the reallocation of grazing land reduces the resources available for cattle, goat and sheep production. This could ultimately reduce the quality of draft resources and revenue from livestock sales. Government concern for this problem has helped motivate experimentation with the establishment of grazing schemes and prompted efforts to reestablish grazing land boundaries.

on animal numbers. Smaller numbers of farmers own wheel barrows, ox-carts and cultivators. The greater historical profitability of Mangwende farming is indicated in the region's higher equipment ownership numbers.[4]

Table 5.3
Fixed Capital Resource Ownership in Mangwende and Chibi, 1986 Zimbabwe

	Mangwende (percent)	Chibi (percent)
Households Owning Adequate Draft (2 or more cows, oxen, or donkeys)	62	42
Households Owning a Plough	65	73
Households Owning Cultivator	37	14
Households Owning an Ox Cart	39	21
Households Owning a Wheel Barrow	46	27

Source: Mangwende and Chibi Surveys

5.1.4 Alternative Income Sources

Crop production offers the largest source of farm income in both regions (Table 5.4). In Mangwende, the largest share of crop income is obtained from crop sales to the GMB. In Chibi, agricultural income is dominated by the value of crop retentions for household consumption. Most households in the two areas also derive a major portion of income from other farm and non-farm sources. Families with members working away

[4] Farmers can, however, borrow or rent draft animals and equipment from neighbors. See section 5.3.3.

Table 5.4
Alternative Sources of Income in Mangwende and Chibi, 1985-86
Zimbabwe

	Mangwende	Chibi
Income from Crop Sales: a/		
1985 Harvest (mean $Z)	583	119
1985 Harvest (median $Z)	389	0
Value of Crop Retentions: b/		
1985 Harvest (mean $Z)	321	364
1985 Harvest (median $Z)	224	189
Income from Other Sources c/		
July 1985-86 (mean $Z)	780	306
July 1985-86 (median $Z)	459	129

Source: Mangwende and Chibi Surveys

a/Includes major crop sales during the 7-9 months following harvest. Does not include vegetable sales.
b/Major crop retentions valued at local market prices.
c/All other sources of family cash income except cattle sales. This includes income derived from vegetable sales.

generally receive remittances, though the size and frequency of these varies considerably. The husband's remittances are generally steady, while those from other family members tend to be infrequent and small.

During the winter season, most households in both Mangwende and Chibi engage in a range of locally based cash generating activities including brick making (18 percent of households), building (16 percent of households), transporting goods (14 percent of households), weaving and mat making (12 percent of households), and thatching roofs (12 percent of households). Throughout the year most households engage in such activities as vegetable production for sale (50 percent of households), poultry production (28 percent of households), beer brewing (28 percent of households) and unspecified work for others (11 percent of households). The level of income derived from these activities depends, in part, on the success of the cropping season. If more income flows into the community from crop sales (or remittances), monetary flows between households in the community increase.

Mangwende farmers earn two to four times more income from crop production than Chibi producers, depending on the quality of the farming season. They also earn at least twice as much income from other sources. In both regions, many of the households earning the greatest amounts from crop production also earn the largest amounts from remittances and alternative farm enterprises.

The distribution of income within each farming region is also highly skewed. In Mangwende, the top 20 percent of households earn over half of total income (Figure 5.1). The poorest 40 percent of households earn about ten percent of total income. In Chibi, the top 20 percent earn over 60 percent of farm and non-farm income, while the poorest 40 percent of households earn only about five percent of the region's income (Figure 5.2). This distribution worsens in drought years.

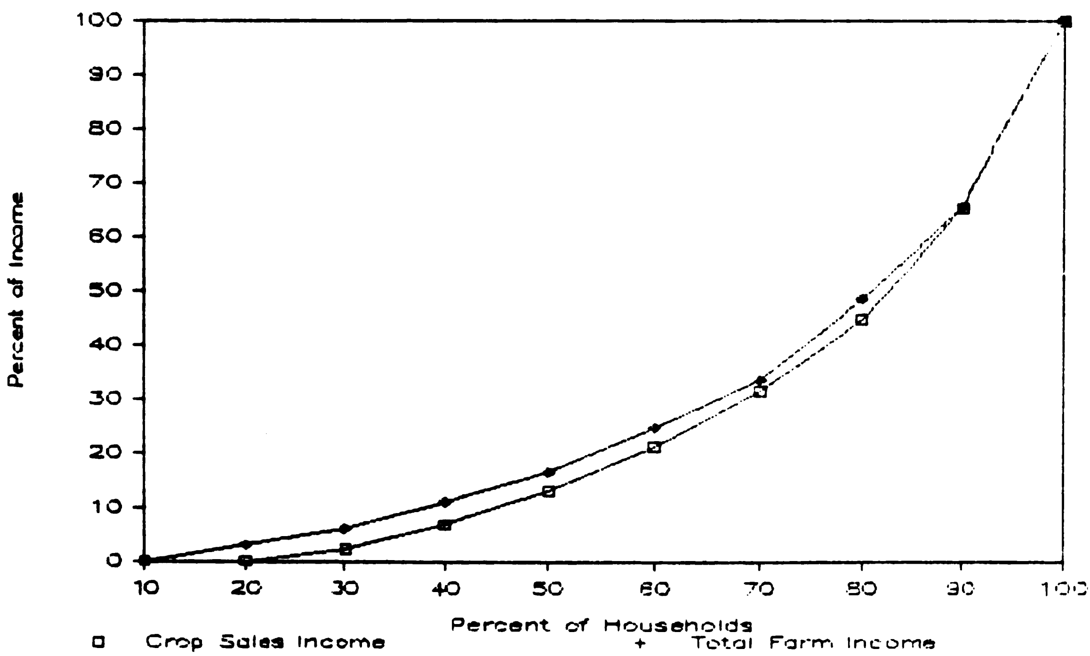

Figure 5.1 Lorenze Curve for Mangwende Income, 1985/86; Zimbabwe

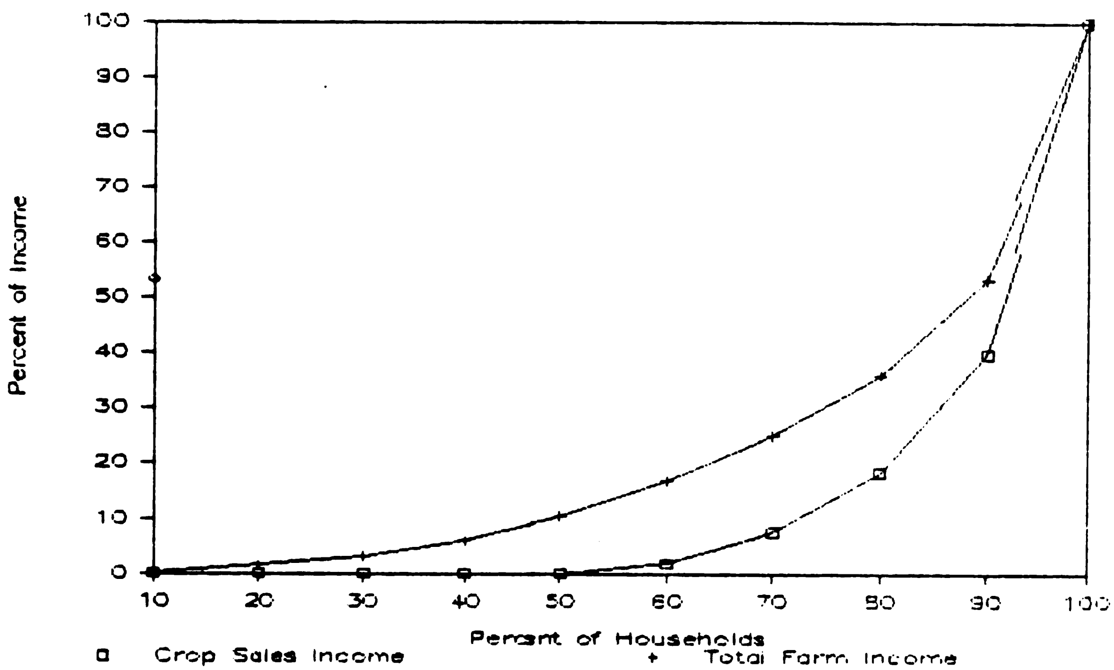

Figure 5.2 Lorenz Curve for Chibi Income, 1985/86; Zimbabwe

5.2 The Maize Based Cropping System

Each farmer's investment decisions are guided by the perceived returns to resource allocation among alternative farm and non-farm enterprises. Crop production investments depend on family consumption requirements, the level of market incentives and the availability of production inputs and improved technologies. The recent rapid growth in smallholder maize production in Zimbabwe indicates a substantial increase in resource investment in the maize enterprise. In this section, the broad cropping strategies of

Mangwende and Chibi households are reviewed, and the relative importance of the maize enterprise is identified.

The Mangwende and Chibi cropping systems are surprisingly similar despite substantial differences in rainfall levels and trends. Maize accounts for roughly two-thirds of area planted in each region (Table 5.5). Most farmers also grow groundnuts, finger millet and bambara nuts. Sunflower is relatively more important in Mangwende.[5] However, partly as a result of locally based on-farm agronomic research trials, Chibi farmers have recently shown a growing interest in this crop. Sorghum and bulrush millet are more widely grown in Chibi due to their relative drought tolerance. Yet interest in cultivating these grains remains low despite the fact that Chibi has experienced drought or mid-season dry spells during five of the first seven cropping seasons since independence.

Farmers were asked how they decide how much area to allocate to alternative crops. This question was difficult for many to answer, because the complex tradeoffs considered were difficult to articulate. In addition, planting decisions tend to change, particularly in Chibi, as the planting season

[5] Prior to Independence, vegetable oil manufacturers contracted with individual Mangwende farmers to produce sunflower. This practice ended when the GMB began purchasing sunflower in 1982.

progresses.[6] As a result, the answers obtained only provide an indication of the concerns motivating planting decisions. Nevertheless, in three different iterations of this question a consistent series of responses was obtained.

Table 5.5
Crop Area Allocation in Mangwende and Chibi, 1985/86
Zimbabwe

	Mangwende			Chibi		
Crop	Planted (Ha.)	Area (%)	Growers (%)	Planted (Ha.)	Area (%)	Growers (%)
Maize	1.5	69	100	1.3	60	100
Groundnuts	0.2	10	90	0.3	13	71
F. Millet	0.2	10	75	0.2	11	68
Bambara Nuts	0.1	5	71	0.1	7	79
Sunflower	0.1	5	27	a/	a/	3
Sorghum	a/	a/	4	0.1	4	30
Other	0.1	2	17	0.1	6	21
Total	2.2	101	100	2.2	101	100

a/ = negligible

Source: Mangwende and Chibi Surveys

In both communal areas, maize almost universally represents the dominant food and cash crop. This commodity provides roughly 90 percent of cereal calories and a similar proportion of crop sales revenues regardless of the two

[6] Some farmers explained they plant mor finger millet and sorghum if rains are late or inconsistent during the planting season.

regions' agroecological differences.[7] Mangwende and Chibi farmers reported maize plantings were also influenced by the availability of cash to purchase inputs. This seems particularly to affect the quantity of land allocated to production for the market. The principal cash inputs in Mangwende are hybrid seed and maize fertilizer. The principal cash input in Chibi is hybrid seed.

Groundnut plantings were identified in both regions as dependent on the availability of seed. Yet most groundnut seed is derived from the previous year's harvest. Shortages occur following seasons affected by drought, because groundnuts retained for seed are consumed. Normally, however, seed availability depends on an antecedent decision regarding the quantity of seed to set aside following the previous year's harvest. Utilization patterns indicate groundnut plantings are primarily geared to family consumption preferences.

Finger millet plantings depended, according to Mangwende farmers, on the availability of labor. In Chibi, the importance of finger millet for beer brewing was cited. (This was also a major form of finger millet consumption in

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[7] Calorie supplies were estimated from farmer estimates of the level of crop retentions designated for food and level of planned food purchases following the 1986 harvest. The proportion of maize earnings from crop sales was derived from 1985 farm sales estimates.

Mangwende.) The allocation of land to bambara nut, the only major crop not purchased by the GMB, was identified in both areas as largely dependent on seed availability and perceived consumption requirements. In Chibi, sorghum and bulrush millet were said to provide food in the event of drought. Plantings depended on preferred stock levels and the perceived risks of maize deficits. In Mangwende, sunflower plantings depended on the availability of cash to purchase seed and the availability of family labor.

The complexity of planting decisions is also evidenced in the size and extent of the planting task. In both regions, the summer planting season begins in mid to late October. Most planting is completed in Mangwende in early January. Some farmers in Chibi continue planting fields until the end of the month. Mangwende farmers plant at least three major crops[8] in an average of almost ten different plots.[9] At least one-half of these plots contain maize. Households in Chibi most frequently plant four major crops in an average

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[8] Farmers in Chibi and Mangwende also frequently plant several minor crops such as sweet potatoes, pumpkins and cowpeas. The later two are generally interplanted at low density with maize.

[9] A plot was defined as a field with a unique set of production practices. Various plots are distinguished by planting date or fertilizer rate or seed variety, etc. That is, if a field was planted on a particular date, with a given type of seed, and received basal fertilizer, but only half the field received top dressing, this is distinguished as two plots.

6.5 different plots. Four of these plots contain maize. One-half of Chibi farmers plant at least one field with a maize-finger millet or maize-groundnut intercrop. This practice is rare in Mangwende.[10] Groundnuts tend to be planted first. Otherwise, there is no clear relationship between planting date and crop type. Farmers in both regions try to sow a portion of their maize crop early. However, late fields are also frequently planted to maize.

In summary, while farmers in Mangwende and Chibi sell small amounts of groundnut, finger millet, sorghum and sunflower, production resources are primarily invested in the maize enterprise. The alternative crops, except sunflower, are grown essentially for family consumption. The opportunity cost of small grain and groundnut purchase is high enough to stimulate production, but market returns are too low, relative to the returns to maize, to prompt cultivation of a market surplus. In effect, once family consumption requirements are met, farmers must decide whether to invest additional farm resources in maize production for the market, in household consumption (eg. clothing, housing, leisure) or in production enterprises other than crop production (eg. schooling, poultry production, small-scale local industry such as tailoring, or off-farm employment).

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[10] In Table 5.3, the Chibi intercrops are divided roughly into their constituent elements.

5.3 Resource Markets and Opportunities for Expanding Resource Use

The capacity and incentive of farmers in Mangwende and Chibi to expand their maize production depended on the severity of their farm resource constraints. Households were broadly questioned about local resource markets and their capacity to expand resource usage.

5.3.1 Land Constraints

Despite the widespread public concern about a land constraint, as symbolized by the political importance attached to resettlement of large-scale commercial farms, relatively few farmers identified land availability as a major problem.[11] In Mangwende, only three percent of the sample identified insufficient land as one of their five major agricultural problems. In Chibi, 31 percent of the farmers complained about lacking sufficient land. New farmers in both regions were still being allocated land and some experienced farmers were expanding their holdings. However, new fields were situated an increasing distance from most homesteads or in widely separated locations. The Zimbabwe government has recently established a policy of relocating families from grazing lands and centralizing

[11] See Bratton (1986) and Moyo, et. al (1986) for further discussion of this issue.

village settlement.[12] If restrictions against the cultivation of grazing land are enforced, the land constraint could become severe.

5.3.2 Labor Markets

The lack of sufficient labor was frequently among the first farming problems identified in both agroecological regions. In Mangwende, 28 percent of the farmers identified this as a major constraint. In Chibi, over one-half the farmers cited this problem.

Approximately 50 percent of the farmers in both Mangwende and Chibi belong to labor groups. These provide a basis for organizing community work in the fields of all group members on a rotating basis. All group members are expected to contribute to and benefit from group activity equally. If this is true, participation in labor groups does not increase the net availability of labor to a given household. There is no evidence of economies of size among crop production activities. However, insofar as group activity reduces the tedium of agricultural labor, this could increase the total quantity of labor employed by the group as a whole or by individual members. Group labor could also

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[12] See Weinrich (1978) for a historical perspective of smallholder settlement patterns and land allocation. See GRZ (1986) for a brief discussion of the new communal area resettlement policy.

increase the timeliness of practices. These group activities are particularly prominent during the weeding period.[13]

Farmers in both regions supplement their family labor resources by hiring workers, mostly from neighboring farms. Forty to 45 percent of the households in each region employ paid laborers both for crop production and other farm activities. Labor is commonly supplied when draft services are hired. Labor is sometimes hired for crop weeding, particularly if a husband works elsewhere. In addition, labor is often hired for activities other than crop production such as brick making, house construction, grass cutting for thatch, transporting goods and tending cattle. However, since labor is perceived as expensive,[14] hirings are infrequent and for short periods. No households consistently hired labor over the full cropping season. Nor did any household identify labor hire as a major household expense.

Another response to labor constraints is the staggering of crop plantings.[15] This allows households to spread family

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[13]See Bratton (1984) and (1986) for a discussion of farmer groups.

[14]Rural wages are increasingly paid in cash, generally for piecework (e.g. by the number of rows or area weeded). One acre of ploughing services costs about $Z20.

[15]This practice also results from the lack of timely access to draft resources and represents a strategy to reduce the risks of false starts to the rainy season and mid-season dry spells.

labor (particularly weeding labor) more evenly over the course of a season. In Mangwende, the average amount of time between first and last summer planting is 54 days. In Chibi, this is 76 days.

The labor requirements for maize production were estimated, in the enterprise labor survey as ranging from 111 to 210 mandays per hectare for low to high input enterprises in Mangwende, and roughly 110 mandays per hectare for the average Chibi crop (Makombe, Bernsten and Rohrbach, 1987). This could be reduced depending on the care taken in crop management. Fertilizer could be broadcast rather than incorporated, the number of weedings could be reduced and the quality of weedings can be adjusted. This would likely reduce yields. Yet if labor costs are high, the reduction in labor use could increase net returns. The small amount of labor hiring for crop production suggests farmers either do not face a major labor constraint or view the returns to intensive crop management as lower than the costs of labor hire.

5.3.3 Capital Markets

Over one-half of all households identified the lack of adequate draft resources as a major farming problem in both Mangwende and Chibi. This corresponds with the high proportion of farmers in each region lacking basic draft resources (38 percent in Mangwende and 58 percent in Chibi). Yet draft resources are readily lent and borrowed. A household owning one animal may borrow another from a neighbor to make up a team. Alternatively, a farmer can rent animals or hire ploughing services. Forty-four percent of households in Mangwende and 63 percent in Chibi borrow or hire draft resources. Fields are rarely prepared by hoe.

Though all households have access to draft power, farmers who own cattle can plough their fields earlier in the planting season, or time their planting more closely with the sequence of early rains. They can plant the day after a significant rainfall, rather than wait several days to borrow animals. Recognition of the importance of timeliness underlies the widespread identification of the lack of sufficient draft animals as a major farm problem. Despite this, most borrowers stated they could get animals when they needed them. The survey evidence also unexpectedly shows no relationship between the number of animals owned and the first planting date.[16] A strong positive relationship was found, however, between draft ownership and the size of area cultivated.[17]

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[16] However, planting date is not necessarily a good indicator of the timeliness of planting, particularly when early rains are inconsistent.

[17] The simple correlation in 1985/86 in both Mangwende and Chibi was about .45.

A robust market for draft animals exists in both regions, at least in good rainfall years. In Mangwende, one quarter of all households either bought or sold cattle between March of 1985 and March 1986. Only two more animals were purchased than sold indicating no major build-up of draft resources. In Chibi, close to 30 percent of households participated in these transactions, many both selling and buying, or trading one animal for another. More animals were purchased than sold, as farmers attempted to build their stocks. In both regions farmers were as concerned about the quality of their herds as the quantity. Purchasers often sought improved breeding stock from nearby commercial farms.

Farmers identified high input costs and the lack of cash to purchase inputs as an additional major agricultural constraint. This problem has been partially offset by the availability of credit. However, access to credit is limited, particularly in Chibi, by restrictive loan qualification requirements.[18] Participation in the AFC program was also limited by widespread confusion about repayment requirements.[19]

[18] Loan recipients must be a member of a farming group, must show evidence of previous crop marketing and the ability to repay a loan, must obtain a GMB registration card and must be recommended by community leaders as a good farmer.

[19] Many smallholders receiving loans did not understand their repayment obligations.

The size of potential investment income is also determined by the quantity of production marketed and the availability of alternative income sources. Farmers in Mangwende have better access to credit as well as alternative income sources. Due also to the higher returns to fertilizer investments, input expenditures in this region were about five times those in Chibi (Table 5.6). In both regions, almost all expenditures are for maize production inputs.

Table 5.6
Variable Input Purchases in Mangwende and Chibi, 1986/87
Zimbabwe

Input Expenditures	Mangwende	Chibi
Ave. Total Input Expenditure ($Z)	282	58
Ave. Maize Input Expenditure ($Z)	254	46
Maize/Total Expenditure (%)	90	79
Proportion of Farmers Receiving Formal Credit (%)	37	5
Proportion Maize Inputs Purchased With Credit (%)	69	39

Source: Mangwende and Chibi Surveys

5.4 The Expansion of Institutional Services

Access to institutional services has increased, since independence, for farmers in both Mangwende and Chibi. Markets have expanded, research and extension support have increased and educational opportunities have improved. These interventions have increased maize production incentives, created new investment opportunities and shifted farm priorities.

5.4.1 Education

One of the Zimbabwe government's highest post-independence priorities was to expand educational opportunities, particularly for rural households.[20] The achievement of this commitment is reflected in the increasing number of farm household members with secondary education. In Chibi, less than 10 percent of family members over 30 years of age have attended secondary school. In comparison, over half of family members between the ages of 16 and 20 have obtained secondary schooling. In Mangwende, one-third of family members over 30 have attended secondary school, whereas three-quarters of children between the ages of 16 and 20 have had this opportunity. In both regions, over 90 percent of school age children under 16 are enrolled in school. Both boys and girls seem to have equal educational opportunities.

Increased access to schooling has reduced labor available to farming activities as children previously

[20] Prior to Independence, rural education was largely the responsibility of local churches.

contributing to crop production are now in school and graduates are leaving the farm for urban jobs. In Chibi, 70 percent of male household heads with less than seven years of education remain on the farm, but only 56 percent of those with greater education remain at home. In Mangwende, a region situated closer to a major urban center, the impact of education is even more evident. Here, three-quarters of male household heads with greater than seven years of education work off the farm. Only one-third of those with less education work elsewhere.

Educated children who find employment elsewhere occasionally send remittances to their parents. Farm labor is contributed with lesser frequency. Acceptance of these traditional responsibilities has been declining. However, married children may reestablish rural households if income from off-farm employment is insufficient to support a family. In such cases, the husband is likely to retain his off-farm job while the wife manages the farm and family. The off-farm income then provides a source of capital for production investments.

5.4.2 <u>Credit</u>

The importance of credit as a source of working capital was noted above. Agricultural loans were available to a small number of Mangwende farmers before the AFC established its smallholder loan program in 1978. A local church group (Silviera House) made loans available to approximately one percent of the region's farmers. Soon after the government established a credit program for smallholders, responsibility for providing agricultural credit shifted entirely to the AFC. By the 1986/87 season, 67 percent of Mangwende farmers had received AFC loans. All short term funds were used for maize inputs.

Significantly, credit accessability did not necessarily correspond with continuing use, in part, because farmers had difficulty repaying loans. Yet some farmers who readily repaid their loans viewed the credit package as unprofitable or did not want to accept the risks of loan liabilities in the event of drought. As a result, over the three year period covered by the survey (1984-86), a declining proportion of Mangwende farmers were receiving loans.[21] During the 1984/85 season, 48 percent of households received credit. A year later this declined to 42 percent and by the 1986/87 season only 37 percent of respondents received loans. Further, while the number of recipients was declining, some farmers were still receiving loans for the first time. Only one-fifth of Mangwende farmers received loans consistently over the three year period. On average, these are among the largest maize

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[21] Information of credit receipts was collected from farmers for the 1984/85, 1985/86 and 1986/87 seasons.

producers.

