HOUSEHOLD AND NATIONAL FOOD SECURITY IN SOUTHERN AFRICA

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FOREWORD

In 1985 the University of Zimbabwe and Michigan State University initiated a Food Security Research Network for Southern Africa. The objectives of the network are to conduct research that informs policymakers about food security issues and to help strengthen the regional capacity for food policy analyis. The underlying premise of the network is that building excellence in research capacity for national policy analysis comes through experience. In practice, this requires a long-term commitment to analytical capacity building, consistency in funding, and constant interaction between researchers and policymakers.

The network has sponsored four annual conferences for network researchers, policymakers, SADCC officials, and representative of international and donor agencies. The aim of the conference is to share research findings, identify new research themes, and provide an opportunity for policy dialogue between regional researchers, policymakers, and government officials.

The 1988 conference brought together 110 participants who deliberated on 28 papers. In the Official Opening, Vice-Chancellor W.J. Kamba of the Univesity of Zimbbawe highlighted the importance of including health related-issues as a component of food security; and Zimbabwe's Senior Minister of Finance, Economic Planning, and Development B.T.G. Chidzero outlined policy reform priorities for Southern Africa. Subsequent sessions focused on *SADCC's Food Security Programme, the Impact of Market Reform on Food Security, Food Security Policy Options, New Technology to Improve Food Security, Family Food Security Options in Low-Rainfall Areas, Expanding Agricultural Trade in the SADCC Region, Nutrition and Food Security, the Contribution of Small-Scale Rural Enterprises to Employment Generation and Food Security, and the Impact of Irrigation on Food Security.*

A highlight of the 1988 conference was the participation of five nutritionists from Zambia, Zimbabwe, Sweden, and the United States. The presence of the nutritionists stimulated formal and informal discussions on the food access side of the food security equation and drew attention to the need to initiate more research in this area.

A second highlight of the 1988 conference was the attention given to reducing barriers to expanded intraregional trade in the SADCC region. Results presented suggest that there appear to be substantial price and nonprice barriers to expanded trade. Nevertheless, there exist significant opportunities for expanding intraregional trade that can be realized through appropriate government initiatives.

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FOOD SECURITY POLICY OPTIONS

GRAIN RETENTIONS AND CONSUMPTION BEHAVIOUR AMONG RURAL ZIMBABWE HOUSEHOLDS

Jayne L. Stanning[1]

INTRODUCTION

Most observers of contemporary Sub-Saharan Africa agree that food policy analysis is often formulated on an inadequate base of knowledge about a country's food situation. For instance, Mellor, Delgado, and Blackie (1987) comment on the dependence of useful policy prescription on "accurate factual information which is largely missing from Africa". Current debates in Zimbabwe highlight large knowledge gaps concerning existing patterns of production, consumption, marketing, and storage; and farmer and consumer response elasticities to price and income.

Government programmes concerned with family food security require an understanding of

- o who is most vulnerable to inadequate food intake,
- o strategies used by households to secure access to food,
- o how do the poor change food consumption patterns when circumstances change,
- o to what extent is on-farm food production shortfall the problem,
- o the role of other farm and nonfarm activities in household food security, and
- o programme interventions that will raise food intake.

To address these issues requires data on food consumption patterns, household level food availability, and nutritional status of individuals within the household. Since the primary variable to improve household nutritional status is access to food resources, this paper looks primarily at data relating to household food availability and consumption. Basic food grains supply the bulk of calories of most rural households, so the analysis focuses on food grains. For Zimbabwe these are, in order of importance, maize, sorghum, bulrush millet (*mhunga*), and finger millet (*rapoko*).

This study uses cross-sectional data to look at grain consumption behaviour among rural households in Zimbabwe. While the sample--in terms of the universe of communal areas--is inevitably narrow, the study provides an opportunity to investigate grain consumption behaviour among a broad spectrum of communal producers. The three locations studied incorporate farm households in both grain surplus and deficit areas:

- o Hurungwe communal land is a grain-surplus area in Mashonaland West, 260 km northwest of Harare. Maize occupies over 90% of the area under grain crops in this region and accounts for 70% of the cultivated area. Mean

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landholding size is around 4.2 hectares. Sample households were selected on the basis of a stratified random sample to incorporate households with good, moderate, and poor access to market.

- o Bushu communal land, also a grain-surplus area in most seasons, is located in Mashonaland Central 110 km northeast of Harare. Land holdings are on average smallest in Bushu (1.8 ha) due to high population pressure on available arable land. Maize accounts for 95% of the area under grain crops which occupy some 65% of the total cultivated area. Sample households in this area face relatively uniform environmental conditions and differ little in their access to market.
- o Binga District is a grain-deficit region located in a marginal rainfall area Southeast of Lake Kariba in Matabeleland North. Grain crops account for almost 100% of the cultivated area with bulrush millet and sorghum the two most important ones. Average landholding size is relatively large (7.2 ha) due to the low quality of the soils and to the fact that polygamous and extended households are a common feature of the people in this area of Zimbabwe.

The data used were generated by a grain transaction survey administered in the areas between April 1986 and May 1987. The 1986 harvest represents a slightly below average season. Farmers reported that in general, grain production was similar or slightly below the previous season. The survey instrument was administered to each household monthly. Information collected includes grain flows, grain consumption, income and expenditure, and related variables such as household composition and resource endowments for a total sample of 128 households[2]. The present analysis evaluates data for the 12-month period from June 1986 to May 1987 in the case of Hurungwe and Bushu, and April 1986 to March 1987 for the Binga sample which has a shorter growing season and an earlier harvest than the other survey areas.

The paper is structured according to the following sequence of analytical questions:

- o What conceptual models and principles of theory can we use to organise the analysis?
- o What are the specific variables of interest and how are they measured?
- o What are the sample characteristics with respect to the variables to be included in the analysis?
- o What is the likely impact on food consumption of changes in the key parameters?

[2] Only households for which there was a complete data set for the full 12-month period are included in the analysis. Nine households are excluded from the Binga sample because dissident activity disrupted data-collection in one location. Fourteen households are excluded from the Hurungwe sample because of incomplete or conflicting data.

FRAMEWORK OF ANALYSIS

Peasants as both producers and consumers

In rural Zimbabwe as in many LDCs, farm households are both producers and consumers and are semi-commercialised. They meet a significant proportion of their food consumption requirements from own production, but also trade produce and buy some of their requirements. They purchase some production inputs, but also provide some (notably labour and draft power) themselves. This dual character of the peasant household raises complex questions for researchers searching for a framework of analysis. The conventional approach to the peasant economy has been to abstract independent producers and consumers from the complex of peasant society--ignoring that the peasant 'runs a household and not a business concern' (Wolf, 1966). More recently, building on the earlier theoretical analysis of peasant households behaviour by Chayanov and Nakajiama, a number of household economic models have incorporated both production and consumption. (Barnum and Squire, 1979; Singh, Squire, and Strauss, 1987).

