
FOOD SECURITY RESEARCH PROJECT

**Statistical Report on Categorization of Rural
Cropping Households in Zambia:
Section I –Introduction and Methods**

by

**A. Kuteya, S. Kabwe, M. Beaver, A. Chapoto, B. Burke,
N. Mason and M. Weber**

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Section I – Introduction and Methods**

**National Household-Level Net Yearly Income and Related Food Security
Categorization Indicators for Zambian Rural Cropping Households by Low, Medium
and High Income Terciles, and by Maize Market Categories for
2007/2008, 2003/2004 and 2000/2001 Marketing Years**

by

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(With prior contributions by T. Lungu, now at MoFNP
and many other CSO, MACO, and FSRP Staff)**

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Any views expressed or remaining errors are solely the responsibility of the authors.

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Summary – Categorization Report Organization

In 2009/2010 agricultural farming season, Zambia recorded a historical bumper harvest in maize production of 2,795,483 rounded to 2.8 million metric tons, of which 90% came from smallholder farmers. Thus, smallholder farmers play a major role in maize production. Well-designed support programs/policies and effective targeting of smallholder farmers can bring about agricultural development and improve welfare of rural cropping households.

The purpose of this study is to empirically identify and understand characteristics and resource situations of smallholder farmers as one important input into developing improved smallholder assistance programs and policies. The full categorization report is organized into eight sections. It is being released for review and discussion in standalone sections so to circulate results to enable stakeholder use and suggestions. After all Sections have been completed and reviewed, a final composite version of the entire report will be created so that all information can be accessed in one single document, as well benefit from insights gained from extended stakeholder review.

Data used in this report is drawn from the Central Statistical Office's nationally representative Post-Harvest Survey (PHS) of 1999/2000, and the linked Supplemental Surveys (SS) of 2001, 2004, and 2008 designed and conducted jointly by the government's Central Statistical Office, the Ministry of Agriculture and Cooperatives, and the Food Security Research Project (FSRP). For purposes of the analysis in this report, only rural cropping households in a given year were considered.

Summary for Discussion – Introduction and Methods

This section introduces the categorization topic and the logic of analysis as well as explains the sources of data used and statistical test completed. It also explains ranking and other base variables created, and discussed how the base tables are organized. Details are given about the extensive livelihood coverage of the supplemental surveys, covering on farm cropping and livestock activities as well as off-farm income generating activities. The approach to net income analysis is explained wherein key on-farm and business expenses are deducted from gross incomes to derive net household income estimates which are used for ranking households into income terciles. A key household-level food security indicator is explained – calories available per adult equivalent per day from on-farm production and retention of all cereals and tubers.

The two principal analysis formats used throughout the study are introduced: 1) the three-year household income tercile perspective; and the yearly maize market by income format. Results of a test of allocation into four main maize market categories are presented. Examples are given to illustrate the process of allocating household from national income terciles into maize market by income terciles to better understand household income distribution and maize marketing relationships.

Statistical Report on Categorization of Rural Cropping Households in Zambia

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ACRONYMS

ACF	Agricultural Consultative Forum
ANOVA	Analysis of Variance
Cal/ae/day	Calories per Adult Equivalent per Day
CFS	Crop Forecast
CSA	Census Supervisory Areas
CSO	Central Statistical Office
EC-Deg	European Commission Delegation
FAO	Food and Agricultural Organization
FSRP	Food Security Research Project
GDP	Gross Domestic Product
MACO	Ministry of Agriculture and Cooperatives
MACO-SADFS	Ministry of Agriculture and Cooperatives- Support to Agricultural Diversification and Food Security
MoFNP	Ministry of Finance and National Planning (Zambia)
MSU	Michigan State University
NGO	Non-governmental Organizations
PAM	Programme Against Malnutrition
PHS	Post Harvest Survey
SEA	Standard Enumeration Areas
SIDA	Swedish International Development Agency
SS	Supplemental Surveys
UNZA	University of Zambia
USAID	United States Agency for International Development
ZMK	Zambia Kwacha
ZNFU	Zambia National Farmers' Union