In Chibi, low rainfall and corresponding AFC concerns about repayment have limited access to agricultural loans. The first recipients in the survey sample received loans in 1984. By the 1986/7 cropping season only five percent of sample farmers had received loans. The recipients were the largest producers from only one of the six sample villages. The AFC had not made credit available to farmers in other villages. Again, despite low rainfall levels, production credit was only granted for maize.

5.4.3 Extension

Extension support was withdrawn from both Mangwende and Chibi during the later stages of the war, and reestablished after 1980. It is unclear whether the number of field agents expanded in the survey region. However, these agents gradually were provided access to motor bikes, substantially expanding their potential coverage. By the end of 1986, all but one field agent in the two survey zones had a motor bike. Local agents also were provided improved housing, increasing their motivation to remain employed in the rural areas. Two-way radios are also being delivered to regional supervisors and some local agents.

The quality of extension support is difficult to evaluate. Farmer visits are more frequently made in Mangwende. Two-thirds of farmers in this higher potential zone saw an extension worker at least once between March 1985 and March 1986. Most of these saw extension workers at least three times during the period. These farmers generally received advice on all major crops and cropping practices.In Chibi, only one-third of the farmers saw an extension worker over the survey period, though most of these were visited several times. Here also, advice ranged broadly across crops and management practices.

The activities of different agents vary greatly, much depending on the individual's initiative. One worker visited 94 percent of the farmers sampled in his region, all at least twice. Another visited only six percent of the respondents in one sample village. Local agents were asked how they choose the farmers with whom they worked. Most suggested farmers must take the initiative to seek out assistance. The lower coverage in Chibi may indicate that farmers in this region do not view the assistance as useful.

Extension agents were asked about the recommendations they offered for all major crops. Standard recommendations are provided by AGRITEX for the various natural regions. The agents were knowledgeable of the maize recommendations, though most had made minor adaptations to meet their local agroecological conditions.[22] Advice offered for groundnuts and other minor crops tended to differ more substantially from the head office standards. For example, some extension workers recommended fertilizer for sorghum while others did not. Local fertilizer recommendations for groundnuts varied widely.[23] The justification for these changes was unclear. The differences seem to reflect lack of knowledge of the standard recommendations.

5.4.4 Market Institutions

Since independence, input availability has also expanded in both regions. Mangwende farmers have long had access to input retail outlets in Harare, Marondera and the District center of Murewa. They still purchase a portion of their inputs in these locations. Since 1980, however, inputs have become more locally available. Two cooperative depots were established in the survey area to sell inputs. Local general merchandise retailers in smaller business centers began to stock seed, fertilizer and agrochemicals. The fertilizer companies sent salesmen to villages and individual farms to promote sales further. One agrochemical company conducted a

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[22] Locally recommended fertilizer rates, seed rates and planting dates varied. The justification for these changes could not be determined.

[23] For example, in both Mangwende and Chibi fertilizer recommendations for groundnuts ranged from 100 to 250 kg/ha of single superphosphate and 100 to 250 kg/ha of gypsum. In Mangwende recommended groundnut seed rates ranged from 65 to 125 kg/ha. In Chibi, these ranged from 20 to 100 kg/ha.

series of on-farm herbicide demonstration trials to promote sales in the area.

In Chibi, a similar expansion of retail suppliers occurred. Of the 15 locally based retail agents serving survey farmers, 11 began selling inputs after 1980. Most, however, simply sell seed, a few major insecticides and minor plough parts. Three local retail outlets sell fertilizer, though one of these sells only on the basis of a special order. For inputs not commonly used or major equipment, farmers must still travel to the larger towns of Masvingo or Chiredzi at least 60 km away. The fertilizer and agrochemical company representatives do not conduct demonstrations trials or seek direct farmer purchases in this region.

Both Mangwende and Chibi have also experienced an expansion in product markets. The GMB established a buying depot in Mangwende in 1977. Prior to this, farmers had to travel to Harare or Marondera to deliver their produce. After independence, three GMB Approved Buyers began serving survey farmers and the two cooperatives bought grain for a short period. In 1985, the GMB established a collection point in the area, though this did not operate during the following year. (These services will be discussed further in Chapter 6.)

In Chibi, farmers could sell crops to a single GMB Approved Buyer established in the early 1960s or to a GMB depot 70-100 kilometers north in Masvingo. Crop sales were encouraged with the establishment of two GMB collection points in the area in 1985. One collection point operated just outside the survey zone in 1986.

The establishment of product marketing facilities and increase in crop sales prompted a large increase in the number of transporters serving Mangwende farmers after independence. Of the 18 transporters used by respondents in 1985, only two operated before 1980.

In Chibi, there are no locally based crop transporters. One school teacher transported small quantities of grain for a few producers in 1985. But most produce travelled to market by ox cart, bus, wheel barrow and on the backs of animals.

The timing of product market expansion corresponds with growth in both the number of producers selling crops to the GMB and in the quantity of deliveries. Before the GMB depot was established in Mangwende in 1977, only 10 percent of producers had sold crops to the GMB. By 1985, 80 percent had done so. Since 1980, local maize deliveries to the GMB have risen from three to 70,000 metric tons. Before the local GMB collection points were established in Chibi in 1985, only 5 percent of the respondents had sold crops to the marketing board. In that year, over one-third of these farmers sold grain through formal channels. Maize deliveries have increased from less then 200 metric tons in 1980 to over 18,000 metric tons in 1986.

5.5 Production Distribution

The farming circumstances of Mangwende and Chibi are surprisingly similar. Both regions have maize based cropping systems. Both groups of farmers supplement crop production with income earned from a variety of additional farm and non-farm sources. The two areas have been similarly affected by the expansion of educational facilities and growth of institutions serving the market oriented producer.

Basic agroecological differences still distinguish the two smallholder farming areas. As a result, Mangwende farmers have built a stronger capital (farm equipment and draft animals) base and have more productive farming opportunities. They have greater access to improved agricultural inputs, particularly fertilizer. As well, the technical recommendations guiding the use of these inputs have been better tested and adapted for this region.[24] A broader and stronger system of institutional support has developed, since 1980, to enable farmers to exploit this potential.

Maize production and market sales have increased in both Mangwende and Chibi. The similarity of the production systems suggests a related set of forces may be acting on each group of producers. The difference in levels of resource endowment suggests the relative impact of these influences should be different. This hypothesis is tested by analyzing factors influencing smallholder production decisions within each region.

Before this, however, it is important to note the difficulties associated with using cross-sectional data to evaluate the justification for changes in production practices over time. This analysis assumes that changes over time are reflected in the diversity of a cross-sectional sample. Estimation of the differential impact of a particular policy, technology or institution on a range of different farmers provides a basis for roughly evaluating the impact of related development interventions on a larger population over time. For example, if farmers with lower transport costs or better product market access produce and sell more than those

[24] Because they were initially developed for the large-scale farm sector. A major part of Mangwende is located in a similar agroecological zone.

facing poorer access, one can infer that the expansion of market access is an important stimulant to production growth.

The analysis also assumes farmers with the highest current levels of production, yields or sales are those making the greatest contributions to a region's recent production growth. Similarly, the major determinants of production decisions today are assumed similar to those influencing the expansion of production since independence. Factors, for example, which currently lead one farmer to allocate more land to maize than another, are related to those provoking recent growth in aggregate maize area. The explanation for current differences in plot-specific yields indicates why yields have recently increased. This analysis of area and yield growth is particularly concerned with evaluating the impact of variables affected by development policy or technological change.

In Mangwende and Chibi, a simple breakdown of the distribution of farm family maize production levels provides clear evidence of the diversity of the household sample. Once again, the result is surprisingly similar in the two communal areas (Table 5.7). Twenty percent of households in each region produce at least half of the population's maize. They contribute a similar or higher proportion of each region's maize sales.[25] As will be shown in the analysis which follows, these farmers have larger holdings, own greater production resources and participate more strongly in commercial input and product markets. Forty percent of producers can be classified as transitional. In Mangwende, these farmers generally purchase fertilizer and sell grain, though neither at very high levels. In Chibi, some of these farmers sell grain in exceptional years, but most are largely concerned with producing enough to meet family consumption requirements. The poorest 40 percent of households in each area are marginal or subsistence producers. In Mangwende, these farmers purchase few inputs and sell little. In Chibi, seed is typically the only input purchased. In dry years, harvests fail to fulfill family consumption requirements. Thus, frequently, these are net food purchasers.

Table 5.7
Distribution of Maize Production in Mangwende and Chibi
1984/85 and 1985/86 Seasons, Zimbabwe

	Proportion of Total Maize Harvest			
	Mangwende		Chibi	
Production Distribution Class:	84/5 (%)	85/6 (%)	84/5 (%)	85/6 (%)
Top Quintile	54	49	54	67
Second Quintile	19	21	21	17
Third Quintile	15	20	14	9
Fourth Quintile	9	7	8	5
Bottom Quintile	3	2	4	1

Source: Mangwende and Chibi Surveys

[25] See page 233, Chapter 7 below.

This distribution suggests a major part of the recent sector-wide increase in maize production and sales have come from a relatively small portion of producers. This hypothesis will be tested as household production decisions are more closely examined. Further, the analysis will consider what distinguishes the larger producers, and examine the implications of this skewed distribution for future development assistance strategies in each region.

5.6 Factors Influencing the Allocation of Land to Maize

5.6.1. Area Trends in Mangwende and Chibi

Aggregate national smallholder maize area is estimated to have increased sharply between 1979 and 1981. Thereafter, area cultivated remained steady. Local estimates from the same series of AGRITEX data indicate Mangwende farmers partly followed these trends. Maize area increased an estimated 150 percent in 1981 and then declined by 20 percent the following year. Thereafter, it remained steady. Chibi farmers, according to regional Agritex estimates, did not follow national trends. Here, maize area doubled during the late 1970s, while national trends were still declining. Maize area then declined after 1981. (AGRITEX, various years).

Survey respondents were asked to provide their own rough estimates of their crop area allocations since 1975, five years before independence. These approximate data correspond with the more accurate data for regional maize sales trends and with available information indicating a post-independence surge in producer numbers (Table 5.8).

Table 5.8
Farmer Estimates of Crop Area Trends in Mangwende and Chibi
1974/75 to 1985/86, Zimbabwe a/

	Mangwende			Chibi		
Index (1975=100)	1975	1981	1986	1975	1981	1986
Total Crop Area	100	118	172	100	129	189
Maize Area	100	129	187	100	179	258
Non-Maize Crop Area	100	99	146	100	89	135

a/ These numbers do not account for producers who died or left the two communal areas. Accordingly, the indices overstate the magnitude of the aggregate increase in Mangwende and Chibi's crop area. There was no evidence, however, of major losses in population from either area.

Source: Mangwende and Chibi Surveys

In contrast to both aggregate national and local AGRITEX data, farmers revealed that their maize area increased throughout the 1975 to 1986 period. Further, in both Mangwende and Chibi, the largest increase in area planted occurred after 1981. Crop substitution appears to have been limited. While regional plantings of alternative crops remained steady up to 1981, these increased sharply thereafter. The growth in maize hectareage in both Mangwende and Chibi was simply faster than the growth in plantings of alternative crops.

The analysis of these crop area trends is extended by disaggregating the proportion of increase in maize area associated with the local increase in producer numbers following the war (the establishment of new holdings) and comparing this with the gain associated with the expansion of existing holdings (Table 5.9). This shows that much of the increase in maize area in both regions resulted from an increase in the number of farming households. Additional information identifying when farmers started their operations indicates the largest share of this gain occurred between 1979 and 1981 as the independence war ended and the government instituted a program to support rural resettlement. Yet producer numbers continued to rise more quickly than population growth rates in each region until 1985. After 1981, an increasing proportion of maize area gains resulted from an expansion of plantings per existing household.

The household data also reveals that many of the farmers in each region operating in 1975 decreased their maize hectareage during the later stages of the war. Much of the expansion in these farmers plantings during the 1981 to 1985 period represents the replanting of fields previously abandoned. Some of these farmers also planted newly allocated land to maize.

Table 5.9
Sources of Increase in Maize Area in Mangwende and Chibi 1974/75 to 1985/86, Zimbabwe

	Mangwende		Chibi	
Proportion of Maize Area Gain Resulting From:	75-81 (%)	81-86 (%)	75-81 (%)	81-86 (%)
a) Increase in Number of Farmers	71	40	86	69
b) Increase in Area per Existing Farmer	29	60	14	31

Source: Mangwende and Chibi Survey

Insofar as much of the increase in maize area, particularly before 1981, was associated with an increase in producer numbers, most of the additional harvest was likely destined for family consumption. Though production for national markets also expanded, survey data indicate the larger portion of this increase likely occurred after 1981. This relationship corresponds with the regional GMB sales data for both communal areas.

5.6.2 Maize Area Determinants: 1985 and 1986

A theoretical, time-series model of arable land allocation assumes planting decisions are based on the relative returns to alternative crop enterprises reflected in producer and input prices and a series of structural constraints influencing resource access and production returns. This takes the following general form:

$$A = f(Pp, Ps, Pi, Z)$$

where A = land area allocated to a particular crop
Pp = producer price of the crop under consideration
Ps = producer price of potential substitute crops
Pi = input prices
Z = structural variables influencing resource access and production returns (e.g. rainfall, input and product market constraints, factors influencing technological change)

Essentially, farmers will allocate more land to a given crop, such as maize, if the relative profitability of maize is greater than the profitability of alternative crops. The profitability of the enterprise depends on product prices, input prices, and the major determinants of allocative and technical efficiency.

A time-series analysis of factors influencing smallholder land allocation to maize cannot be performed due to the questionable accuracy of the aggregate area data and the lack of historical information on key variables affecting the land allocation patterns of households in the survey sample. The descriptive analysis above indicates, contrary to national trends, that Mangwende and Chibi farmers continued to plant larger quantities of land to maize throughout the immediate post-independence period (1979 to 1986). The major factors influencing this area growth include the ending of the war, an increase in producer numbers, the expansion of product and input markets, the reestablishment of extension support, as well as the relative increase in maize prices. Yet, information regarding the historical incidence of each of these variables at the household level could not be obtained in the surveys. A combination of aggregate regional (communal area) and household level data provided a basis for constructing a general picture of the relationship between changing institutions, policy and technology and production decisions. This does not, however, provide a basis for creating a combined cross-sectional and time-series quantitative model. Instead, the analysis must rely on inferences about area allocation decision making over time from an explanation of the variability in area allocation patterns during the 1985/86 and 1986/87 cropping seasons. This assumes the major determinants of current maize area variability are at least partially related to those factors explaining the growth in maize area during the full post-war period (1979 to 1985).

A cross-section model of maize area allocation should be essentially the same as the time-series model, in this case accounting for differences in producer and input prices and structural constraints across different locations. The Mangwende and Chibi survey data, however, do not include adequate variability in prices to measure these elasticities. Instead, the model for each Natural Region must attempt to measure the significance of constraints in the availability of fixed resources and the impact of variable levels of household allocative efficiency. Resource constraints can be roughly indicated by varying levels of access to land, labor, draft power and cash or credit for variable input purchase. Allocative efficiency can be roughly measured by indicators of maize profits obtained during the previous cropping season. This model is based on the assumption that a larger amount of land will be allocated to maize if a farmer has access to greater land, labor, draft and cash or credit resources and if he expects to obtain relatively greater profits from the maize enterprise.

The relationship between input availability and maize area across the three production classes identified above (Table 5.7) is displayed in Table 5.10. This shows that farmers with larger maize plantings both owned greater production resources and invested greater sums in variable inputs. As expected, maize plantings appear closely related to holding size. The correlation coefficients for the two variables (in the 1985/86 season data) are .67 and .62 in Mangwende and Chibi, respectively. Further, these data indicate that as holding size increases, the area allocated to maize increases while that allocated to other crops remains roughly unchanged. This relationship corresponds with the observation above that farmers in both regions first allocate land to meet their basic consumption requirements, then allocate the remainder of their holdings to producing maize for the market. Accordingly, the cross-sectional variability in maize plantings primarily reflects the ability and willingness to produce a surplus for the market.

Table 5.10
Relation Between Household Production and Resource Levels
Mangwende and Chibi, Zimbabwe

	Mangwende			Chibi		
Production Distribution Class:	Top 20%	Middle 40%	Bottom 40%	Top 20%	Middle 40%	Bottom 40%
Ave. Maize Area (HA.)	2.6	1.5	0.9	2.5	1.5	1.1
Ave. Other Crop Area (HA.)	1.2	1.4	1.2	0.9	0.8	0.7
Ave. Land Holding (HA.)	3.8	2.9	2.1	3.4	2.3	1.8
Ave. Draft Animals (No.)	7.6	4.4	1.6	4.1	2.3	1.5
Ave. Full Time Labor (No.)	1.9	2.1	1.7	3.2	2.7	2.6
Ave. Input Expenditure ($Z100)	7.3	3.7	1.4	0.9	0.3	0.2

Source: Mangwende and Chibi Surveys

Area planted is also affected by draft availability, though the strength of this relationship is offset by the length of the planting season and the opportunity to borrow animals or hire ploughing services. The correlation between maize area and draft ownership in 1985/86 is .51 in Mangwende and .38 in Chibi.

The availability of full-time labor appears less closely related to maize production levels and land allocation patterns. Roughly 90 to 95 percent of maize production labor is provided by adults. Most of this is provided by full time workers. Many households hire ploughing services (including labor) if they do not have animals. Yet only a small proportion hire workers for other activities such as weeding. Many families participate in cooperative labor groups, however, most fieldwork is done by household members. The correlation between 1985/86 maize area and full time labor is .22 in Mangwende and .25 in Chibi. The strength of this relationship may be offset by the extended planting period and associated reduction in labor bottlenecks.

Most farmers identified the cost and affordability of inputs as major determinants of their maize area. They complained that inputs were expensive and that they did not have enough cash or credit for input purchase. This restricted the size of maize plantings. It implies farmers face a severe capital constraint. Normally, one would expect input expenditures to be determined by the profitability of input investment and use. The more profitable the enterprise, the more inputs applied. In this case, however, more farmers claimed that their input expenditure patterns are guided by input costs and cash or credit available than by the profitability of maize.

In Mangwende, the cost of maize seed is relatively small compared to the apparent availability of cash resources.

Accordingly, land allocation decisions are more significantly influenced by the ability to purchase fertilizer. Many farmers suggest maize is not worth planting if fertilizer is not available. A high correlation (.78) between the total value of input expenditures and the size of maize plantings in 1985/86 supports this claim. This relationship is partly offset by the fact that fertilizer application rates are highly variable, ranging from 15 to 310 kg N per hectare. Yet over 90 percent of maize plots receive at least small amounts of fertilizer.

In Chibi, where few farmers apply fertilizer, respondents claimed the availability of cash to purchase seed is limited. Yet the relative cost of maize seed is small compared with rough indications of total household expenditure levels. The cost of maize seed for one hectare, for example, is roughly 20 percent of the cost of the average investment in schooling. The correlation between total input investment levels and maize area in 1985/86 was .46.

As stated above, maize area allocation should also depend on the perceived profitability of the enterprise. Due to the lack of local variability in prices and transport costs, two proxies were employed as rough indicators of enterprise profitability. The proxy for the 1986/87 season model was an estimate of net maize returns per hectare for the 1985/86 cropping season. The proxy for the 1985/86 season model was an estimate of average household 1984/85 season yields. This was used because no input use data were available for measuring net returns during this season. Yields offer a poor proxy for returns, however, given the fact that the highest yields may be associated with high input costs and lower profitability. The simple correlation between yields and maize area was .30 in Mangwende and .32 in Chibi. The correlation between net returns per hectare and maize area was .10 in Mangwende and .46 in Chibi.

Two additional structural variables require consideration in the Mangwende and Chibi models for maize area planted. In Chibi, local GMB crop buying outlets (other than the single Approved Buyer) were established for the first time during the harvest season of 1985. The unexpected level of revenue obtained from 1985 crop sales may have additionally influenced 1985/86 season planting decisions. While this variable is correlated with 1985 production levels and maize area, Chibi farmers may also have decided to sell grain normally retained for consumption. The sales revenue indicates the existence of this additional incentive to produce larger quantities of maize for the market.

During the 1986/87 planting season, many smallholder farmers, particularly in Mangwende, were confused about the coverage of the recent government maize price announcements designed to limit large-scale commercial production. Some believed maize prices had been lowered on all sales. Planting decisions were also affected by government efforts to promote groundnut production. Smallholders were told they ought to plant more groundnuts, though no increase in groundnut prices was announced. Some Mangwende farmers responded by substituting groundnuts for maize. The significance of this misunderstanding for the area planted to maize is measured by the change in groundnut hectares planted between 1985/86 and 1986/87.

In summary, the cross-section model of maize area should encompass variables identifying the production resources available to the household and expected returns to resource investment in maize production. Since maize is the only major cash crop enterprise in both Mangwende and Chibi, the relative returns to alternative cropping enterprises are ignored. The principal economic decision being modeled is whether to produce more or less maize surplus for the market. Linear regression equations were estimated for household maize area planted during both the 1985/86 and the 1986/87 cropping seasons. The variables employed in these equations are broadly defined above. These are summarized as follows:

MZAREA = f(LH, DRAFT, FTLABOR, INPUTCST, YLD85, MZRET86, SLSREV85, GNAREA)

where: MZAREA = maize planted (HA)
LH = arable land holding (HA)
DRAFT = draft animals owner (No.)
FTLABOR = full time workers in the household (No.)
INPUTCST = total investment in variable inputs ($100)
YLD85 = maize yield per hectare in 1984/85 (KG/HA)
MZRET86 = maize net returns in 1985/86 ($100/HA)
SLSREV85 = maize sales revenue following the 1984/85 season ($100) [Chibi only]
GNAREA = change in area allocated to groundnuts between 1985/86 and 1986/87 (HA) [Mangwende only]

Table 5.11
Summary of Variable Characteristics in Maize Area Regressions

	Mangwende		Chibi	
	Mean	S.E.	Mean	S.E.
MZAREA (1985/86)	1.5	0.9	1.5	1.0
MZAREA (1986/87)	1.2	0.7	0.7	0.4
LH	2.8	1.7	2.4	1.4
DRAFT	4.0	4.4	2.4	3.1
FTLABOR	1.9	1.2	2.7	1.6
INPUTCST (1985/86)	3.5	3.2	0.4	0.6
INPUTCST (1986/87)	2.9	2.5	0.6	0.9
YLD85	2.7	1.8	1.7	1.3
MZRET86	1.3	1.9	0.7	0.8
SLSREV85			1.2	2.6
GNAREA	0.1	0.2		

Source: Mangwende and Chibi Surveys

5.6.2.1 Mangwende Area Regression Results

The results of the two regressions are consistent and conform partly to expectations. Mangwende maize plantings during both the 1985/86 and 1986/87 cropping season appear most strongly related with the size of total investment in variable inputs (Table 5.12). A $Z100 increase in input expenditures corresponds with a 0.4 hectare increase in area planted. Mangwende farmers identified the lack of capital (and high input costs) as one of their severest resource constraints. Most farmers also identified the lack of draft power as a major constraint. However, the relatively low elasticity of this variable corresponds with the widespread practice of draft lending and borrowing. As expected, land holding size is also strongly and positively related to maize area. Recalled information about land allocations, however, indicate land holding was not a binding constraint and few farmers identified it as such.