The basic household model consists of four elements: a utility function, a production function, an income constraint, and a time constraint. Agricultural household modelling assumes that markets exists for all goods and that households are price takers which enables the production and consumption side to be estimated separately. According to this line of reasoning, the amount of say maize to produce can be determined independently of the amount of maize consumed since the family can always buy and sell maize at a fixed price. The only constraint on consumption arises from total household income. The production and consumption components are therefore linked through the income constraint. The model uses the full income concept which incorporates the effects of income earned on the production side of the model and the value of the household's time endowment. As explained by Singh *et al.* (1987) "production decisions determine profits which are a component of household income which in turn influences consumption". This one-way relationship between production and consumption is referred to as the profit effect. The key conceptual issues raised by the farm household model are the need to explicitly take into account the dual nature of the farm household as both family and enterprise, consumer and producer, and the desirability of including the value of home consumption in a measure of household income, thereby allowing for the profit effect which does not occur in traditional demand theory.

Peasant consumers are rational

Peasant consumers are rational. Some of the plausible assumptions about what constitutes rational behaviour are embodied in standard consumer theory. These include the notion that consumers choose the combination of goods (food, nonfood, leisure, etc.) that maximises their satisfaction. Second, that there exists a decreasing rate of commodity substitution and, third, that consumer choice is constrained by income and the price of commodities. Therefore, according to consumer theory the main demand shifters are household income, prices, and tastes.

Food Consumption behaviour

Economic theory together with empirical investigation provides an important set of expectations concerning the relationship between food consumption and the key demand shifters--income and price.

The relationship between demand and average income is a demand curve plotted in price-quantity space. The response of the demand for food to changes in average income is measured by income elasticity of demand. The majority of income elasticities for food are positive, but less than unity--indicating that an increase in income is associated with a less than proportionate increase in the demand for the product in question. This relationship is known as Engels' Law. It implies that the proportion of income spent on food staples declines as income rises. It may not, however, be an accurate guide to the behaviour of low income households who may actually have an income elasticity of demand for food of one or greater. As a partial equilibrium concept, demand curves incorporate both substitution and income effects of price changes as a move along the demand curve, but assume that average income has not changed. Partial equilibrium demand curves are problematic where a significant proportion of consumers are also producers and the good (maize) accounts for a large proportion of real expenditures.

Income elasticity coefficients estimated for a population over a range of average incomes show that income elasticity is likely to vary with different income levels. Generally, the trend is expected to indicate declining elasticity with income.

Bennet's Law states that as incomes go up, the proportion of basic staples in the diet tends to decline as staples are substituted by higher quality or convenient carbohydrates such as wheat products or rice and as a wider variety of food sources are incorporated in the diet, such as meat protein, vegetables, and fats.

Bennet's and Engel's Law combined suggest that income elasticity of demand for food is likely to be larger for low income consumers than upper income consumers and that this pattern will be sharper for staples like maize.

Empirical studies suggest that for most food products, the quantity demanded of a good falls when the price increases and that a proportionate change in price is associated with a less than proportionate change in the quantity demanded. Price elasticities, like income elasticities, vary with equilibrium prices.

The theoretical perspective on food consumption is conveniently summarised by the Slutsky equation which decomposes the demand relationship into its substitution and income components. If the price of a food increases, this is likely to lead to substitution of the food in question by cheaper commodities. However, a price increase also means that real incomes decline and this is likely to lead to further substitution of a cheaper commodity. According to Timmer (1986), the income component alone of the Slutsky equation normally leads to observed negative price elasticities since in low income societies the budget share devoted to basic food commodities is likely to be large and the income elasticity significantly greater than zero. Since the pure substitution effect is always negative, the traditional approach of consumer demand analysis would predict unambiguous decrease in consumption of maize following an increase in its price.

This theoretical perspective does not allow for the profit effect previously noted. When the price of maize increases, farm profit increases. This means more household income, which will increase the demand for maize. In an integrated household model, the demand for maize comprises two forces pulling in opposite directions. On the one hand, an increase in price is likely to reduce demand as a result of traditional substitution and income effect of consumption theory. On the other hand, the profit associated with the same increase in price will tend to increase demand. As noted by Singh *et al.* (1987), "the ultimate effect is therefore a matter for empirical investigation. The profit effect could outweigh the other effects and reverse the traditional conclusion".

IDENTIFICATION AND MEASUREMENT OF VARIABLES

This study examines grain retentions and grain consumption patterns in selected survey areas to try and understand what determines effective demand for different grain crops and how basic economic forces and government policy affect consumption patterns of different groups in the population. Therefore, variables of interest are household grain consumption and it's major explanatory variables--income, prices, and household characteristics. The definition, source of data, and measurement of these variables is outlined below.

Grain consumption data

Grain utilisation data are based on a monthly enumeration of survey households. The monthly data are aggregated to provide seasonal and annual estimates of household grain use. The use of grain by farm households can take a variety of forms. Grain is used on the farm for both home consumption, feeding livestock (particularly chickens and pigs), and beer brewing. It may also be used for labour payment and exchange. Surplus grain is sold either locally or to the parastatal marketing agency. In examining the effective demand for grain, it is important that food and nonfood uses are clearly distinguished since these components are likely to be determined by different factors. While from a planning perspective, one is interested in understanding the factors which determine the total on-farm retentions and utilisation of grain, this paper focuses primarily on grain used for human consumption.

The relative importance of different staples varies between regions in Zimbabwe. The different ways in which each grain is processed before preparing it for consumption influences the level of accuracy with which it is possible to assess grain consumption by the monthly recall method used in this study. Households in areas where maize is the major staple, as is the case in Hurungwe and Bushu, are well served by local mills. The majority of households take maize grain for milling before preparing it for consumption. The volume of maize consumed by a household in any given month, measured in terms of the standard units on which local milling charges are based, is therefore known by the household with a high degree of accuracy. In contrast, in communal areas where sorghum and millets are the dominant staples,

there are very few mills due to the absence of appropriate technology for small grain dehulling. Food processing is largely done by hand on a daily basis, using a pestle and mortar. As this is the situation among rural households in the Binga area, quantitative estimates of grain production and utilisation are therefore more difficult to establish and need to be treated with some caution.

It should be noted that in the analysis, transactions involving commercially-milled maize meal are converted to a maize-grain equivalent for comparative purposes.

Income

Household income is probably the single most important variable affecting food consumption. In rural areas of Zimbabwe, a substantial part of household income consists of the food grown on the farm. Households also often receive payment in-kind for tasks undertaken, rather than cash wages. Therefore, in defining household income, it is necessary to take into account the net value of farm production consumed on the farm and the value of income received in-kind, in addition to cash income earned from the sale of own production or employment. Income can be formally defined as follows:

$$Y = \sum_{i=1}^{n} p_i Q_i - \sum_{j=1}^{m} p_j V_j + E$$

where Q = Output, for i=1, ...N
V_j = Variable Inputs, for j=1, ...M
p_i = Price of Q
p_j = Price of V
E = exogenous income (in cash and in kind).

All farm output (grains, vegetables, oilseeds, and livestock products etc.) that is domestically produced, whether utilised on the farm or marketed, should be valued. However, due to limitations on the length of the questionnaire used to collect data for this study, information concerning on-farm utilisation of production was not collected for livestock or crops other than grains. Consequently, the value of farm production is based on grain output and income received from any other farm production that was marketed. Although grain crops make up a large proportion of the home produced foodstuffs of rural families, it is recognised that for food security purposes, this measure is limited.