Section I. Introduction and Explanation of Tables

1.0 Introduction of “Categorization” Research and Outreach Work

Zambia's economy has experienced strong growth in recent years, with real GDP growth in 2005-08 about 6% per year. However, poverty - especially in rural areas - remains a very significant problem in the country. In 2009/2010 agricultural farming season, Zambia recorded a historical bumper harvest in maize production of 2,795,483 rounded to 2.8 million metric tones, of which 90% came from smallholder farmers. Analysis has shown that favorable weather contributed to 47% of the maize yield growth between 2009 and 2010, whilst 25% came from increased fertilizer use from both private and public sector sources, and 23% from planted area expansion (Burke et al. 2010). At the same time, analysis of the CSO/MACO Crop Forecast survey (CFS) data for this crop shows that in this record production year, home production and consumption of maize still dominates, as only 43% of all maize production was to be sold, and this would be offered by only 36% of the households making up the smallholder sector in Zambia (MACO/CSO and ACF/FSRP, 2010). Overall many smallholder households eat better when there is a record crop of maize but benefits through interactions with the market are relatively highly concentrated within the sector. Over the longer-run, having well designed support programs and policies in place with careful and effective targeting to a broad range of different kinds of smallholder farmers has great potential to develop the agricultural sector and improve welfare of a broad majority of the rural sector.

Objectives Motivating this Work

This study is primarily driven by the need to empirically identify and understand characteristics and resource situations of smallholder farmers as one important input into developing improved smallholder assistance programs and policies.. Towards this objective, a number of Zambian public and NGO organizations (ACF, MACO, PAM, FAO, UNZA, MACO-SADFS, EC-DEg, ZNFU and FSRP) met in August of 2008 at Kafue Gorge to initiate a “smallholder categorization” activity aimed at organizing and using as much information as possible to promote better understanding of the different kind of typical smallholder households in Zambia. A major reason for doing this is not only to design more effective programs and policies to meet the specific circumstances facing different types of smallholders, but to also understand key features that can be used to help provide different kinds of assistance to needy households. Indeed, this report should be seen as an outgrowth of that workshop, as well as from follow up discussions, wherein ACF/FSRP researchers have taken on the task of trying to use existing CSO/MACO/FSRP data bases to describe discernable groups or categories of smallholders according to significantly different, yet typical agricultural production, asset, resource, household income and demographic situations.

It is our intention that the information in this paper will help develop relevant categories of rural cropping households in Zambia. The objective therefore is to better understand typical resources, opportunities, and bottlenecks facing different types of smallholders, and to make this information widely available and understood as part of a process to help in the development of improved assistance programs and policies.

1.1 Background on Source of Nationally Representative Household-level Data

Data used in this report is drawn from the Central Statistical Office's nationally representative Post Harvest Survey (PHS) of 1999/2000, and the linked Supplemental Surveys (SS) of 2001, 2004, and 2008 designed and conducted jointly by the government's Central Statistical Office, the Ministry of Agriculture and Cooperatives, and the Food Security Research Project (FSRP). The PHS is a nationally representative survey using a stratified three-stage sampling design. Census Supervisory Areas (CSA) were first selected within each district, next Standard Enumeration Areas (SEA) were sampled from each selected CSA, and in the last stage a sample of households were randomly selected from a listing of households within each sample SEA. The SEA is the most disaggregated geographic unit in the data, which typically includes 2-4 villages of several hundred households. Map 1 shows the distribution of SEAs and how they cut across the four agro-ecological zones of Zambia.

The 2001, 2004, and 2008 full livelihood supplemental surveys are based on the same sample frame of the PHS survey of 1999/2000 of about 7,400 small-scale (0.1 to 5 hectares) and medium-scale farm households, defined as those cultivating areas between 5 to 20 hectares. The intent was to revisit starting in 2001 as many of the same households as had been surveyed in the original PHS of 1999/2000. The number of households visited in the PHS and follow up SS are detailed in Table 1.1. Nationally representative survey coverage numbers decreased from the original 1999/2000 PHS sample size due to modest sample attrition. At the time of the SS of 2008, a relisting of the original SEAs was completed and random sample methods were used to select 3524 new households to enter the sample and restore the sample size to a level similar to the 1999 PHS. Of the original PHS sample, 4301 were revisited in the 2007/2008 SS.

For purposes of the analysis in this report, attention is focused on households who conducted cropping activities in a given year. Preliminary use of the survey data shows that a small number of smallholders can be classified as non-agricultural rural households, or among those that undertake no cropping but did have some minor livestock activity. However further analysis shows that these households were primarily dependent on non-farm income sources. Therefore, to carefully focus this categorization analysis on a relatively similar set of households, the few non-agriculture and livestock/non-farm households captured in the supplemental surveys were excluded from the analysis. The analytical results in the majority of the tables in this report are therefore based on a full nationally representative sample of cropping households in each given year. As shown in Table 1.1, the cropping household sample size varies from 7,448 to 5,315. Given these sample sizes, results are statistically valid at the national and provincial, but not district level. No analysis is therefore undertaken in this report at the district level.