Table 5.12
Regression Equations for Mangwende Maize Area, 1985/86 and 1986/87; Zimbabwe

	1985/86			1986/87		
Variables	Coeff.	S.E.	Signif	Coeff.	S.E.	Signif
LH	0.14	0.04	.00	0.16	0.03	.00
DRAFT	0.04	0.01	.00	0.03	0.01	.04
FTLABOR	0.08	0.04	.08	0.01	0.04	.77
INPUTCST	0.18	0.02	.00	0.16	0.02	.00
YLD85	-0.11	0.08	.18			
MZRET86				0.03	0.03	.26
GNAREA				-0.30	0.23	.19
$\bar{R}^2$ =	.71			.61		
n =	97			89		

Source: Mangwende Surveys

The availability of full time family labor is also positively related to maize plantings, though not statistically significant during the 1986/87 cropping season. The elasticity is low in the 1985/86 season model. The coefficient for the 1984/85 maize yields variable is unexpectedly negative, though not significant. The coefficient for 1985/86 maize returns is positive, though similarly not significant. The coefficient on the variable measuring the change in groundnut area indicates the existence of crop substitution, but is not significant.

The justification for the apparent lack of response to maize yields, and particularly to the level of net maize returns, is difficult to determine. As noted above, the lack of response to lagged yields could result from the association of high yields with declining net returns. Some farmers apply fertilizer rates above recommended levels and despite the fact that fertilizer prices were recently rising.[26] There are several possible reasons for the apparent lack of responsiveness to net maize returns. Mangwende farmers may not have an accurate sense of the relative profitability of their enterprises. Alternatively, variability in risk preferences may lead to different responses to a given level of returns. Thirdly, the lack of response could be a further indication of the severity of the

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[26] See Chapter 6 for a further review of the inpact of rising input prices on maize profitability.

capital constraint farmers face, a constraint which may vary depending on access to credit and alternative income sources. This issue is further examined in the investigation of input expenditure and investment patterns in Chapter 6.

5.6.2.2 Chibi Area Regression Results

The regression results for Chibi had less explanatory power (Table 5.13). In the equation for the 1985/86 season, the strongest determinant of maize area seems to be land holding size. At the mean, more than one-half of each additional hectare of land is allocated to maize. The previous year's maize yield and the previous years maize sales revenue each influenced maize plantings positively though less strongly. The nonsignificance of the draft coefficient may reflect the ease with which draft can be borrowed and the length of the planting season. Despite farmer's claims that inputs were costly and unaffordable, the input expenditure coefficient is not statistically significant. The negative coefficient on this variable could reflect the intensive cultivation of land by the small number of farmers receiving fertilizer.

The low explanatory power of the 1986/87 Chibi equation reflects the impact of very poor rains during the start of the season. These were inconsistent and simply stopped altogether during the main part of the planting period. Some farmers, particularly those who had yet to plant any maize, continued preparing their fields, hoping the rains would start again. However, many farmers who would normally plant larger areas reduced the land they cultivated.

Table 5.13
Regression Equations for Chibi Maize Area, 1985/86 and 1986/87; Zimbabwe

Variables	1985/86 Coeff.	S.E.	Signif	1986/87 a/ Coeff.	S.E.	Signif
LH	0.33	0.06	.00	0.05	0.03	.10
DRAFT	0.002	0.03	.95	0.002	0.01	.87
FTLABOR	0.02	0.05	.61	0.02	0.03	.47
INPUTCST	-0.23	0.20	.27	0.17	0.06	.01
YLD85	0.12	0.06	.05			
SLSREV85	0.15	0.05	.00			
MZRET86				0.01	0.06	.10
$\bar{R}^2$ =	.50			.33		
n =	95			86		

a/ poor planting rains

Source: Chibi Surveys

The significance of the input expenditure variable reflects the fact that farmers who purchased more inputs tended to plant their fields earlier. Given the early cut-off of planting rains, those planting earlier planted more land. Yet the elasticity of the input expenditure variable is low.

5.6.2.3 Discussion of Area Equation Results

The descriptive analysis revealed maize area increased as a result of an increase in producer numbers and an increase in land cultivated per producer. This also showed that land seems to be allocated first to food crops and secondly to marketed crops. This suggests that those farmers with the largest maize area aim to produce the largest marketable surplus. Land is not a constraining resource. Given that allocations generally depend on full utilization, farmers with larger allocations have gained these, at least in part, as a result of their interest in expanding their maize hectareage. In fact, those farmers selling the largest quantities of maize to the GMB, particularly in Mangwende, increased their maize area the most.

In the regression equations, the land holding variable reflects not simply the amount of land available to a household, but also the amount of land obtained in order to meet family food and market production objectives. This changed as market incentives improved. This explains the strong relationship between maize area and total land holding size registered in the equations above.

The significance of the input expenditure variable reflects both the significance of household capital constraints and the importance of policy measures, such as the establishment of a smallholder credit program, in offsetting this constraint. Farmers in both Mangwende and Chibi also widely benefited from the expansion of local input markets after the war and an associated decline in transport costs. These relationships are examined further in the analysis of factors influencing maize yields and input expenditure patterns below.

Draft ownership does not appear to be a major farm constraint affecting cultivated area. While draft ownership is linked to the size of maize plantings in Mangwende, the relationship is weak. In both regions, the long planting season and ability to borrow animals may offset the severity of this problem.

The availability of family labor also does not appear to be a major constraint on area planted. Male household heads working off the farm commonly return to the rural areas to contribute planting labor. Also, households frequently hire ploughing labor when they hire draft animals or ploughing services.

The lack of a clear link between maize area and maize yields can be explained by the fact that net returns are declining at the highest input rates when yields are maximized. Yet Mangwende and Chibi farmers either do not have an accurate perception of their net returns, face severe capital constraints allowing only partial responsiveness to the previous season's returns or hold differing risk preferences. Yields and input application rates are, in fact, highly variable across plots on the same farm and this variability is not explainable by soil or other micro-level differences.

5.7 Factors Influencing the Level of Maize Yields

5.7.1. Yield Trends in Mangwende and Chibi

Aggregate national data on smallholder maize yields indicates most growth in per hectare production occurred after 1981 (Figure 4.3). In fact, this gain appears to have occurred almost entirely during the 1984/85 season. However, the 1982-84 drought may hide what would otherwise have been a more consistent growth trend.

The AGRITEX extension worker estimates indicate most of the Mangwende yield gain occurred before 1979 with a further marginal increase with the 1981 harvest. In Chibi, the pattern of yield growth corresponds with the national averages with a single large gain in 1985.

It is reasonable to assume local extension workers have a better ability to estimate regional yield levels than the size of area planted.[27] Even so, the view that Mangwende yields did not increase during the post-independence period, despite improvement in extension support and the availability of inputs, is unexpected. Most farmers in Mangwende and Chibi similarly stated their maize yields had not increased since 1980. However, this perception may have been biased by the 1982-84 drought, and the fact that rainfall, during the 1985/86 season when the question was asked, was lower than in 1984/85.

5.7.2. Maize Yield Determinants, 1985/86 Cropping Season

Average household and plot maize yields, in any given year, depend on rates of input application and the quality of crop management. The distribution of average maize yields and related level of these major explanatory factors are shown in Table 5.14. Again, this distribution distinguishes the top 20 percent, middle 40 percent and bottom 40 percent of producers in each communal area.

Maize yields appear positively related with the rates of application of fertilizer and insecticide. These correspond closely with the distribution of access to credit. Households

[27] This was perception was supported by the head of the AGRITEX Crop Production Branch.

producing larger quantities of maize have greater support from extension agents. These larger producers both receive more visits from extension agents and are more likely to independently seek out extension advice. Production and yield levels are also positively related to the number of years of farming experience of the male or female household head. These do not, however, appear related to the educational level of the household head. This may result from variability in the quality of schooling at various local educational institutions or the irrelevance of the school curriculum to farming.

Table 5.14
Factors Influencing Maize Yields in Mangwende and Chibi, 1985/86; Zimbabwe

	Mangwende			Chibi		
Production Distribution Class:	Top 20%	Middle 40%	Bottom 40%	Top 20%	Middle 40%	Bottom 40%
Ave. Maize Yield (MT/HA)	2.9	2.2	1.9	0.8	0.6	0.4
Ave. Fertilizer Use (KG/HA)	591	356	230	57	7	3
Ave. Insecticide Use (KG/HA)	2.4	1.4	0.4	0.6	0.0	0.0
Ave. Credit Received ($Z)	474	180	47	54	0	0
Proportion Gaining Extension Advice on Maize (%)	85	63	28	70	21	10
Head of Household's Average:						
a.) Years Farming Experience	19	14	16	16	13	10
b.) Years Education	5	6	5	4	4	3

Source: Mangwende and Chibi Surveys

The analysis of aggregate smallholder production growth (Chapter 4) identified the significance of the rapid post-independence growth in maize seed and fertilizer sales. The establishment of a smallholder credit program also expanded usage of maize insecticide. Further, the possible significance of the Zimbabwe government's expanded investment in smallholder extension programs was cited. This cross-sectional analysis asseses the impact of input use and extension support in Mangwende and Chibi on maize yields. This information will be reexamined in the context of an analysis of technology adoption and investment decisions in Chapter 6.

A series of yield regressions were estimated for maize plot specific data from both Mangwende and Chibi. These were estimated in the standard double log or Cobb-Douglas form commonly used for production function analysis. The yield-response functions estimated for the two survey locations take the following theoretical form:

$$Y = f(Xi,\ Ej,\ Mk)$$

where Y = crop yield
Xi = input levels
Ej = environmental variables
Mk = crop management variables

The inputs include basal fertilizer rates, top dressing fertilizer rates, seed rates, insecticide rates, manure application rates and labor use. The environmental variables include soil quality (texture, pH and level of P2O5), the timing and level of rainfall and solar radiation. The crop management variables account for methods of input application and factors influencing the quality of crop management. These include such variables as planting date, days between planting and basal application, number of weedings, winter ploughing, days between planting and first weeding, years of education, years farming experience, degree of extension support, an indication of whether the plot is planted for sales or consumption. These management factors ought, theoretically, to be considered as input levels or factors distinguishing a series of different yield functions. The practice of winter ploughing, for example, is actually a production input. Years of education represents a proxy for the efficiency of input application which should ideally be measured in terms of application rates, timing and methods. The artificial distinction, however, is useful for two reasons. The broad definition of management variables allows the consideration of a series of proxies for missing information encompassing difficult to measure details of input application practices. In addition, this provides a conceptually useful rough distinction between rates of physical input application and methods of application.

A series of different yield-response equations for Mangwende and Chibi were estimated employing most of these variables. Unexpectedly, most, including the soil sample data available for a subset of the plots, offered little explanatory power. The final reported regression contains those variables expected to have the greatest impact on yields. These encompass the basic elements of the extension recommendations for maize production in Mangwende and Chibi. This takes the following basic form:

YIELD = f(MANURE, SEED, BASAL, TPDR, INSECT, LABOR, SORC, DP, EXT EDUC)

where:
YIELD = maize yield (KG/HA)
MANURE = manure applied during the twelve months before planting (KG/HA)
SEED = maize seed planted (KG/HA)
BASAL = basal fertilizer applied (8-14-7 in KG/HA)
TPDR = top dressing applied (34.5-0-0 in KG/HA)
INSECT = insecticide applied (KG/HA)
LABOR = family members contributing labor to crop production (No.)
SORC = plot's crop designated for sale at planting time (yes=1, no=0)
DP = planting date (days from January 1, 1985)
EXT = extension visits (No.)
EDUC = education of principal plot decision maker (if both husband and wife, the highest educational level was chosen) (years schooling)

The mean and standard error of these variables for Mangwende and Chibi plot data are listed in Table 5.15.

Table 5.15
Summary of Variable Characteristics in Maize Yield Regressions

	Mangwende		Chibi	
	Mean	S.E.	Mean	S.E.
YIELD	2077	1893	532	655
MANURE	2312	8996	1092	3520
SEED	26.7	7.2	24.5	14.4
BASAL	174	164	7.6	36.3
TPDR	180	126	5.1	22.7
INSECT	1.0	2.3	0.5	0.4
LABOR	5.4	2.7	5.3	2.6
SORC	0.1	0.3	0.01	0.1
DP	335	18	344	39
EXT	4.1	1.9	3.3	1.9
EDUC	4.9	2.9	3.6	3.0

Source: Mangwende and Chibi Surveys

5.7.2.1 Mangwende Yield Regression Results

Despite large variability among both dependent and independent variables, only the two fertilizer variables were statistically significant at the ten percent level (Table 5.16). In fact, these are significant at the one percent level. The signs on the coefficients of all remaining variables, except family labor availability, are as expected. However, most of these have such high standard errors that they are not meaningful.

Table 5.16
Mangwende Maize Plot Yield Regression Results, 1985/86
Zimbabwe

Variable	Coefficient	SE	Significance
MANURE	0.01	0.02	.55
SEED	0.22	0.20	.28
BASAL	0.09	0.03	.00
TPDR	0.23	0.03	.00
INSECT	0.17	0.35	.63
LABOR	-0.05	0.11	.65
SORC	2.59	2.20	.24
DP	-0.33	1.18	.78
EXT	0.09	0.13	.50
EDUC	0.06	0.08	.44
CONSTANT	7.11	6.93	.31

$\bar{R}^2 = .31$ n=241

Source: Mangwende Surveys

The significance of the fertilizer variables suggests the importance of the expansion of input markets, input sales and credit access during the post-independence period. This confirms the link between the increase in input sales and the growth of smallholder maize production and sales identified in the aggregate analysis.

Several reasons can be offered for the lack of significance of the remaining independent variables. Manure application rates are low relative to the levels R&SS trials indicate yield a significant response.[28] Seed rates are, for the most part, fairly uniform. Farmers, themselves, have not identified the value of insecticide application. As a result, this input is not purchased, except as required in credit packages. The impact of planting date on yields depends on the timing of rains, both at the beginning of the season and during the pollination period. During the 1985/86 season in Mangwende, rains fell consistently through most of the season. The number of extension visits and number of years of schooling may not provide good proxies for the quality of extension advice or training. Most extension advice, particularly for crops other than maize, was ignored. Schooling may not have taught the skills necessary for

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[28] The Mangwende manure application rates average roughly tow and one-half tons per hectare. R&SS field experiments suggest 15 tons per hectare may be required to obtain a yield response, depending on manure quality (Dendere, 1986). Greenhouse experiments show yield responses to manure at much lower rates of application, though these also reveal wide variability in manure quality (Tanner and Mugwira, 1984; Mugwira, 1984; and Mugwira and Mukurumbira, 1984). The nutrients available in farm level manure applications were likely similarly variable.

improving cropping practices.

A second regression was estimated for a subsample of maize plots with soil sample results. The soil analysis measured soil texture, pH and phosphorus. However, these analyses were remarkably consistent across the sample. All plots had sand or loamy sand soils. The pH levels were low, ranging from 4.2 to 5.4. Phosphorus levels were also low, ranging from 1 to 30 ppm Resin P2O5. As a result, these did not affect the earlier regression results.

The explanatory contribution of several additional plot management variables was also tested. These included a dummy variable indicating whether the plot was winter ploughed, and variables identifying the number of weedings, the timing of the first weeding and the timing of basal fertilizer application. None of these variables had statistically significant coefficients (at even the thirty percent level) or affected the coefficients on the remaining variables.

The limited explanatory power of the crop management variables was surprising as several of these were found to significantly influence Mangwende yields in another survey sample (Shumba, 1987). On the basis of 1982 household survey results, planting date, time of basal application and the number of days between planting and first weeding were each identified as important determinants of maize yields. However, several factors could explain these differences. First, Shumba appears to have employed average farm yield data rather than plot-specific yield information in his production functions. Shumba's questionnaire requests plot data for management practices but not for yields. Second, the survey results may have been biased by the collection of all data during a single visit near the end of the cropping season. Efforts to help farmers remember planting dates, fertilizer application and weeding dates and fertilizer application levels may have been influenced by expected or perceived harvest levels. In the surveys conducted for this investigation, some farmers had difficulty remembering planting, fertilizer application and weeding dates within a month of the operation.

5.7.2.2 Chibi Yield Regression Results

The yield regression in Chibi had little explanatory power. This is not surprising, because rainfall during this season was poor. During the planting period rains were inconsistent, starting early, stopping for an extended period and then starting again late in the ploughing season. Further, Chibi experienced a long mid-season dry spell. This substantially reduced harvests. Many farmers experienced very low yields simply because their crops received no water during the critical maize flowering period. This experience substantiates the value of the commonly practiced strategy of staggered plantings.

Only seed rates appear significantly related to yield levels (Table 5.17). The signs on the coefficients for manure application rates, basal fertilizer application, family labor availability and extension support are are not statistically significant. The poor quality of the season probably offset the impact of fertilizer application. In experimental trials located roughly 60 kilometers north of the survey location, a strong positive response to fertilizer application was obtained (Olver, 1986). However, 1983/84 season on-farm trials in Chibi showed no significant response to fertilizer (R&SS, 1985). This was a similarly poor rainfall season compared to 1985/86.

Soil sample results are available for 23 plots in this sample. Again, these do not significantly affect the dependent variable. Similarly to the soil sample results in Mangwende, most plots had a sandy texture, low pH (4.1-5.7) and low phosphorus content (1-27 ppm).

The significance of additional management variables for winter ploughing, number of weedings and the timing of the first weeding were also tested. These did not improve the explanatory power of the equation.

Table 5.17
Chibi Maize Plot Yield Regression Results, 1985/86
Zimbabwe

Variable	Coefficient	SE	Significance
MANURE	-3.91	23.10	.87
SEED	1.11	0.25	.00
BASAL	-0.04	0.15	.80
TPDR	0.20	0.14	.15
INSECT	1.23	1.30	.35
LABOR	-0.01	0.21	.96
SORC	11.96	13.49	.38
DP	-1.00	1.01	.32
EXT	-0.01	0.22	.96
EDUC	0.05	.12	.64
CONSTANT	7.96	6.08	.19

$\bar{R}^2$ = .22 n=127

Source: Chibi Surveys

The continuing use of fertilizer by the few adopting farmers in Chibi suggests that, at least in relatively favorable rainfall years, a positive response must be perceived. However, these farmers must be able to withstand the investment risks of a poor season in order to derive a average gain over time. Given that fertilizer has only recently been adopted by Chibi farmers, the evaluation of these risks may still be underway.

5.8 Summary

The household level survey data for Mangwende and Chibi indicates maize production in both regions strongly increased during the post-war period (1979-1985). According to farmer estimates, maize area increased by almost 90 percent in Mangwende and almost 150 percent in Chibi between 1975 and 1986. Most of this gain occurred after independence. In Mangwende, roughly one-half of the maize area gain can be associated with an increase in the number of farmers and half can be attributed to an increase in plantings per established farmer. In Chibi, most of the maize area gain resulted from a post-war increase in producer numbers.

The magnitude of the increase in the number of farmers in each area was unexpected. The implementation of a massive nationwide refugee resettlement program after the war supports these estimates. In addition, survey results indicate that many young farmers established holdings during this period, and some households moved to new areas where they could expand their holdings. This led to increases in the cultivation of most crops, though maize registered the largest gains.

The larger increase in area planted by established households in Mangwende can be attributed to the fact that this is a higher rainfall zone and a region experiencing greater expansion of market institutions. Mangwende benefited substantially more than Chibi from the establishment of a smallholder credit program, the expansion of product markets, improvements in transport facilities and greater input accessability. Further, improved maize technologies, fertilizer in particular, were readily available for these farmers. As a result, the net returns to maize production increased.[29]

The cross-section regression analysis of the determinants of household maize area does not adequately account for these historical changes. The analysis does, however, provide information helping to explain the current distribution of maize area. In Mangwende, the allocation of land to maize appears closely related to the availability of cash or credit to invest in inputs. Most farmers identified the high cost of inputs or lack of adequate money to purchase inputs as the major determinant of their maize planting plans. They identified these as one of their most significant farming problems. Farmers with the largest maize area purchased and applied the largest amounts of inputs for maize on a per hectare basis. Input costs did not simply increase in proportion with the increase in maize area, but increased more rapidly. Larger farmers applied higher rates of fertilizer. As a result, these producers obtained substantially higher production levels than the average smallholder.

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[29] The budget data showing the gain in maize returns is reviewed in Chapter 6.

The regression results do not indicate a strong relationship between maize yields and returns and acreage allocations. Though the larger maize producers tended to achieve higher yields, this implies that planting decisions and rates of input application were more closely dependent on the availability of cash or credit for input purchases. If capital was available, more inputs were purchased and more maize land was planted. The Mangwende regressions also indicate a positive relationship between the size of a household's landholding and the availability of draft resources with maize area. Given the apparent ability of farmers to obtain more land over the post-war period, the relationship between holding size and maize area reflects the decision of some established producers to increase their holdings in order to plant more maize. Only three percent of these producers identified land availability as a constraint. The significance of the draft ownership variable is partly offset by the widespread practices of draft hiring, lending and borrowing.

In Chibi, maize area appears more closely related to land holding size. In this region, 30 percent of Chibi farmers identified the lack of sufficient land as a constraint, indicating opportunities for area expansion were more limited in this region. Farmers with more land tended to be older.

Less evidence is available, in Mangwende and Chibi, for the growth in maize yields. AGRITEX estimates indicate yields did not increase in Mangwende after 1980. In Chibi, are estimated to have increased in 1985. Yet most farmers in both regions claimed no major changes in their maize yield levels during the post-independence period.

The strength of the regression analyses of yield determinants was limited. In Mangwende, variability in 1985/86 maize yields across plots were most strongly related to fertilizer application rates. This reflects the low fertility of most Mangwende soils. Yet many plots with similar purchased input levels had sharply differing yields. The justification for this variability could not be determined. Input response could be strongly affected by differences in management practices. Yet the explanatory power of practices included in the regressions was weak. This could be the result of poor measurement of the management variables or the failure to measure those which were most important. Further investigation of these management practices is required.

In Chibi, the explanatory power of the yield regressions was offset by inconsistent planting rains and a long mid-season dry spell. These problems have similarly limited the usefulness of local on-farm agronomic trials in the region. While maize yields were statistically related to rates of seed and top dressing fertilizer application, these explained only 20 percent of the region's yield differences.

In both Chibi and Mangwende, the quantity and timing of rainfall is one of the most significant determinants of maize yields. If plot-specific measures of rainfall had been available, a substantially larger proportion of yield variability would likely have been explainable. Nevertheless, enterprise recommendations must be developed which account for regional rather than plot specific rainfall patterns. These must account for the risks of a poor season. Such risks are particularly significant in Chibi.

CHAPTER 6

HOUSEHOLD PRODUCTION DECISIONS: ENTERPRISE CHOICE AND INPUT EXPENDITURE

The growth in maize area after the war was associated with both an increase in the number of farmers and an increase in the area planted per established producer. The expansion in the number of farmers occurred throughout the country and resulted in a sharp increase in total area planted in the smallholder sector. Yet the largest gains were registered in maize cultivation. The growth in maize area among established producers was concentrated in regions of higher rainfall with expanding access to Grain Marketing Board outlets, credit and input markets. Higher maize yields corresponded with the adoption of improved technologies including hybrid seed and fertilizer. This chapter further examines how area allocation and yields were affected by the availability of improved technologies and shifting profitability of enterprise investments. First, the pattern of adoption of improved maize technologies is reviewed. The contribution of new technologies to maize yields is estimated. Next, the analysis explores the relative returns to the maize enterprise in order to identify why this is the favored cash crop in both Mangwende and Chibi. Finally, current input expenditure and enterprise investment patterns are examined in order to explain the wide variability in rates of input usage and skewed distribution of household maize production levels.

6.1 Technology Adoption Patterns

6.1.1 Hybrid Seed Adoption

The first locally adapted maize hybrids were released in Zimbabwe in 1960. Prior to this most farmers planted improved open-pollinated varieties initially developed in South Africa. The early hybrids (SR52 and SR14) were long season cultivars particularly suited to the higher potential zones. Priority placed on the development of shorter season hybrids led to the release of additional hybrids including R200, R201 and R215 during the early and mid-1970s.[1] SR52 and R201 were still the most commonly planted hybrids during the mid-1980s. The adoption of hybrids was estimated to increase yields up to 46 percent (Tattersfield, 1982). Hybrid maize yields have been found to be higher than the yields of the old open-pollinated varieties without fertilizer and under conditions of drought. The yield advantage of R200 without fertilizer is estimated to be 30 percent with good rainfall, and even greater under drought conditions (Olver, 1986).