For the purpose of valuing grain output, total grain production is subdivided into various components, based on method of utilisation as follows:

$$Q^{prod} = Q^{hcons} + Q^{sales} + Q^{sbeer} + Q^{other} + Q_{t+1}^{stock} - Q_t^{stock}$$

where Q^{hcons} = quantity of grain used for human consumption.
Q^{sales} = quantity of grain sold.
Q^{sbeer} = quantity of grain used to brew beer for sale.

Q^{other} = quantity of grain used for other on-farm consumption and processing (excluding brewing of beer for sale) plus grain used in nonmonetary transactions.
Q_{t+1}^{stock} = quantity of grain in storage at the end of the season.
Q_t^{stock} = quantity of grain in storage at the beginning of the season.

In terms of the income model described in the preceding paragraph, each of the above components of grain production can be regarded as distinct outputs.

The valuation of subsistence and other output that doesn't enter the market is problematic. One might argue that the relevant price to associate with, say, maize utilised on the farm is the opportunity cost of this maize (*i.e.*, the price maize could be sold at in the market). In a world characterised by perfectly competitive markets, the opportunity cost would be equal to the buying price and there would be no problem in using the opportunity cost to value consumption. However, because of transport and other frictional costs and because of the Zimbabwe Government's key role in setting guaranteed prices for output and fixed prices for the sale of maize meal, the price that a farmer can get for her maize is often different than the price she would have to pay to buy maize. Therefore, one could argue that subsistence should be valued at the farmgate buying price. This is particularly true in areas such as Binga where quite a few households are deficit producers and have to purchase additional grain for subsistence. This study values all maize consumed as human food at its buying price--whereas maize used in any other on-farm use, stored, or exchanged is valued at its selling price.

The value of grain sales is equal to cash receipts, less direct marketing costs such as transport. Grain used in brewing beer for sale is valued on the basis of actual income received from beer sales, less the cost of any purchased ingredients.

In calculating the cost of variable inputs used in the production process, only those costs paid for directly in cash or kind are taken into account. The contribution of unpaid family resources, such as labour and draft power, is not deducted from income. Details of production costs were established from a farm management survey and from details of repayment of Agricultural Finance Corporation (AFC) loans out of crop receipts.

Nonfarm income includes all income earned or received from other sources by household members resident on the farm, including remittances from family or relatives working in urban areas, or in any other wage employment.

It is appropriate to comment on the level of accuracy that can be attached to cash income data used in this study, since income is a sensitive and difficult variable to monitor. Estimates of annual and seasonal income are based on aggregated monthly recall data. This, therefore, avoids the problem of trying to draw far-reaching conclusions based on income data collected from a single visit survey which relies on farmers' ingenuity and willingness to recall and divulge their income for the previous year. Generally, the enumerators involved in carrying out this survey established good rapport with the households and believed that they were being provided with accurate income data. This was particularly true in the Binga area where farmers have few cash income sources. However, some errors are likely to have occurred

in monitoring the income of families in Bushu and Hurungwe operating business concerns, since even they themselves found it difficult to estimate net profits.

Prices

The buying price used to value grain used on the farm for human consumption was calculated on the basis of the cost of its maize-meal equivalent, since this is generally the food which producers use to make up family consumption requirements. The selling price of grain varies between households and is calculated as a weighted average of the net price farmers received for grain they sold during the survey period. This enabled both variations in households' access to market and quality of grain marketed to be taken into account. If farmers didn't market any grain during the survey period, the opportunity cost of grain they used on the farm for purposes other than human food is estimated as a weighted average of the net sale price received by other survey farmers in their village who had marketed grain.

Household characteristics

A number of household characteristics could be explanatory variables affecting the pattern of grain consumption. These include household size and composition, productive assets, source of income, and socioeconomic characteristics such as whether the household is headed by a female or a male. Most of these variables do not present any measurement problems. However, in order to net out the effect that household composition may have on consumption, a weighting system based on the standard calorie requirements is used to calculate the size of a household, in terms of adult equivalents (AE). A weighting scheme is not ideal because it doesn't allow for economies of size in food preparation, but it represents a reasonable way to standardise household size. The coefficients used to calculate adult equivalents are given in Appendix 1.

DATA CHARACTERISTICS

Socioeconomic characteristics of the survey areas

Table 1 presents characteristics of the sample households, grouped by survey area. There is considerable variation within and between areas in access to land--a determining factor in a farm household's ability to meet its food needs and participate in the market. Households in Binga have relatively larger holdings, but this reflects the low quality of the soils in this area and the fact that polygamous and extended households are a common feature of people in this part of the country. Land holdings are smallest in Bushu where there is considerable population pressure on available cultivable land.

Average cattle ownership is highest in Hurungwe and lowest in Bushu. Sheep and goat ownership is highest among Binga households where they act as an important cash reserve to be drawn on during drought. Over one-quarter of sample households own no cattle and this proportion is highest in Bushu where population pressure on land is greatest.

Table 1. Socioeconomic profile of households in three survey areas, Zimbabwe, 1985.

	Hurungwe		Bushu		Binga	
Field area (ha)	4.2	(3.0)	1.8	(1.2)	7.19	(4.41)
Garden area (ha)	0.1	(0.08)	0.12	(0.11)	0.13	(0.4)
Average number of:						
cattle	7.8	(9.6)	3.9	(6.2)	4.6	(4.6)
donkeys	0.2	(0.8)	0.0		0.5	(2.1)
sheep and goats	7.6	(9.4)	1.8	(3.1)	28.7	(38.9)
pigs	2.1	(3.8)	0.4	(1.9)	0.2	(0.7)
Households with no cattle (%)	28.0		33.0		26.0	
Female-headed households (%)	5.0		4.0		0.0	
Household head absent year (%)	10.0		36.0		10.0	
Average number of:						
adult males	1.0	(0.6)	0.7	(0.9)	1.3	(0.7)
adult females	1.5	(0.9)	1.2	(0.8)	3.7	(2.5)
unmarried post-school children	0.8	(0.9)	0.8	(1.2)	0.3	(0.8)
school age children	2.8	(2.3)	2.1	(1.5)	4.6	(3.5)
pre-school children	1.3	(1.3)	1.4	(1.6)	3.0	(2.2)
Total number of:						
household members present	7.4	(4.2)	6.3	(3.7)	12.9	(7.1)
household members present in AE	5.4	(3.0)	4.5	(2.6)	9.0	(4.9)

[a] Standard deviation in parenthesis.
[b] Includes only those households with complete 12 months of grain transactions data for period June 1986 to May 1987.
[c] Households with household head absent 4-12 months per year.
[d] Average number present
[e] 17-24 years of age.
Source: Data from author's baseline surveys, 1985.

The number of female-headed households is relatively small, but since over one-third of household heads are absent for most of year in Bushu, these households are effectively managed by women.

The composition of survey households is similar in Hurungwe and Bushu, except the number of absent male members is higher in the latter area. These households support 6-7 persons on average. Households are larger in Binga due to the fact that many men are polygamists and because it is quite common for married sons and their wives to continue residing at the father's homestead.

