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ASSESSING THE IMPACT OF HIGH-YIELDING VARIETIES OF MAIZE IN RESETTLEMENT AREAS OF ZIMBABWE

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Abstract

This study is part of a larger effort to explore the impact of agricultural research on poverty reduction. It examines the diffusion and impact of hybrid maize in selected resettlement areas of rural Zimbabwe, paying particular attention to varieties made widely available from the mid-1990s onwards. While "Zimbabwe's Green Revolution" of the early 1980s was characterized by the widespread adoption of hybrid maize varieties and significant increases in yields, the subsequent diffusion of newer varieties occurred more slowly and had a more modest impact. Several factors account for this. Government now plays a much-reduced role and one that increasingly focuses on "better farmers." Private-sector institutions that have entered the maize sector operate mainly in areas of high agricultural potential. Consequently, "adoption" partly reflects "choice" but also the (sometimes) limited physical availability of varieties. A further factor is the nature of the technology being introduced. Newer varieties are bred to meet the evolving needs of commercial farmers, but these new needs—most notably improved disease resistance—are not shared by the farmers in our survey and are not associated with significantly higher yields where use of fertilizers is limited. A further consideration is that information is disseminated via multiple channels and in a fragmentary fashion in an environment where tolerance of dissent is limited, the behavior of neighbors is viewed suspiciously and some actors involved in dissemination (such as extension workers) are increasingly viewed with mistrust. The presumption that farmers "learn from each other" is less applicable in circumstances such as these.

Our case studies indicate links between the production of maize in excess of subsistence needs, the accumulation of assets such as livestock and tools, payment of school fees, and the acquisition of inputs such as fertilizer and labor for the subsequent cropping season. This coincides with the views of farmers who see high-yielding varieties of maize as an influential factor in raising livelihood above the level of poverty that prevailed when they first moved into the area. However, new varieties appear to have increased incomes only marginally. When we control for farmer characteristics and

the endogeneity of adoption, use of these new varieties increases crop incomes only by about 10 percent; a 10-percent increase in maize income is associated with an increase in livestock holdings ranging from 4 to 12 percent. However, these modest impacts result in an improved ability to deal with vulnerability. Hybrids do raise productivity in maize production. Higher income from maize, and from other crops, leads to investment in livestock. And livestock holdings are an important means through which child health is protected when drought occurs. All such changes are associated with an improvement in well-being and a reduction in poverty.

Keywords: poverty, agricultural research, sustainable livelihoods, vulnerability, agricultural extension, social capital, hybrid maize, Zimbabwe

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Acknowledgments

This summary was prepared by Michael Bourdillon, Paul Hebinck, and John Hoddinott, based on a longer document (Bourdillon et al. 2002) to which all team members contributed. Interested readers are encouraged to obtain this paper, as it fully documents the findings described here, as well as providing additional results. We thank seminar participants in Harare and Washington as well as Michelle Adato, Tony Bebbington, Jere Behrman, Robert Chambers, Lawrence Haddad, Peter Hazell, and Ruth Meinzen-Dick for helpful comments. Addresses for correspondence: mbourdillon@esanet.zw; paul.hebinck@wur.nl; j.hoddinott@cgiar.org.

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1. Introduction

High-yielding varieties (HYVs) of maize have been widely adopted in Zimbabwe. Although germplasm from the Consultative Group on International Agricultural Research (CGIAR) system was used in the development of these hybrid maize varieties, further research and dissemination activities involved organizations in both private and public sectors. Further, while adoption of earlier hybrids was widespread—in 1985, more than 85 percent of smallholder maize area was planted with hybrid maize and production doubled over the period 1979–85—rural poverty and child malnutrition remain endemic. Some argue that the gains from these hybrids have been concentrated on a few agroclimatic areas and that there has been little impact on child nutritional status. This possibility has implications for policy debates, not only about raising nutritional status within Zimbabwe, but also about the CGIAR system and its mandate to link improvements in agricultural technology to better nutrition.

This study, which forms part of a larger effort to explore the impact of agricultural research on poverty reduction, probed the relationship between high-yielding hybrid varieties of maize and the reduction of poverty by looking at two communities of resettlement farmers, comparing long-term surveys of their situation with detailed knowledge of selected cases to obtain the perspectives of the farmers and their families. The study examines the diffusion and impact of hybrid maize in selected resettlement areas of rural Zimbabwe, paying particular attention to varieties made widely available from the mid-1990s onward.

Drawing on the Sustainable Livelihoods Framework (SLF), we address three questions:

1. What factors have affected the diffusion of new maize hybrids in the 1990s?
2. How did the introduction of maize hybrids influence the development of asset bases, livelihood strategies, and livelihood outcomes?

3. What is the relationship between these asset bases, livelihood strategies, and nutrition outcomes?

This paper summarizes our findings. It begins with a description of the research methods used and the localities in which primary data collection were situated. It then provides an overview of the analysis of these questions. The final section summarizes results, discusses methodological issues, and comments on future directions for hybrid maize in Zimbabwe. The full report for this case study (Bourdillon et al. 2002) provides considerably more detail on the issues and findings raised here.

2. Methodology

A further motivation for the inclusion of this case study was the existence of a unique, longitudinal survey, covering three resettlement schemes (Mupfurudzi, Sengezi, and Mutanda) in different agroecological zones of Zimbabwe. The initial survey was conducted in 1983–84, and the sample households were reinterviewed in the first quarter of 1987 and annually, during January-April, since 1992. These surveys contain extensive information, inter alia, on agricultural activities, nonfarm activities, assets, and child nutritional status. On two occasions, it was possible to include questions on the adoption of hybrid maize varieties.

While these surveys were rich in quantitative data and there was little sample attrition, there remained substantial information gaps. To address these, the case study commenced with a workshop in Harare where stakeholders were invited to identify, discuss, and prioritize research questions. We took the SLF, added the comments of stakeholders, and developed a research design matrix (see Table II.1 in the full report). We determined that qualitative field methods and analysis would allow us to understand more fully the vulnerability context and obtain participant-defined characterizations of livelihood strategies and outcomes.

In implementing the qualitative fieldwork, we decided to mix approaches. The core method was series of household-level case studies, supplemented by participant observation in villages found in two resettlement areas. The plan was that fieldworkers would reside for six months in these areas and collect material for their cases studies based on issues that came up in the stakeholder workshop. This would be followed by focus-group discussions in the selected villages, together with some focus-group discussions in the third resettlement area to confirm findings of individual case studies, reconcile divergent findings, and allow a wider range of voices to be heard. Because of the deteriorating political situation, the fieldworkers were in each area for only four-and-a-half months.

The first step was to choose villages for the case studies. In addition to logistical considerations, the choice was based on information gleaned from the quantitative surveys to ensure that we had villages with different histories of adoption of maize hybrids. We selected two villages in Mupfurudzi and Sengezi (reduced from a planned three). In each village, the quantitative data were used to profile all households included in the longitudinal study, including demographic characteristics, maize varieties grown in the last five years, time of adoption of new hybrids, whether the household also grew other cash crops, and wealth estimated by holdings of livestock, housing quality, and ownership of physical assets. Fieldworkers selected respondents guided by a summary of this quantitative information. We also included three people not in the quantitative study, two who were politically important and wished to be in the study, and one who was of interest because he was using maize as part of a cattle-feeding project.

A legitimate concern associated with the use of case studies is the degree to which they represent the broader population. There is a danger that the interactions between locally resident enumerators and respondents will lead to a selection of case studies, which while interesting, are too idiosyncratic to be informative of broader tendencies. Given this concern, Table 1 indicates that in terms of two types of observable characteristics: demographic and rates of adoption, the case study households are, on average, broadly similar to other households in the same settlement scheme.

Table 1—Characteristics of households selected for case studies

	Settlement scheme data source			
	Mupfurudzi		Sengezi	
	Case studies	Longitudinal data	Case studies	Longitudinal data
Characteristic				
Mean household size	9	9	7	7
Mean age of head	62	56	57	58
Proportion of female-headed households (percent)	28	23	31	33
Households adopting HYVs (percent) in				
1995/96	21	34	12	23
1997/98	64	65	38	30
1999/2000	100	90	100	71

The case studies involved a series of visits of differing duration as well as participant observation work. A fuller understanding of certain processes can be enhanced through direct observation—seeing the pathways through which information and seeds enter a community rather than relying on how these are reported; attending field demonstrations to see how these function, and so on. Further, a significant attraction of collecting case study narratives with both historical and current content is that they can be compared with the household survey data.

Political tensions curtailed the program. The focus group discussions were not conducted in Mupfurudzi. In Sengezi, before the fieldworker was withdrawn, he held discussions with 14 informal groups of 3–10 people. Half of these groups consisted of youths. They covered topics identified in the midterm seminar as of interest for wider comment, principally critical events in the area that had affected the whole village, confusions surrounding advice from AGRITEX agents,[1] and investment in communal capital. In both study areas, we attended various village meetings where information on various issues was disseminated, especially issues of community governance. We also carried out a series of key informant interviews, both in the field and in Harare, to tap information available from persons with specialist knowledge. Interviews were conducted in Harare and in the field.

[1] AGRITEX agents are employees of the Department of Agricultural Technical and Extension Services.