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[1] SR52 and SR14 are 160-165 day hybrids at higher altitudes (Natural Region II) and require roughly 140 days to maturity in the lowveld (Natural Regions IV and V). R200, R201 and R215 require about 140 days for maturity in higher regions and 120 days in the lower semi-arid parts of the country.

The Seed Cooperative estimates hybrid seed adoption in the smallholder sector increased rapidly after independence (Table 4.9). The proportion of communal maize area planted to hybrids increased, according to industry data, from between 20 and 30 percent before 1980 to over 80 percent in 1985. These are rough estimates based on subtracting an estimate of commercial purchases (assuming 100 percent of commercial land is planted to hybrids) from total sales. Yet they indicate a major potential source of increasing smallholder yields.

These aggregate data do not correspond with the adoption patterns identified by farmers in the two survey areas.[2] Most farmers (70 percent) in Mangwende adopted hybrid maize seed before 1980 (Figure 6.1). Adoption rates increased from about 35 percent in 1974 to almost 90 percent by 1982. All farmers in Chibi claim to have adopted maize hybrids by 1970 (Figure 6.2). The earlier adoption of hybrids in this drought prone region may have resulted from both the greater yield advantage of hybrids over the open-pollinated varieties in years of poor rainfall, and because farmers were forced by drought to purchase seed more frequently. In both Mangwende and Chibi, farmers claimed these adoption decisions were primarily based on the evidence of higher yields obtained by

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[2] The justification for the difference between apparent aggregate adoption trends and adoption patterns in Mangwende and Chibi is not known.

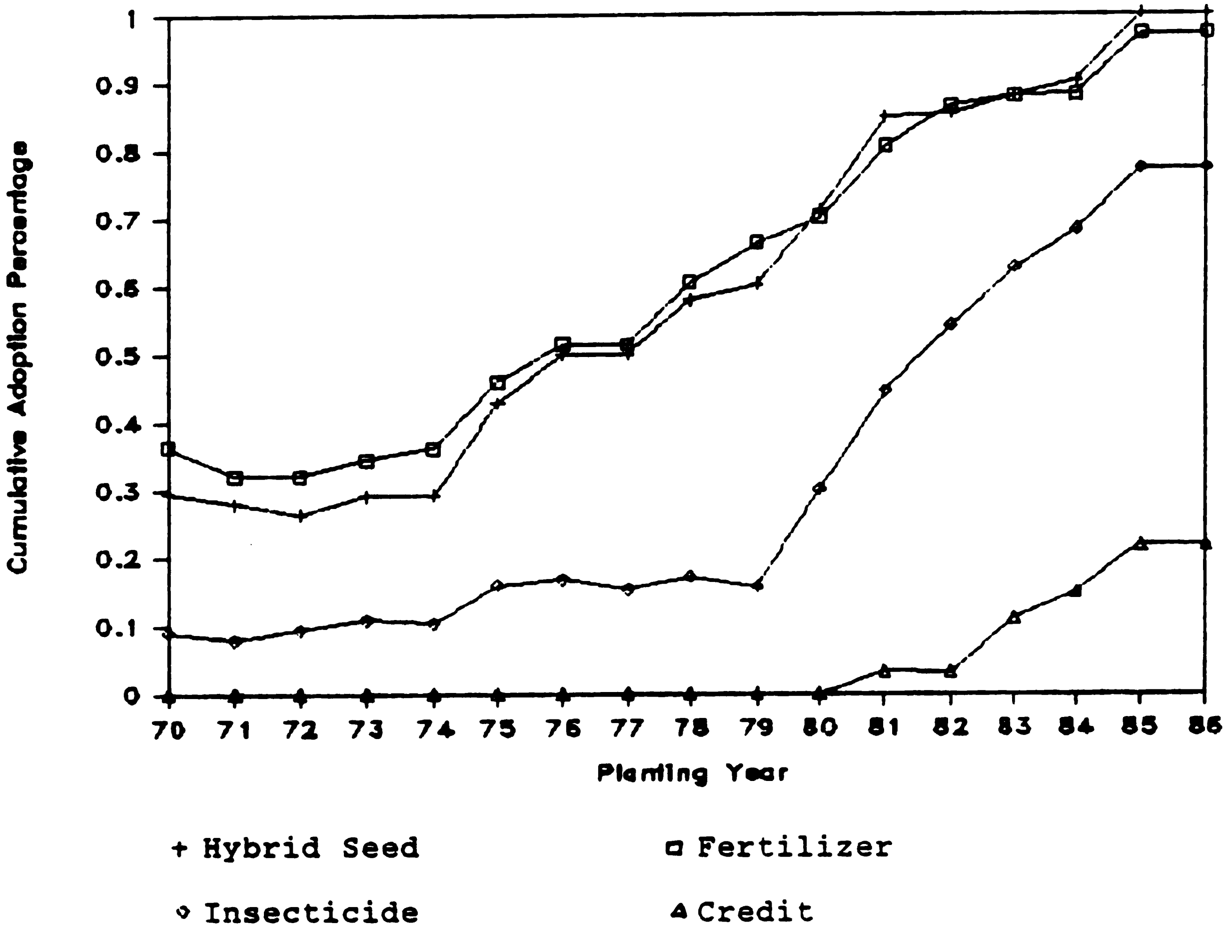

Figure 6.1 **Mangwende Technology Adoption Trends, 1970-86; Zimbabwe**

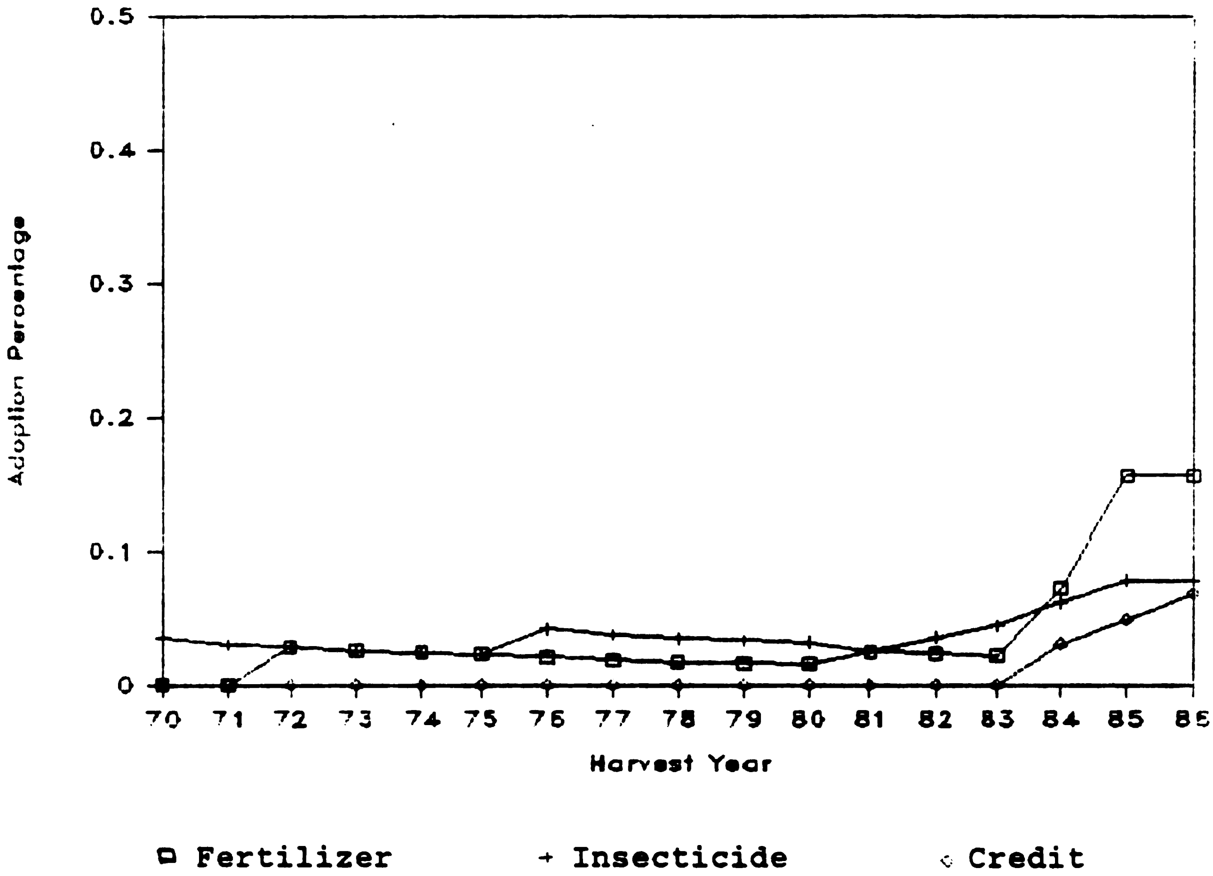

Figure 6.2 Chibi Technology Adoption Trends, 1970-86; Zimbabwe

neighbors. In Chibi, farmers particularly noted the fact that unfertilized hybrids provided higher yields than the old open pollinated varieties even in years of poor rainfall. Once tried, hybrid seed was consistently employed. No plots were identified without hybrid seed. Only rarely were plots planted with seed recycled from the previous year's harvest. These results indicate that most of the yield gain associated with the use of hybrids alone, in these regions, occurred before independence.

6.1.2 Fertilizer Adoption

The use of fertilizer at currently recommended rates in high rainfall regions such as Mangwende is estimated to increase maize yields up to 200 percent (Tattersfield, 1982).[3] The response to fertilizer application in semi-arid regions such as Chibi depends on the timing and quantity of rainfall. FSRU trials have shown highly variable and inconsistent responses (Dendere, 1987).

Estimates of fertilizer deliveries to the communal sector similarly identify a tripling of fertilizer usage in 1980 (Table 4.9). Approximately 60 percent of this increase

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[3] The recommended rate of fertilizer application in Mangwende for the 1986/87 season called for 156 kg/ha N, 52 kg/ha P2O5 and 26 kg/ha K2O. The 200 percent yield advantage was likely estimated on the basis commercial farm trials where soils are of higher quality.

in sales can be attributed to government purchases under a post-war refugee resettlement program. Thereafter, most fertilizer sales are attributed by Bushnell (1984) to purchases under the newly established smallholder credit program. The fertilizer companies also began promoting fertilizer sales in the communal areas after independence with on-farm demonstration trials, direct farm sales and the development of local retail outlets.

In Mangwende, the adoption of fertilizer coincided closely with the use of hybrid seed. Farmers widely recognized the complementarity of these inputs, some suggesting that maize is not worth planting without fertilizer. No data is available on early rates of application. Yet if current practices are indicative of past usage, these were highly variable.[4] Most likely, rates of application increased as fertilizer became locally available and farmers gained access to credit. Farmers who do not receive credit purchase substantially less fertilizer than those with loans.[5]

In Chibi, only 17 percent of farmers have tested fertilizer on maize. Adopters tend to be the largest farmers

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[4] These range from 0 to over 300 kg N per hectare.

[5] See section 6.2.1 below for a further discussion of this issue.

and those receiving credit. Rates of application remain very low, averaging 28 kilograms of nitrogen per hectare among users.

6.1.3 Insecticide and Herbicide Adoption

Tattersfield (1982) estimates that the use of insecticide for stalk borer control can increase yields by five to ten percent. However, the adoption of insecticide lagged substantially behind fertilizer use.[6] In Mangwende, less than 15 percent of the farmers tried insecticide before AFC credit became available in 1980. Thereafter, insecticide use closely corresponds with access to credit. In Chibi, only eight perecnt of farmers have tried insecticide. Most recent adoption has similarly been linked with participation in credit programs.

Most commercial maize is now treated with herbicide. Only a small proportion of smallholders have tested this input. No Mangwende farmers tried herbicide before 1981. Thereafter, adoption is directly linked with involvement in agrochemical company demonstration programs. No farmers in Chibi have tried herbicide.

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[6] This, and all future references to insecticide, applies to insecticide for field crops. A larger proportion of farmers, particularly in Mangwende, consistently apply insecticide to stored maize.

6.1.4 Input Adoption Versus Continued Usage

Once hybrid seed was initially tested, most farmers consistently used this input (Table 6.1). Initial adoption of fertilizer in Mangwende was similarly followed by fairly consistent use. This sequence did not hold for fertilizer use in Chibi, nor for the use of insecticide and herbicide in both regions. Fewer than half of the Chibi farmers who have tried fertilizer were still using this input in 1986/87. In both regions, the only farmers continuing to use insecticide are those participating in smallholder credit programs. The maize loans available from the AFC require insecticide purchase. However, despite the low cost, farmers do not perceive a positive insecticide response.[7] This may be because rates of insect infestation are low. Also, application procedures may require improvement. Herbicide usage ended, in Mangwende, when externally administered demonstration trials stopped. This input is perceived as costly, and problems may have been encountered in its management.

6.1.5 Acceptance of Extension Recommendations

The only recommended practice Mangwende farmers consistently applied was for maize seed rates (25 kg/ha). During 1985/86 season, extension workers were recommending

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[7] This judgement is supported by the results of the yield response analysis above.

Table 6.1
Adoption Versus Continued Usage of Maize Production Inputs
Mangwende and Chibi, Zimbabwe

Proportion of Households:	Mangwende (percent)	Chibi (percent)
Hybrid Seed		
Adopting by 1986/87	100	100
Using in 1986/87	100	100
Fertilizer		
Adopting by 1986/87	96	17
Using in 1986/87	80	7
Insecticide		
Adopting by 1986/87	78	8
Using in 1986/87	38	5
Herbicide		
Adopting by 1986/87	22	0
Using in 1986/87	0	0
Credit		
Receiving by 1986/87	67	5
Receiving in 1986/87	37	5

Sources: Mangwende and Chibi Surveys

application rates of 371 kg/ha of Compound D (8-14-7) and 247 kg/ha of AN (34.5-0-0) to Mangwende farmers.[8] Farmers are advised to apply the basal application at planting, and the top dressing in two stages, when the crop is at knee height and at flowering. Two-thirds of the maize plots received some basal fertilizer, though only 20 percent received at least recommended dosages. Basal was rarely applied at planting and frequently applied more than three weeks later.[9] Almost 85 percent of maize plots received top dressing, though multiple applications were unusual. Thirty-five percent of the plots received at least recommended levels of top dressing. Three-quarters of Mangwende farmers used less than one-half the recommended rates of fertilizer.

Mangwende extension workers also recommended planting maize before the end of November. Yet almost half the plots were planted in December or early January. Less than 20 percent of maize plots received recommended levels of insecticide. While basal applications were suggested at planting, almost all plots received this late, most, more than two weeks after planting.

Recommended input levels for crops other than maize were

[8] Actual recommendations were for 150 kg/acre of Compound D and 100 kg/acre of AN.

[9] Late applications were justified by farmers as a means to offset the risks of losses if planting rains fail.

essentially ignored. Fertilizer was recommended for all major crops. The majority of finger millet plots received minor amounts of fertilizer (in almost all cases less than 15 kg of N/ha), however, this input was rarely applied to other crops. Seed rates for crops other than maize were highly variable and none of these plots received recommended herbicides or insecticides.

In Chibi, farmers similarly only accepted recommended maize seed rates. Though fertilizer was consistently recommended at roughly half the rate suggested to Mangwende farmers, application rates were universally less than 50 percent of this. No farmer applied basal fertilizer at planting. Insecticide was applied to less than five percent of maize plots. While farmers were advised to plant maize in October, 90 percent of the plots were established after this. Over 50 percent of plots were planted after mid December. The recommended practices for other major crops were essentially irrelevant to the needs of local farmers.

These results indicate the need for a major realignment of extension and research strategies in each region. While farmers are willing to adopt improved technologies providing high returns at low costs, such as hybrid seed, they are more reluctant to follow recommendations demanding large capital outlays, those which increase the risks of significant losses or those without readily apparent returns. Adoption patterns show a willingness to test new technologies. When discussing their cropping practices, farmers in both Mangwende and Chibi commonly referred to their own experimentation. Yet initial adoption does not necessarily lead to consistent usage. Similarly, farmers frequently adapt extension advice to their own circumstances. A major factor under consideration in this adaptation process is the availability of capital for input investment.

6.2 Investment in the Maize Enterprise

Farmers in both Mangwende and Chibi identified input costs and affordability as major constraints and determinants of their cropping practices. The close link between insecticide usage and fertilizer deliveries with the receipt of credit supports this observation. Yet most farmers in Mangwende earn substantial farm and non-farm cash income relative to the size of their variable input costs. In Chibi, though incomes are generally limited, input expenditures are also low. In this context, the character of the capital constraint requires further consideration.

6.2.1 Credit Access and Use

Since the Agricultural Finance Corporation initiated its smallholder credit program in 1979, the institution has strongly promoted the rapid expansion of loans to communal farmers (See Table 4.8). As noted above, two-thirds of Mangwende farmers have received loans from the AFC since credit first became available in 1980.

Mangwende and Chibi farmers receiving credit in 1986/87 were generally larger producers with greater production and cash resources (Table 6.2). They own more land and draft animals than non-recipients and have more family labor. Unexpectedly, the male heads of household of most Mangwende families receiving loans in 1986 (57 percent) work elsewhere. More than two-thirds of the households consistently receiving credit over the 1984 to 1986 period had heads working off-farm. Credit recipients in both Mangwende and Chibi earn substantially more than non-recipients from both crop sales and other farm and non-farm sources. These help offset the risks of holding credit liabilities in a poor season by providing cash for household expenses when repayment obligations were unusually high.

The importance of credit is evidenced in the fact that fertilizer purchases and corresponding rates of application are closely linked to the receipt of loans (Table 6.3). In Mangwende, almost three-quarters of all fertilizer purchased in 1986/87 was bought with credit. While most farmers without credit purchased fertilizer, the quantities bought with other

Table 6.2
Distinguishing Characteristics of Credit Recipients in Mangwende and Chibi, Zimbabwe

	Mangwende		Chibi	
	Recipients	Others	Recipients	Others
Ave. Land Holding (Ha)	3.2	2.6	5.1	2.2
Ave. Draft Ownership (No)	5.2	3.4	5.4	2.1
Ave. Maize Area 1986 (Ha)	2.1	1.2	2.7	1.2
Ave. Maize Yield 1986 (Mt/Ha)	2.4	1.4	1.4	0.4
Proportion of Male Household Heads Working Off Farm (%)	57	37	0	35
Ave. Number Family Workers	6.0	4.8	7.4	4.9
Own Resources Invested in Crop Production Inputs ($Z)	92	135	32	42
Ave. Crop Sales Income 1985 Harvest ($Z)	1320	397	805	92
Ave. Cash Income From Other Sources in 1985-6 ($Z)	972	728	796	278

Source: Mangwende and Chibi Surveys

sources of funds were low. In Chibi, almost 90 percent of all fertilizer was purchased with credit. Only two percent of the farmers not receiving credit purchased this input.

Table 6.3
Contribution of Credit to Fertilizer Investment in 1986/87, Mangwende and Chibi, Zimbabwe

	Mangwende	Chibi
Credit Recipients: a/		
Ave. Fertilizer Purchased (KG)	1080	640
Bought With Credit (%)	94	100
Non-credit Recipients:		
Ave. Fertilizer Purchased (KG)	228	18
Proportion of Total Purchased With Credit (%)	72	88

a/ Includes Compound D (8-14-7) for basal dressing and Ammonium Nitrate (34.5-0-0) for top dressing.

Source: Mangwende and Chibi Surveys

Despite the heavy reliance on loan funds for fertilizer purchases, the number of credit recipients in Mangwende has been declining. Forty percent of Mangwende farmers who have received loans in the past no longer participate in the credit program. Only 21 percent of Mangwende farmers consistently received loans between 1984 and 1986.

Complete information is available for survey household input purchases during the 1985/86 and 1986/87 seasons. In this period, the number of credit recipients in Mangwende declined from 42 to 37 percent of the farm population.

Nevertheless, the proportion of fertilizer brought with credit increased. Non-credit recipients marginally reduced their average fertilizer purchases. More significantly, those farmers still receiving credit reduced the amount of fertilizer they were purchasing with cash. Whereas in 1985/86 credit recipients bought 21 percent of their fertilizer with cash, a year later this declined to less than six percent. In Chibi, loan recipients obtained 100 percent of their fertilizer with credit. This provides further evidence of a cash constraint. In addition, these purchase patterns indicate that Mangwende and Chibi farmers view the opportunity cost of credit was lower than the value attached to their own cash resources.

Several justifications can be advanced for the instability and decline credit program participation in Mangwende. First, when loans were first provided to these farmers in 1980, repayment obligations were not fully explained. Confusion regarding loan liabilities was increased by the coincident delivery of free inputs under the post-war refugee resettlement program. Politicians travelled the countryside promising the rapid expansion of support for smallholder production from the newly elected government. Some credit recipients assumed the inputs obtained from the AFC were simply early benefits of independence. These farmers were surprised when the loan obligations were deducted from their receipts for crop sales.

The incidence of drought during the 1982/83 season compounded these difficulties. Some farmers believed their loan obligations would be forgiven. They had been told they had paid an insurance fee covering this circumstance. However, in fact, the insurance payment only covered the debt obligation in the event of the death of the farmer. When unexpectedly large repayments were deducted from the returns for 1984 crop sales, some farmers simply refused to participate further.

In addition, Mangwende farmers could not obtain local assistance in resolving questions about their credit liabilities. Farmers were told that if they had problems, these could only be resolved at the head office in Harare. Farmers complained this trip was both expensive and time consuming. Some may have feared interaction with the head office bureaucracy.

6.2.2 Investment of Cash Resources in Maize Production

Farmers were asked where they obtained money (other than credit) to purchase agricultural inputs. The principal source in both Mangwende and Chibi was cash from crop sales to the

GMB and to other farmers. Secondarily, farmers reported funding input purchases from cash derived from remittances gained from husbands or sons working elsewhere and family earnings derived from local petty trade and labor (beer brewing, brick making, grass cutting, poultry sales, building, carrying goods, etc.).

Income levels of most Mangwende are substantial relative to the level of investment in crop production inputs. The average investment of household cash resources in variable crop production inputs equals less than 15 percent the median level of family income. The investment equals only about 20 percent of the average value of maize sales. Most cash income is being invested elsewhere - to pay school fees and purchase groceries or other consumer items. Annual school fees alone average about $Z200 for Mangwende households, though these can rise up to $Z2000 per year depending on the number of children, level of schooling and the schools chosen. The reluctance to invest cash resources in inputs is particularly evident in the investment practices of credit recipients. While the incomes of these producers are almost double those of non-recipients, credit recipients invest less of their own cash in crop production (Table 6.2).

Among Chibi farmers, the cash constraint is more severe. Thirty percent of these households earn less than $Z100 in income. Sixty percent earn less than $Z300. Here also, school fees average roughly $Z100 per household. In addition, cash income must frequently be used to purchase food, particularly in periods of drought. Yet, again, credit recipients with high average cash incomes invest less of their own cash resources in production inputs than non-recipients. The 35 percent of Chibi producers who do not receive credit, but earn incomes over $Z300, invest only 10-15 percent of these resources in variable crop inputs.

The majority of farmers in Chibi clearly do face severe cash constraints. Yet the cash shortages of most Mangwende farmers and many Chibi households seem to result from the existence of alternative investment priorities. While some farmers experience a cash flow constraint at the beginning of the cropping season, many appear simply to have made a conscious decision to invest their resources elsewhere. Farmers in both Mangwende and Chibi are investing heavily in school fees, often paying higher sums for better quality secondary schooling. A small, but increasing number are investing in lorries, retail shops and sewing machines. Many seek improved housing, clothing, stereo systems, manufactured cooking oil, bread and beer. Accordingly, the capital shortage partly reflects the growth of alternative investment opportunities and evolving consumer demand. The value of these investments is perceived as greater than that associated with the expansion of maize production for the market.