Household income sources

Economic theory suggests that income is a key demand shifter, with respect to food consumption. Household income has been calculated using the approach outlined previously and is summarised for the three survey areas in Table 2. Except in the case of grain crops, it was not possible, due to lack of data, to incorporate in the estimation of income the value of other farm outputs consumed as food. To the extent that other home-produced items--such as livestock products, vegetables, and oilseeds are important--this leads to an underestimation of household income.

Table 2. Annual household income in the three survey areas, Zimbabwe, 1986-1987.

Survey areas	Type of income (%)				
	Grain consumption:		Net farm income	Nonfarm income	Full income
	Human	Other			
Hurungwe (June 1986-May 1981)					
Mean (household)	303	53	684	973	2013
Standard deviation (household)	(167)	(50)	(1435)	(1622)	(2921)
Mean AE[a]	96	14	110	218	438
Standard deviation AE	(30)	(15)	(201)	(250)	(339)
Percentage (household)	15	3	34	48	100
Bushu (June 1986-May 1987)					
Mean (household)	228	22	350	908	1508
Standard deviation (household)	(90)	(37)	(590)	(611)	(898)
Mean (adult equivalent)	58	6	101	313	478
Standard deviation (adult equivalent)	(21)	(9)	(193)	(406)	(547)
Percentage (household)	15	2	23	60	100
Binga (April 1986 - March 1987)					
Mean (household)	595	42	358	165	1159
Standard deviation (household)	(355)	(52)	(323)	(241)	(723)
Mean AE	68	5	47	21	141
Standard deviation AE	(20)	(5)	(45)	(29)	(57)
Percentage (household)	50	4	31	14	100

Source: Data from author's monthly income surveys, 1986-1987.
[a]Adult equivalent

Average household income (Z$2,013 per annum) is highest for Hurungwe, but Bushu households have a higher level of income per adult equivalent. At Z$1,159 per household, or Z$141 per AE, average income in Binga is considerably less than in either of the other two survey areas. Some 52% of income for Binga housholds is derived from the value of grains consumed or utilised on the farm, whereas the share of these items in the income of households in the other two survey areas is only 18%. Net farm income, derived predominantly from the sale of small livestock and beer, accounts for two-thirds of cash income received by Binga households. For both Bushu and Hurungwe housholds, nonfarm income accounts for the largest share of cash income received. This is particularly striking among Bushu households for whom nonfarm income is Z$313 per AE per annum and nearly twice the value of grain production and marketed output.

Farm household grain transactions

Farm household grain transactions involve both inflows and outflows. Sources of grain include own production, purchases, nonmonetary transactions, and carryover stocks. Purchases may be in the form of grain or commercially milled maize meal.

Nonmonetary transactions include exchange of services, such as labour and draft power and commodities such as meat for grain. Uses of grain also take a variety of forms. There is an on-farm demand for grain for both human consumption and feeding livestock (mainly chickens and pigs) and beer brewing. Households also use grain for exchange. Surplus grain are either sold locally or to the parastatal marketing agency, the Grain Marketing Board (GMB).

A summary of household grain transactions in the three survey areas over a 12-month period is provided in Tables 3-5. There is considerable variation between survey areas in the availability and composition of grain supplies. Average level of grain supply and disposal among Hurungwe households in the 1986 season was just over 9 mt per household or 1,715 kg/AE. In aggregate terms, households in Hurungwe were self-sufficient in grain and had a significant marketable surplus. Average level of transactions per household was fairly similar among sample households in Bushu and Binga, but the AE figures show that total grain transactions in Binga were only 339 kg/AE compared to 580 kg/AE in Bushu. Therefore, grain supplies in Binga are significantly lower than in either of the other two study areas.

Maize is clearly the dominant grain in both Hurungwe and Bushu with the other grains generally accounting for less than 6% of transactions. In these areas the production of other grains is limited and they are mainly used for brewing beer. Bulrush millet is the dominant staple of survey households from the Binga area and accounts for around two-thirds of all grain transactions. The balance is derived from a combination of sorghum, maize, and purchased maize meal. All of these grains are used for food purposes, in addition to other on-farm uses.

The seasonal pattern of grain flows is largely as expected. Activity is greatest during the postharvest period and, with the exception of Hurungwe households, purchases are concentrated in the preharvest period when on-farm stocks are falling. The high percentage of monetary and nonmonetary transactions occurring between June and September for Hurungwe households is largely accounted for by grain received in payment for beef that had been disposed of before harvest and by purchases of maize intended for resale to the GMB.

Strategies used by farmers to secure access to food

Since meeting food requirements generally takes priority over other production goals in the survey areas (Table 6), own production is generally the dominant source of grain for most households; except in a drought season or if the household has limited production resources.

The extent to which sample households were able to secure access to food requirements through carry over stocks and own production is illustrated in Table 7. In all the survey areas, the average supply of grain is greater than that consumed by the family as food. Supplies were also, on average, large enough to meet other on-farm consumption requirements. Binga households were borderline subsistence, whereas in Hurungwe and Bushu 59% and 84%, respectively, of available supplies was marketed. However, these aggregate figures mask wide variations in the grain situation of individual households within the survey areas.

Table 3. Summary of farm household grain transactions, Hurungwe Communal Land, Zimbabwe, June 1986-May 1987[a].

Transaction type	All grains			Share	Share by grain (%)[c]:					Share by season (%):		
	Total	Mean per[b]:										
	(mt)	H/H (kg)	AE (kg)	%	Mz	Sg	Bm	Fm	Mm	Jun-Sep	Oct-Jan	Feb-Mar
Source												
On-farm stocks (1.6.86)	0.9	24	4.4	0.2	48	9.0	0	43.0	0	100	0.0	0
Harvest 1986 season	341.3	8,751	1,620.0	94.5	98	neg	0	2.0	0	100	0.0	0
Monetary transactions	2.1	54	10.0	0.6	94	0.0	0	6.0	0	95	5.0	0
Non-monetary trans.	15.0	385	71.0	4.1	98	1.0	0	neg	0	99	0.0	1
Used from 1987 harvest	2.2	55	10.0	0.6	100	0.0	0	0.0	0	0	0.0	100
Subtotal	361.5	9,267	1,715.0	100.0	98	0.2	0	1.8	0	99	0.0	1
Use												
Own consumption	46.2	1,185	219.0	12.8	98	0.0	0	2.0	0	35	32.0	34
Monetary trans.	287.8	7,379	1,366.0	79.6	99	neg	0	1.0	0	93	2.0	5
Other on-farm consumption and processing	14.2	363	67.0	3.9	95	2.0	0	3.0	0	44	19.0	37
Non-monetary trans.	8.5	218	40.0	2.4	97	2.0	0	1.0	0	95	4.0	1
Ending stocks (31.5.87)	4.8	122	23.0	1.3	79	3.0	0	18.0	0	0	0.0	100
Subtotal	361.5	9,267	1,715.0	100.0	98	0.2	0	1.8	0	83	6.3	10.7

[a]Hurungwe sample (number of valid observations = 39). [b]Ratio of means. [c]Mz = Maize, Sg = sorghum, Bm = bulrush millet, Fm = finger millet, Mm = maize meal.
Source: Data from author's monthly food grain survey, Hurungwe Communal Land, 1986-87.