3. Hybrid Maize in Zimbabwe

The development of improved varieties of maize in Zimbabwe began in the early 1900s when a department of agriculture was established to reorganize agricultural production through insights from agrarian sciences. In 1919, commercial farmers founded the Maize Breeders Association to promote selection and production of better seed and scientific maize breeding started in 1933 (Mashingaidze 1994). The first hybrid maize varieties bred outside the United States were produced to fit the country's climate. Commercial farmers established the Seed Maize Association of Southern Rhodesia in 1940 to ensure the timely production and supply of high-quality seed. Experiments in the post-1945 period showed that these new hybrids provided significantly higher yields in both normal and drought years (Rattrary 1956). A second milestone was the release in 1960 of SR52, the world's first single-cross hybrid. By 1970, 98 percent of Zimbabwe's commercial maize area was planted to SR52.[2] In the late 1960s, attention shifted to breeding three-way-cross hybrids, such as R201 and R215, which showed good adaptation to areas of unreliable rainfall and sandy soils (Masters 1994; also World Bank 1991). In 1973, the Plant Breeders' Right Act was passed to protect ownership of maize varieties. Subsequently, the Seed Maize Association established the country's first private research station in 1974, which tested experimental varieties that came out of public research programs.

After Independence in 1980, the state-funded maize-breeding program was decimated by loss of experienced staff and severe funding reductions. Public-sector breeding efforts were boosted in 1985 with the arrival of the Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT) in Harare, which introduced both expertise and germplasm. In 1983, the Zimbabwe Seed Maize Association and the Crop Seeds

[2] Initially, breeders did not consider the needs of smallholder farmers in communal areas. In the mid-1950s, the Department of Agriculture began developing maize varieties that would be suitable for areas with less rainfall, where most communal farmers lived. The program generated four improved OPVs and one top-cross hybrid. However, only the hybrid variety was released and the breeding program was eventually discontinued.

Association merged to form the Seed Co-operative Company of Zimbabwe (Seed Co), which initially worked in cooperation with the government. Changes in policy in 1995 cleared the way for increased foreign investment in Zimbabwe's maize seed industry. Although Seed Co now faces competition from large international seed companies, which invest more resources in maize breeding than the government and CIMMYT combined, it remains the most important player in Zimbabwe's maize seed industry.

The most dramatic change in the early postindependence period was in the pattern of usage of hybrids. Between 1950 and 1975, adoption was largely limited to commercial farmers. Subsequently, agricultural extension workers started to encourage the adoption of hybrids among communal farmers as a way to ensure national food self-sufficiency. These efforts were complemented by government investments in rural infrastructure. In the postindependence period, adoption of R201 and R215 ("first generation hybrids") skyrocketed (see Rohrbach 1988), with dramatic increases in yield (Rukuni and Eicher 1994).

In the last 10 years, Seed Co's maize breeding program has paid more attention to resistance to diseases of concern to commercial farmers and improved drought tolerance, rather than increased yields. Consequently, Seed Co now produces a wide variety of hybrid maize seeds ("second-generation hybrids") with these improved traits, although these improvements may not be visible to all farmers. These are the SC40x, SC50x, and SC60x series of seeds (see Bourdillon et al. 2002, for a more detailed description). These new varieties are marketed to farmers in a number of ways, including field days and trial or demonstration units, advertisements in the print and electronic media, and the production and dissemination of seed manuals written in both Shona and English. Institutions that provide inputs or input loans (such as the Grain Marketing Board) also

play a part in the diffusion of new hybrid varieties as does AGRITEX. As of 2000–01, Seed Co has discontinued production and dissemination of R201 and R215.[3]

4. The Study Area

Background

The study areas are three resettlement schemes: Mupfurudzi in Mashonaland Central (which is north of Harare), Sengezi in Mashonaland East (east of Harare), and Mutanda in Manicaland (southeast of Harare but farther away than Sengezi). As the history of the people in these resettlement areas is somewhat unusual, we provide an introduction to their background.

Access to land has long been an issue of major economic and political importance in Zimbabwe. Anger at the gross disparities in landownership between blacks and whites was a rallying point during Zimbabwe's liberation struggle and the new ZANU-PF government saw it fit to immediately deliver on some of its promises to redistribute land equitably. As part of this commitment, households were resettled on farms previously occupied by white commercial farmers, in most cases in peripheral areas bordering on communal areas. Initially land was acquired for resettlement on a willing-seller/willing-buyer basis. The farmers in Sengezi, Mupfurudzi, and Mutanda are among the 56,000 families resettled by the government immediately after independence. The vast majority of farmers in Sengezi joined the resettlement scheme in 1980 because they had no lands in the villages where they lived; most of those in Mupfurudzi settled in 1981; and farmers in Mutanda moved into their villages in 1981 and 1982.

Criteria for selection into these schemes included being a refugee or other person displaced by war, unemployed, a landless resident in a communal area, or having

[3] Recognizing that many popular hybrids were poorly adapted to the marginal production conditions faced by most communal farmers, Seed Services (Zimbabwe's sole seed certification authority) introduced Kalahari Early Pearl, an improved OPV from Botswana, and persuaded a number of local companies to multiply this seed for distribution. But the Ministry of Trade and Commerce prohibited the sale of OPV seed. Seed Co now produces OPVs only for sale in neighboring countries.

insufficient land to maintain one's family (Kinsey 1982). In our sample areas, some 90 percent of households settled in the early 1980s had been adversely affected by the war for independence in some form or another. Before resettlement, most (66 percent) had been peasant farmers with the remainder being landless laborers on commercial farms, refugees, or workers in the rural and urban informal sectors. At the time of settlement, the household heads were also supposed to be married or widowed, age 25–50, and not in formal employment. Families selected for resettlement were assigned to these schemes, and the consolidated villages within them, largely on a random basis.

Families settled on these schemes were required to renounce any claim to land elsewhere in Zimbabwe. They were not given ownership of the land on which they were settled, but were instead given permits covering residential and farm plots. Each household was allocated 5 hectares of arable land, with the remaining area in each resettlement site being devoted to communal grazing. In return for this allocation of land, the Zimbabwean government expected male heads of households to rely exclusively on farming for their livelihoods. Until 1992, male household heads were not permitted to work elsewhere, nor could they migrate to cities and leave their wives to work the plots. Although this restriction has been relaxed, with male heads being allowed to work off-farm (provided that household farm production is judged satisfactory by local government officials), in this sample agriculture continues to account for at least 80 percent of household income in nondrought years.

Resettlement was intended to create a rural farming community that would move from subsistence to commercial production. The government worked to provide an enabling environment for sustainable economic growth in the resettlement areas. It provided appropriate infrastructure, such as roads, to ensure the successful marketing of produce: in Sengezi and Mupfurudzi (and to a lesser extent Mutanda), there are well-developed road networks. The government provided housing units, clinics, and schools in the resettlement villages to improve production and the quality of life. Initially, the government provided widespread access to agricultural extension services, with virtually all resettled farmers being visited by AGRITEX staff in the early 1980s. Loan facilities

were made available to the farmers through the Agriculture Finance Corporation. Through its seed packs given to resettled families in 1980, the government was a vehicle for the initial diffusion of the R215 and R201 hybrid maize varieties.

Institutions, People, and Structures

Governance and Access to Power

In both Mupfurudzi and Sengezi, farmers remain loyal to ZANU (PF), which is seen to have helped them in the past. The ruling party is a visible actor in the resettlement villages and there is no tolerance of dissent. The party imposes strict rules that control the behavior and activities of other organizations and their personnel in the area. Agricultural extension officers, teachers, and nurses are expected to support party views.

All respondents maintained that there was no relationship between power and wealth, and in Sengezi, positions of authority relate to participate in the liberation war rather than wealth. Nevertheless, in Mupfurudzi wealth brings influence: at the *dare* (community court), the people who dominate the discussions or whose views merit serious consideration are the wealthy. The most influential people in both villages were usually the rich people, the more successful farmers, and those holding political office. The top political offices at district level were held only by wealthier people. Another limited form of power is a relationship with traditional spirits or a reputation for powers of witchcraft.

Institutions

A number of institutions operate in these areas, including Seed Co and AGRITEX. The seed from Seed Co are used in Mupfurudzi, Sengezi, and Mutanda. Seed Co's direct presence is most marked in Sengezi, where it sponsors a demonstration plot as well as displays maps and charts indicating the varieties suited to different areas. These maps are displayed in stores in Wedza, where farmers from Sengezi buy their seed.

In contrast, these were not displayed in Mupfurudzi in 2000. Agricultural extension officers employed by AGRITEX perform a number of roles including running periodic courses (including those leading to a master farmer's certificate), holding field days prior to the planting period, and visiting farmers' fields. Seed Co works with AGRITEX, historically an important mechanism through which technical information is passed to farmers. AGRITEX staff played an important role in the dissemination of hybrid maize in the immediate postindependence period, and helps with local trial plots of new varieties of seeds.