6.3 Historical Returns to Maize Production

At several points in this dissertation, the increasing returns to smallholder maize production have been identified as a major source of the post-1979 growth of smallholder investment in this enterprise. In the analysis of aggregate sales growth, higher returns were attributed to higher maize prices, a higher ratio of the maize to fertilizer price, and the expansion of market infrastructure. The growth of maize area in Mangwende and Chibi, was partly attributed to increasing maize returns which particularly stimulated an expansion of maize area among established (as opposed to new) farmers. The largest gains in area were made by those producers most heavily involved in formal maize markets. Both area and yield growth in the two survey areas were related to the establishment of credit programs, the improved availability of inputs and the profitability of input investments. Signs of a leveling-off and possible decline in investment in Mangwende in 1986 may correspondingly be the result of declining returns. These observations can be tested by constructing a series of maize enterprise budgets covering the pre- and post-independence period.

6.3.1 Mangwende Budget Analysis

Three sets of maize budgets were constructed on the basis of 1985/86 survey data for high input, medium input and low input maize producers. The first set accounts for price levels during the 1974/75 cropping season, the second set covers the 1980/81 cropping season and the third covers the 1985/86 season. The high, medium and low input levels roughly correspond with the distribution of fertilizer application rates in the plot level data. In addition, a similar series of budgets for groundnuts were estimated for comparative purposes. Seed, fertilizer, insecticide and product prices reflect the actual prices farmers faced, or where these were not available, administered price levels.[10] Other prices (e.g. for labor, transport, and grain bags) were set at 1985/86 levels due to lack of information necessary to estimate their change over time. However, all prices were deflated by the GDP deflator. Input and yield levels were also set according to 1985/86 estimates. The impact of the change in input application rates can be inferred by comparing the three maize budgets. Groundnut technologies did not change during this period.

The historical change in gross returns, variable costs

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[10] The base data from which these budgets were derived can be found in Appendix B.

and net returns to maize and groundnut production are outlined in Table 6.4. Net returns are estimated in terms of gross margins, gross margins per Z$100 variable costs, total labor days and labor days excluding post-harvest labor. All measures of production returns indicate the profitability of maize production increased substantially between 1974/75 and 1980/81. Gross margins and labor returns at least tripled. The sharpest increase occurred in high input maize, a set of production practices which roughly match recommended technologies. While the returns per Z$ 100 of variable costs were highest for low input maize, the gross margins and labor returns were greater for medium and high input maize. This implies that farmers facing a severe capital constraint are best off using little or no fertilizer. If capital is available, however, fertilizer investments were highly profitable. Farmers were best off applying fertilizer at rates near recommended levels. By 1985/86, however, higher fertilizer prices and declining real maize prices brought a decline in maize profitability. Farmers applying lower rates of fertilizer achieved returns roughly equal to those applying recommended levels.

The sharp increase in post-independence returns to maize production is clearly evident in these budgets. During the mid-1970s, groundnut production yielded higher returns than maize. Yet by most measures the advantage shifted in favor of

Table 6.4
Maize and Groundnut Enterprise Returns for Mangwende
1974/75 to 1985/86, Zimbabwe

	GROSS OUTPUT VALUE	TOTAL VARIABLE COSTS	GROSS MARGIN		RETURN PER LABOR DAY	
			TOTAL	PER $100 VARIABLE COSTS	EXCLUDING POST-HARVEST	TOTAL
MAIZE						
Low Input:						
1974/75	74	38	36	95	.38	.33
1980/81	124	31	93	305	.98	.84
1985/86	95	29	66	224	.69	.59
Medium Input:						
1974/75	328	236	92	39	.68	.44
1980/81	545	252	292	116	2.17	1.40
1985/86	417	231	186	81	1.38	.89
High Input:						
1974/75	459	362	97	27	.63	.38
1980/81	763	393	370	94	2.39	1.43
1985/86	585	364	221	61	1.42	.85
GROUNDNUTS						
1974/75	354	184	170	92	1.20	1.14
1980/81	346	142	204	144	1.45	1.37
1985/86	248	112	137	122	.97	.92

Source: Mangwende Surveys

maize by 1980/81. In addition, these budget results do not fully account for the impact of market expansion and the establishment of a smallholder credit program. While historical transport cost data is not available, the increase in the number of market outlets and expansion of transport facilities likely reduced real transport costs. While these benefited all enterprises, the growth of input and product markets particularly benefitted the maize enterprise. Credit became available on subsidized terms.[11] This further increased the returns to input investment funded with loans.

The limited cash investment in the maize enterprise, relative to the resources available to many producers, appears justified by the low returns to labor. The labor returns available to medium and high input producers declined by 40 percent between 1980/81 and 1985/86. The lowest minimum wage obtainable in the formal sector in 1985/86 was Z$4.00 per day, more than four times higher than the return provided by maize production. Maize returns further declined during the 1986/87 season as a result of the continuing fall in real producer prices. Mangwende farmers may simply have been responding to this when they marginally reduced their input investments.

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[11]Loan interest rates were 13 percent compared to a 16 percent inflation rate in 1985/86.

6.3.2 Chibi Budget Analysis

A similar set of budgets were constructed for the maize and groundnut enterprises in Chibi. In this case, only two maize budgets accounted for the practices of the few farmers applying fertilizer and those using no fertilizer. One groundnut budget reflected the standard cropping practices for this enterprise. In 1985/86, Chibi encountered inconsistent planting rains and a mid-season drought. As a result, the yields employed in these budgets, particularly for maize, are lower than those achieved during the 1984/85 season. Since Chibi has experienced drought or mid-season dry spells during five of the first seven years since independence, however, these yields more closely reflect average levels.

Maize consistently provided higher returns than groundnuts over the eleven year period (Table 6.5). The advantage was particularly strong just after independence in 1980/81. During the 1980s, the total gross margin and returns to labor (excluding post harvest work) of medium input maize were higher than those to the low input enterprise. In 1985/86 the returns to total labor were essentially the same. The gross margin per $Z100 variable costs was consistently higher, however, for low input maize. This suggests that farmers facing a severe capital constrains, as most do, may be better off without fertilizer.

Table 6.5
Maize and Groundnut Enterprise Returns for Chibi
1974/75 to 1985/86, Zimbabwe

	GROSS OUTPUT VALUE	TOTAL VARIABLE COSTS	GROSS MARGIN		RETURN PER LABOR DAY	
			TOTAL	PER $100 VARIABLE COSTS	EXCLUDING POST-HARVEST	TOTAL
MAIZE						
Low Input:						
1974/75	65	63	3	4	.03	.02
1980/81	109	47	62	131	.72	.60
1985/86	83	35	48	139	.57	.48
Medium Input:						
1974/75	164	191	-28	-15	-.24	-.18
1980/81	272	149	122	82	1.04	.77
1985/86	208	126	83	66	.70	.52
GROUNDNUTS						
1974/75	206	213	-8	-4	-.06	-.05
1980/81	201	169	31	19	.24	.20
1985/86	180	126	54	43	.40	.33

Source: Chibi Surveys

The returns to labor for all enterprises in each of the three years considered are quite low compared to formal sector minimum wages, and low also by Mangwende standards. In high rainfall years, such as 1984/85, groundnut yields increase by 50 percent and maize yields roughly triple. Taking rough account of the greater labor requirements associated with weeding, harvesting and post-harvest operations, labor returns may double. The returns to medium input maize will increase relatively more as a result of the greater fertilizer response. Yet these still fall far short of formal sector minimum levels.

6.4 Summary

Aggregate data on hybrid seed and maize fertilizer sales indicate smallholders sharply increased their purchases of these improved inputs in 1980. Though estimates of average maize yields did not significantly increase until 1985, the effect of the new technology may have been initially hidden by the 1982-4 drought. Unexpectedly, most farmers in Mangwende had adopted hybrid seed and fertilizer before independence. In Chibi, hybrid seed was universally adopted, though fertilizer had been tested by only a small minority of producers. The evidence of post-1980 yield gains in each region is ambiguous. Both extension workers and farmers claim maize yields have not been increasing in Mangwende. Extension workers estimated sharp yield gains in Chibi in 1985, though most farmers suggested their yields had not changed.

Roughly one-half the farmers in each region identified the cost and affordability of inputs as a major constraint. This is reflected in the variability in rates of application, particularly of fertilizer in Mangwende, and in the common suggestion that the size of maize plantings depends on the quantity of inputs which can be purchased. The severity of the implied capital constraint is also reflected in the close correspondence between fertilizer purchases and the receipt of credit. In 1986, over 70 percent of the fertilizer bought in Mangwende was purchased with loan funds received by 37 perecnt of the farmers. The proportion of credit funded purchases is increasing while a declining number of farmers are obtaining loans. Almost 90 percent of fertilizer bought in Chibi was purchased with loans received by only five percent of producers. The fertilizer companies claim that most fertilizer bought by smallholders since 1981 has been paid for with credit.

A major justification for the post-independence growth in maize area, yields and input purchases is readily apparent in the sharp increase in maize returns between 1974/75 and 1980/81. The budget analysis was not able to account fully for the impact of institutional changes such as product market and input market expansion on enterprise profitability. Even despite this, however, the increase in maize returns was significant. Assuming the expansion of market institutions lowered input and marketing costs, the actual gain in maize profitability was even greater than that identified in the budgets.

The budget analysis indicates that since 1981, net returns to the maize enterprise have been declining. This loss in profitability has led commercial farmers to shift land out of maize. Yet continuing expansion of institutional support appears to have offset the effect of the decline in real maize prices and rising input costs in the smallholder farming areas. Both communal sector maize area and input usage continued to expand until 1985/86. During the following season, however, survey evidence indicates smallholder investment in maize had levelled off and may even have begun to decline in some regions. Either the gains associated with institutional expansion no longer offset the decline in real maize prices, or relative investment opportunities were improving for non-crop enterprises.

The low investment of household cash resources in crop production indicates the cash constraint many farmers identified is a relative perception. The returns to labor in maize production were low during the mid-1980s, particularly in comparison with official formal sector minimum wages. While formal sector employment opportunities are increasingly limited, these still offer one reasonable benchmark by which the profitability of farming can be measured. Smallholders have displayed a willingness to invest in crop production when the returns are rising. Yet they have also shown a strong interest in providing schooling for their children as a means to facilitate their movement out of agriculture. Further gains in smallholder maize production will require a reversal of the decline in returns if maize is to remain competitive in the portfolio of investment priorities farmers consider.

CHAPTER 7

HOUSEHOLD MAIZE UTILIZATION TRENDS

This chapter examines additional micro-level evidence to explain why aggregate smallholder maize sales increased so sharply after 1979. The previous analysis revealed that production decisions were influenced by institutional and policy changes which improved production incentives and helped smallholders increase their productivity. The following analysis evaluates the marketing strategies of smallholders following the harvest. The chapter examines what factors determine the relative quantities of maize farmers sell or retain for home consumption?[1] It addresses the following questions: Are smallholder maize sales primarily a function of production levels? How do market prices and access influence maize retentions? Do farmers sell maize after harvest and later purchase maize meal to meet their consumption requirements? Or is there a consistent relationship between retentions and family consumption requirements? What impact has the expansion of market infrastructure had on utilization decisions? How does the

[1] A fuller and more detailed treatment of this issue is being provided by Jane Stanning, of the University of Zimbabwe (c.f., Stanning 1987b). Stanning has collected monthly household transactions and consumption data over a two year period in two communal farming areas and one year of monthly data in a third.

availability of alternative grains affect smallholder stockholding decisions? In answering these questions, particular attention is focused on the influence of product market expansion on household food security.

The chapter starts by comparing the trends in maize sales for Mangwende and Chibi with the aggregate trend for the smallholder sector as a whole. This shows the representativeness of the two regions. Next, the degree of concentration in each region's sales is compared with the concentration of production. Third, the analysis of factors influencing the growth of sales volume begins by assessing the impact of the expansion in product market infrastructure. Fourth, the relation between household sales and maize purchases is examined to evaluate smallholder responsiveness to relative consumer and producer prices, and the incidence of sales to meet end of season cash needs. Fifth, the analysis reviews the relationship between household maize retentions and family consumption levels. The micro-level evidence is then reexamined in the context of a quantitative regression analysis modelling household sales decisions.

7.1 Maize Sales Trends in Mangwende and Chibi

According to GMB intake data, maize sales trends in both Mangwende and Chibi correspond with the aggregate sales trends for the smallholder sector as a whole. In Mangwende, maize deliveries to the GMB rose marginally during the later half of the 1970s, then increased sharply after 1980 (Figure 7.1). Between 1980 and 1985 these increased almost tenfold. These deliveries account for over ten percent of the GMB's intake from the smallholder sector.

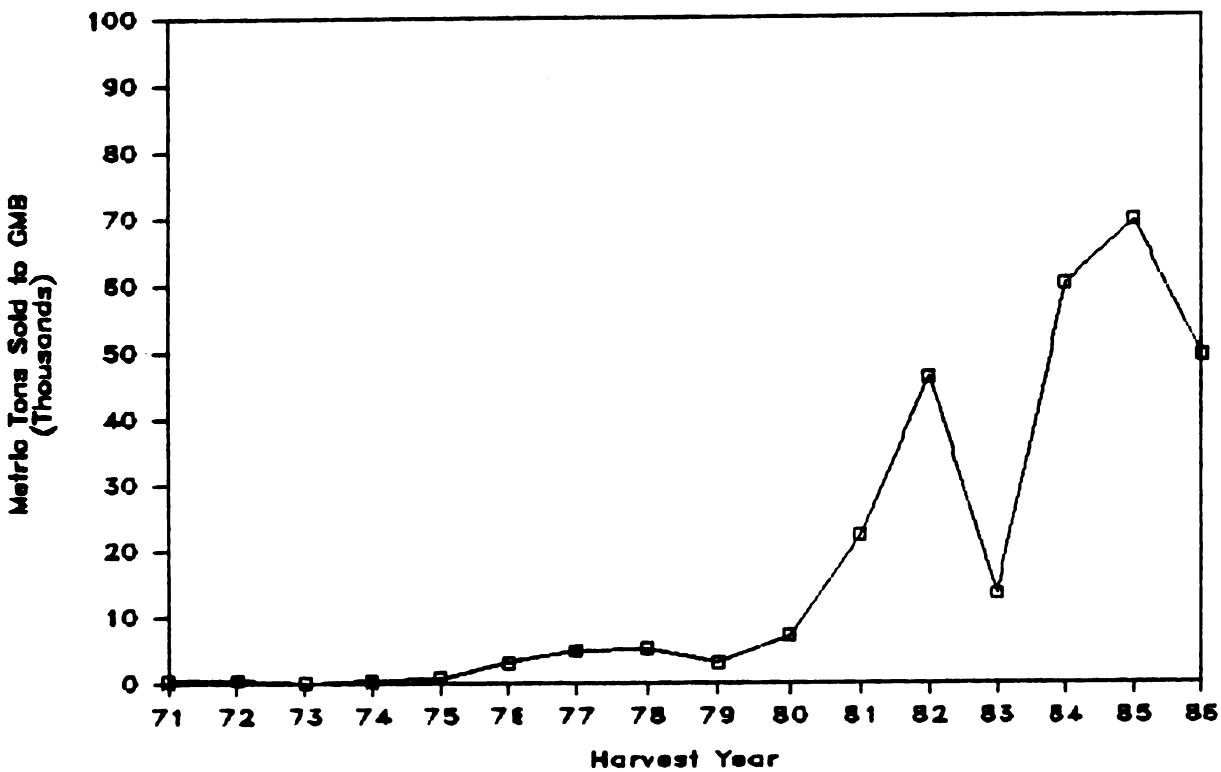

Figure 7.1 Mangwende Maize Deliveries to the Grain Marketing Board, 1970-86; Zimbabwe

Maize is clearly the principal cash crop in the Mangwende region. Survey data indicates that in 1985 and 1986, maize accounted for over 95 percent of the total value of crop sales to the GMB. Mangwende farmers also sell small quantities of sunflower, finger millet, sorghum and groundnuts. All sunflower sales and most sorghum sales are made to the GMB. However, most finger millet and groundnut sales are made locally, primarily to other farmers.[2] The income earned from the sale of these alternative crops has consistently remained marginal in comparison to maize.

Roughly three-quarters of the maize harvested in Mangwende is sold with 95 percent purchased by the GMB. Available evidence indicates local informal market sales have always been limited. While a small number of farmers sold maize to local churches and mission schools, the quantities involved were low. Farmers with surpluses simply sold excess grain to their neighbors. Similarly, available evidence suggests the level of household retentions has generally remained constant. The timing and growth of maize sales to the GMB corresponds with the consistent rate of production gains evidenced in local survey data (see Chapter 5).[3]

Until 1985, the participation of Chibi farmers in formal maize markets was limited. Maize deliveries to the GMB

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[2] This includes the value of peanut butter sales made by local farmers both to other farmers and to consumers in nearby towns and business centers.

[3] By contrast, extension workers estimated maize production peaked in 1981, implying a sharp decline in retentions while the producer-to-consumer price ratio was declining

increased more than twenty-fivefold after independence (Figure 7.2). Yet most of this gain occurred in 1985. At this time, roughly 80 percent of regional maize sales were made to the GMB. This proportion declined below 60 percent during the following drought affected season.

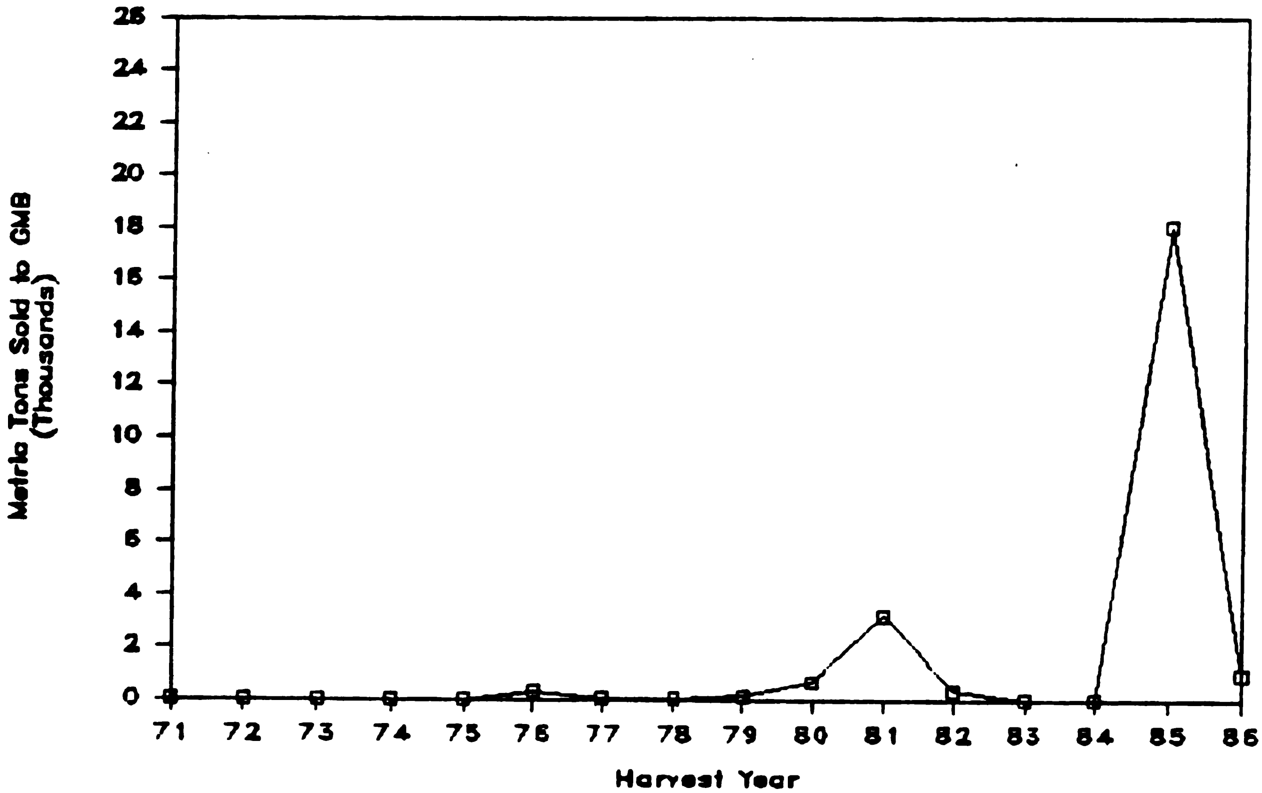

Figure 7.2 Chibi Maize Deliveries to the Grain Marketing Board, 1970-86; Zimbabwe

In 1985, maize accounted for two-thirds of the value of Chibi's crop deliveries to the GMB. Sales of bulrush millet, sorghum and finger millet were also relatively important. While almost all bulrush millet sales in the region were made to the marketing board, farmers sold the larger share of sorghum and finger millet locally. During the 1970s, groundnut sales dominated GMB deliveries. However, by 1985, groundnut sales had sharply declined and most sales were made to other farmers.

In contrast to the situation in Mangwende, two factors indicate most of the growth in GMB deliveries of maize from Chibi did not result from a large increase in production. First, almost the entire increase in market sales occurred in one year. While rains were unusually good in 1985, this did not significantly affect the maize area planted. Most of the post-war growth in Chibi's maize area resulted from an increase in producer numbers. Second, since maize sales account for only 15 to 35 percent of production, depending on the season, the 1985 deliveries could easily have come from a shift in sales out of local markets or a decline in retentions.

7.2 The Distribution of Maize Sales

The analysis of maize production patterns in Mangwende and Chibi showed that the top 20 percent of farmers harvested over 50 percent of each region's maize supplies. A corresponding picture emerges of the concentration in maize sales (Table 7.1). In Mangwende, the top quintile of maize producers account for over half of total maize sales.[4] The bottom 40 percent of producers account for no more than seven percent of maize sales. In Chibi, the top 20 percent of maize producers account for at least 72 percent of maize sales. Most producers sell nothing. In each region the distribution becomes increasingly skewed when the quality and quantity of rainfall decline.

Table 7.1
Distribution of Total Maize Sales in Mangwende and Chibi, 1984/85 and 1985/86 Cropping Seasons, Zimbabwe

Production Distribution Class:	Mangwende 1984/5 (%)	Mangwende 1985/6 (%)	Chibi 1984/5 (%)	Chibi 1985/6 a/ (%)
Top Quintile	54	60	72	92
Second Quintile	25	22	21	3
Third Quintile	14	14	5	0
Fourth Quintile	7	4	0	5
Bottom Quintile	0	0	1	0
TOTAL	100	100	99	100

a/ A mid-season dry spell reduced production in Chibi during the 1985/86 season.

Source: Mangwende and Chibi Surveys

The distribution of maize sales in Mangwende and Chibi closely matches the distribution of production. The simple correlation of production and sales is over 85 percent.[5] The

[4] This includes sales made through depots, collection points, Approved Buyers and sales to other farmers.

[5] In Mangwende, the correlations between harvests and sales in 1985 and 1986 are .93 and .91, respectively. In Chibi, the respective correlations are both .86.

largest twenty percent of producers and sellers are almost identical. Further, farmers selling the largest quantities of maize also tend to sell the largest quantities of alternative crops. This reinforces the picture of a clear distinction between larger and poorer producers which emerged in the discussion of maize production patterns.