Given that the supplemental surveys were designed to revisit as much as possible the same set of smallholder households over this 8 year study period, it is also possible to constitute a 3-wave panel data set from the national survey sample. This is available for the three agricultural production seasons, 1999/2000, 2002/2003, and 2006/07. As shown in Table 1.1, the number of households included in the 3-wave panel is 50-70% of the size of the national survey sample for each respective year. When using the panel data, tests have been done to correct for attrition bias (see Chapoto and Jayne 2008). Survey method details and survey instruments are detailed in the Survey Instrument and Document portion of the references to this publication.

Map 1: Map of Central Statistical Office Statistical Enumeration Areas (SEAs) Sampled in the CSO/MACO/FSRP Post Harvest Survey in 1999/2000 and Supplemental Surveys in 2000/2001, 2003/2004 and 2007/2008 by Zambia's Agro-Ecological Zones

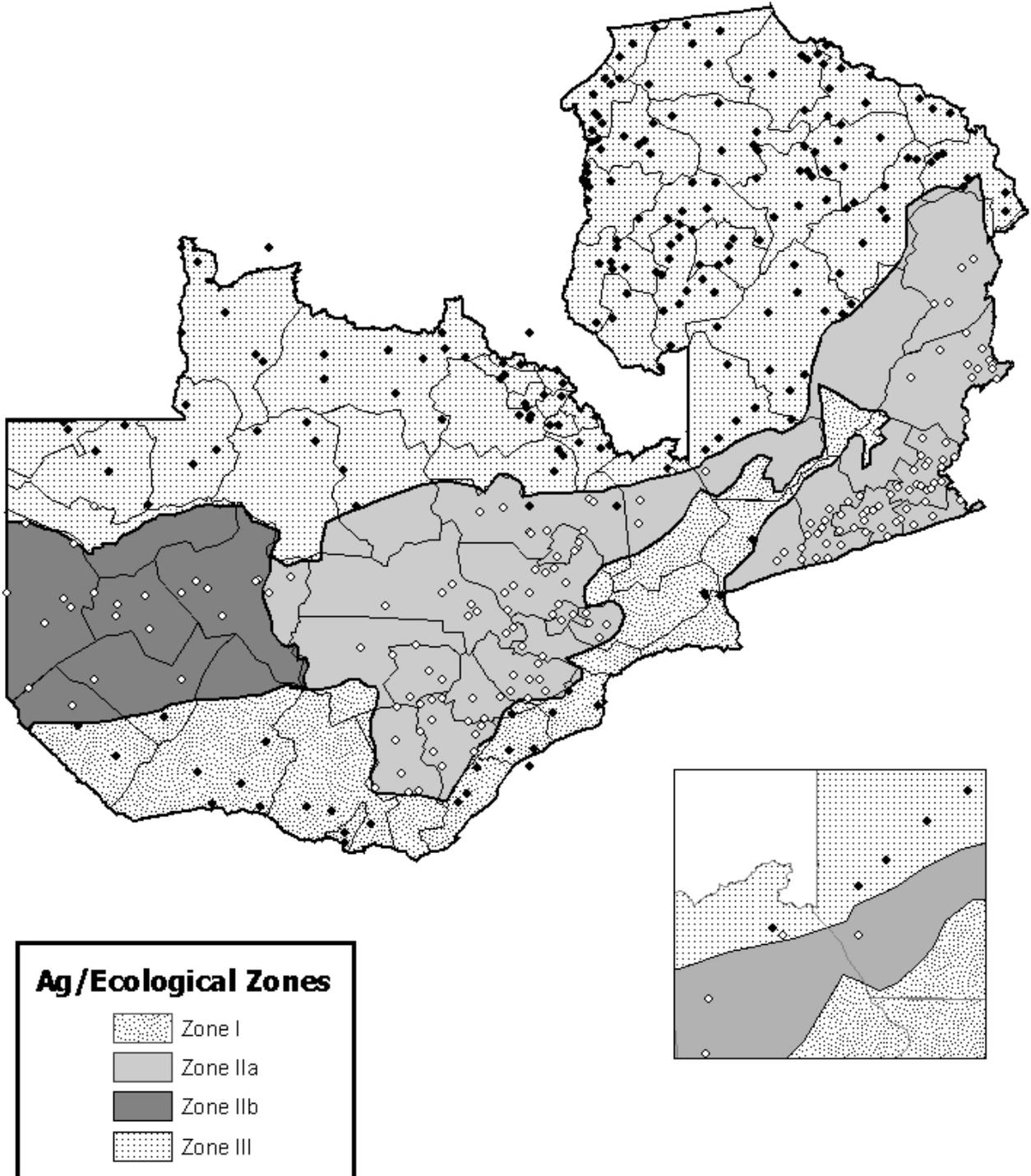


Table 1.1 Post Harvest and Supplemental Survey Sample Sizes: 2000-2008 Surveys

Survey Date	Production Year Coverage	Marketing Year Coverage	Supplemental Survey – All HHs Surveyed	Supplemental Survey - Cropping HHs Coverage	Supplemental Survey Panel Cropping HHs Coverage
PHS August 2000	99/00	00/01	7,400	6,817	
SS - 1 June 2001	99/00	00/01	6,922	6,817	3,839
SS - 2 June 2004	02/03	03/04	5,344	5,315	3,839
SS - 3 June 2008	06/07	07/08	7,825 (4301*)	7,448	3,839

Source CSO/MACO/FSRP data files

* Number of original PHS HHs surveyed

1.2 Content Coverage of the Supplemental Surveys

Crop Forecast (CFS) and Post Harvest Surveys (PHS) in Zambia are primarily aimed at estimating/measuring crop production. The original concept of implementing a follow-on supplemental survey to the PHS of 1999/2000 was to obtain a more complete set of household-level information in Zambia that could help policy makers gain a much more complete livelihood picture of challenges and opportunities facing smallholders. The supplemental surveys implemented in 2001, 2004, and 2008 measure household level responses covering 11 categories of questions. Smallholder responses to these then provide the information to help construct the categorization analysis undertaken in this report. The categories of questions in the supplemental surveys include the following:

1. Extensive demographic dimensions at the household member level;
2. Extensive off-farm income/expenses, and remittances;
3. Farm land access and use at the field-level, including details about planting and harvesting by crop;
4. Crop stocks and sales from own production;
5. Food purchases and processing;
6. Fertilizer acquisition in current and prior season;
7. Agricultural loans used;
8. Agricultural information received, including extension information;
9. Household asset and implement ownership;
10. Household-level livestock, poultry and fish farming ownership and activities;
11. Inheritance and extended family information