Table 4. Summary of farm household grain transactions, Bushu Communal Land, Zimbabwe June 1986-May 1987[a].

Transaction type	All grains			Share	Share by grain (%)[c]:					Share by season (%):		
	Total	Mean per[b]:										
	(mt)	H/H (kg)	AE (kg)	%	Mz	Sg	Bm	Fm	Mm	Jun-Sep	Oct-Jan	Feb-Mar
Source												
On-farm stocks (1.6.86)	5.4	79	18	3.0	97	1.0	0	2	0.0	100	0	0
Harvest 1986 season	161.4	2,337	518	89.4	99	1.0	0	neg	0.0	100	0	0
Monetary transactions	8.1	102	23	4.5	66	0.5	0	12	21.5	18	32	50
Nonmonetary trans.	4.5	51	12	2.5	69	0.0	0	6	25.0	36	16	48
Used from 1987 harvest	1.2	17	4	0.6	100	0.0	0	0	0.0	0	0	100
Subtotal	180.6	2,617	580	100.0	94	2.0	0	1	3.0	94	2	4
Use												
Own consumption	60.7	880	198	33.6	93	1.0	0	1	5.0	31	32	37
Monetary trans.	97.6	1,414	318	54.0	100	neg	0	0	0.0	96	2	2
Other on-farm consumption and processing	8.3	120	27	4.6	80	0.0	0	20	0.0	45	31	24
Non-monetary trans.	7.2	104	24	4.0	100	0.0	0	neg	0.0	22	58	20
Ending stocks (31.5.87)	6.8	99	22	3.8	98	2.0	0	4	0.0	0	0	100
Subtotal	180.6	2,617	580	100.0	94	2.0	0	1	3.0	62	15	23

[a]Hurungwe sample (number of valid observations = 39). [b]Ratio of means. [c]Mz = Maize, Sg = sorghum, Bm = bulrush millet, Fm = finger millet, Mm = maize meal.
Source: Data from author's monthly food grain survey , Bushu Communal Land, 1986-87.

Table 5. Summary of farm household grain transactions, Binga District, Zimbabwe April 1986-March 1987[a].

Transaction type	All grains: Total (mt)	All grains: Mean per[b]: H/H (kg)	All grains: Mean per[b]: AE (kg)	Share %	Share by grain (%): Mz	Sg	Bm	Fm	Mm	Share by season (%): Jun-Sep	Oct-Jan	Feb-Mar
Source												
On-farm stocks (1.6.86)	5.7	300	33		5	11	84	0	0	100.0	0.0	0.0
Harvest 1986 season	46.2	2,431	270		13	27	70	0	0	100.0	0.0	0.0
Monetary transactions	3.0	158	18		0	2	11	0	87	8.0	36.0	56.0
Nonmonetary trans.	2.2	113	13		68	13	12	0	7	11.0	10.0	79.0
Used from 1987 harvest	0.9	38	5		0	0	100	0	0	0.0	0.0	100.0
Subtotal	58.0	3,050	339		13	17	66	0	4	90.0	2.0	8.0
Use												
Own consumption	42.7	2,243	249		14	19	61	0	6	33.5	33.8	32.7
Monetary trans.	2.7	143	16		40	4	56	0	0	11.0	78.0	11.0
Other on-farm consumption and processing	2.6	137	15		1	20	73	0	6	39.0	33.0	28.0
Non-monetary trans.	2.5	132	15		7	22	62	0	9	11.0	63.0	26.0
Ending stocks (31.5.87)	7.5	395	44		5	7	88	0	0	0.0	0.0	100.0
Subtotal	58.0	3,050	339		13	17	65	0	5	27.0	32.0	41.0

[a]Binga sample (number of valid observations = 19). [b]Ratio of means.
Source: Data from author's monthly food grain survey, Manjolo Communal Land, 1986-87.

Table 6. Household production goals for maize, sorghum, bulrush millet, and finger millet in the three survey areas, Zimbabwe, 1985.

Production goal (%)	Hurungwe Mz	Hurungwe Sg	Hurungwe Bm	Hurungwe Fm	Binga Mz	Binga Sg	Binga Bm	Binga Fm	Bushu Mz	Bushu Sg	Bushu Bm	Bushu Fm
Surplus: sell and store[a]	46.2	7.7	0.0	12.8	31.3	37.5	31.3	0.0	82.4	0.0	0.0	1.5
Surplus: sell[b]	41.0	3.8	0.0	3.8	0.0	0.0	6.3	0.0	5.9	4.4	0.0	5.9
Surplus: store[c]	6.4	1.3	0.0	7.7	6.3	62.5	62.5	0.0	2.9	0.0	0.0	1.5
Meet needs[d]	6.4	9.0	0.0	16.7	62.5	0.0	0.0	0.0	8.9	2.9	0.0	2.9
Less than needs[e]	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Little/no grain: buy[f]	0.0	28.2	0.0	24.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
None[g]	0.0	48.7	100.0	34.6	0.0	0.0	0.0	100.0	0.0	92.6	100.0	88.2

[a]More grain than the household needs so that you can sell some and store extra in case of a bad season.
[b]More grain than the household needs so that you can sell some.
[c]More grain that the household needs so that you can store extra in case of a bad season.
[d]Just enough grain for the household needs.
[e]Less than the household needs.
[f]Little or no grain and buy all the grain the household needs.
[g]Do not grow or use this grain.
Source: Data from author's baseline surveys, 1985.

Table 7. Grain available from on-farm stocks and 1986 harvest in three survey areas, Zimbabwe, 1986-87[a].

Survey area	Mean kg per:		On-farm supply as % of:			Sales as % of on-farm supply
	Household	AE[a]	Human consumption	All on-farm consumption	All grain used	
Hurungwe	8,775	1,624	740	567	95	84
Bushu	2,416	536	271	242	92	59
Binga	2,731	288	122	115	80	2

[a]Adult equivalent.
[b]Data are for the following 12 month periods: Hurungwe, June 1986-May 1987; Bushu, June 1986-May 1987; Binga, April 1986-March 1987.
Source: Data from author's monthly food grain surveys, 1986-87.

The proportion of households whose available supplies of grain did not meet effective demand for grain for home consumption is as follows. Among Binga households, some 37% of families were only in a position to meet between 63% and 94% of food needs out of own supplies. A further 11% were able to meet between 100-115% of their needs and, therefore, had limited grain available for other on-farm uses or exchange. The situation was somewhat better in Bushu, where some 19% families were unable to meet their food requirements from available grain supplies. Although aggregate supplies in Hurungwe were over seven times the total quantity of grain consumed as food, a small percentage of households (10%) were not self-sufficient in grain--although generally the shortfall for these households was quite modest. Around 20% of the Hurungwe households had grain supplies that were more than 20 times the quantity that these households consumed as food. This reflects the marked inequality in the distribution of maize production among households in this area.

Among Binga households, on-farm stocks were sufficient to meet requirements through to December, but thereafter the percentage of households with no grain in storage rises (Table 8). Households stock bulrush millet longer than either sorghum or maize stocks. The majority of households in Hurungwe and Bushu had on-farm stocks through to February 1986. Thereafter, the percentage of households with maize in storage declined and households used the current crop for home consumption.