7.3 Impact of the Expansion of Product Market Infrastructure

The historical increase in GMB maize deliveries from Mangwende and Chibi corresponds closely with the expansion of local market infrastructure. The GMB established the Mangwende depot in 1977. This was one of two depots established in the communal areas before independence. Before 1977, only 15 percent of Mangwende's farmers had sold crops to the Marketing Board.[6] By 1980, the proportion of formal market participants had marginally increased to 22 percent. Yet as market infrastructure further expanded after independence, market participation sharply increased.

In 1981, the first marketing cooperative, serving survey respondents, was established. A second was created in 1984. Three GMB registered Approved Buyers began buying crops from

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[6] Of those farmers operating currently who were also farming at this time.

survey respondents in 1982. The Approved Buyers, in particular, filled an important niche in the local market by providing immediate cash for crop deliveries. These also purchased grain rejected by the GMB early in the market season for having too high a moisture content. Most farmers sold maize directly to the GMB depot, particularly if large quantities were being marketed. However, the Approved Buyers improved market access to producers selling smaller quantities or those with more severe cash constraints.

When the Mangwende and Chibi sample was originally chosen, villages were stratified in terms of their relative market access.[7] The principal criterion of market access was not distance from farm to market, but the distance of each village from a publicly maintained road. The chief marketing constraint distinguishing villages was the difficulty of getting crops from the household to an easily passable road. The significance of this constraint was confirmed in Mangwende by the close correspondence between the expansion of transport facilities and the growth of crop sales.

Only two of the 15 private sector transporters serving Mangwende respondents in 1985, were operating before 1980. As the number of market outlets expanded, the demand for transport services increased. This stimulated local farmers

[7] Categorized as good or poor.

and shopkeepers to invest in lorries. Though truckers complained about the rising costs of operating farm to market transport services, these investments annually increased.[8]

Mangwende farmers, particularly those in isolated villages still cite transport constraints as major farming problems. Transporters, in fact, acknowledge a preference for serving farmers situated near better roads. While transport charges are informally regulated by a District Transport Board, isolated farmers, on average, pay marginally higher transport prices.[9]

In 1985, three GMB collection points were established in Mangwende to reduce transport costs and further improve the accessability of marketing services. One was set up in the survey zone. However, by this time, local product market infrastructure was well developed. Farmers expressed a corresponding concern about the quality of collection point storage, delays in crop grading and delays in transshipment to the nearby depot for final processing necessary for payment. As a result, the collection points in this region

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[8] Transporters were questioned about their operational constraints. Despite rising costs, the returns to these investments were perceived as higher than the returns to investments in the farming system.

[9] The exact level of this surcharge was difficult to determine as transport charges are deducted from GMB payments for crop sales. Many farmers did not know the size of these deductions.

received few deliveries.

The impact of market expansion is clearly evidenced in both the growth of market participation and sales volume. Despite a decline in the real level of guaranteed producer prices, the number of farmers selling maize to the GMB increased most sharply following the 1981/82 and 1982/83 cropping seasons. Eventhough 1982/83 was a drought year, the volume of maize sales continued expanding. By 1985, roughly 80 percent of Mangwende farmers sold crops to the GMB. The volume maize sales stood at record levels.

These trends are reflected in the increasing number of Mangwende producers registered with the Marketing Board. In 1980, registrants equalled roughly 20 percent of the region's households. By the end of the 1985/86 market year the number of registrants exceeded the number of households in the area (as estimated from 1982 census data).[10]

In Chibi, the establishment of collection points had a major impact on regional sales patterns. The first local market outlet serving the southern Chibi survey area was an Approved Buyer facility established during the early 1960s. However, farmers complained that this only offered payment in

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[10] Multiple cards were requested in the event of name changes, the loss of cards previously granted and in order to avoid full loan repayments.

the form of credit for the purchase of goods at the buying agent's general merchandise store. They noted their corresponding reluctance to use this outlet. By 1980, only five percent of local farmers claim to have sold crops to the GMB.

In 1985, the GMB established two collection points in the survey region. In this year, one-third of Chibi farmers sold crops to the GMB, 28 percent for the first time. Many of these formal market sales would not have occurred without the establishment of these local buying points.

The impact of the Chibi collection points on crop sales resulted from the lack of transportation facilities in the region. No locally based transporters operating with trucks are available in the region. In 1985, a small number of deliveries were made with the help of a local school teacher who owned a pick-up truck. Late in the season, government lorries were sent to Chibi villages to help transport grain. Yet almost all deliveries to the collection points were made in ox-carts, on the tops of buses, in wheelbarrows or on the backs of animals.

The stimulus provided by the collection point is reflected in a surge in the number of Chibi producers registered with the GMB. Just before the 1985/86 market season, less than 20 percent of Chibi households held registration cards. After the season, roughly 45 percent were registered.

In both Mangwende and Chibi, market expansion had a greater impact on producer behavior than shifting administered prices. The opening of market access provided farmers the opportunity to earn administered prices. Further, infrastructural expansion lowered marketing costs. The full magnitude of the associated increase in farm gate prices is difficult to estimate. However, Mangwende farmers have shown a willingness to sell to Approved Buyers at a discount from guaranteed GMB prices averaging 20 percent. While real maize prices offered by the GMB declined by 25 percent between 1981 and 1985, maize sales continued to rise.

In Chibi, the 60 percent increase in the real producer price in maize between 1979 and 1981 stimulated only a marginal increase in GMB deliveries. Almost the entire gain occurred after local collection points were established in 1985. This effectively reduced marketing costs by substantially reducing the critical transport constraint. For the first time, many producers found the maize prices obtainable in formal markets were higher than local neighborhood prices. When local prices increased during the following harvest season as a result of regional drought, sales to the Marketing Board declined. The only farmers in the survey sample selling grain to the GMB in 1986 were those obligated to repay credit liabilities.

7.4 The Relationship Between Maize Sales and Retentions

The analysis of the determinants of aggregate smallholder maize sales (Chapter 4) identified a statistically significant relationship between sales quantities and the historical producer-to-consumer maize price ratio. This suggests farmers may sell larger quantities of maize when the difference between these prices increases, and later purchase back maize meal as required for consumption.

The largest gap between producer and consumer maize prices occurred over the 1979 to 1981 period. While the nominal producer price doubled, the consumer price remained virtually unchanged.[11] During this period aggregate smallholder maize sales sharply increased from 19 to 291 thousand metric tons. However, evidence of a sharp drop in smallholder retentions and associated increase in maize meal purchases is limited. Between 1979 and 1980, GMB sales to the

[11] The heavy subsidy on maize meal prices was then reduced in 1982 and 1983.

milling companies did, in fact, increase by 13 percent. Yet in 1981, when the producer-to-consumer price ratio was greatest, GMB sales declined.

While the spread between the producer and consumer maize price may have influenced the marketing decisions of some smallholders, the post-independence growth in consumer sales can be more readily attributed to an increase in the incomes and employment of the principal purchasers of manufactured maize meal, urban-based public and private sector employees. Between 1979 and 1981, the real per capita earnings of manufacturing sector employees, for example, increased by more than 20 percent CSO, 1987). Strong post-independence growth in the national economy stimulated a five percent increase in employment.

The cross-section farm level data for Mangwende and Chibi cannot directly measure producer response to shifting maize prices, but it can provide a related set of information about marketing strategies. Family stockholding strategies can be gauged in part by examining the relationship between smallholder maize sales and purchases.

The principal source of information about smallholder decision making regarding maize sales and purchases was a question eliciting information on planned marketing strategies following the 1986 harvest. Farmers were questioned about planned crop sales, retentions and purchases. The responses to this inquiry roughly correspond with results obtained by Stanning (1987a and 1987b) from a detailed set monthly surveys. These also correspond with the evidence of stockholding behavior following the 1985 harvest.

In Mangwende, despite the relatively high level of regional production in 1986, 24 percent of the farmers planned to make maize purchases for family consumption. These averaged one-third of the estimated consumption needs of these households. Since the aggregate shortfall equalled less than three percent of Mangwende's level of maize sales, the region's production surplus could easily supply local demand. In 1985, despite unusually good rains, an estimated 12 percent of Mangwende households experienced production shortfalls. However, only four percent of all farmers planned to both purchase and sell maize. This practice was limited to households with low production and indicated an immediate post-harvest need for cash. No farmers sold their entire harvest.

In Chibi, poor rainfall during the 1985/86 season led almost 60 percent of households to plan purchases of maize. Only nine percent of the households planned to sell maize. Planned maize purchases, in 1986, were more than twice the level of total maize sales. Consequently, food had to be imported into the region. Seven months after the 1986 harvests, the government began distributing food aid in the area. While three percent of the Chibi farmers both sold and planned to purchase maize, indicating a cash constraint, none sold their entire harvest.

7.5 On-Farm Storage Decisions

The level of maize deliveries to the GMB is also influenced by the willingness of farm households to store grain. Every farm has a granary. In most cases, on-farm storage capacity is large enough to maintain stocks equal to one year of consumption. When retentions exceed the capacity of granaries, additional grain is stored in living and cooking huts.

The quality of storage facilities is variable. Farmers generally use insecticides and traditional preservatives to maintain grain quality and prolong storage life. In Mangwende, almost all farmers employ insecticides. In Chibi, 30 percent of farmers use insecticides and an additional 15 percent employ traditional preservation methods including Eucalyptus tree bark and leaves, special grasses, ash, charcoal and millet chaff. Despite these measures, farmers in both regions consistently estimated maize hybrids can be stored for only nine months without major deterioration. This roughly covers the period from initial placement in granaries until green maize harvests begin the following year. Mangwende and Chibi farmers estimated the storage life for sorghum as similar to that for maize. All other major crops have longer storage lives. Farmers claimed finger and bulrush millet can be stored reasonably well for two to five years. Farmers, accordingly, use these grains as food security stocks.

The incentive to store grain beyond annual consumption requirements is also reduced by the GMB's pan-seasonal prices. Local, informal market prices will rise between harvests, particularly in the event of drought. In 1986, for example, Chibi farmers producing a marketable surplus retained additional maize for local inter-household sales. Seven months after the harvest, local maize prices had increased 30 percent above those offered by the GMB. In Mangwende, however, local demand is limited, and farmers generally seek to sell their grain as quickly after harvest as possible. In fact, the desire to dispose of maize before the quality deteriorates leads to frequent attempts to sell grain to the GMB depot before it has adequately dried (to a 12.5 percent moisture level). When the depot rejects this grain, farmers are forced to sell to Approved Buyers at an average 20 percent discount.

In summary, the most important determinant of the quantity of maize retained and stored appears to be the family consumption requirement. By corollary, maize sales to the GMB primarily represent a production surplus. A few households sell additional maize to meet immediate cash needs. Households in low rainfall regions may retain additional maize to meet demand in informal, neighborhood markets. In general, however, the historical growth in smallholder maize deliveries to the GMB largely reflects a response to market forces embodied in production decisions.

7.6 Household Maize Utilization

Household maize utilization requirements vary by family size, planned ceremonial obligations (e.g., marriages, death ceremonies and holiday gatherings), the use of maize to feed animals, the availability of alternative cereal grains, and food aid obligations to nearby relatives experiencing production shortfalls.

In Mangwende, the median household seeks to retain 164 kilograms of maize per capita per year for family consumption.[12] This includes the quantities of maize actually retained plus planned purchases by households facing production deficits. Insofar as a portion of retained grain will deteriorate in storage, the figure overestimates the level of maize actually consumed, though in most cases poor quality grain will be fed to animals. No farmers acknowledged saving maize for seed. Three percent of the households acknowledged retaining small amounts of maize for other unspecified uses (Table 7.2).

Table 7.2
Average Farmer Estimates of Household Maize Utilization, (KG)
1986/87, Mangwende and Chibi, Zimbabwe

Use:	Mangwende	Chibi
Harvest	3179	689
Sales	2503	154
Purchases	66	322
Food	744	797
Seed	0	0
Other	9	2
Stocks	-11	+58 a/

a/ This surplus likely reflects an overestimate of maize purchases.

Source: Mangwende and Chibi Surveys

Farmers were asked how long they expected their retentions stored for food consumption to last. Mangwende

[12] Male household heads living and working off the farm and children under the age of six were assumed to consume one-quarter of the quantity of maize of farm-based adults and older children. Part of what farmers identified as retentions for food is consumed in the form of beer or used for wage payments, gifts and loans to other farmers.

households with no planned maize purchases reported placing an average eleven months of their consumption requirements in storage. This practice is remarkably consistent regardless of differences in each household's per capita consumption estimates. Less than ten percent of households planned to retain less than eight months or more than thirteen months worth of their consumption requirements.

Households facing maize production shortfalls did not plan to use supplies of other small grains to offset this deficiency. Finger millet retentions were allocated to beer and ceremonial meals. While sorghum and bulrush millet could serve as food security stocks for the few households planting these crops, the quantities of these crops retained for food were low. Instead, the maize production shortfall was simply resolved with maize purchases sufficient to meet eleven months of family utilization requirements. In both surplus and deficit households, the additional month of consumption was covered by green maize harvests.

Similar relationships exist in Chibi. Median estimates of per capita maize consumption requirements were 139 kilograms per year, though the average was close to 170 kilograms. Following the relatively poor 1986 harvest, Chibi households retained an average 5.5 months of maize for family consumption. Virtually all households producing less than seven months of their maize utilization requirements planned to purchase more. The combination of harvest retentions and planned purchases brought maize supplies, for most households, close to a ten month median level of consumption. The two month deficit was covered by green maize and small grains consumption.

Unexpectedly, there was no consistent relationship between the level of maize retained or purchased and the level of more drought tolerant coarse grains available. This suggests Chibi households do not perceive these crops as close substitutes. Rather, a household first attempts to satisfy its maize requirements and only uses the alternative grains if absolutely necessary - if cash is unavailable for maize purchases.

7.7 A Quantitative Review of Factors Influencing Maize Sales

In a theoretical model of sales response, maize sales are likely determined by the relative profitability of maize and its close production substitutes, and consumer prices for maize and its principal consumption substitutes and rainfall. In a cross-section model for a sample without substantial variability in product, input and consumer prices or rainfall, sales must be primarily linked to factors explaining the variability in household production and retentions. These include farm resource endowments, family size, market access and the availability of supplementary institutional support in the form of extension assistance and credit. In its simplest form:

$$\text{Sales} = \text{Production} - \text{Retentions}$$

The principal determinants of production levels were explored in Chapters Five and Six. In this context, an understanding of the determinants of sales levels can be extended with a closer examination of the factors influencing the level of household retentions.

The variability of household retentions in any given year should be affected by production levels, product price changes over the course of a season, consumer price levels, factors influencing market access, the availability and prices of close consumption substitutes, the quality of granaries, grain storage quality, the risks of production shortfalls, the number and composition of household consumers, the range of alternative uses of stored grain including labor payments and animal feed and family income requirements. In the descriptive analysis above, the most important factors influencing retentions, for which data are available include production levels of maize and alternative small grains, the number of household consumers, market access and family income requirements.

In view of the sales identity described above, regression models for Mangwende and Chibi can employ either sales or retentions as the dependent variable. The two representations are mirror images, though the relative explanatory power of the independent variables are likely different. These equations take the following basic form:

MZRETEN or MZSALE =
f(CONSUM, HARV, SORGRET, FMILRET, BRMILRET, MKTACCESS, SCHFEE)

where:

MZRETEN	= maize retentions (kg)
MZSALE	= maize sold to any buyer (kg)
CONSUM	= weighted index of number of consumers in the household = (0.25*number of household members working off the farm contributing labor to crop production) + (0.25*number of children under six) + (number of other household members)
HARV	= maize harvested (kg)
SORGRET	= sorghum retained (kg)
FMILRET	= finger millet retained (kg)
BRMILRET	= bulrush millet retained (kg)
MKTACCESS	= village situated near or far from a secondary (dirt) road: 1 = near; 0 = far
SCHFEE	= school fees paid during the 1985-86 school year ($Z)

Two of these variables require further explanation. The market access indicator corresponds with the stratification criteria employed in the initial sample selection. The variable representing the value of school fees paid by each household provides a proxy for the severity of post-harvest cash constraints. This was the largest single expense unrelated to crop production which most households faced. A portion of this payment was required by primary and secondary schools approximately a month before planting begins.

Two additional variables were employed in the models for Chibi. An indicator of the existence of a credit liability was used to account for the need to sell maize in order to repay AFC loans. Following the 1986 harvest, the only Chibi sample farmers selling maize to the GMB were those with credit liabilities. In most years, repayments may require larger formal market sales than if the farmer did not have a loan. This constraint does not generally arise in Mangwende due to the region's higher average production levels. This variable is identified in the Chibi equation as CREDIT. Since no accurate measure of loan liabilities in 1985 could be obtained, this variable takes the form of a dummy whereby 1 represents credit received and 0 represents no credit received.

In addition, given the high proportion of Chibi farmers experiencing production shortfalls, and the difficulty of accurately measuring farm-to-farm loans, gifts and late season sales, a second variable was added to the Chibi equation indicating the likelihood that extra retentions were held to help offset village supply shortages. This variable, called DEFICIT, measures the proportion of farmers in each village not selling crops to the GMB.

Given the correspondence between the sales and retentions equations, only the results of the sales equation are reported in detail below. This was estimated for the 1985/86 cropping season in Mangwende. Data from the 1984/85 cropping season were used in estimating the Chibi equation, because this was a relatively good rainfall year. As a result, a larger proportion of families had maize to sell. The means and standard deviations of variables included in the equations are listed in Table 7.3.

Table 7.3
Means and Standard Deviations of Variables Included in the Maize Sales and Retentions Equations for Mangwende and Chibi

	Mangwende		Chibi	
Variable:	Mean	S.D.	Mean	S.D.
MZSALE	2413	2516	586	1193
CONSUM	5.3	2.4	5.8	2.5
HARV	3089	2675	1754	1666
SORGRET	0.2	1.2	17.5	41.4
FMILRET	16.2	20.2	36.2	50.5
BRMILRET	0.6	4.2	6.8	22.3
MKTACCESS	0.7	0.5	0.7	0.5
SCHFEE	237	431	87	170
CREDIT			0.02	0.2
DEFICIT			0.6	0.2

Sources: Mangwende and Chibi Surveys

7.7.1 Mangwende Sales Regressions

As expected, the maize sales equation for Mangwende shows household sales are primarily related to production levels (Table 7.4). The simple correlation between the two variables is over 90 percent. Sales are secondarily influenced by the number of consumers in the household. This confirms the observation, based on descriptive evidence, that households first retain what they require for consumption and sell the remainder. Market access has a statistically significant relationship with sales, though the strength of this linkage is not strong. The post-independence expansion in the number of local transporters has undoubtedly reduced this constraint for most farmers.

Table 7.4
Regression Equation for Household Maize Sales
Mangwende, Zimbabwe

Variable	Coefficient	S.E.	Signif.
CONSUM	-57.03	11.36	.00
HARV	0.95	0.01	.00
SORGRET	13.72	21.27	.52
FMILRET	-0.36	1.43	.80
BRMILRET	-2.61	6.50	.69
MKTACCESS	122.48	58.41	.04
SCHFEE	0.03	0.06	.63
Constant	-304.49	76.12	.00

n=90 $\bar{R}^2=.99$

Source: Mangwende Surveys

The lack of significance of the retention levels for alternative small grains confirms the observation that these are not close maize substitutes. Finger millet is primarily used for beer brewing and little sorghum or bulrush millet are grown. The lack of significance of the variable for school fee payments indicates that income levels are generally high enough so that maize does not need to be sold simply to obtain cash. The low level of cash maize sales to Approved Buyers and high average incomes of Mangwende households support this conclusion.

7.7.2 Chibi Sales Regressions

The Chibi regression for household maize sales similarly shows that sales levels are most closely related to the quantity of maize harvested (Table 7.5). As expected, this link is partly offset by the number of household consumers. In addition, farm retentions are strongly influenced by the size of the production deficit faced by their village. If more households experience production shortfalls, more maize will be saved for local loans, gifts and possible future sales. Further, the use of maize as payment for labor is more common in Chibi than Mangwende. The elasticity on this variable, in fact, appears larger than that for the variable measuring the number of household consumers.

In Chibi, finger millet does represent a substitute for maize in consumption, though the elasticity of this variable is fairly low. Finger millet is commonly intercropped with maize in the expectation that if rains are poor and maize harvests are low, this small grain will be available. Most of this grain, however, is allocated to beer brewing. Sorghum and bulrush millet are not close substitutes for maize.

Table 7.5
Regression Equation for Household Maize Sales
Chibi, Zimbabwe

Variable	Coefficient	S.E.	Signif.
CONSUM	-43.09	25.51	.09
HARV	0.53	0.04	.00
SORGRET	-0.35	1.46	.81
FMILRET	-2.22	1.19	.07
BRMILRET	-0.61	2.61	.82
MKTACCESS	254.60	126.66	.05
SCHFEE	0.59	0.35	.10
CREDIT	2484.39	426.10	.00
DEFICIT	-809.90	390.61	.04
Constant	-304.49	76.12	.00

n=88 $\bar{R}^2$=.82

Source: Chibi Surveys

Though the credit variable is highly significant, in statistical terms, the elasticity on this variable is low. Farmers receiving credit also produced large harvests and had no difficult repaying their loans. As noted above, however, this was not the case the following year.

The significance of the variable accounting for school fee requirements reflects the more severe cash constraint faced by most Chibi farmers. The elasticity on this variable, however, is also low. This may reflect the fact that farmers with maize surpluses had relatively little problem paying school fees.

7.8 Summary

Maize marketing decisions in Mangwende and Chibi are remarkably similar. Farmers normally retain enough grain to meet family consumption requirements and sell the surplus. The quantity of surplus depends on the size of harvests. The major determinants of harvest levels were discussed in Chapter Five.

The survey analysis provides little basis for identifying whether sales and retentions behavior have changed over time, or specifically, whether farmers increased their maize sales and reducer their retentions in response to the high maize producer-to-consumer price ratio. In Chibi, however, maize sales to the GMB were low until 1985 when a series of local collection points were established. By this time the producer-to-consumer price ratio had sharply declined. In Mangwende, the largest growth in maize sales to the GMB occurred in 1982 and 1984, similarly after the price ratio had declined. The increase in maize sales in 1981 can largely be attributed to favorable rains. The 1981 increase in aggregate, national maize meal sales can be better explained by the growth of employment and incomes of the principal buyers of milled grain, urban consumers.

Consumption levels, or more properly, the levels of household maize utilization, vary considerably by household around a normal distribution. Despite this variance, farmers in both regions consistently seek to retain quantities of maize necessary for what they estimated to be eleven months of utilization. If unavailable from harvests, farmers plan to purchase the maize necessary to offset the deficit.

Both the descriptive and quantitative analysis show the strong preference of Mangwende and Chibi households for maize. Alternative coarse grains are not perceived as close consumption substitutes. Farmers acknowledge that one reason they grow these grains is for their drought tolerance. In Chibi, these grains offer an important source of food security. Yet, the recent availability of food aid following particularly poor rainfall years, reduces the significance of these plantings.

Two additional institutional factors have had limited influence on maize sales to the GMB, most significantly, in Chibi. Farmers with credit repayment obligations and farmers with better market access will sell more and retain less. This latter relationship is strongly apparent in the first year response to the establishment of local GMB collection point facilities. Though Chibi farmers did not foresee this market access until late in the production season, the market response was strong.

Roughly 25 percent of Chibi farmers and 10 to 15 percent of Mangwende households consistently do not produce enough maize to meet their family consumption requirements. When rains fail, the proportion of deficit households roughly doubles. Insofar as market expansion promoted an increase in production, the access of these farmers to food probably increased. In Chibi, for example, surplus maize available from producers who had expanded their hectareage after the war, probably limited the increase in maize prices following the 1985/86 drought affected season. In addition, greater income from crop sales increases demand for labor services. The persistence of localized production shortfalls, despite the tripling in aggregate production between 1979 and 1985, however, clearly shows the limits of broadly focussed smallholder production policies. Future improvements in food security require increased targeting of assistance to meet the needs of the poorest families.