1.3 Notes on Measuring Net Income

Net smallholder household income for this study is defined as gross income minus important associated production costs that could be measured relatively easily in the supplemental surveys. Gross household income is defined as the total value of production, regardless of whether that production is consumed or sold. Household total quantity produced was measured. Prices of crop and livestock products were obtained for each year of the SS and used to value household production identified in the survey. To make net income estimates comparable over the years of the three SS, all values were converted to constant 2009/2010 terms using the Consumer Price Index of Zambia's Central Statistical Office. Gross income

and production costs can be broken down into main categories, which we discuss briefly below:

Crop income: The supplemental surveys measured the production of some 22 food and cash crops. Fruit and vegetables production and sales were measured in the 2007/08 survey but only volumes marketed were measured in other years. Therefore, for consistency purposes, the crop income measured as used across the three SS years includes only the total value of fruit and vegetable sales.

Livestock income: The number and value of live animals sold or slaughtered was measured, as was the quantity and value of the main livestock products, milk, and eggs. For fish, the value of sales was measured.

Off-farm income: This is divided into three income components, being income from salaried work, from business income and from remittances. Income from salaried labor was measured directly, as was the value of sales from informal and formal businesses of the households. Remittances are in net terms by measuring items received in cash or kind and deducting the value of remittances given out in cash and kind.

Production costs: For smallholder households, own labor used in cropping, livestock, and business activity is the primary production cost. It was not possible to value this labor in a recall survey as was done in the SS. Therefore, the estimate of net income in this report is a measure of returns on household labor and management skills as well as on land held by the household. Major direct recall questions did quantify household cash outlays in the form of business expenses, and cash outlays for fertilizer purchased, either from commercial sources, or from the fertilizer support program.

Mathematically, the following expression of net household income holds:

$$NI_t = GI_t - PC_t \quad (1)$$

where

$NI_t, t = 1, \dots, N$, is the net household income observed in supplemental survey year t
 $GI_t, t = 1, \dots, N$, is the gross household income observed in supplemental survey year t
 $PC_t, t = 1, \dots, N$, all associated costs of production in supplemental survey year t .

To remain consistent on measuring household income in all three rounds of the supplemental surveys (ss01, ss04 and ss08), we only considered variables that were measured in all rounds.