In these localities, farmers perceive that AGRITEX officials focus on the best—and therefore the wealthiest—farmers, although the official policy is that all farmers should receive help. Nevertheless, farmers growing cash crops still receive priority. We were struck by discrepancies between official policies of Harare and the reported practices of officers in the field. The fact that AGRITEX incorrectly predicted drought in the 1999/2000 season and the current political climate has lead to an increasingly mistrustful atmosphere. Some Mupfurudzi farmers view the phasing out of the older "more reliable" varieties and replacing them with newer "less reliable" varieties as a conspiracy between AGRITEX officers and Seed Co to discredit the government. In Sengezi, AGRITEX officers are said to have only impracticable, book knowledge about maize, but are trusted for advice on the main cash crops.

In addition to AGRITEX and the seed companies, the Grain Marketing Board operates in all survey areas. A number of other organizations—Purity, Farmer's World, Cottco, Cargill, and Agribank—operate only in Mupfurudzi.

Kinship

Kinship has little relevance to the dissemination of technology. There were cases of information being passed through close kin, but even this was very limited when they did not share the household. Although there were many links by marriage in the communities, in-laws maintain social distance and none mentioned in-laws as a source of information about maize. Although intermarriage may lead to social cohesion, it did not

increase the flow of information within the community. When people were asked why they had to go outside the community to obtain information, they pointed out that people are jealous and suspicious and stingy with information. This could be partly explained by tense relations between in-laws, since many of the households are related by marriage.

In Mupfurudzi, relationships that enabled the exchange of information were those based on *usahwira*—formal joking friendships. These are institutionalized friendships and involving much exchange of services and gifts (Bourdillon 1987, 61 ff.). They are taken up by choice (rather than kinship, which is ascribed) and provide a system of support and security in times of need, which in other societies are often attributed to kinship. When asked to mention sources of information on new hybrids, people often mentioned *usahwira,* both outside and within the village. In Sengezi, the communities were more heterogeneous in their origins and had fewer kinship links. Information was shared between people sharing the same totem, and calling each other *sahwira* or interpreted as distant kin.

Gender

Women were not resettled in these villages in their own right. This, together with existing roles of men and women within households, has consequences for the control and use of resources. In the public sphere, men occupy most public positions. In the domestic sphere, men make most decisions, including those related to the disposition of the produce and the proceeds within the households. This unequal distribution of power is reflected in many domestic disputes, which frequently call for the intervention of the village court: women are contesting inequality because they perform most agriculturally demanding tasks. Even in female-headed households, men, such as adult sons, are frequently expected to make most decisions concerning agriculture. In Mupfurudzi, men have better access to inputs and to formal markets. So counting women household heads tells little about gender politics.

Culture, Magic, and Religion

Cultural beliefs are relevant to understanding causes of success and failure in agriculture. In the communities studied, the vast majority believe that magic can affect the performance of one's crops and that it is possible for certain people to steal the yields of others through magical means. People frequently attribute magical powers to those who achieve unusually high yields. Fears and suspicions of witchcraft were pervasive. In Mupfurudzi, they resulted in people being unwilling to show interest in the crops of others. Even to observe how others grow the crops is liable to arouse suspicions of witchcraft. In Sengezi, there is a widespread belief that implements or animals lent to other farmers could be returned bewitched. Belief in witchcraft can inhibit the spread of improved technology.

Vulnerability, Assets, and Livelihoods

Three factors particularly affect the vulnerability of farmers. One is erratic rainfall (see Kinsey 1999), something of considerable concern given reliance on rain-fed agriculture. A second is the HIV/AIDS epidemic. AIDS does affect availability of labor and restrict sources of income. Farmers did not perceive different labor requirements to affect choice of maize varieties, but input requirements are relevant. A third factor is the very volatile economic situation in the country, particularly as it affects the costs of inputs and opportunities for nonagricultural incomes.

When farmers were asked why they perceived themselves to be relatively well-off or relatively poor, the key criterion was ownership or lack of cattle (26.3 percent and 27.1 percent, respectively, Kinsey 1999). Cattle provide draught power, fertilizer supplement, security against drought or other disaster, and a source of cash for inputs or other needs. Other important assets were having enough food (15.8 percent—meaning money available for farming: farmers in Sengezi ranked maize as the most important crop even though they did not use it for cash), having access to remittances of employed family members and to savings (14.4 percent), good farming skills (11.4 percent), having farm

equipment (7.9 percent) and having access to good land (5.7 percent). Relative poverty was blamed on lack of savings and remittances (16.4 percent), lack of farm equipment (15.8 percent), lack of labor (7.9 percent), lack of social support (6.8) percent, lack of food (4.5 percent), and lack of land or good land (4.5 percent).

Crops and livestock are the dominant sources of livelihoods for these households. Crop income is the single most important source of household income, accounting (in nondrought years) for 73 percent or more of total household income and 70 percent of income for households defined as poor. This partly reflects the legal restrictions that limit nonagricultural work by household heads but also the fact that land resettlement endowed these households with, relative to communal area farmers, a relatively large amount of land. The exception to this general pattern is drought years such as 1994/95 when other sources of income—most notably government transfers and dissavings of livestock—play an important role.

5. The Diffusion and Adoption of New Varieties of Hybrid Maize in the Late 1990s

We summarize our findings in three steps: by describing the patterns of adoption of the new hybrids; by exploring the role played by policies, institutions, and processes in the (dissemination and) adoption of these new hybrids; and by assessing the determinants of adoption using econometric techniques.

Patterns of Adoption

Table 2 provides quantitative information on the adoption of hybrids made available in the 1990s (SC 40x, SC50x and SC60x).

The more rapid adoption of these varieties in Mupfurudzi reflects its better agroecological potential for maize as well as the presence of a greater number of organizations. In Mupfurudzi, the newer varieties gradually displace the older hybrids with only little change in total acreage under maize cultivation. In Sengezi and Mutanda,

Table 2—Adoption of new varieties of hybrid maize, by year and location

Year	Proportion of households adopting new varieties of hybrids			Percentage of land sown to new varieties of hybrid maize		
	Mupfurudzi	Sengezi	Mutanda	Mupfurudzi	Sengezi	Mutanda
	(percent)					
1994/95	13.1	2.0	4.6	12.4	5.6	8.3
1995/96	34.1	23.2	13.8	22.6	15.2	20.6
1996/97	47.2	38.4	32.3	35.4	27.7	22.7
1997/98	64.9	30.3	33.8	63.4	41.2	36.6
1998/99	81.1	50.5	56.9	80.6	55.2	54.5
1999/00	90.3	70.7	80.0	90.2	75.0	75.8

adoption of new hybrids coincides with an increase in land devoted to maize cultivation. In Mutanda, mean acreages planted to maize more than doubled. When looking at these data, it is also important to note that the older hybrids—R201 and R215—were gradually withdrawn from production in the late 1990s. Households continuing to use these older varieties are either drawing on stocks of seeds purchased several years earlier, are obtaining these seeds from older inventories held by a merchant or trader or are using seeds from the previous harvest.

An interesting pattern in terms of the types of new varieties adopted is that in Mupfurudzi, initially SC50x type varieties dominate. Over time, however, SC40x and SC60x varieties became more popular. The SC40x varieties are attractive for farmers who are risk-averse as these have superior tolerance to heat and drought. SC40x varieties silk faster, making them less susceptible to mid-season droughts (such as the one that occurred in 1994/95 in Mupfurudzi) and mature more quickly. By contrast, SC60x varieties silk and mature more slowly, but offer the prospect of significantly higher yields.

In Sengezi, initially no one type of new hybrid dominates, but gradually over time the proportions of different new varieties evolve to one similar to that found in Mupfurudzi. In Mutanda, by contrast, the drought resistant SC40x varieties initially dominated but over time, these appear to be less favored when compared to SC50x. By 1999/00, patterns of adoption in Mutanda are comparable to those of Mupfurudzi.

Policies and Institutions in the Dissemination of New Hybrids

In this section, we explore pathways of information and dissemination: how these new seeds enter into the study area areas and how farmers learn about them.

Physical Availability

Availability of seeds plays a significant role in people's adoption of certain varieties. Our interviews with households and local retailers revealed several points of interest. In 2001, only two people (both in Mupfurudzi) said they were always able to secure the kind of seed they wanted: most have to settle at times for varieties they had initially not intended to cultivate. Second, local retailers do not play a dominant role in making seeds available to local farmers. Three farmers in Mupfurudzi bought their seeds from local retailers whilst the rest of the farmers in the sample went to nearby towns and a few to Harare. In Sengezi, those who planted certified seed usually went to Wedza, about 30 minutes travel by bus, rather than the shops located in the area. Local retailers appeared passive in the selection of seed varieties they offer, although they do appear to take advice from AGRITEX officers particularly in Mupfurudzi. One of the retailers claimed that there was a high demand for R201 and R215 from farmers but he never received these varieties from Seed Co. He said that he simply accepted the seed supplied by the seed companies, which claimed to supply the seed most suited for the area (he was supplied with SC501 and SC403). He was oversupplied with the latter, which the farmers did not like at all. This claim was supported by remarks from several respondents: "We adopted the new seed varieties because our trusted variety R201 is no longer available. If it comes back from wherever it is, we who will go back and grow it." "When we changed from R201, we planted SC501, because R215 was not there in the shops in Shamva and Bindura." Another said, "When you go to the shops to buy maize, you just get whatever seed is available or you risk planting late or not at all. That is why this year I bought SC513, because that is what I found when I went to buy seeds at the

shops…last year we bought seed from Chakonda, (SC513) and Harare (R201). I never really looked for SC601, but I bought the seed I came across."