Households secure additional grain through a number of sources (Table 9). Although on average the quantity of additional grain supplies is highest for Hurungwe households, most of these inflows are related to commodity exchange and purchases of maize for resale and were not made by food insecure households. This is not the case in either of the other survey areas, where the acquisition of grains was generally associated with food deficit households acquiring grain for home consumption. The few exceptions to this were purchases of finger millet by Bushu households for beer brewing.

Table 8. Household grain storage among households in three survey areas, Zimbabwe, 1986-87.

Month April 1986 to May 1987	Households with stocks (%):					
	Hurungwe	Bushu	Binga	Binga		
	Any grain	Any grain	Any grain	Maize	Sorghum	Bm[a]
April	na	na	100	55	80	100
May	na	na	100	62	90	100
June	11	100	100	62	90	100
July	99	98	100	74	90	100
August	100	100	100	65	90	100
September	100	98	100	50	90	100
October	100	98	100	50	90	100
November	100	98	100	30	50	100
December	100	98	89	10	30	85
January	100	96	74	10	15	70
February	100	94	84	30	10	70
March	95	78	95	65	55	95
April	86	84	100	65	80	100
May	57	71	100	65	75	100

[a] Bulrush millet. Na = no data collected.
Source:Data from author's monthly food grain surveys, 1986-87.

For food purposes, Bushu households depended mainly on purchases of maize grain from local farmers, although some people received grain in exchange for labour or as a gift. Binga households depended mainly on purchased maize meal since there was little surplus grain in the local market. For Binga households, drought relief accounted for 29% of total grain consumed coming from outside the household. However, a point of concern is that all of this drought relief was in the form of maize which is normally the least important grain in the local diet. Given that Zimbabwe has considerable stocks of both sorghum and bulrush millet, it is surprising that these grains were not used for drought relief.

The primary and secondary sources of income most likely to be used to purchase additional grain by Bushu households are remittances from family members working away from home and casual employment; and for Binga households, the sale of livestock and beer brewing (Table 10).

Grain retentions and grain utilisation

A detailed breakdown of retentions and utilisation of grain by households is given in Table 11. Grain that was sold on the local market is included because, although this represents part of the marketed surplus, it also comprises part of the stock of grain that households retain and withold from the formal market. All figures are expressed in AE terms to enable comparisons to be made between survey areas.

Table 9. Pattern of acquisition of food grains in three survey areas, Zimbabwe, 1986-87[a].

	Hurungwe	Bushu	Binga
Total food grains acquired (kg)	17,121	10,557	5, 149
Average per sample household (kg)	439	153	271
Average per adult equivalent (kg)	81	36	30

Source of Acquired grain	Share	Share by grain (%)					Share by season (%)		
	%	Mz	Sg	Bm	Fm	Mm	Jun-Sep	Oct-Jan	Feb-May
Hurungwe									
Purchase	12	98	2	0	0	0	99	0	1
Labour payment	3	65	15	0	17	3	97	3	0
Gift	1	100	0	0	0	0	0	0	100
Exchange[b]	84	100	0	0	0	0	100	0	0
Bushu									
Purchase	64	66	1	0	12	21	18	32	50
Labour payment	15	85	0	0	11	4	47	32	21
Gift	19	56	0	0	2	42	34	6	59
Exchange[b]	2	64	0	0	34	0	55	45	0
Binga[a]									
Purchase	58	0	2	11	0	87	8	36	56
Labour payment	4	5	24	57	0	14	45	55	0
Gift	8	4	28	68	0	0	39	13	48
Exchange[b]	1	0	0	0	0	100	0	0	100
Drought relief	29	100	0	0	0	0	0	0	100

[a]12 month period for Binga sample is divided into the following seasons: April 1986-July 1986, August 1986-November 1986, and December 1986-March 1987. [b]Commodity exchange.
Source: Data from author's monthly food grain surveys, 1986-87.

Table 10. Primary and secondary sources of income for purchase of additional grain for households in Bushu and Binga survey areas, Zimbabwe, 1986-87.

Primary income source (% households)		Source	Secondary income source (% households)	
Bushu	Binga		Bushu	Binga
56	7	Remittances	2	0
16	0	Casual employment	23	7
11	0	Handicrafts	16	0
5	50	Small stock sales	23	29
5	36	Cattle sales	2	0
0	7	Beer brewing	2	57
7	0	Crop sales	0	0
0	0	Gold sales	14	0
0	0	Loans	12	0
0	0	Other	6	7

Source: Data from author's supplementary surveys, 1986-87.

Table 11. Annual on-farm grain utilisation (kgs per adult equivalent[a]) in three survey areas, Zimbabwe 1986-87.

	Hurungwe (June-May)					Bushu (June-May)					Binga (April-March)				
	Mz	Sg	Fm	Mm	Total	Mz	Sg	Fm	Mm	Total	Mz	Sg	Fm	Mm	Total
Human consumption	244	1	2	0	25	210	1	0	3	216	36	47	154	14	251
Standard deviation	115	2	5	0	115	80	4	3	21	78	21	23	75	20	77
Percentage	98	0	2	0	100	93	1	1	5	100	14	19	61	6	100
Livestock feed	76	0	0	0	76	15	0	0	0	13	0	0	1	0	1
Standard deviation	88	0	0	0	88	41	0	0	0	41	0	0	4	0	4
Percentage	100	0	0	0	100	100	0	0	0	100	0	0	100	0	100
Brewing beer	7	3	4	0	15	11	0	7	0	18	0	5	15	1	21
Standard deviation	13	17	8	0	27	18	0	12	0	30	1	7	9	2	8
Percentage	50	23	27	0	100	59	0	41	0	100	1	24	69	6	100
Local sales & exchange	53	1	9	0	63	41	0	0	0	41	7	5	0	12	24
Standard deviation	65	3	31	0	75	59	1	0	0	59	18	10	1	29	46
Percentage	84	2	14	0	100	99	1	0	0	100	29	20	1	50	100
Carry-over stocks	20	1	6	0	26	27	0	1	0	28	3	1	50	0	55
Standard deviation	33	3	22	0	41	45	1	5	0	47	8	4	57	0	60
Percentage	76	3	21	0	100	97	1	2	0	100	5	7	88	0	100
Total utilisation	399	6	21	0	427	303	1	9	5	318	46	58	220	16	339
Standard deviation	230	19	55	0	249	161	6	15	21	168	34	30	130	20	133
Percentage	93	2	5	0	100	95	neg	3	2	100	13	17	65	5	100

[a] Mean of ratios, data rounded to nearest whole number.
Source: Data from author's monthly food grain surveys, 1986-1987.

Total retentions were highest for Hurungwe households and lowest for Bushu households. It could be hypothesised that the high level of retentions in Hurungwe is due to the generally higher level of grain production in this area. However, if there was a simple correlation between these two variables, one would expect retentions in Bushu to be higher than those in Binga--which is not supported by the data. The lower level of retentions in Bushu appears related to less grain consumed as food. This is probably related to differences in families' ability to utilise alternative staples, either due to the availabilty of cash to purchase other foods, or to better access to retail outlets where they can be obtained. Bushu is in a more favourable position than Binga with regard to both of these factors, due to its better accessibility and the relativeley large number of households in this area where the head engages in wage employment locally or elsewhere.