CHAPTER 8

SUMMARY AND CONCLUSIONS

Prior to 1980, smallholder farming in Zimbabwe was broadly characterized by low productivity and slow growth. Production of maize, the smallholder sector's principal farm enterprise, was stagnant. Small farm maize yields averaged roughly one-seventh those obtained by the commercial farm sector. While planting two-thirds of the country's maize area, smallholders harvested only one-quarter of total maize production. Smallholder maize sales accounted for less than five percent of total deliveries to national markets. These farmers made up 95 percent of the country's producers, yet earned less than ten percent of the agricultural income derived from crop and livestock sales through the marketing authorities.

During the six years from 1979 to 1985, smallholder maize production more than tripled. Smallholder maize area increased by 90 percent. Maize yields roughly doubled. These farmers now produced over one-half of the country's main staple. Sixty percent of the production gain was delivered to national markets. As a result, the smallholder contribution to Grain Marketing Board intake rose to over one-third of total maize deliveries. National maize stocks increased to record levels. By the end of 1986 these were greater than the total level of domestic maize consumption. The remaining 40 percent contributed to an increase in household retentions and family consumption. New optimism regarding smallholder productivity led the Zimbabwe government to project a seven percent average annual growth rate in communal sector production over the 1986 to 1990 period (GRZ, 1986:25).

The principal objective of this research has been to identify the major causes underlying the remarkable post-independence gains in smallholder maize production. The analysis first examines the relative significance of increases in relative market prices and structural changes embodied in the expansion of market infrastructure and adoption of improved technologies. The investigation then assesses the distributive impact of the realignment of production incentives and opportunities. It questions who contributed the most to the smallholder production and market gains and why. This leads, ultimately, to an evaluation of the food security implications of the increase in maize production.

This chapter reviews the results of the analysis. It reconsiders the hypotheses set out in the introduction to this study, and briefly discusses the significance of the conclusions for future smallholder development strategies in Zimbabwe. The chapter concludes by listing some of the major issues raised by the study which require further investigation.

8.1 Sources of Growth in Smallholder Maize Production

The first major hypothesis underlying this study attributed the growth in smallholder maize production and sales to a complementary set of changes in agricultural policies, institutions and technologies (p.7). The hypothesis suggests there was no single or even predominant 'engine of growth' underlying smallholder production gains. Rather an interrelated set of public and private sector interventions both improved maize production incentives and expanded production and market opportunities.

The results of the analysis support this hypothesis. Five of the most important stimulants to smallholder maize production between 1979 and 1985 were: the ending of the war establishing a multiracial government, the expansion of input and product market infrastructure, the availability of a proven set of maize technologies, the establishment of a smallholder credit program and the sharp 1980 and 1981 increase in maize producer prices.

8.1.1 The Ending of the War

The independence struggle in Zimbabwe widely disrupted smallholder agriculture, particularly during the mid to late 1970s. As violence in the rural areas escalated, a portion of the limited set of agricultural support institutions provided to smallholders was destroyed or abandoned. Extension workers were withdrawn, dip tanks were razed and isolated government buildings were demolished. More importantly, communal farmers abandoned some of their more distant fields and fewer new holdings were created. Many farmers left their holdings altogether. While post-independence estimates of the number of refugees requiring resettlement (one-third of the smallholder sector) appear high, the loss of production was substantial.[1]

The end of the war brought a sharp increase in smallholder maize area. This resulted, in part, from a sudden increase in the number of smallholder farmers. Families which had left farming during the war, returned. In addition, survey evidence in Mangwende and Chibi indicates many younger families took advantage of the ending of the war to move out of their parents' households and establish independent holdings. Smallholder maize area also increased when

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[1] This loss does not appear fully reflected in aggregate estimates of communal production during the period. This may be because the extension workers responsible for making these estimates were withdrawn from many areas.

producers who had continued farming during the war replanted abandoned fields and further expanded their holdings. Between 1979 and 1981, the total crop area cultivated my smallholders increased by roughly 25 percent. The largest portion of this increase in aggregate crop area was planted to maize.

8.1.2 Expansion of Market Infrastructure

After Independence, the input and product market infrastructure serving the smallholder sector rapidly expanded. A larger number of small shopkeepers in the communal areas began stocking seed, fertilizer, insecticide and agricultural equipment. Stores based in urban centers branched out to establish rural outlets. The fertilizer and agrochemical companies began promoting deliveries of agricultural inputs with direct village-based sales and demonstration trials. The growth of input markets was particularly strong in high potential regions such as Mangwende.

The Grain Marketing Board invested heavily in the establishment of depots and collection points in the smallholder farming areas. A corresponding private sector investment was made in Approved Buyer facilities and transport. Small shopkeepers registered with the GMB to purchase crops and smallholders, themselves, began to buy lorries. In addition, the number of marketing cooperatives buying crops and selling inputs increased.

The expansion of smallholder sales to the GMB corresponded closely with the expansion of product markets. As farmers gained improved access to market outlets, many began selling crops in formal markets for the first time. The reduction in marketing costs increased farm gate prices providing a further incentive to expand plantings.

8.1.3 The Availability of Improved Technology

The growth in smallholder productivity was made possible by the availability of improved technologies, particularly hybrid maize seed and fertilizer. Though most agricultural research had been geared, before 1980, to the needs of the large-scale commercial farm sector, some of the results were also applicable to smallholders. Decades of breeding work had produced hybrids adapted broadly to high and low potential zones. Fertilizer trials provided recommendations roughly attuned to the agroecological conditions of much of the small farm sector, particularly to regions with better rainfall.

Between 1979 and 1985, hybrid maize seed sales to the smallholder sector are estimated to have increased roughly fivefold. Smallholder purchases of maize fertilizer are estimated to have increased more than fourfold. Up to one-half of these gains can be linked with the nationwide increase in maize area planted. The remainder contributed directly to a doubling of average smallholder maize yields.

The sudden rapid growth in seed and fertilizer sales can be attributed, in part, to the expansion in the number of input suppliers and establishment of private sector marketing strategies promoting sales in the smallholder farming areas. In addition, under a 1980 refugee resettlement program, free inputs were distributed to farmers returning from the war. Thereafter, input sales were primarily stimulated by the establishment of a smallholder credit program.

8.1.4 The Establishment of a Smallholder Credit Program

Smallholders first gained wide access to agricultural credit with the establishment of a major small farm credit program in 1978. By 1985, roughly ten percent of smallholders received credit. The growth of fertilizer sales after 1980 corresponds closely with the expansion in the number and size of smallholder loans. The importance of credit is clearly displayed in the farm level survey data. In Mangwende, fertilizer was purchased by 80 percent of all farmers in 1986/87. Yet the 37 percent of farmers receiving loans purchased almost three-quarters of the total. In Chibi, the five percent of farmers receiving credit purchased almost 90 percent of the fertilizer used in this region.

8.1.5 Producer Prices

Commercial sector maize sales, during the post-war period, shifted closely with the rise and fall of administered producer prices. The link with communal sector sales was less pronounced. The influence of administered prices on smallholder production and sales depended on the distribution of access to product market infrastructure. Between 1979 and 1981, real administered prices increased by almost 80 percent. After 1981, real producer prices declined. In Mangwende, smallholder maize sales continued increasing through the 1979 to 1985 period. In Chibi, deliveries remained marginal until 1985.

The producer price increases in 1980 and 1981 primarily affected the small proportion of smallholders who already had relatively good access to product markets. This includes the 15 percent of producers registered to sell grain to the Grain Marketing Board by harvest time in 1981. The increase in administered prices likely also helped stimulate further expansion in market infrastructure, particularly in high rainfall regions. The post-1981 rise in maize sales in Mangwende corresponds closely with an increase in the number of market outlets and availability of transport. In Chibi, maize sales did not increase significantly until local collection points were established in 1985. As market facilities continue to improve, smallholder responsiveness to administered prices can be expected to increase.

8.2 Price Incentives and Structural Change

This investigation hypothesized that the production decisions of most smallholders were more significantly influenced by institutional and technological changes than by product price adjustments (p.7). This observation has similarly been largely confirmed. The limited analysis of aggregate smallholder sector data shows a close correspondence between the increase in administered producer prices and the growth of maize sales. Yet a closer investigation of regional and farm level data reveals that a number of structural changes in the smallholder maize economy, correlated with the increase in producer prices, more directly influenced production decisions. The significance of these structural factors could not be accurately measured in the aggregate analysis. As a result, the change in producer prices appeared more important than it actually was.

Between 1979 and 1981, the only post-war period in which real maize prices and the producer-to-consumer maize price ratio increased, aggregate smallholder production levels were also strongly affected by the ending of the war. The largest proportion of the increase in area planted, during this period, can be attributed to the return of refugees and reclamation of abandoned fields. Little of this gain can be attributed to the substitution of maize for other crops. The largest gains in both the number of farmers selling to the GMB and the size of deliveries occurred after real producer prices and maize producer price ratios had declined. Most smallholders selling grain to the GMB in 1985 only began participating in formal sector markets after 1981. This participation was linked with the expansion of market infrastructure and market accessability.

The increase in producer prices and expansion of market infrastructure improved the farm gate prices of all crops. All crops, except bulrush millet, registered increases in production. Yet by far the largest increases in area and production were registered by maize. This disparity cannot be explained by shifts in the ratio of maize-to-alternative crop prices. The difference must be attributed to the availability of improved maize technologies which increased the net returns to maize production above its principal competitors. The most important improved technologies were hybrid seed and fertilizer.

The returns to the use of these technologies improved with the expansion of input markets and establishment of credit programs. These provided cash-poor farmers greater accessability to the inputs and lowered input costs. The institutional changes did not directly discriminate in favor of maize. However, farmers viewed the technologies recommended for alternative crops as either inappropriate or less profitable than those for maize.

In effect, producer prices offered a necessary, though insufficient means to promote smallholder maize production. These farmers were clearly responsive to prices, yet institutional and technological changes were required to make the administered producer price adjustments effective. High guaranteed producer prices now limit Zimbabwe's ability to export grain without taking a loss. The smallholder maize production experience shows, however, that further growth in market deliveries can be achieved through improvements in production and marketing opportunities rather than the maintenance of artificially high product prices. There remains much room for further improvements in production and marketing efficiency through such measures as improving production technologies, further reducing transport costs and improving the administration of credit programs. Such interventions could offset the effect of further declines in real producer prices.

8.3 Distribution of Smallholder Production Gains

This investigation also initially hypothesized that the distribution of maize production and sales gains would be skewed in favor of those producers with the greatest production and institutional resources (p. 8). At first glance, the breadth of participation in the maize production trend appears extensive. Extension worker estimates indicate area gains were registered in every province. These were distributed roughly according to population levels, except in Matabeleland, which experienced small gains. In the aggregate data, the difference in production trends first appears in the distribution of smallholder maize yields. While maize yields increased, according to extension estimates, in all parts of the country, the largest gains occurred in the higher potential regions. These farmers were best situated to take advantage of the improved maize technologies, particularly fertilizer recommendations.

The advantages characterizing the high rainfall zones become even more evident in the picture which emerges out of the regional survey data. This shows that both input and product markets expanded most, over the 1979 to 1985 period, in the high potential areas. Credit was most available to these farmers. Extension support was better and extension recommendations appear most applicable to these producers. As a result, the survey data indicate that per capita maize production in a high potential region such as Mangwende averaged more than twice the level of production in low potential Chibi when rains were generally good and more than five times better when rains were poor. These advantages are also reflected in the distribution of growth in maize sales. Most of this growth occurred in the high potential regions of the country. In Mangwende, per capita maize sales were five times greater than Chibi in good years and more than twenty times higher in poor years. The significance of this disparity is increased when considered in relation to the fact that 25 percent of Zimbabwe's smallholder farming areas are considered high or medium potential regions (receiving greater than 650 mm of rainfall) and 75 percent are considered semi-arid regions.

The survey data reveal that the concentration of maize production and sales within each agroecological zone is as large, if not larger, than that between the different regions. In both areas, the top 20 percent of producers harvest at least 50 percent of the region's maize and market at least 55 percent of all maize sold. The skew in this distribution increases when rainfall is poorer. The top producers in low rainfall Chibi achieve yields and production levels similar to the average producer in Mangwende. Despite favorable rainfall in the high potential region, roughly 15 percent of these farmers seem to be consistent net maize purchasers.

The justification for this disparity requires further investigation. Yet several characteristics of the top producers in each region can be identified. These tend to have larger land holdings, though in part because they expanded their crop area during the post-independence period. They also own more draft animals and farm equipment. These farmers hold better access to input and product markets. In particular, they have obtained steady access to agricultural credit.

The combination of aggregate and regional survey data provide a rough basis for estimating the distribution of maize production and sales across the entire smallholder sector. The top ten percent of smallholder producers, concentrated in the nation's high potential zones, appear responsible for over 50 percent of smallholder maize production and three-quarters of smallholder maize sales. Again, the concentration of production and sales increases in drought years. These estimates correspond with the fact that by 1985 only one-third of smallholders were registered to sell crops to the GMB.

The skew in the level of participation in smallholder maize production and market growth again displays the importance of complementary resource availability. Production and market gains were widespread. Yet the farmers contributing most to these gains had better rainfall, better access to input and product markets, better access to improved technologies and greater land and capital resources. The greatest beneficiaries of government policy changes and infrastructural investments designed to promote smallholder production were those producers facing the smallest food security risks. Producers facing frequent or consistent production shortfalls have benefited least. To improve the circumstances of poorer producers throughout the country, future assistance strategies will need to be targeted to resolve the particular constraints of these farmers.

8.4 Smallholder Investment Priorities

The third major hypothesis underlying this study stated that farm and off-farm income were complementary, and that investment in crop production depends, in part, on the relative returns to crop enterprises relative to the size of available off-farm earnings (p.8-9). The analysis displays the responsiveness of smallholder maize producers to a sharp post-independence increase in production incentives and opportunities. Yet the smallholder sector must still be viewed as a highly diversified economy. Forty-four percent of the household heads in Mangwende and over one-third of the heads in Chibi live and work off the farm. Twenty to 40 percent of most households' income, accounting for the value of crop retentions, is earned from sources other than crop production.

The increase in the returns to maize and the returns to improved maize technologies, after 1979, stimulated the expansion of acreage planted, larger allocations of family labor to production and larger cash investments. Yet, in most households, these investments remain small relative to family income levels. Further, farmers in Mangwende and Chibi are not investing most of their cash in production inputs, but are relying on credit. Little off-farm and crop sales income is being invested in production inputs. Instead, farmers are investing heavily in education. Most are also investing in improved housing, clothes and other consumer items. Some of those with the largest cash resources are investing in trucks, retail shops and sewing machines.

The returns to maize will need to remain competitive with these alternative enterprises if existing levels of investment are to be maintained, much less increase. By 1987, the growth of hybrid seed and fertilizer sales had substantially slowed. In Mangwende, fewer farmers were accepting credit while the proportion of maize inputs purchased with credit was increasing. Investment in school fees was also increasing and farmers expected educated children to leave the farm. High minimum wages compared with the returns to labor in crop production justify educational investments and labor migration. These results bring into question government assumptions that smallholder maize production will continue to increase at rates comparable to those of the 1979 to 1985 period. Instead, the likelihood appears stronger that the competition for farm labor and capital resources is becoming more severe.

Farm survey evidence also suggests, however, that off-farm employment is at least partially complementary to the farm enterprise. While large quantities of remittances are not being directly invested in farm production, access to this income allows higher levels of farm investment than would otherwise occur. Most of the farmers consistently participating in agricultural credit programs in Mangwende earn substantial non-farm income. These earnings provide a buffer against the risks credit liabilities after a poor season. Farmers with greater cash resources hold a larger stock of investment funds to meet a broader set of spending priorities. Money is available to support food production, educational investments, consumer good purchases, as well as maize production for the market. During the early 1980s, farmers chose to invest in expanding their marketable surplus. By 1986, however, this expansion had greatly slowed.

8.5 Replicability of the Maize Production Gains

This investigation's fourth hypotheses suggested the maize production gains will not be easy to maintain over time or repeat across crops. The analysis identified several factors which make the post-war situation in Zimbabwe unique. Much of the increase in production, particularly that associated with area gains, resulted from the ending of the war. The resolution of rural instability and violence stimulated a return of refugees to farming, reclamation of fields once abandoned and expansion of holdings as farmers took advantage of the period of flux seek additional land.

Second, the new Zimbabwe government found a well developed set of agricultural institutions which could be readily expanded to serve the smallholder. Discrimination against communal agriculture in the past had limited this sector's productivity. Once this discrimination ended, the improved access of smallholders to existing technologies and national markets stimulated immediate gains. If these institutions had to be newly built, the transition would have been substantially slowed.

Third, the largest expansion in smallholder maize production and sales after the war came from producers best endowed with farm resources and institutional support. These were primarily farmers in high rainfall zones with the greatest technological opportunities for expanding production. Government and private sector institutional expansion was concentrated in favor of these producers as this was where the highest returns to expanded support lay. The extension of these gains across a wider set of more poorly endowed farmers will prove both more expensive and yield lower investment returns. The Zimbabwe government has already pulled back on its commitment to establish collection points throughout the communal areas. The prospects for further expansion of credit and input deliveries, particularly in the large semi-arid regions of the country, are unclear.

While the production of alternative smallholder crops has also increased since 1979, these gains have been limited compared to those achieved by maize. These have largely resulted from the widespread increase in aggregate area planted following the war. The returns to maize are broadly perceived to be higher than those to alternative crop enterprises. A major reason for this difference is the availability of a profitable set of improved maize technologies.

Farmers have proven their willingness to adopt improved technologies if these are perceived as profitable. In the pattern of adoption of maize recommendations, smallholders have discriminated between technologies yielding higher returns and those offering questionable gains. Hybrid seed has broadly proven its profitability in high and low rainfall zones. Fertilizer has proven its effectiveness in higher rainfall regions, though not necessarily at the rates of application recommended by extension workers. Credit recipients have tested insecticide and found the returns to this investment do not justify even the limited cost. No maize field crop insecticide is purchased except as required by the credit program. Similarly, Mangwende farmers have tested herbicide and rejected this technology.

Farmers in Mangwende and Chibi have consistently rejected recommended technologies for sorghum, millet and groundnuts. Without technological improvements, the low returns to these enterprises justify production for food, but limit production for the market. Extension workers have recently been encouraging farmers in Chibi to reduce their maize production and plant more drought tolerant crops. This advice increased following the incidence of mid-season dry spells and drought during four of the first six cropping seasons following independence. Yet, despite the likelihood of drought, Chibi farmers perceive the returns to maize production to be generally higher than the returns to the recommended alternatives. While they will still plant sorghum and millets, acknowledging their relative drought tolerance, maize remains the preferred food and cash enterprise. Until yields of these alternative crops can be profitably increased, maize will continue to dominate these cropping patterns.

8.6 Food Security Implications

The concentration of both production and sales raises the question of whether food security in Zimbabwe has improved. Aggregate national food supplies are undoubtedly higher in Zimbabwe than they were at independence. Given that a large proportion of the growth in maize production has been retained, food supplies in most maize producing regions within the country are also higher. Yet the largest gains in production and largest contributions to national maize stocks have been made by those smallholders facing the lowest risks of encountering consumption deficits. In high potential Mangwende, 15 to 20 percent of all households still do not produce enough maize to meet their basic consumption requirements. One-quarter of the households in low potential

Chibi still have to buy maize in relatively good years, and at least 60 percent face production shortfalls in poor seasons.

The food insecure have benefited from the expansion of support for smallholder agriculture and associated increase in aggregate maize production. The widespread dissemination of hybrid maize seed has lifted these farmers' yields. The rise in productivity of the better producers sets an example of the gains the poorer can achieve. While the establishment of alternative market outlets increased local prices in the better rainfall years, the expansion of regional production has probably lowered local food prices in poor years.

Per capita food consumption among most poorer maize producing households has probably not declined. Without the aggregate gains in production and market sales this would likely have occurred. Yet the majority of Zimbabwe smallholders in semi-arid zones still face severe consumption risks associated with large drought induced fluctuations in production. The growth of national maize stocks offers a basis for the timely delivery of food aid. Yet the high costs of maintaining these stocks and high costs of food aid programs justify the search for new strategies for promoting higher production and greater production stability in the semi-arid regions. These farmers will not necessarily benefit from further investments in expanding market infrastructure or agricultural credit. Rather they will require further improvement in low cost agricultural technologies, and most likely, the expansion of income earning opportunities from sources other than crop production.

8.7 Implications for Development Policy

Numerous issues relevant to the orientation of future smallholder development strategies have been raised by this study. A few merit particular comment.

First, quick action is required to test, reconcile and improve the various estimates of smallholder production and to build up a stronger inventory of smallholder production and market data. This requires reaching agreement on a standard set of measurement methods, variable definitions, farm sector categories and reporting procedures. Further consideration should also be given to identifying the range of information required for policy analysis and ensuring that this is consistently published.

Second, as market infrastructure expands, adjustments in administered product prices will have an increasing influence on smallholder decision making. However, production levels of maize, and particularly of other crops, may be more significantly influenced by alternative policy, institutional and technological changes. Further, policy makers need to consider the interdependence of development interventions. Any particular intervention, such as an expansion of credit programs may represent a necessary, but insufficient means to increase smallholder productivity. Farmers must obtain both the incentive and opportunity to improve their practices.

Third, post-independence government assistance for smallholders has been too broadly focussed. Little attempt has been made to distinguish the unique needs of various subgroups within the small farm population or to account for the variable effect of a single set of government policies. Pricing policies have been assumed to affect most smallholders equally. A single credit program was strongly promoted in all parts of the country, regardless of the appropriateness of available technological packages or severity of production risks. The objective of providing collection point facilities for all smallholders was initially established before evaluating the relative costs and returns applicable in different regions of the country. The high expense of institutional expansion alone argues for a more moderate series of goals. The wide variability in agroecological conditions in various parts of the country suggests the need for some degree of institutional targeting to best take advantage of local circumstances. A broad first basis for distinguishing smallholder development strategies is between high potential and semi-arid rainfall zones.

In conjunction with this need to account for the diversity in the smallholder sector, the government should consider the value of establishing distinct sets of development goals for different regions of the country. The distinction between aggregate, national food security and household food security highlights the need to target assistance to the poorest farmers subject to both consistent production shortfalls and those facing periodic losses associated with drought. Rather than calling for increased groundnuts production in the communal sector as a whole, consideration ought to be placed on exploiting the advantage of regions where groundnut production is comparatively most profitable. If credit is to be viable in semi-arid regions subject to drought, new, location-specific strategies may be required to offset weather related risks.

Fourth, the importance of private sector initiative has been identified. This ought to be further encouraged. Following the war, private sector input suppliers began expanding marketing services and extension support to smallholder farmers, particularly in high potential regions. Small shopkeepers and farmers invested in lorries to help transport crops to markets and inputs to the farm. These services were complementary to government investments in market infrastructure and agricultural credit. They have substantially broadened the impact of government programs while generating rural employment. Additional measures to promote these investments, particularly in drier regions of the country merit exploration.

Fifth, the smallholder ought to be more broadly recognized as a diversified entrepreneur. He is not simply a crop producer or a farmer. Substantial amounts of income are also frequently derived from petty trade and industry as well as off-farm employment. These earnings provide sources of investment capital, offset farm production risks and allow continued purchases of food and consumer goods in the event of drought. These links between the farm and non or off-farm economy need to be encouraged.

Sixth, the extension recommendations currently available for crops other than maize in high potential regions and for all crops in the semi-arid zones need reconsideration. Recommended technologies are not being adopted. Neither the research nor extension service has much idea why. In fact, these agencies have barely considered the need to evaluate technology adoption patterns. Though input and product prices have varied considerably over the post-independence period, no economic analysis of extension recommendations has been conducted in order to evaluate input profitability. Yet an appropriate set of recommendations is of critical importance to the success of credit programs and the credibility of field agents.