For those who receive loans, the time seeds became physically available also affected the seed variety they planted. On being asked why he had changed from the Seed Co variety he had planted the previous year to planting a Cargill variety this year, one household head maintained that he had got SC501 from the GMB later than the CG4141 he had planted. As a result of this delay on the part of the GMB, he had planted CG4141 and intended to plant the SC501 the next season. Two farmers had planted larger proportions of saved seed in their fields because they received seeds from the GMB late.

Sources of Information

The government played a critical role—including providing seed packs, fertilizers and technical support from AGRITEX—in resettlement and communal areas in the 1980s, leading to rapid adoption of R201 and R215. Adoption was furthermore spurred by the radical increase in yields these varieties produced. A striking feature of the current environment is the much-diminished role of state institutions. Sources of information on new hybrids are now more diffuse with the media, neighbors, seed companies and AGRITEX all playing a role. The current political climate also plays a role in this regard. In Mupfurudzi, increased mistrust was noted between farmers and AGRITEX. In Sengezi, information obtained from commercial farmers had to be kept secret or disguised.

One possibility that we had not considered when fielding the quantitative surveys was that youth and schools might also be a source of information. We used the opportunity to undertake qualitative fieldwork to pursue this in Sengezi. The young had a different outlook on knowledge from that of the elderly. In group discussions, and contrary to the older farmers, young people trusted the knowledge from AGRITEX officers, whom they regarded as reliable because they were trained staff and had several years of experience in their field. On the other hand, the older people trusted their own

experiments and demonstration units. This might be because the youth had a higher level of formal education and could communicate with AGRITEX staff at the same level. There was also a generation gap in the way the youth and their parents obtained new information. Parents mostly depended on observation, experimentation and demonstration units, while the youth mentioned advertisements placed in buses, radios and booklets of seed companies. While the adults regarded their practical knowledge as superior, young people's knowledge was mostly theoretical. This difference might be due to the mobility of the youth and greater exposure to things outside the villages.

This perceived superiority of practical knowledge over theory was the consensus in group discussions with both men and women. Trusting knowledge from the youth might be gendered: men claim a monopoly over farming knowledge and are unwilling to admit to their limitations. Culturally the greater a person's age, the wiser he is supposed to become and the more people come to him for advice. This conventional attitude is being challenged by the learning of youth. To remain the controllers of knowledge and maintain their positions, elders have to belittle knowledge of the youth.

Farmer Agency in the Adoption of New Hybrids

Experimentation

Another way to acquire knowledge about varieties of maize is through personal experimentation. Farmers indicated that they were eager to individually experiment with the different varieties. Before fully adopting the new varieties accessed though the market, they plant a larger proportion of the seed they are used to and a smaller proportion of the new seed. At harvesttime they compare the yields, resistance to pests and drought tolerance; and then decide whether to adopt the new varieties. In the first three years the newer hybrids were available, roughly one out of three farmers practiced this experimentation.

However, farmers who depended on seeds given to them by relatives had no opportunity to experiment with the new seed while continuing with the old seed.

Similarly those who obtained seeds from GMB loans grew the variety given and did not practice experimentation on small pieces of land. Two farmers in Mupfurudzi simply used the new hybrid varieties on all their land allocated for maize, accepting the recommendations of AGRITEX officers. Increased seed costs may also be contributing to the likelihood of experimentation. For example, people found it cheaper to buy larger packs of one variety than smaller packs of different varieties.

Adaptation of the Maize Package

An intrinsic element of adoption process is that farmers redesign technologies such as hybrid maize. Intercropping, fertilizer use, maintenance of soil fertility and the use of saved seed are examples of such redesigning in the study areas.

Intercropping. Intercropping is widely practiced in the study areas, but appears to be contested. In Sengezi and Mupfurudzi, farmers intercropped maize with "peripheral" crops or those that are considered as women's crops including cucumbers, pumpkins (pumpkin leaves are a preferred relish in the village), sweet cane (*magunde*—the stalks are eaten, like sugarcane), and/or cowpeas (*nyemba*). Farmers believe that these crops do not disturb and compete with maize. Farmers said they wanted the bean crop to benefit from the fertilizers they applied to the maize crops and that the maize is protecting their beans from wind, excessive rains and sun. Some argued that intercropping saves labor and time.

On the other hand, 10 Mupfurudzi farmers contested intercropping practices. An argument is that cowpeas and beans climb on maize stalks and this makes the harvesting of maize difficult. These farmers also said intercropping results in unnecessary competition for soil nutrients among crops. Five farmers pointed out that AGRITEX officers had taught them that intercropping results in declining yields. Another five said their experience with intercropping before they were resettled taught them that the practice reduces yields. Interestingly, the Acting Chief of Crops in AGRITEX

encouraged intercropping, which they saw as beneficial for the crops and ideal in situations of land scarcity.

In Sengezi, the practice of intercropping influenced the choice of maize variety. All Sengezi farmers in the sample preferred to intercrop the R215 or R201 variety with beans. The farmers felt that these varieties can withstand the competition from other crops, as they do not require a lot of fertilizers. The farmers felt that the resistance to drought of these varieties ensures that they can offer protection to bean crops from drought for a longer period. Commenting on the new varieties, farmers said they would intercrop with either SC501 or SC513 but they would increase the amount of fertilizers.

Fertilizer and soil fertility. The use of fertilizer is redesigned in two ways: applying less than recommended or not applying at all. The patterns of fertilizer application differ from household to household due to a variety of reasons. All farmers, however, complain of the cost of fertilizers, and many limit its use for this reason. For many farmers, the cost results in their preferring varieties of maize that they perceive to be less dependent on chemical fertilizer.

Three farmers pointed out that they applied different amounts of fertilizers to plants in the same field. They apply little fertilizer onto crops on anthills. Two farmers applied only top dressing on anthills and on areas on which they had spread cattle manure. Farmers' knowledge regarding the quality of their soils also determined the rate and pattern of fertilizer application. In Mupfurudzi, soil referred to as *Shapa* (sandy soil) requires more fertilizer and maize planted in such soil requires two applications of Ammonium Nitrate. Methods of fertilizer application also resulted in differential rates and patterns application. Nine farmers in the sample used cups found in fertilizer packs. These farmers mechanically applied equal amounts of fertilizer to their plants regardless of the differences in fertility on their soils. These farmers were also of the view that different varieties of maize do not require different amounts of fertilizers. Differences in rates and patterns of fertilizer application in Mupfurudzi also resulted from the controversies surrounding the recommended amounts of fertilizers per acre. Some

farmers maintained that AGRITEX had recommended three 50-kilogram bags of Compound D and two 50-kilogram bags of Ammonium Nitrate whilst others argued that it was three bags of Compound D and one of Ammonium Nitrate per acre.

Despite its widespread albeit redesigned use, some farmers regarded chemical fertilizers as detrimental to the natural fertility of their soils. "Fertilizer spoils the soil" is commonly heard. However, others stated that fertilizer is not detrimental to their soil.

Farmers monitor declines in soil fertility through observation of the growth patterns of crops in their fields and through designing simple experiments. Twelve farmers in the study sample regarded decline in yields, even with fertilizer applications, as signs of a soil that is losing its fertility. When maize crops develop yellowish or purple leaves and when they are thin and tall with small or no cobs, some farmers interpret this as a decline in fertility. Others regarded the growth of witch weed in their field as a symptom of loss of soil fertility. One farmer in Sengezi said that the knowledge has been passed down to him from his forefathers. In addition to chemical fertilizers, farmers in the study area have adopted a variety of ways to retain soil fertility and enhance crop production, including applying cattle manure, spreading anthill soil, leaving land fallow and the practice crop rotation.

Use of saved seed. A further adaptation is to save seed from one harvest for planting the following year. Out of our 30 case studies, all but two households (both in Mupfurudzi) had used saved seeds at least at some point, with the majority (21 of 28) using saved hybrid varieties (most of them old generation hybrids). Only four very poor households admitted having used saved hybrid seed last year.

Saved seed (except for certain open pollinated varieties) was never ranked positively compared to the newer hybrids. Saved seed was regarded as prone to diseases, pests, and as having fewer cobs, which are smaller in grain size and require more fertilizer to produce a good crop. Apart from Hickory King, saved seed was regarded as a sign of poverty. Hickory King was not negatively viewed, because the variety was not

available in the shops and was well regarded on taste grounds, making it popular even among rich farmers.

Households used saved seed for a variety of reasons. Availability of money is one clear dimension to consider. Another is that the saved variety matured earlier than the hybrid varieties. Most people admitted to planting saved seed in periods of great distress or as a security precaution. Physical availability was another reason why people planted saved seeds. In Sengezi, where most people planted saved R201 and R215 seeds, they claimed that they did so because the seeds were no longer available in the shops. However, for Mupfurudzi the situation is different. Although R215 is no longer available in the shops, people do not plant saved R215 seeds. Instead, they buy new seeds and plant them alongside other saved open pollinated varieties. It is only when they cannot afford to buy certified seed that they plant saved hybrid varieties.