Gross household income for each year of the supplemental survey can be expressed as:

$$GI_t = \sum_{i=1}^n (gvarv_t + vegsales_t + totlivs_t + livprod_t + grossoffarm_t) \quad (2)$$

where

$gvarv_t, t = 1, \dots, N$, is simply gross value of harvest for crops observed in year t
 $vegsales_t, t = 1, \dots, N$, equals total value of fruits/vegetable sales observed in year t
 $totlivs_t, t = 1, \dots, N$, represents total income for livestock observed in year t
 $livprod_t, t = 1, \dots, N$, is total income for livestock products observed in year t
 $grossoffarm_t, t = 1, \dots, N$, total off farm income observed in year t

We now show the Production Costs equation.

$$PC_t = \sum_{t=1}^n (buscost_t + tof fertcost_t) \quad (3)$$

where

$buscost_t, t = 1, \dots, N$, represents total business expenses observed in year t

$tof fertcost_t, t = 1, \dots, N$, is total fertilizer costs observed in year t

Fitting equation 1 for each year of the supplemental survey, we have,

$$NI_t = \sum_{t=1}^n (gvharv_t + vegsales_t + totlivs_t + livprod_t + grossoffarm_t - buscost_t - tof fertcost_t) \quad (4)$$

1.4 Logic and Overview of Basic Analysis Results Reflected in Report Tables

Following the topical organization shown in the table of contents, there are seven unique sections of categorization analytical results in this report. Within each section, a majority of the statistical analysis results are presented in two basic and related tabular analysis formats: 1) one focuses on three-year household income terciles; and 2) one focuses on yearly maize market categories by income terciles. Each of these formats is explained in further detail below.

Format for Three-year Household Income Terciles

Net household-level income is one important perspective to use to examine differences in smallholder farmer behavior. Survey data results are used to determine net household-level income for each household interviewed in each of the survey years. Next, all households in the sample are ranked from low to high according to net income, and the entire sample is then divided into three equal sized groups or terciles. Overall national net income is determined, as well as estimates at each tercile level by computing an average of household-level income within each tercile.

After this tercile ranking, additional analysis examines a number of other basic household-level features vary according to the national and tercile-level mean income estimates. To implement this, additional variables are identified and computed to determine average household-level measures of other important socio-economic and agronomic characteristics of each household. To explain this process in further detail, a brief description of the ranking and other variables is shown in Table 1.2 below with explanation notes according about each variable. The results from ranking analysis, as well as from computation of other base variables are then placed in a results framework with 17 variable columns (hereafter abbreviates as “col”), as shown in Table 1.3.

Let us review in this table selected results in the three-year income tercile format. Note first that for the survey-marketing year 2007/08 the population of cropping households is estimated to be 1,493,197 (col 5). For 2003/04, the household population was estimated at 1,243,811, and for the 2000/01, it was 1,109,898. The increase over time in the number of rural households is consistent with rural population estimates of the Central Statistical Office of Zambia. Observe further in these results that for 2007/08, Table 1.3 shows an average household-level net national income of ZMK 5,070,524 (col 5). The estimate of national net household income measured in 2000/01 is ZMK 4,004,343 and for 2003/04 is ZMK5,144,841. As will be discussed later in this section, these differences were tested and found to be statistically significantly for 2000/01 as compared to the other years, but there is no statistical difference between 2003/04 and 2007/08. These findings make it clear that

overall household-level average net incomes increased some 28% from the first to the second survey period. However, there is basically no change from there on ward. One of the advantages of this three-year table format with results in constant 2009/2010 value terms is to allow quick comparisons - as done above - of important net household-level income changes (or the lack thereof) over the 8 years covered by this analysis.

Table 1.2 Three-Year Household Income Tercile Ranking and Related Base Variables

Column Number	Variable Name	Definition Notes/Explanation
Base Ranking Information		
1	Year & National HH-Level Income	Income calculations are net of cash business and fertilizer expenses
2	Income Tercile Group	HHs are ranked according to net income and divided into 3 groups
3	Percent of Households	Restricted to just cropping households
4	Number of HHS	The national estimate is for all agricultural cropping households
5	Net Household Income	Sums over both farm and non-farm income
Related Base Variables For Other HH Characteristics		
6	Percent of HHs Growing Maize	Growing is defined as planting this crop
7	Net Maize + Mealie Sales or (-Purchases)	A positive value reflects maize sales while a negative value reflects purchases of maize grain and/or maize meal
8	Value of Maize Production	Production valued in 2009/2010 ZMK terms
9	Value Ag Production (Crops & Livstk)	Includes all crop production and livestock/livestock product sales
10	Net Off Farm Income	Cash business expenses are deducted to get net off-farm income
11	Value of Productive Assets	The same set of basic productive assets were valued for each year
12	HH Land Size in Crops	Area planted to all crops grown by the hh, not just maize
13	Family Size (in Adult Equivalent)	Family size measurement that takes into account the age and sex of each family member, and the amount of time in the hh.
14	Prime-Age Adults per HH	Prime age defined as any family member > 15 and < 59 years old
15	Highest Level Education of any HH Member	Could be any household member, not just the head of the household
16	Quantity of Maize Grain Retained On Farm	Taking into account sales, median value of grain retained
17	Calories/Adult Equivalent/Day On Farm	Cereals and Tubers are considered to provide 85-90% of calorie eaten