In conjunction with this, there is substantial scope for promoting the more efficient use of existing maize technologies. In particular, rates and timing of fertilizer usage in Mangwende are extremely variable. Ultimately, more than one fertilizer recommendation for these farmers may be required - e.g. for early versus late plantings, early versus late appliers, or for farmers with more and less severe capital constraints. Only credit recipients use field insecticides. Herbicide experimentation by farmers has failed. The more efficient use of such inputs offers the prospect of substantial increases in enterprise profitability at little additional cost.

Seventh, government efforts to reinforce the often artificial distinctions between grazing land and cropping land need more careful consideration. Efforts ought to be taken to control environmental degradation. Yet the availability of grazing land for crop production provided an important basis for resettling families in the communal areas after the war, and still provide the main source of holdings for new households. Rather than moving families back off the grazing land, measures can be taken to manage cattle and goats more efficiently with limited resources. These include further experimentation with grazing schemes, stall feeding programs, the production of animal feed, more effective use of crop residues and the encouragement of draught power sharing.

8.8 Issues for Future Research

A number of issues are raised by this investigation which merit further analysis. First, the coverage of this analysis of smallholder decision making needs to be extended to encompass a broader range of smallholder farming regions. Resource constraints confined the farm level survey work underlying this inquiry to only two limited smallholder farming regions. As a result, the conclusions drawn have limited applicability to the smallholder sector as a whole. Inferences have been drawn about this relationship which are justified, in part, by the consideration of aggregate sector-wide data. However, the accuracy of these inferences cannot be fully judged without a wider household sample.

Second, the plot level analysis identified substantial variability in maize production practices across, and more significantly, within the two farming regions. Fertilizer application rates are particularly variable. Yields, in each region, display a constant rather than a normal distribution. These differences range across the different plots of a single farm household as well as the plots of neighboring households. Substantial gains may be achieved by simply lifting the yields of the poorest farmers to median levels. But further detailed investigation of production practices and decision making is required to identify how this is possible.

Third, the instability and recent decline in credit acceptance in Mangwende demands investigation. Credit provides the principal source of crop investment capital. Yet many farmers who have participated in the AFC loan program in the past, no longer do so. While some farmers have dropped out after experiencing difficulty repaying loans, others have simply declined to accept new credit which has been offered. Given the apparent severity of farm capital constraints, investigations seeking ways to improve credit use require priority.

Fourth, the link between farm and non-farm enterprises merits further analysis. Ties between male household heads and their farm based families are generally strong. However, off-farm income is not being directly invested into crop production. Instead, schooling investments have become increasingly significant. As a result, Zimbabwe faces an unprecedented increase in secondary school leavers who are seeking off-farm employment. Yet off-farm formal sector jobs are limited. In this context, future research ought to further examine the nature of farm and off-farm household links and assess ways in which these can be encouraged and ways in which they can ultimately stimulate greater investment in crop production.

Fifth, the basic constraints to improving sorghum and millet production require socio-economic as well as agronomic investigation. These drought tolerant crops are not perceived as competitive with maize in semi-arid Chibi. They are grown for their drought tolerance, but consumers strongly prefer maize and this enterprise, accordingly, receives the greatest proportion of inputs and attention. The elasticity of rural consumer preferences for alternative coarse grains should be examined. The significance of labor constraints in sorghum and millet production and processing require measurement. This research should consider the feasibility of strategies designed to promote production of these crops for sale with subsequent purchase of maize required for consumption.

Sixth, research is required on alternative strategies for providing greater input and product market support for farmers in semi-arid and more remote regions. Low input demand and low or inconsistent crop sales increase the costs of both private entrepreneurs and public agencies in meeting production and market needs. As a result, farmers must still travel long distances for major or unusual input purchases. The establishment of collection points in 1985 and their closure in 1986 and 1987 has left farmers unsure of whether they can obtain access to official product markets. These problems particularly affect many of the better producers who may be community leaders and agents of change. Extension support geared toward improving small farmer operated marketing cooperatives provides one alternative option.

APPENDICES

APPENDIX A

SELECTED ZIMBABWE AGRICULTURAL SECTOR DATA

Table A.1. Zimbabwe Maize Production 1970-1986 (1000 MT)

Harv. Year	Large Scale Commercial	Small Scale Commercial	Reset- tlement	Communal	Communal as a % Total
1970	839.6	a	-	245.7	22.6
1971	1400.4	a	-	455.0	24.5
1972	1762.1	a	-	555.1	24.0
1973	810.4	a	-	145.0	15.2
1974	1634.4	a	-	470.0	22.3
1975	1328.1	a	-	435.0	24.7
1976	1287.8	a	-	550.0	29.9
1977	1213.3	a	-	400.0	24.8
1978	1178.2	a	-	450.0	27.6
1979	705.0	35.0	-	420.0	36.2
1980	887.0	38.0	-	700.0	43.1
1981	1713.0	97.0	b	957.0	34.6
1982	1121.0	70.0	b	595.0	33.3
1983	576.0	23.0	b	285.0	32.2
1984	817.0	12.0	b	454.0	35.4
1985	1180.0	68.0	117.0	1585.6	53.7
1986	1133.0	64.0	148.0	1200.0	47.2
1987(est)	440.0	21.4	109.3	360.0	38.7

a = included in large scale commercial estimate
b = included in communal estimate

Sources: Data for 1970-78 - CSO. (1985) Statistical Yearbook of Zimbabwe 1985. Harare.

Data for 1979 - AMA. (1986) 1985-86 Grain Situation and Outlook Report. Harare.

Data for 1980-86 - AMA. (1987) 1986-87 Grain Situation and Outlook Report. Harare.
except for data for resettlement and communal production in 1985 & 1986 which is from the CSO Crop Forecasting Committee Estimates.

Data for 1987 - CSO Crop Forecasting Committee Estimate (First).

Table A.2. Zimbabwe Maize Area 1970-1987 ('000 HA)

Harv. Year	Large Scale Commercial	Small Scale Commercial	Reset-tlement	Communal	Communal as % of Total
1970	292.0	a	-	610.8	67.7
1971	384.0	a	-	672.0	63.6
1972	338.0	a	-	664.7	66.3
1973	315.3	a	-	475.0	60.1
1974	311.1	a	-	725.0	70.0
1975	278.2	a	-	725.0	72.3
1976	257.3	a	-	760.0	74.7
1977	264.4	a	-	600.0	69.4
1978	273.1	a	-	700.0	71.9
1979	191.0	30.0	-	600.0	73.1
1980	218.0	31.0	-	900.0	78.3
1981	287.0	39.0	b	1114.0	77.4
1982	262.0	46.0	b	1100.0	78.1
1983	223.0	49.0	b	1050.0	79.4
1984	190.0	30.0	b	1136.0	83.8
1985	200.0	40.0	51.0	1137.0	79.6
1986	200.0	40.0	74.0	1000.0	76.1
1987(est)	110.0	35.7	121.4	900.0	77.1

a = included in large scale commercial estimate
b = included in communal estimate

Sources: Data for 1970-78 - CSO. (1985) Statistical Yearbook of Zimbabwe 1985. Harare.

Data for 1979 - AMA. (1986) 1985-86 Grain Situation and Outlook Report. Harare.

Data for 1980-86 - AMA. (1987) 1986-87 Grain Situation and Outlook Report. Harare.
except for data for resettlement and communal area in 1985 & 1986 which is from CSO Crop Forecasting Committee Estimates.

Data for 1987 - CSO Crop Forecasting Committee Estimate (First)

Table A.3. Zimbabwe Maize Yields 1970-1986 (KG/HA)

Harv. Year	Large Scale Commercial	Small Scale Commercial	Resettlement	Communal
1970	2875	a	-	402
1971	4607	a	-	677
1972	5213	a	-	835
1973	2570	a	-	305
1974	5254	a	-	648
1975	4774	a	-	600
1976	5005	a	-	724
1977	4590	a	-	667
1978	4374	a	-	643
1979	3699	1167	-	700
1980	4066	1226	-	778
1981	5975	2522	b	859
1982	4277	1518	b	541
1983	2582	472	b	271
1984	4300	400	b	400
1985	5900	1700	2300	1394
1986	5688	1600	2000	1200
1987(est)	4000	600	900	400

a = included in large scale commercial estimate
b = included in communal estimate

Sources: Data for 1970-78 - CSO. (1985) Statistical Yearbook of Zimbabwe 1985. Harare.

Data for 1979 - AMA. (1986) 1985-86 Grain Situation and Outlook Report. Harare.

Data for 1980-86 - AMA. (1987) 1986-87 Grain Situation and Outlook Report. Harare.
except for data for resettlement and communal yield in 1985 & 1986 which is from CSO Crop Forecasting Committee Estimates.

Data for 1987 - CSO Crop Forecasting Committee Estimate (First)

Table A.4. Zimbabwe Maize Sales to GMB 1970-1987 ('000 MT)

Harv. Year	Large Scale Commercial	Small Scale Commercial	Reset- tlement	Communal	Communal as % of Total
1970	616.0	a	-	12.0	
1971	1061.0	a	-	51.0	
1972	1340.0	44.2	-	14.8	1.1
1973	540.0	a	-	11.0	
1974	1290.0	33.2	-	13.8	1.0
1975	958.0	31.3	-	17.7	1.8
1976	875.0	50.7	-	33.3	3.5
1977	856.8	45.1	-	39.2	4.2
1978	813.4	33.2	-	30.4	3.5
1979	473.7	18.8	-	19.4	3.8
1980	728.6	19.7	-	66.6	8.2
1981	1650.6	72.8	b	290.5	14.4
1982	1021.9	53.0	b	316.4	22.7
1983	464.5	15.4	b	137.0	22.2
1984	552.0	55.7	b	334.3	36.7
1985	1009.0	152.1	b	666.9	36.5
1986(est)	983.6	39.0	105.0	480.2	29.9
1987(est)	290.0	15.4	56.3	160.0	30.7

a = included in communal estimates
b = included in small scale commercial estimates

Sources:

LSC data 1970-76 from Muir-Leresche (1985).
1977-85 from AMA Grain Situation and Outlook (various issues).
1986-87 from CSO Crop Forecasting Committee Estimate.

SSC data 1970-76 from Muir-Leresche (1985) minus communal data from GMB files.
1977-85 from AMA Grains Situation and Outlook (various issues) minus communal data from GMB files.
1986-87 from CSO Crop Forecasting Committee Estimate.

Communal 1970-85 [except 1970, 71, 73] from GMB files; 1970, 1971 and 1973 from Muir-Leresche (1985).
1986 estimate based on GMB files data for 31 October 1986.
1987 from CSO Crop Forecasting Committee Estimate.

Table A.5. Zimbabwe Maize Stocks, Purchases and Sales 1970-86 ('000 MT)

Harvest Year	Purchases Local	Purchases Imports	Sales Local	Sales Exports	Closing
1970	628.0	-	410.0	243.0	59.0
1971	1112.3	-	310.5	716.5	142.0
1972	1400.2	-	213.9	891.2	412.0
1973	550.4	-	446.5	356.8	158.0
1974	1336.9	169.0	371.4	710.0	408.0
1975	1006.9	-	386.5	758.2	263.0
1976	958.5	-	392.7	297.3	530.0
1977	941.1	-	503.9	419.7	538.0
1978	877.0	-	545.3	553.5	310.0
1979	511.9	149.0	635.1	265.2	64.8
1980	814.8	83.4	716.1	86.3	157.9
1981	2013.8	-	664.9	305.1	1200.7
1982	1391.3	-	1046.2	492.0	1035.1
1983	616.9	-	1273.2	252.3	122.7
1984	942.0	269.0	860.0	-	462.0
1985	1828.0	-	560.0	285.0	1426.0
1986(est)	1677.6	-	650.0	480.0	1884.7

Source: AMA Grains Situation and Outlook (various issues). AMA Economic Review of the Agricultural Industry of Zimbabwe, 1985.

Table A.6. Zimbabwe Maize Prices 1970-1986

Harvest Year	Pre-planting Price	Prescribed Price a/	Final Price	Selling Price
1970	-	32.97	38.43	46.33
1971	-	30.05	32.51	46.33
1972	-	25.88	30.38	46.56
1973	-	36.37	38.17	46.56
1974	-	40.11	43.51	43.24
1975	-	37.00	48.25	51.54
1976	42.00	44.00	48.00	51.54
1977	46.00	52.00	52.00	51.54
1978	48.00	53.00	53.00	57.07
1979	56.00	60.50	60.50	63.00
1980	75.00	85.00b/	85.00	89.00
1981	120.00	120.00	120.00	137.00
1982	-	120.00	120.00	137.00
1983	-	120.00	120.00	157.00d/
1984	140.00	140.00c/	140.00	177.00e/
1985	180.00	180.00	180.00	222.00f/
1986	-	180.00	180.00	222.00
1987	-	180.00	180.00	222.00

/a = grade A maize
/b = $5/tonne bonus for 15% incr in area planted; early delivery bonus: $10/tonne to 30 April; $5/tonne to 31 May.
/c = early delivery bonus: $20 to 30 April; $15 for May; $10 for June.
/d = with effect from 5 Sept 83
/e = with effect from 20 July 84
/f = with effect from 1 Aug 85

Sources: AMA Economic Review of the Agricultural Economy 1985.
AMA Grain Situation and Outlook 1986/87.
Mudimu (1987) personal communication.

Table A.7. Zimbabwe Fertilizer Prices, 1971-1986 (Z$/tonne ex-Harare)

Cropping Season	Comp D	AN
1971/72	55.40	63.20
1972/73	55.40	63.20
1973/74	55.40	63.20
1974/75	66.60	74.20
1975/76	91.40	127.40
1976/77	99.40	116.40
1977/78	106.00	129.40
1978/79	114.20	138.80
1979/80	128.20	141.60
1980/81	154.00	168.20
1981/82	168.00	187.20
1982/83	189.40	206.80
1983/84	189.40	206.80
1984/85	331.00	347.21
1985/86	355.60	406.00
1986/87	355.60	406.00

Source: Windmill (1986)

Table A.8. Zimbabwe Population 1970-86. ('000)

1970	5400
1971	5590
1972	5780
1973	5980
1974	6180
1975	6390
1976	6600
1977	6810
1978	7020
1979	7240
1980	7480
1981	7730
1982	7600
1983	7820
1984	8047
1985	8280
1986	8520
1987	8767

a = based on projection from 1982 census estimate of 2.9% annual population growth rate.

Source: CSO (1986b)

Table A.9. Land Distribution by Natural Region 1980 ('000 HA)

Natural Region	Large Scale Commercial		Small Scale Commercial		Communal	
	HA	%	HA	%	HA	%
I: Specialized and diversified	430	2.7	10	0.7	140	0.9
II: Intensive	4330	27.6	250	17.6	1270	7.8
III: Semi-intensive	3240	20.7	540	38.0	2820	17.2
IV: Semi-extensive	4020	25.7	520	36.6	7340	44.9
V: Extensive	3650	23.3	100	7.0	4780	29.2
TOTAL	15670	100.0	1420	99.9	16350	100.0

Source: CSO (1985a).

Table A.10. Zimbabwe GDP at Factor Cost by Industry of Origin 1974-1985 (Z$ million at 1980 prices)

Year	Ag & For.	Mining	Manufact	Total
1974	315	136	421	1791
1975	323	131	447	1902
1976	350	152	480	2064
1977	334	149	460	2069
1978	292	156	514	2257
1979	325	226	623	2651
1980	458	285	802	3226
1981	649	250	1016	4049
1982	662	217	1121	4609
1983	592	284	1385	5081
1984	673	330	1565	5686
1985				

Source: CSO (1986b)

Table A.11. Zimbabwe Income Per Capita 1974-1984 (Z$)

Year	GDP a Current	Constant	GDP Deflator	Estimated Population
1974	306	557	0.571	6080
1975	318	520	0.608	6280
1976	334	498	0.665	6490
1977	328	425	0.718	6700
1978	341	418	0.790	6920
1979	404	426	0.915	6993
1980	478	478	1.000	7198
1981	598	537	1.111	7410
1982	675	519	1.264	7628
1983	762	513	1.443	7852
1984	810	500	1.652	8083

Source: MFEPD (1986)

Table A.12. Zimbabwe Gross Agricultural Output & Index of Producer Prices, 1975-1985 (Z$ million)

Year	Communal Sales to Mkt Auth	Communal Retentions	Commercial Output	Ntnl Gross Output	Implied Deflator 1980=100
1975	26.6	68.6	362.7	457.9	63.3
1976	28.2	90.2	383.0	491.4	66.3
1977	22.0	84.0	393.4	499.4	68.9
1978	22.5	51.8	409.8	484.1	72.7
1979	16.9	85.5	410.0	512.3	77.9
1980	28.9	117.1	565.5	711.5	100.0
1981	79.5	185.1	756.9	1021.5	124.0
1982	84.6	186.7	808.7	1080.0	131.7
1983	68.7	97.8	802.6	969.1	149.0
1984	128.2	139.6	982.2	1250.0	167.9
1985					

Source: CSO (1986b)

Table A.13. Zimbabwe Statuatory Minimum Wage Rates 1980-85 (Z$)

Year	Domestic Serv	Agriculture	Mining	Industry
1980	30	30	43	70
1981	30	30	58	85
1982	50	50	105	105
1983	55	55	110	115
1984	65	65	120	125
1985	75	75	143.75	143.75
1986	85	85		

Source: MFEDP (1986).

Table A.14. Zimbabwe Consumer Price Indices, 1970-1985 (1980=100)

Year	High Income Urban		Low Income Urban		Retail Roller Meal (c/kg)
	Food	All	Food	All	
1970	46.0	50.0	50.6	48.4	33.1
1971	47.2	51.6	51.8	49.9	34.9
1972	49.5	53.8	53.2	51.3	34.8
1973	51.2	55.8	55.5	52.9	34.2
1974	56.7	60.0	59.3	56.4	36.0
1975	61.4	64.6	66.8	62.1	42.7
1976	66.9	70.4	72.1	68.9	43.7
1977	73.5	77.1	78.3	76.0	44.0
1978	82.1	82.3	86.1	83.4	49.4
1979	91.3	91.6	96.5	94.9	52.9
1980	100.0	100.0	100.0	100.0	50.9
1981	113.4	114.6	112.0	113.1	51.5
1982	126.3	135.7	123.8	125.2	57.6
1983	152.1	158.0	159.1	154.1	92.3
1984	183.8	177.7	198.8	185.2	113.0
1985	200.6	195.3	212.3	200.9	137.0

Sources: CSO (1986b)
Buccola (personal communication).

Table A.15. Zimbabwe Rainfall, 1969-1986 (mm)

	Belvedere Meterological Station			Chibi Central Station		
Year	January	February	Total	January	February	Total
1969	187.6	61.0	248.6	117.3	24.5	141.8
1970	83.6	37.3	120.9	2.0	46.0	48.0
1971	132.6	129.8	262.4	275.8	17.5	293.3
1972	352.3	149.6	501.9	302.4	130.1	432.5
1973	193.4	22.8	216.2	94.0	18.5	112.5
1974	141.8	324.0	465.8	97.6	103.7	201.3
1975	115.2	348.4	463.6	94.8	160.4	255.2
1976	265.0	107.8	372.8	66.1	164.6	230.7
1977	101.8	385.4	487.2	54.5	350.2	404.7
1978	280.7	246.3	527.0	178.0	54.5	232.5
1979	161.7	67.0	228.7	101.0	90.5	191.5
1980	102.5	93.7	196.2	74.5	175.0	249.5
1981	140.8	394.5	535.3	254.1	105.0	359.1
1982	138.2	185.2	323.4	169.5	74.5	244.0
1983	115.9	57.0	172.4	27.0	34.6	61.6
1984	115.8	124.8	240.6	26.5	107.0	133.5
1985	379.1	107.8	486.9	277.0	84.2	361.2
1986				70.0	0.0	70.0

Sources: 1969-85 Meterological Service.
1986 FSRU (personal communication).

APPENDIX B

MAIZE ENTERPRISE BUDGET PARAMETERS

Table B.1 Mangwende Enterprise Budget Parameters

Parameter Value	Unshelled Groundnuts	Low Input Maize	Medium Input Maize	High Input Maize
Yield: MT/HA	0.52	0.53	2.32	3.25
Seed Rate: KG/HA	120	27	29	28
Basal Fertilizer				
Compound D: KG/HA	0	0	176	369
Top Dressing Fertilizer				
Ammonium Nitrate: KG/HA	0	0	200	288
Insecticide				
Thiodan: KG/HA	0	0.1	0.6	0.7
Credit Received: $Z	0	0	132.6	214.7
Labor Mandays Per Hectare				
Total	149	112	209	259
Excl. Post-Harvest	141	95	135	155

Table B.1 (cont'd)

	Crop Enterprise Prices		
	a/ 1974/75	b/ 1980/81	c/ 1985/86
Producer Prices			
Maize: $Z/MT	141.27	234.74	180.00
Groundnut: $Z/MT	546.68	534.04	478.50
Seed Prices			
Maize: $Z/KG	0.47	0.67	0.79
Groundnut: $Z/KG	0.80	0.82	0.75
Compound D Price: $Z/KG	0.22	0.30	0.35
Am. Nitrate Price $Z/KG	0.24	0.33	0.41
Thiodan Price $Z/KG	-	0.78	0.75
Interest Rate: %	0.13	0.13	0.13
Loan Application: $Z	-	9.78	5.00
Transport			
Fertilizer: $Z/50 KG	3.25	1.98	1.00
Crop: $Z/Bag	4.06	2.45	1.25
Marketing Bags: $Z/Bag	0.29	0.18	0.09
Opportunity Costs			
Labor: $Z/Manday	1.62	1.47	1.00
Ploughing: $Z/HA	32.47	19.56	10.00

a/ no credit and insecticide use; deflated by GDP Deflator: 30.80
b/ deflated by GDP Deflator: 51.12
c/ current prices

Table B.2 Chibi Enterprise Budget Parameters

Parameter Value	Unshelled Groundnuts	Low Input Maize	Medium Input Maize
Yield: MT/HA	0.38	0.46	1.16
Seed Rate: KG/HA	120	24	27
Basal Fertilizer			
Compound D: KG/HA	0	0	71
Top Dressing Fertilizer			
Ammonium Nitrate: KG/HA	0	0	65
Insecticide			
Thiodan: KG/HA	0	0	0.14
Credit Received: $Z	0	0	19.88
Labor Mandays Per Hectare			
Total	161	102	159
Excl. Post-Harvest	133	85	118

	Crop Enterprise Prices		
	a/ 1974/75	b/ 1980/81	c/ 1985/86
Producer Prices			
Maize: $Z/MT	141.27	234.74	180.00
Groundnut: $Z/MT	546.68	534.04	478.50
Seed Prices			
Maize: $Z/KG	0.47	0.67	0.79
Groundnut: $Z/KG	0.80	0.82	0.75
Compound D Price: $Z/KG	0.22	0.30	0.35
Am. Nitrate Price $Z/KG	0.24	0.33	0.41
Thiodan Price $Z/KG	-	0.78	0.75
Interest Rate: %	0.13	0.13	0.13
Loan Application: $Z	-	9.78	5.00
Transport			
Fertilizer: $Z/50 KG	6.49	3.91	2.00
Crop: $Z/Bag	9.74	5.87	3.00
Marketing Bags: $Z/Bag	0.29	0.18	0.09
Opportunity Costs			
Labor: $Z/Manday	1.62	1.47	1.00
Ploughing: $Z/HA	32.47	19.56	10.00

a/ no credit and insecticide use;
deflated by GDP Deflator: 30.80
b/ deflated by GDP Deflator: 51.12
c/ current prices

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THE GROWTH OF SMALLHOLDER MAIZE PRODUCTION IN ZIMBABWE: CAUSES AND IMPLICATIONS FOR FOOD SECURITY

By

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A DISSERTATION

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