Over the years people had developed skills in saving and using saved seed. This knowledge was mostly passed from parents to children although people could also access this information through their social networks. When people were saving seed for the next season, they looked for certain characteristics like bigger maize cobs with big well-matured grains, since this would ensure that the resultant crop would have these desirable qualities. There were many ways of preserving seed for the next season. Only two household heads (both females) smoked seed as a preservation method, although it is susceptible to attack by rodents. Some households applied chemicals that guard seeds from rodents as well as enabling them to save a large amount at the same time. People also adopted other less expensive methods when they did not have money to buy chemicals, including smearing Surf washing powder onto the maize, using old eucalyptus leaves or tobacco whose bitterness would stop the weevils from boring into the maize.

Decisionmaking, Perceptions, and Preferences

Decisionmaking processes, household perceptions, and preferences also affect the adoption of new maize varieties.

In the majority of our case studies (16 out of 28), the selection of a maize variety was made by the household head, or the person responsible for purchasing seeds, without consulting others. In the remaining 12 cases, household heads claim to consult other members on the selection of maize variety. The involvement of children in deciding which maize varieties to grow seems minimal and has much to do with the discussion of the relevance of book knowledge versus practical knowledge. In Mupfurudzi, women in all households were involved in decisions affecting the choices of peripheral crops such as groundnuts, roundnuts, rapoko, and open pollinated varieties of maize that are regarded as women's crops. In female-headed households, it was not uncommon for sons to buy seeds without consulting their mothers.

Farmers' preferences for the different varieties of maize they adopt are shaped by a variety of factors. Most reflected the households' concerns with food security, obtaining a sufficient harvest in an uncertain environment. Taste and appearance, input requirements, marketing considerations, postharvest processing, and nutrition were also mentioned by respondents.

The majority of farmers (78 percent of the case study households) prefer a drought resistant maize variety. This is not surprising in an environment characterized by substantial and unpredictable variations in rainfall. It also explains why farmers stated that they preferred the first-generation hybrid varieties (R201 and R215). The SC40x, SC50x, and SC60x series are still relatively new to these farmers, who are still acquiring knowledge regarding their pest resistance, yield potential, and fertilizer requirements. Farmers' perceptions regarding the variety with a high yield potential differ across and within households. Farmers did not agree on which variety has the longest cob among both the old- and second-generation hybrid varieties. In part, this may be due to the fact that unlike the varieties introduced in the early 1980s, newer varieties display less dramatic increases in yields and this may also influence farmers' perceptions of them. The practice of saving seed from the previous harvest can be explained by their trust in the older varieties in this regard. In group discussions, it was stated that the new hybrid

varieties could not be successfully used as saved seed in comparison to the R201 or R215 old varieties. As a result, most people cultivated saved R201 varieties.

In considering the yield potential of a maize variety, farmers took cognizance of the extent to which different varieties resist pests, especially weevils. All farmers in Sengezi and Mupfurudzi deplored the SC401 variety for its lack of resistance to weevils both before and after harvest. Coupled with its poor resistance to excessive moisture, it was also labeled a poor crop in terms of yield potential. As a Mupfurudzi farmer explained: "401 is useless. No matter how much fertilizer you put, the maize cob is small. When selling, it is very difficult to get a grade A when selling 401. We want R215 but we can't find it in the shop. R215 is a very good seed. Even if you plant late, you will get something unlike these new varieties." This perception contrasts with Seed Co, which presents SC401 as early-maturing, good for late planting, and recommended for areas of high yield and to complement more drought-resistant varieties in areas of low yield.

Most respondents did not regard labor requirements as an important factor in the decision to adopt. This was so because farmers weeded and cultivated their maize crops once only; this did not vary across varieties. However, some pointed out that in cases of severe illness such as HIV\AIDS, the concerned households had to adopt short-season varieties such as R201 since they require less labor than other varieties.

Taste and food qualities received some attention in both areas. In Mupfurudzi, men disregarded these for commercial crops: women, on the other hand, considered the taste of maize as important when it is roasted, cooked as green mealies, and for the quality of its mealy-meal. Women grew open-pollinated varieties for their good taste. Whilst this gender dimension was clear in Mupfurudzi, in Sengezi there were no gender distinctions. Men also actively sought open-pollinated varieties and grew them both in their gardens and fields. The difference between the men in these two study areas is that in Mupfurudzi men consider maize a cash crop; thus they are indifferent toward the taste. Sengezi farmers regard maize as a food crop; this may explain why both the men and women expressed concern about the tastes of various varieties.

Assets and Adoption

We now consider the role that asset holdings play in the adoption of maize hybrids in the 1990s using econometric techniques (Table 3). The dependent variable is whether a household has adopted a new variety in a given crop year. Regressors are drawn from the SLF asset pentagon: human capital (age and education of household head, log number of resident adults); physical/financial capital (value of livestock

Table 3—Probit analysis of the role of assets in the adoption of new maize hybrid

	1994/95		1995/96		1996/97	
	Mupfurudzi	**Other**	**Mupfurudzi**	**Other**	**Mupfurudzi**	**Other**
Age of head	0.001	–0.00002	0.002	–0.002	–0.0003	–0.007
	(0.49)	(0.04)	(0.39)	(0.70)	(0.08)	(1.71)*
Education of head	0.019	0.007	0.019	0.010	0.008	0.004
	(2.57)**	(1.94)*	(2.05)**	(1.38)	(1.09)	(0.19)
Log number of adults	0.054	–0.005	–0.048	0.033	0.180	0.194
	(0.86)	(1.06)	(0.47)	(0.33)	(2.91)**	(1.73)*
Real value of livestock	0.008	0.0003	0.013	0.001	–0.0002	–0.002
	(2.45)**	(0.54)	(1.64)	(0.16)	(0.03)	(0.59)
Land is sloped	0.065	–0.019	0.094	0.031	0.144	0.003
	(1.65)*	(2.88)**	(1.24)	(0.48)	(1.87)*	(0.04)
Number of plots	0.030	–0.006	–0.019	0.029	0.052	–0.045
	(1.66)*	(1.08)	(0.62)	(0.92)	(0.99)	(1.06)
Distance to resettlement center	0.003	0.001	0.002	–0.026	–0.009	–0.006
	(0.87)	(0.77)	(0.20)	(1.87)*	(1.23)	(0.54)
Chi-squared statistic	48.84**	86.83**	17.16**	20.48**	182.48**	17.89**
Sample size	200	136	200	136	193	140
	1997/98		**1998/99**		**1999/2000**	
Age of head	–0.003	–0.009	–0.003	0.003	–0.004	0.002
	(0.79)	(2.54)**	(1.25)	(0.81)	(0.29)	(0.78)
Education of head	0.012	0.021	0.001	0.021	0.011	0.016
	(1.13)	(1.24)	(0.13)	(1.31)	(0.25)	(1.58)
Log number of adults	0.116	–0.017	0.126	–0.048	0.020	0.216
	(1.86)*	(0.21)	(3.42)**	(0.44)	(0.83)	(2.06)**
Real value of livestock	0.007	–0.009	0.014	0.005	0.001	–0.004
	(2.77)**	(1.56)	(2.68)**	(0.10)	(0.34)	(1.15)
Land is sloped	0.145	0.003	0.103	0.000	0.058	–0.094
	(1.98)**	(0.05)	(3.38)**	(0.00)	(1.88)*	(1.18)
Number of plots	0.069	0.063	–0.002	0.077	–0.028	0.061
	(1.59)	(1.49)	(0.05)	(1.76)*	(1.52)	(1.78)*
Distance to resettlement center	–0.007	0.008	–0.002	–0.051	–0.003	–0.024
	(1.16)	(0.70)	(0.51)	(2.55)**	(1.85)*	(1.81)*
Chi-squared statistic	171.24**	161.51**	563.04**	35.44**	31.76**	48.76**
Sample size	200	136	199	141	198	134

Notes: Controls for location included but not reported. Figures in parentheses are absolute value of z statistics.
* Significant at the 10 percent level. ** Significant at the 5 percent level.

holdings); natural capital (number and distance to plots). Distance to the resettlement center (also called the growth point) is included as a measure of ease in obtaining information and dummies for village location to capture differences in vulnerability context across localities for any given year. The model is estimated as a probit; standard errors are robust to heteroscedasticity and correlations in the disturbance terms within villages. Because Mupfurudzi is better served by private sector institutions, we hypothesize that the determinants of adoption may differ between it and other localities. Hence, we report results separately for it and for the other two schemes. Coefficients are reported in terms of marginal effects.

Apart from 1996/97 (which appears anomalous) and 1999/2000 (when adoption is nearly universal), wealthier farmers in Mupfurudzi are more likely to adopt these new hybrids. Education of household heads matters for early adoption in Mupfurudzi, but not elsewhere. By contrast, distance to the resettlement center is more important in Mutanda and Sengezi where penetration by outside institutions is less marked. The number of adults in the household becomes more important over time. We have noted that an issue for many households is the physical availability of seeds; it may be that some households find it easier to search for particular varieties, either because they are less isolated or there are more individuals who can undertake these searches.