Additional results in Table 1.3 reveal that when the ranked national household-level average income is ranked and then disaggregated into tercile grouping, for study year 2007/08, the upper one third of households have an average income of ZMK 12,098,524 (col 5-highlighted in red) which is more than twice the national average. In contrast, households in the lower income tercile have average net incomes of only ZMK773,562. As discussed later in this section, these tercile mean are tested to establish the extent to which the differences among the tercile groups are statistically significantly. Results will show that all tercile-level differences are statistically significant.

After income levels have been determined and the households in these tercile groups are held constant, the use of additional variables on the right hand side of the table helps examine important differences across household income levels. For example, in Table 1.3 for SS 2007/08, some 75% of households in the low net income tercile produce maize (col 5), while 90% of households in the high income tercile produce this important crop. Using other variables in the base table, we can examine a household's net market position on maize production, sales, and purchases, which are very important dimensions in Zambia with over 82% of households both producing and consuming different amounts of maize. The net maize position variable (col 7) establishes the relative size and direction of the household's maize market interaction. A positive value for this variable indicates maize net sales to the market, and a negative value shows that households on balance buy more maize and maize meal from the market than they sell

As an example of the potential insights from this indicator in Table 1.3, in the net maize sale or purchase variable (col 7) we find that on average it is only the group in the low household income tercile that are net maize grain/mealie meal buyers, purchasing some 96,377 ZMK per year of maize grain and/or meal. Those falling into the middle household income tercile have a very small positive value of sales to the maize market. At the same time, the vast majority of all net sales of maize are found among households falling into the high-income tercile, with average sales of ZMK854,845. The net maize sales position correlates well with the measure of the value of maize production (col 8), with households in the high income tercile with a maize value of production of some ZMK2,271,684 while those in the low income tercile only reach a value of maize production of some ZMK328,934. The variable for off-farm income (col 10) and the value of productive assets (col 11) vary considerably across the tercile groups with relatively high income tercile households at levels more than double the national mean. Households in the low-income tercile crop less than 1 ha of land on average (col 12) while those in the high tercile group cultivate some 2.2 ha.

Additionally, the household-level food security indicator or proxy variable (col 17) in Table 1.3 provide an overall estimate of the extent to which sufficient calories are produced and retained per day and per adult equivalent in the household. This indicator is constructed by converting into calories the quantity of all cereals and tubers produced by the household, and retained on farm. Household production that is sold is not included in this proxy indicator. The calorie conversion uses standard FAO calorie conversion factors. Zambia's Central Statistical Office uses an adult equivalent food security consumption target objective of 2700 calories per adult equivalent per day. Results (col 17) indicate that households in Zambia on average at the national level are able to reach the CSO food security target. However, the national average hides the fact that one third of the population of cropping households in the low-income tercile, are only able to retain some 1,626 cal/ae/day. The average income of these households is also very low (col 5), and the value of net maize meal purchases they are able to make (col 7) are not sufficient to help them reach the target food security level. Households in the high-income tercile retain many more cal/ae/day than needed for human

consumption and are believed to use some of their retained cereals and tubers for feeding animals.

Background Discussion of Format for Yearly Maize Market Category By Income Terciles

While the income tercile breakdown from the yearly format is informative, it can still hide important differences across as well as within income groups. In Zambia, the goal of crop diversification is important, but in the short-term based on recent experience, some 75-85% all cropping households grow maize, so this crop and its markets, as well as all related maize policy issues, still dominate smallholder production and consumption welfare. For this reason, we use an additional categorization analysis format for examining the category of maize market interaction of cropping households. To do this we use the concept of a cropping household's maize market interaction category.

Conceptually it is possible to identify four possible ways that a cropping household may potentially interact with the maize market. A household can grow maize, and either sell it or also buy it if production is not sufficient for household requirements. Cropping households may also have no interaction with the maize market as sellers or buyers. In addition, non-maize growers may also be buyers of maize. These four categories are identified in Table 1.4, and at the highest level of aggregation, these categories are mutually exclusive. However, as shown in detail in the subcategories in Table 1.4 (col 2) there can be subdivisions within categories 1 and 2 if household grow, and both sell and buy maize during a given marketing season. Therefore, it is important to test for the extent to which this happens, and for general similarity of behavior among these main market categories. For example, among maize growers and sellers are households who unambiguously only sell (subcategory 1a) in a given marketing season. At the same time, there may be some portion of the group of growers who both sell and buy some quantity of maize in the same season (subcategory 1b).