Notable differences between survey areas in the utilisation of grains for nonfood consumption purposes are the higher levels of grain used by Hurungwe farmers for livestock feed, local sales, and exchange. The utilisation of grain for other purposes by households in Binga was probably dampened by the fact that more than one-third of these households were production deficient in the 1986-1987 season. Nevertheless, Binga farmers had the highest level of grain use for beer brewing.

Carry-over stocks represent between 1.3 to 1.5 months of food requirements for Hurungwe and Bushu and about 2.5 months supply for Binga housholds. However, the high standard deviations on mean stocks in all three survey areas indicate that carry-over stocks vary considerably among households. Generally, households in both Hurungwe and Bushu carry forward minimal levels of maize stocks to the next season. They often use maize that is in the granary, when the new crop is harvested, as livestock feed. If supplies are available, Binga households will try and store extra bulrush millet or sorghum in case of a bad season (Table 6).

EMPIRICAL ANALYSIS OF CONSUMER GRAIN DEMAND

This section analyses the major explanatory variables affecting rural grain demand. The analysis is exploratory and its purpose is to indicate statistical patterns in the data, rather than to provide a complete consumption analysis with refined parameters. The results provide a basis to extend the complexity of the analysis to estimating the type of agricultural household model discussed previously.

The most important explanatory variables that are explored are household income, household size and composition, assets (in particular size of land holding and cattle ownership), source of income (*e.g.*, farm versus off-farm income, cash versus self-provisioning), and socioeconomic variables such as whether the household head is absent from the household in wage employment elsewhere. Economic theory suggest that relative prices are also an important explanatory factor affecting the pattern of food consumption, but cross-sectional data used in this study does not lend itself very well to the analysis of price variables. Due to government producer and consumer price controls, households do not face very different prices for the same commodity. However, farmers do face some variation in producer prices in the sense that transport costs from household to marketing depots vary according to the

distance from depot. Because of this, transport cost from household to depot can be used as a proxy for price differences in Hurungwe and Bushu. This is not possible for the Binga data, since there are no grain depots in this district.

Consumer grain demand has been disaggregated into grain demand for food and demand of grain for other purposes (including on-farm processing, livestock feed, and nonmonetray exchange, but excluding sales). This was done in expectation that different factors might account for different types of grain use. For instance, the quantity of grain fed to pigs is more likely associated with the level of livestock ownership than with household composition; whereas the reverse is true for grain consumed as food.

In examining the pattern of grain demand among sample households in Binga, all grain crops are included. Only maize is examined for Bushu and Hurungwe households since grain in these areas consists overwhelmingly of maize, and sorghum and millets are largely used in beer brewing.

Multivariate analysis

The combination of factors influencing the food consumption demand for grain are likely to differ from those that influence household grain demand for other purposes. Therefore, these two aspects of demand are best treated separately. Only the demand for food is considered here. Multiple regression equations, explaining grain consumption on the basis of selected variables, are shown in Tables 12 and 13. Total grain consumption and grain consumption per AE are the respective dependent variables. In general, the adjusted R^2 is quite high in all regressions, except the Hurungwe regressions on household consumption of maize per AE.

Determinants of household consumption

Table 12 which shows the results of regressing household consumption on selected variables, indicates that both houshold size and household compostition are highly significant explanatory variables. The parameter on total production is also statistically significant for the Binga and Hurungwe regressions. The best specification of the income variable differed slightly between regressions. The production parameter was sufficient to explain variations in total consumption of Binga households and no income variable was specified. This is consistent with the fact that production represents a sizeable component of household income for Binga farmers. The level of cash income was the most significant income variable for the Hurungwe regression; whereas both full income and the share of imputed value of home consumption and utilsation of maize in full income were positively correlated with consumption in the Bushu regression. The positive coefficient on the transport cost variable, a proxy for the selling price of maize, is consistent with economic theory and implies that lower prices are associated with higher consumption, but the correlation is not statistically significant.

The multiple regression results explaining household grain consumption per adult equivalent (Table 13) suggests the following main points:

Table 12. Multiple regression equations explaining grain consumption on the basis of selected variables, Zimbabwe[a].

	Const	HHPR	ADULT	CHILD	PROD	SHCON-INC	CASHINC	FULLINC	TCST	F	R^2	SE
Hurungwe	308.40 (2.4)[b]	100.80 (6.2)	-	-	-	-	0.06 (2.5)	-	-	33.3	0.64	388.20
Bushu	299.90 (7.74)	80.12 (15.7)	-	-	0.017 (2.47)	-	-	-	-	133.1	0.80	151.46
	-23.60 (-.168)	69.38	-	-	-	790.60 (3.46)	-	0.098 (3.60)	62.40 (1.03)	74.8	0.82	144.81
Binga	58.50 (0.30)	-	171.50 (3.50)	-	0.48 (6.30)	-	-	-	-	94.2	0.91	401.13
	452.80 (2.20)	-	-	-	0.69 (10.18)	-	-	-	-	103.6	0.85	552.60

[a] HHPR = number of household members; SHCONINC = % share of imputed value of own consumption; ADULT = number of adults present; CASHINC = cash income; CHILD = number of children present; FULLINC = full income; PROD = grain production; TCST = transport cost to depot per bag maize.
[b] T statistics are in paranthesis for the independent variables.

Table 13. Multiple regression equations explaining grain consumption per adult equivalent on the basis selected variables, Zimbabwe[a].

	Const	FLDAE	HHPR	ADEQ	TCST	FULINC AE	FULINC AE^2	SHCON INC	SHOTH INC	F	R^2	SE
Hurungwe	178.40 (2.6)[b]	3.10 (0.43)	- -	-15.5 (-2.3)	- -	0.19 (2.84)	- -	214.6 (1.7)	- -	5.70 -	0.34 -	94.8 -
	89.60 (1.9)	- -	- -	- -	14.70 (0.53)	0.57 (4.0)	-0.0003 (-3.1680)	- -	- -	6.8 -	0.32 -	96.1 -
Bushu	155.7 (8.7)	22.86 (4.0)	- -	-9.9 (-4.5)	- -	0.092 (8.141)	- -	159.60 (3.27)	- -	53.67 -	0.76 -	38.8 -
Binga	-381.5 (-3.2)	- -	2.6 (1.4)	54.7 (1.4)	- -	1.75 (6.80)	- -	519.1 (6.1)	78.90 (1.12)	11.25 -	0.74 -	39.0 -

[a] FLDAE = field area per adult equivalent; FULINCAE = full income per adult equivalent; HHPR = number of household members; FULUNCAE^2 = full income per AE squared; ADEQ = household size in adult equivalent; SHCONINC = % share of imputed value of own consumption; TCST = transport cost to depot per bag maize; SHOTHINC = % share of nonfarm income in full income
T statistics are in paranthesis for the independent variables.

- o Household income is statistically significant in all the areas.
- o Household size, expressed in terms of AE, is significant for both Bushu and Hurungwe regressions. The negative parameter attached to this variable implies that each additional household member, *ceteris paribus*, reduces maize consumption/AE by between 9-15 kg/pa.
- o The farm size variable is positive, but only significant for the Bushu regression and likely reflects the shortage of land experienced in this area.
- o The income source variable indicates that greater reliance on consumption of own production improves household consumption, although the effect is not statistically significant for the Hurungwe regression.
- o The proxy variable for price is not statistically significant.