We also explored whether sex of head affected adoption, finding no significant impact. The might seem surprising given that female heads are unlikely to attend group meetings and have considerably less interaction with formal markets. But recall that young people are also a source of information about new varieties. When we interacted sex of head with the number of adults in the household, we found that during the first years of dissemination, female-headed households had a lower likelihood of adoption, but as the number of adults increased, this negative effect diminished. Lastly, we explored whether access to extension services influenced adoption, but found no association with increased likelihood of adoption.

6. Hybrid Maize, Livelihood Outcomes, Asset Bases, and Child Nutrition

Over the last 20 years, there has been a considerable improvement in the living standards of these resettlement households. For example, housing quality has improved, households own more consumer durables, children are more likely to attend school and have access to basic healthcare. Ascribing precise causes to these changes is, however, problematic. The process of resettlement and the initial diffusion of hybrid maize after 1980 occurred simultaneously. Further, both processes were nearly universal. There is neither a with/without nor a before/after comparison group to assess impact. Further, the best farmers have a number of sources of income. We have identified the importance of cattle for profitable farming. We also notice that those who successfully farm other crops also get good maize yields. It is likely that the early hybrids were important in allowing certain farmers to establish themselves and build up resources in capital and equipment. An adequate maize crop means that family subsistence is obtained at minimal cost, allowing other income to be spent on inputs for the next year's crops. Attribution of causality is made even more difficult by the extreme weather fluctuations throughout the 1990s as well as the changes in input and output markets. This does not deny the importance to farmers of developing new hybrids; it does deny any easy link between the development of hybrids and socioeconomic development.

Changes in Livelihood

Farmers in Sengezi and Mupfurudzi perceived that positive changes have occurred in their livelihoods since resettlement. When prompted to elaborate, all farmers in Sengezi attributed changes in their livelihoods to adequate land from which they could grow different crops to ensure household food security. They all stated that the reliable yields they obtained from R201 and R215 had been important in improving their livelihoods. Only 5 out of 14 farmers in Mupfurudzi attributed changes in their livelihoods to the availability of land, and only 7 attributed changes in their livelihoods to the cultivation of hybrid maize varieties. The remaining farmers attributed changes in

their livelihoods to the cultivation of cash crops such as tobacco and cotton, noting that producer prices for maize in the 1980s and early 1990s had limited returns from that crop.

As already noted, because the adoption of the first generation of HYVs was so rapid, and occurred simultaneously with resettlement, it is not possible to directly assess its impact. Instead, we focus on the second generation of hybrids. For crop years 1994/95–1997/98, households that adopted newer, second-generation hybrids had higher maize yields and higher gross crop incomes. The magnitudes of the latter are particularly striking, ranging from 20 to 100 percent. But ascribing a causal relationship to these associations is premature. A simple explanation could be that wealthier farmers with better access to inputs are more likely to adopt, obtain advice from extension agents, and thus have higher yields. But controlling for these observable characteristics may not be the whole story. Suppose that more able farmers are more likely to adopt and that they are also likely to have higher crop incomes. As we can control only imperfectly for such abilities, merely taking into account these observable characteristics may not be sufficient.

Consequently, we explored two approaches. First, we regressed a set of the assets listed in the SLF as well as whether the farmer had adopted a second-generation hybrid on the determinants of total crop income. Regressors were livestock holdings (by scheme), number of adults, access to extension, education, age and sex of head, soil type, village, and year dummies. The coefficient on adoption indicates how much crop incomes are raised conditional on these observed characteristics. Second, we estimated a "treatments regression" that treats adoption as endogenous, with lagged values of livestock acting as instruments (having ascertained that these have no explanatory power in the main model when these variables are included in a regression that treats adoption as exogenous). We then calculated the change in expected incomes, conditional on adopting these second-generation varieties, accounting for the endogeneity of adoption. Results are reported in Table 4.

Table 4—Change in incomes associated with adoption of second-generation hybrids

Change estimated from regression, adoption exogenous	549
Change estimated from regression, adoption endogenous	341

These results indicate that the increase in crop income is considerably smaller than suggested by the descriptive statistics.[4] Once we control for the endogeneity of adoption, we observe an increase in crop incomes of around 10 percent.

The Development of Asset Bases

We also used our qualitative surveys to explore the relationship between hybrid maize, incomes, and the development of asset bases. These data revealed that households invested in a variety of assets.

Our interviews in Mupfurudzi indicate that households invest in a variety of assets. While many said that maize was an important crop, not everyone linked it directly to the purchase of major assets. Income from maize was used to purchase solar panels, a water pump, a welding machine, consumer durables, improved housing, clothes, food, and livestock as well as payment for school fees and the hiring of labor. The largely successful cultivation of cash crops (tobacco and cotton) in Mupfurudzi may lead our respondents to downplay the importance of maize as a cash crop. Also, three people pointed out that they sold maize later than other crops; by the time maize was sold they would have got most of the things they wanted from the sale of early cash crops.

> The payments for maize usually come late so that we use the money from maize to buy more inputs. For example, we can buy cotton seeds or even maize seeds so that we can plant early. When the fertilizer loans come, the crops will already have germinated.

In Sengezi, 11 households purchased livestock (cattle) from returns obtained from the marketing of surplus maize, and three used proceeds from maize to buy agricultural inputs. Sengezi farmers also invested their surplus maize into social relationships, giving

[4] See Table IV.2.b.1 of our full report.

maize to relatives residing in urban areas and sometimes to relatives in communal areas. Eleven out of 16 farmers in Sengezi invested their maize in such relationships. Farmers in both Sengezi and Mupfurudzi also invested in their children's education with money obtained from the sale of maize.

Given that the views expressed by our respondents suggest considerable heterogeneity in terms of use of maize and other crop production in terms of the accumulation of assets, it is worth exploring whether any general patterns can be discerned. We do so by focusing on two assets: livestock and agricultural tools. We choose these because our respondents enumerate possession of these as being associated with being relatively well off and their absence as a cause of being relatively poor. We estimate a very simple specification—a flexible accelerator model—in which investment is a function of total gross crop income (the value of production of all crops in a given year) and existing stocks of capital. Also, we disaggregate crop income into maize and other crop income. As all values are expressed in log form, the coefficients are also elasticities.

Table 5 shows that a 10 percent increase in crop incomes is associated with a 0.2 percent increase in holdings of tools and a 1 percent increase in livestock holdings. Put another way, these resettlement households save about 12 percent of any increase in crop incomes in the form of increased holdings of tools and livestock, with the majority of that saving taking the form of livestock. However, the magnitude of this impact is reduced when we control for household-level fixed effects. One rationale for this could be that more able farmers are both more able in terms of growing crops and also tending livestock. Once we control for this characteristic, the coefficient on crop income falls. Results found in columns (2) and (3) show that increases in maize incomes have the same effect on investment in tools and livestock as increases in nonmaize crop incomes. As suggested by our qualitative fieldwork, maize does not play a "special" role in accumulation.

Table 5—Determinants of investment in agricultural tools and livestock

	Tools			Livestock		
	(1)	(2)	(3)	(1)	(2)	(3)
Pooled results across all crop years						
Log crop income	0.021			0.101		
	(7.37)**			(8.46)**		
Log maize income		0.017			0.069	
		(4.40)**			(5.54)**	
Log nonmaize income			0.011			0.067
			(4.12)**			(6.98)**
Log tools	–0.053	–0.063	–0.049			
	(5.91)**	(5.68)**	(5.17)**			
Log livestock				–0.255	–0.268	–0.249
				(10.37)**	(9.51)**	(9.80)**
Constant	0.296	0.426	0.355	1.462	1.902	1.723
	(4.78)**	(4.95)**	(5.27)**	(6.93)**	(8.25)**	(7.55)**
F statistic	29.74**	20.95**	14.67**	68.87**	46.71**	64.22**
R2	0.053	0.054	0.040	0.142	0.165	0.135
Sample size	2,281	1,754	2,155	2,102	1,639	1,996
Pooled results across all crop years controlling for household fixed effects						
Log crop income	0.010			0.048		
	(3.12)**			(3.85)**		
Log maize income		0.008			0.017	
		(2.25)**			(1.45)	
Log nonmaize income			0.009			0.033
			(2.80)**			(2.71)**
Log tools	–0.390	–0.392	–0.403			
	(27.82)**	(22.54)**	(27.67)**			
Log livestock				–0.915	–0.937	–0.919
				(38.72)**	(37.26)**	(37.47)**
F stat on household fixed effects	3.09**	2.42**	3.12**	3.73**	3.40**	3.63**
Sample size	2,281	1,754	2,155	2,102	1,639	1,996

Notes: Figures in parentheses are absolute value of t statistics. * Significant at the 10 percent level. ** Significant at the 5 percent level. Standard errors are calculated using the Huber-White method.

Resource Sharing, Conflict, and Differentiation Within Households

To this point, our discussion of maize, livelihoods, and assets treats the household as a unitary entity. However, resource sharing and distribution is a highly contested issue within these households. Further, people usually gave deceptive answers when probed on household resource allocation, or other household members and members of the local community disagreed with the answers given by household heads. Hence, our discussion draws on a variety of sources and individuals as well as our own observations.