In maize policy discussions in Zambia it is often hypothesized that smallholder households mostly fall into category 1b, that is as grower they are forced to be both sellers and buyers of maize in the same marketing season. It is argued that these farmers are at a disadvantage with pressure to sell maize at relatively low prices at harvest, and to then to buy back maize or maize meal later in the season at a much higher price. The same possibility for subcategories is possible in category 2. For analytical purposes in this categorization effort, it is very important to establish the extent to which smallholder households fall into these cases of both buying and selling, that is, whether they fall into categories 1b and 2b in the framework identified in Table 1.4. Understanding this is of potentially high priority, as policies and programs aimed at delivering assistance through the market to households who are assumed to be sellers of maize may be quite limited in effectiveness if a majority of smallholders is in fact not operating as sellers. At the same time, policies that raise output market prices for maize may negatively affect households who are in categories 2a as well as in 2b, and those in category 3.

Data from SS 2007/08 tests in Table 1.5 for household allocation into the alternative maize market conditions and sub conditions shown in Table 1.4. We also test for a combination of production and market positions ,and household income tercile allocation, shown in columns 4 and 5 of Table 1.5. (Similar test results for SS 2000/01 and SS 2003/04 years are reported in Annex 1, Tables 1 and 2, and the findings are similar to those discussed below for SS 2007/08). In this analysis, we use a number of points of information to allow specific identification of a cropping household's maize production and market category, as well as its average household income characteristics.

Table 1.3 Explanation of Format: Base Variables: National Rural Household-Level Net Yearly Income and Related Food Security Categorization Indicators by Income Terciles, and Marketing. All Values Reported in Constant 2009/2010 ZMK

Year and National Household Level	Ranking Information - Household-Level Net National Income				Values in 2009/2010 ZMK							Family Size & Labor/HH		Qty Maize Grain Retained On-Farm Median (kgs)	Calories/AE /Day Retained On-Farm From Cereals & Tubers	
	Tercile	% of HHs (Col. %)	Number of HHs	Total Household Income	% of HH Growing Maize (Row %)	Net maize + Mealies Sales. Or - Purchase	Value of Maize Production	Agricultural Production (Crop & Animal Net Revenue)	Off-Farm Income	Value of Productive Assets	Land Size Area In Crops (Ha)	Family Size (Adult Equivalents)	Prime-Age Adults Per HH			Highest Level of Education for a Member (Years)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
2007/2008 Survey	Low	33.3	497,797	773,562	74.8	-96,377	328,934	559,612	213,950	626,808	0.9	4.9	2	6	1,013	1,626
	Med	33.4	497,651	2,339,370	83.1	2,693	706,853	1,596,985	742,385	1,450,686	1.4	5.8	3	7	1,381	2,720
	High	33.3	497,749	12,098,524	89.7	854,608	2,271,684	5,406,543	6,691,981	5,862,623	2.2	6.9	4	9	1,860	3,868
National HH – Level Net Income	Total	100	1,493,197	5,070,524	82.5	253,646	1,102,491	2,521,043	2,549,481	2,646,718	1.5	5.9	3	7	1,367	2,751
2003/2004 Survey	Low															
	Med															
	High															
National HH – Level Net Income	Total	100	1,243,811	5,144,841	81.4	183,374	1,133,054	2,837,943	2,306,897	2,784,879	1.7	5.9	3	7	1,315	2,833
2000/2001 Survey	Low															
	Med															
	High															
National HH – Level Net Income	Total	100	1,109,898	4,005,343	79.3	76,416	926,007	1,972,466	2,032,878	1,428,461	1.5	5.8	3	7	1,585	3,220

Source: Supplemental Surveys to the 1999/2000 Post Harvest Survey, Central Statistical Office, 2007/2008, 2003/2004 and 2000/2001 Marketing Seasons. Productive assets in 2007/2008 include only those that match the same set in 2003/2004. Assets in 2000/2001 should not be compared to other years since it is a reduced set of assets measured.