Income elasticity of demand for maize

A number of alternative funtional forms are used to estimate the effect of income on household consumption of grain. The estimated equations are presented in Tables 14 and 15. For all three survey areas, the dependent variable is consumption/AE. The independent variable was household income/AE. The R^2 is quite low for the Hurungwe and Binga regressions, but reasonable for the Bushu regressions, ranging between 0.48 and 0.60. Small sample size in Hurungwe and Binga probably account for the low explanatory power of these regressions. Overall, the quadratic demand function had the higher explanatory power. The implied income elasticities for maize by income class are calculated for the Bushu data and shown in Table 16. They are positive but less than 1.0, implying that the quantity of maize consumed rises with income but less than proportionately. Although economic theory suggest that income elasticities of demand, particularly for a staple, are likely to be larger for low income consumers than upper income consumers, this pattern is not reflected in the data. Rather, income elasticity of demand appears to rise as income increases and then decline at higher income levels. A possible interpretaion of this result is that after a household reaches a certain consumption level, additional income may be allocated to essential purchased foods or other important items such as school fees, rather than to additional maize consumption. Only after some of these essentials are provided will the household use more of any additional income to increase their consumption of maize. Alternatively, the difficulty lies in the specification of the model. This is a matter for further empirical investigation.

SUMMARY AND CONCLUSIONS

The typical rural household is an important consumer of grains and mean annual utilisation/AE ranged between 318 kg and 427 kg in the three areas studied. Generally, food consumption accounted for the bulk of grain utilsation, but households commonly used grain for purposes other than food, particularly grain surplus households in Hurungwe. Own production accounted for the bulk of household requirements but quite a high proportion of households in Binga were production deficient in the 1986-1987 season.

There exist interregional differences in the importance of different grains. In Hurungwe and Bushu areas, grain consists overwhelmingly of maize. Maize is also grown in Binga, but millet and sorghum are of greater importance.

At the household level, grain demands were strongly influenced by the size and composition of the household. Income seems to influence consumption, but the derived elasticities were quite low.

The above findings are consistent with theoretical expectations concerning the relationship between food consumption and key demand shifters, although the absence of any substantial price variation for grains made it difficult to examine price effects and could have biased the income coefficients. Nevertheless, the empirical analysis is complimentary to the descripitive material and provides a basis for further consideration of these issues in the context of an agricultural household model.

Table 14. Maize consumption per adult equivalent relative to household income level, Zimbabwe.

Variables	Constant	I	I^2	F	Adjusted R^2	SE
Hurungwe						
Linear[a]	185.4	0.15	-	8.29	0.16	106.5
	(6.9)	(2.9)				
Quadratic[b]	107.1	0.57	-0.00033	10.29	0.33	95.1
	(3.1)	(4.1)	(-0.3.19)			
Semi-log[c]	-157.7	164.3		15.22	0.28	99.1
	(-1.5)	(3.9)				
Double log[d]	1.6	0.29	-	25.00	0.39	0.14
	(10.9)	(5.0)				
Bushu						
Linear[a]	162.7	0.11	-	90.45	0.57	51.7
	(19.4)	(9.5)				
Quadratic[b]	142.1	0.18	-0.00003	70.61	0.60	50.27
	(11.4)	(5.3)	(-2.20)			
Semi-log[c]	-212.3	168.96	-	70.61	0.51	55.34
	(-4.1)	(8.4)				
Double log[d]	1.6	0.30	-	62.47	0.48	0.10
	(16.2)	(7.9)				

[a]Linear C = a + bI; [b]Quadratic C = a + bI + CI^2; [c]Semi-log C = log a + b log I; Double log log C = log a + b log I; where C = Maize consumption per adult equivalent in kg per annum, I = full income. T statistics are in parentheses for the independent variables.

Table 15. Grain consumption per adult equivalent relative to household income for Binga survey area, Zimbabwe.

Variables	Constant	I	I^2	F	R^2	SE
Hurungwe						
Linear[a]	153.2	0.70	-	6.50	0.23	67.0
	(3.7)	(2.5)				
Quadratic[b]	-3.8	2.85	-.0063	5.60	0.33	62.70
	(-.04)	(2.5)	(-1.9)			
Semi-log[c]	-306.0	263.6	-	8.93	0.30	63.80
	(1.6)	(2.99)				
Double log[d]	1.38	0.47	-	9.30	0.31	0.11
	(4.24)	(3.05)				

[a]Linear G = a + bI; [b]Quadratic G = a + bI + cI^2; [c]Semi-log G = a + b log I; [d]Double log G = log a + b log I; where G = home consumption of all grains per adult equivalent in kg per annum, and I = full income per adult equivalent. T statistics are in parenthesis for the independent variables.

Table 16. Calculations of income elasticity for maize by income class, Bushu survey area, Zimbabwe.

Income class	Mean annual full income (Z$ per AE)	Income elasticity for maize[a]
Bottom quartile	133	0.14
Second quartile	313	0.26
Third quartile	518	0.34
Fourth quartile	1,168	0.44
Highest 10%	1,758	0.42

[a]Calculated from the following Engel function:
$C = 142.1 + 0.181 - 0.000025(I)^2$; where C = maize consumtpion per adult equivalent in kg per annum, I = full income per adult equivalent in Z$ per annum.
Elasticity = $(0.18 - 0.00005(I)) \frac{I}{C}$

REFERENCES

Barnum, H.N. and L. Squire, 1979. *A model of an agricultural household :theory and evidence*. Occasional Paper No. 27. World Bank, Washington, DC.

Mellor, J.W., C.L. Delgado, and M.J. Blackie, (eds.). 1988. *Accelerating food production in Sub-Saharan Africa.* Johns Hopkins, Baltimore, MD.

Singh, I., L. Squire, and J. Strauss, (eds.). 1987. *Agricultural household models.* Johns Hopkins, Baltimore, MD.

Stanning, J.L. 1987. Policy implications of household grain marketing and storage decisions in Zimbabwe. In: M. Rukuni and R.H. Bernsten (eds.). *Southern Africa: food security policy options.* UZ/MSU Food Security Project, Department of Agricultural Economics and Extension, University of Zimbabwe, Harare.

Wolf, E.R. 1966. *Peasants*. Prentice Hall, Englewood Cliffs. NJ.

World Health Organisation (WHO). 1985. *Energy and protein requirements.* Geneva.

Appendix 1. Adult equivalent units

The World Health Organisation has set the daily calorie allowance of a moderately active male at 3,000 calories (Kcals). The consumption of people of other ages and sex can be expressed as a percentage of this standard. Such scales are called adult-equivalent scales. The categories and calorie value used to devise adult equivalent units are as follow:

	Kcal allowance	AE unit
Male over 17 years	3,000	1.0
Female over 17 years	2,200	0.73
Male 6-16 years	2,318	0.77
Female 6-16 years	1,972	0.66
Pre-school child under 6 years	1,415	0.47

Source: WHO (1985).