Men control land, the major means of production, since they were the ones who were resettled as plot holders (except in one case in Sengezi where a female plot holder determined the cropping patterns of her sons to whom she had given subdivided plots). Consequently, they determine cropping patterns, decide on whether a plot is to be extended, land subdivided, and if so how much a person is going to receive. On the issue of division of labor, most respondents agreed that men should plow fields and do all the work that needed great physical strength, while planting seeds was regarded as women's work. While a few household heads agreed that weeding and fertilizer application were women's work, a larger number claimed that they helped each other to weed, apply fertilizers, and harvest. However, in about half of these cases, such statements were contested by other family members and members of the local community who maintained that the male household heads left most of the weeding and fertilizer application to their wives and children.

Most people agreed that when still in the field maize belonged to men but as soon as it was put in the granary it belonged to women. When asked about the distribution of proceeds from the sale of crops, eight respondents maintained that after selling their crops they did not give each other individual shares. They emphasized the household as a single unit. Money from the sale of crops was family money, which would be used for food, clothes, and children's school fees. Presenting the household as a unified entity was misleading. Some women (both those whose households were in the sample and some outside of the sample) were not satisfied with the way their husbands used "family money." In some cases, men were also not happy with the way their wives used money. This resulted in people taking each other to court or to consult others for mediation. Some of the women (not in sample) went on to sell all the "family's maize" to *madhaiza* (informal traders) as a way of getting back at their husbands. Conflicts that resulted were usually because of lack of transparency in the use of proceeds from agriculture, where certain members of the family were regarded as using resources for their own ends.

Family money was usually the household head's money, who in most cases was a man. We came across cases where other family members were disillusioned since they

had very little to no control over family resources. One respondent maintained that all the money they get from selling crops was family money yet the money was kept in her husband's bank account and she did not have a bank account in her name. The husband was always buying cattle with "family money" (cattle are traditionally regarded as male property). The wife was afraid that if her husband should die, she would be left with nothing since her husband's relatives would take all the cattle away. This issue led to conflicts between this woman and her husband. Therefore, in some cases resource conflicts are not about the husband squandering all the money, but about the husband making investment decisions that are not gender sensitive. The "family money" becomes the household head's money depending on the kind of things the money is used for.

Resource sharing was also problematic in polygamous unions, especially where the husband insisted on having a single granary and combining labor in the field. In such a union, the wives did not have the freedom to use proceeds from agriculture in any way they wanted since they usually had to reach a consensus with the co-wives. Usually polygamous families were so large that women could not trade any maize with *madhaiza* since all the maize had to be left for feeding the huge family.

Hybrid Maize, Assets, and the Nutritional Status of Children

Lastly, we turn our attention to the links between hybrid maize, assets, and child nutritional status. Consistent with both the literature on the determinants of nutritional status—as well as the observations of our respondents noted above—we focus here on the links between assets and child height attainments.

Drawing on multiple rounds of the quantitative survey, we take as our dependent variable the growth rate of children initially aged 12–24 months. Using five rounds of these data—from 1993 to 1997—we are able to construct growth rates for four cohorts of these young children. This gives us our dependent variable—growth in stature of children aged 12–24 months at the time of first observation—in cm/year. However, multivariate regression analysis finds no significant impact of assets on child growth once

we take into account child (initial height, sex, age at first observation, duration of observation, and the product of age and duration of observation), maternal height, age, schooling, relationship to the household head, household (soil type and area of land holdings that are sloped or steeply sloped) and village characteristics. We repeated these regressions for older children and again found no association.

However, recall from our discussion of the context of these resettlement areas that the threat of drought is a very important component of their vulnerability context. We have also noted that households report that livestock are an important mechanism for coping with drought and that a drought occurred in the middle of this period, 1994/95. So an interesting question to ask is whether livestock protects these children's health in the aftermath of drought. We explore this idea by stratifying the sample by livestock holdings as measured in 1995. Recall that these were measured just prior to the realization that 1994/95 would be a drought year for these households. Table 6 presents the results of dividing the sample of children initially aged 12–24 months into two groups: those residing in households below and above the median value of pre-drought livestock holdings. Drought only affects the growth of children residing in poorer households. The coefficient for the "drought cohort" is not significantly different from zero for children living in households with pre-drought livestock holdings above the median.

Table 6—Livestock, child growth, and drought, children 12–24 months

	Child resides in household with pre-drought livestock holdings:	
Variable	**Below the median**	**Above the median**
Child in drought cohort	–2.202	–1.281
	(1.795)*	(0.844)
Height	–0.323	–0.284
	(3.062)**	(2.174)**
Mother's education	0.843	–0.542
	(1.748)*	(1.090)
Mother's education squared	–0.075	0.014
	(1.713)*	(0.353)

Notes: Dependent variable is annual (12 month) growth rate in child height. Asymptotic t statistics based on Huber-White standard errors in parentheses. * Significant at the 10 percent level. ** Significant at the 5 percent level.

Does this protective effect really matter? This growth slowdown is unlikely to be important if it is only transitory. To investigate, we examine the determinants of heights of children aged 60–72 months. Because stature by age 3 is highly correlated with attained body size at adulthood, these heights are good predictors of likely completed heights. The dependent variable is expressed as the child's height-for-age Z-score. Table 7 reports the results of estimating a maternal fixed effects model.

Table 7—Maternal fixed effects estimates of determinants of child height-for-age Z-score, children 60–72 months

Variable	Specification (1)	Specification (2)
Child was initially age 12–24 months during 1995/96	–0.602 (1.927)*	–
Child was initially age 12–24 months during 1995/96 and pre-drought livestock holdings were below sample median	–	–0.907 (2.201)**
Child was initially age 12–24 months during years 1995/96 and pre-drought livestock holdings were above sample median	–	–0.379 (1.028)
F statistic on joint significance of maternal dummies	2.60**	2.47**

Notes: Dependent variable is child height-for-age Z-score. Other regressors included but not reported are child sex, mother's age, log value of livestock, and dummies for years 1993–1997. The omitted year dummy is 1998, representing the cohort directly preceding the drought cohort. Sample size is 265. There are 124 different mothers. Absolute value of asymptotic t statistics in parentheses.
* Significant at the 10 percent level. ** Significant at the 5 percent level.

Children aged 60–72 months, measured in early 1999, are the children who were initially aged 12–24 months in the year after the 1994/95 drought. These children have z scores about .6 of a standard deviation below that of comparable children measured in nondrought years. The right-hand column interacts the 1999 year dummy with a variable that indicates whether, pre-drought, the household had livestock holdings below or above the sample median. Children from wealthier households appear to have suffered no long-term effects from this drought. Children from poorer households, by contrast, appear to have experienced a growth slowdown that has persisted to age 60–72 months. Linking this to our earlier results, we have already seen that to the extent that the adoption and use of hybrid maize increases crop incomes, higher crop incomes are associated with

investment in livestock. Holdings of livestock are not directly associated with improved child nutritional status—as measured by growth in stature. However, they play an important protective role in the aftermath of droughts.

7. Summary and Conclusions

In this final section, we summarize our findings, provide an assessment on methodology, and comment on future directions in the development of hybrid maize in Zimbabwe.

Summary of Findings

Zimbabwe's "Green Revolution" was characterized by the widespread adoption of hybrid maize varieties (R201 and R215) and significant increases in yields. The diffusion of newer varieties that replace these has occurred more slowly and has had a more modest impact. Several factors account for this.

One factor is the changing role of the private and public sectors. In the early 1980s, government was heavily involved in the dissemination of hybrid maize as well as the development of supporting institutions such as credit and marketing. Government's current role is much reduced and one that increasingly focuses on "better farmers." Private-sector institutions that have entered the maize sector operate mainly in areas of high agricultural potential. Consequently, adoption partly reflects "choice" but also the (sometimes) limited physical availability of varieties. A further factor is the nature of the technology being introduced. Although R201 and R215 were initially bred to meet the needs of commercial farmers, they contained characteristics (high yielding and drought resistant) that made them attractive to smallholders. Newer varieties are bred to meet the evolving needs of commercial farmers, but these new needs—most notably improved disease resistance—are not shared by the farmers in our survey and are not associated with significantly higher yields where use of fertilizers is limited.

These two factors point to the limitations of relying on the private sector for expanding the options for smallholders. Current conditions in Zimbabwe suggest that smallholder farmers value drought-resistant, low-input varieties (such as open-pollinated varieties [OPVs]); it is unclear—quite apart from legal restrictions on the development and dissemination of these—whether private firms are best placed to respond to this demand. If private suppliers do not find it profitable to service smallholders, it seems that intervention from government and related institutions is desirable, to provide the services or to subsidize the private sector in supplying them.

A further consideration is that information is disseminated via multiple channels and in a fragmentary fashion in an environment where tolerance of dissent is limited, the behavior of neighbors is viewed with suspicion, and some actors involved in dissemination (such as extension workers) are increasingly viewed with mistrust. The presumption that farmers "learn from each other" is less applicable in circumstances such as these.

Our case studies indicate links between the production of maize in excess of subsistence needs, the accumulation of assets such as livestock and tools, payment of school fees, and the acquisition of inputs such as fertilizer and labor for the subsequent cropping season. This coincides with the views of farmers who see HYVs as an influential factor in raising livelihood above the level of poverty that prevailed when they first moved into the area.

However, new varieties appear to have increased incomes only marginally. Not only is this the farmers' view, it is reflected in our multivariate work as well. When we control for farmer characteristics and the endogeneity of adoption, use of these new varieties increases crop incomes only by about 10 percent. Additionally, many respondents convey the view that there is nothing "special" about maize production. This is confirmed in our multivariate analysis. A 10 percent increase in maize income is associated with an increase in livestock holdings ranging from 4 to 12 percent. However, it also shows that income from maize and nonmaize crop production has approximately equal effects on the accumulation of assets.

That said, these modest impacts result in an improved ability to deal with vulnerability. Hybrids do raise productivity in maize production. Higher income from maize and other crops leads to investment in livestock, which are an important means through which child health is protected during drought. All such changes are associated with an improvement in wellbeing and a reduction in poverty.

An Assessment of Methodology

The Sustainable Livelihoods Framework (SLF)

We used the SLF and found it provided a useful checklist of issues to be researched. It also provided a useful base for conversations across disciplines. Although we do not believe it fundamentally affected our research and analysis, this may be due to the fact that we feel that our team would have been able to communicate well with whatever framework it adopted. We found that the framework offered a model that could not always accommodate nuances of particular situations, and many topics appear in a variety of places in the framework, which could pose a problem of repetition for less experienced fieldworkers.

The Use of Detailed Case Studies

Although a method involving six months of fieldwork to cover few households poses problems for replication and generalization, the depth of the understanding gained compared to a more rapid assessment approach is substantial and thus should be considered as a potential method for future impact assessment work.

We found detailed case studies helpful for several reasons. Repeated visits to homesteads led to trust and a willingness to talk about issues on which people had initially been silent, such as witchcraft and politics. Repeated visits also enabled us to verify data and hear the perceptions of the different household members, on such topics as the sharing of resources. We also noted that a person might give different answers depending on who else was present. Observation enabled us to verify data and to gain

access to information that people did not report, such as the use of intercropping and of open-pollinated varieties.

Case studies gave different information than did group discussions. In the group discussions in Sengezi, people did not mention planting Agri-King, a very popular variety among villagers. That the book knowledge of youth is unreliable was the consensus view in groups, whereas there were several dissenters in private. On the other hand, we heard more on community-critical events in group discussions when private discussions focused only on personal crises. The groups also gave the fieldworker an opportunity to talk to the youth, who in most cases were excluded by adults from taking part in the interviews at their homes.

Ideally such studies should cover a full agricultural cycle. In the time available, some questions remained too personal or too sensitive to obtain a reliable answer. In Sengezi, people remained reserved on issues related to magic, levels of education, and ranking other farmers; and women did not want to answer questions related to AIDS and illness. A second problem was related to the timing of the fieldwork, which was dictated by constraints of a larger international study and poorly coordinated with the agricultural season in Zimbabwe. Although research in the off-season meant that farmers had more time to talk, it limited our observation of agricultural activities. We were not able to check on discrepancies in the answers of men and women about decisionmaking. We could not observe the use of fertilizers, the type of seeds planted, or the division of labor along gender and age. We could not observe how stated intentions and ideals related to practice. The issue of gender also posed problems for the researchers in the field. In Sengezi, the male researcher was restricted by husbands in his access to women's views. In Mupfurudzi, some male respondents became less forthcoming when their sexual advances were spurned, a problem that was largely overcome with time.

A further problematic issue was the provision of short-term rewards to participant households who gave time and attention to our study. While these were very small in terms of costs of the study, they were large enough in local terms to create jealousy and conflict.

Integrating Qualitative and Quantitative Techniques

An attractive feature of our approach was our ability to iteratively integrate the qualitative and quantitative analysis. A good example of the benefits of this integration is our analysis of aspects of gender and technology adoption. Our qualitative work indicated that women do not have access to many of the channels through which information on new hybrids is diffused. But our quantitative data showed no difference between male and female-headed households. These apparently contradictory results were reconciled by further qualitative work that indicated that other adult males, such as youth, provided an alternative conduit for information on new hybrids. Reliance on only one approach would not have been satisfactory here.

An integrated approach to this topic, together with the use of the SLF, allowed us to develop a rich understanding of processes of adoption and their impact. Yet such understandings are costly to obtain, particularly in terms of time. One of the dangers of the SLF is that it is associated with the discourse of rapid appraisal methodologies. However useful rapid techniques may be in terms of economy and time, and in eliciting non-controversial answers to specific questions, a detailed understanding of what is happening in agricultural communities cannot be obtained in a hurry.

Future Directions in the Development of Hybrid Maize in Zimbabwe

The current maize landscape in Zimbabwe is significantly different from the pre- and postindependence period up to the mid 1990s. These differences are such that it can be labeled as a *third* stage in the production and adoption of (hybrid) maize. This stage is fueled by a drastic change in the breeding and commercialization of hybrids by seed companies.

Seed Co, the dominant player in the provision of maize seeds in Zimbabwe, serves a variety of clients, including large-scale commercial farmers as well as smallholders in resettlement and communal areas. During pre-independence, Seed Co largely responded to the needs of commercial farmers. Seed Co released successful

varieties R201 and R215, which were favored by resettled and communal farmers because of its high yield potential and drought tolerance. In the late 1980s and early 1990s, when Seed Co reinvigorated its plant breeding efforts, greater attention was placed on developing disease tolerance, an important concern for commercial farmers. Seed Co's recent decision to terminate the production of these "old" hybrids is taken for both agronomic (the need for varieties that were more disease resistant) and technical reasons (problems associated with continuing to attempt to produce older hybrids). But as maize breeders reminded us on several occasions, it is impossible to breed all desirable characteristics into any one variety. In the case of newer hybrids, this has meant that, on the one hand, there is not necessarily any dramatic increase in yield, nor are characteristics such as taste, ears, and flintiness taken into account. So it is not surprising that these new hybrids receive mixed reviews. Although Seed Co sees itself as assisting these farmers, farmers themselves see their options, in terms of seed availability, being substantially reduced.

One of the relevant options provided by the current institutional environment in the region is the work of CIMMYT in the field of OPVs. Many are early maturing, resistant to maize streak virus, suitable for green maize production, and flinty grain types. As such, they are well-suited to smallholder and resettlement farmers. Further, they require fewer inputs, an important consideration in an environment where reliability and cost of input supply are matters of increasing concern. Breeding, and above all, the multiplication and marketing of OPVs does not come without problems though. The importance of OPV breeding is that it is based on genetic variation, through cross-pollination and recycling. Maintaining genetic variation and accessing genetic material is hence crucial. One of the problems for Zimbabwe may be that maize is a recent crop, which implies that naturally present variation is somewhat limited. The OPV program is meant to supplement or improve the lack of genetic variation in the region and through this providing more options for local people's livelihood.

To conclude, we return to our three research questions.

- *Key factors affecting the diffusion of new maize hybrids in the 1990s included*
  - a diminishing role of government and increasing role of the private sector leading to a *caution against relying too heavily on the private sector*;
  - a less dramatic increase in yield offered by the newer varieties, and a neglect of the needs and preferences of smallholders;
  - information is disseminated in a fragmentary fashion, and in a climate of mistrust;
  - smallholders are often more interested in low costs of inputs rather than maximum yield, a preference *that should influence the development of seeds*.
- *We found a correlation between maize production and the accumulation of assets, although the accumulation cannot be attributed to maize alone*.
- *An improved asset base helps households to deal with shocks such as drought, and thus reduces the effects of impoverishment.*

References

Bourdillon, M. F. C. 1987. *Shona peoples*. Gweru: Mambo Press.

Bourdillon, M. F. C. et al. 2002. Impact of agricultural research on poverty reduction, Case Study 2: Assessing the impact of HYV maize in resettlement areas of Zimbabwe. International Food Policy Research Institute, Washington, D.C. Photocopy.

Kinsey, B. 1982. Forever gained: Resettlement and land policy in the context of national development in Zimbabwe. *Africa* 52: 92–113.

Kinsey, B. 1999. Determinants of rural household incomes and their impact on poverty and food security in Zimbabwe. Report submitted to SDAR/IG5 FAO on the Zimbabwe Rural Household Dynamics Project.

Mashingaidze, K. 1994. Maize research and development. In *Zimbabwe's agricultural revolution,* ed. M. Rukuni and C. Eicher. Harare: University of Zimbabwe Press.

Masters, W. 1994. *Government and agriculture in Zimbabwe*. Westport, Conn., U.S.A.: Praeger.

Rattrary, A. 1956. Maize breeding: Maize production in Southern Rhodesia. Proceedings of the second annual conference of the professional officers of the Department of Research and Specialist Services, held at Gwebi Agricultural College, April. Harare: Government Printer.

Rohrbach, D. 1988. The growth of smallholder maize production in Zimbabwe (1979-85): Implications for food security. In *Southern Africa: Food security policy options,* ed. M. Rukuni and R. Bernstein. Harare: University of Zimbabwe Press.

Rukuni, M., and C. Eicher, eds. 1994. *Zimbabwe's agricultural revolution.* Harare: University of Zimbabwe Press.

Seed Co. 1998. Zimbabwe maize. www.samara.co.zw/seedco/maize.html, accessed 17 December, 1997.

World Bank. 1991. *Zimbabwe: Agriculture sector memorandum*, Vol. II, *Maize report*. Report No. 9429-Zim. Washington, D.C.: Southern Africa Department.

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