Table 1.4 Mutually Exclusive Maize Market Interaction Categories for Cropping Households

(1) Main Market Categories	(2) Subcategories of Potential Maize Market Interaction
1. Sellers (Among maize growing households)	1a. Unambiguous - grower/seller household. Only sells during a marketing year. 1b. Net grower/seller household. Sells and buys some (maize grain or maize meal) back in this year, still remain a net seller because total sales of maize for the household during the marketing season are greater than purchases.
2. Buyers (Among maize growing households)	2a. Unambiguous - grower/buyer household. Buy only either maize grain and/or maize meal during a given marketing year. 2b. Net grower/buyer household. Buyer yet also sell in this year, but still a net buyer because total purchases are greater than sales.
3. Buyers (Among non-maize growing households)	3a. Unambiguous – non-grower, buyer of maize. Buys maize grain and/or maize meal during a given marketing year. Not in the maize market as a buyer nor as a seller.
4. Not in the Market (Neither as sellers or buyers –may or may not grow)	4a. Unambiguous – no maize market interaction. No maize market during a given marketing season, regardless of whether a household is growing maize or not.

In Table 1.5, the single largest category of maize growing households, some 35% fall into the unambiguous market position as “only buying”, that is, they fall in category 2a. These grow maize but the relatively low quantity produced is not sufficient for household needs, and with purchasing power, these are in a position of only buying maize or maize meal in this season. If you add to this group, the 10.7% of households who do not grow maize, but are also buyers, we have over 45% of households unambiguously only buying maize in this marketing season (Annex two results show that in SS 2001 some 37% and in SS2008 some 37% of households were buyers).

At the same time Table 1.5 also shows that there are some 4percent of households in market category 2b, are growers but both buy and sell maize in the same marketing season. However, when considered for the balance for the entire season they have a net buyer position, hence they belong in category 2. There are relatively few households in this category, and importantly, a majority of these net buyers have relatively high net incomes (col 5) and high value of maize production (col 8), indicating that these households are not being put at a disadvantage because of their actions of both buying and selling. Importantly, their behavior as buyers, especially those found in the medium and high-income terciles are quite similar to a majority of other unambiguous buyers in market category 2a.

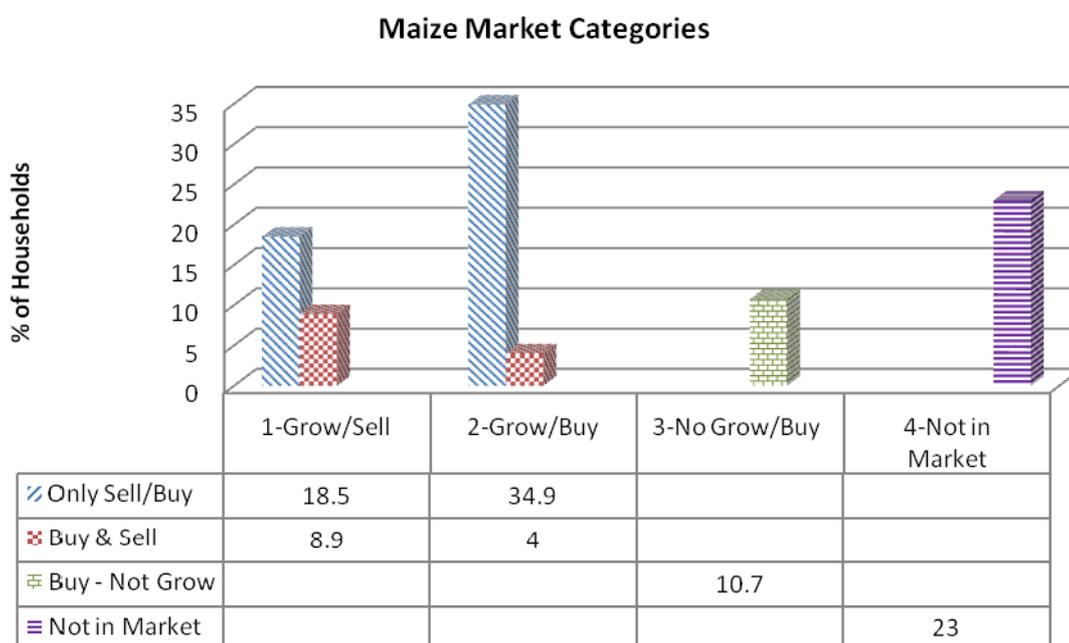
Table 1.5 Test for Allocation in Maize Market Categories and Related Household Indicators for Smallholder Households in SS 2007/08 Marketing Year

Maize Market Category (For Maize Grain and Meal)	Ranking Variables Households-Level Net National Income Terciles			Value of Net Household Income	Percent Of HHs Growing Maize	Value of Net Maize or Maize Meal Sales (- Purchase)	Value of Maize Production	Calories Retained On-Farm From Cereals, Tubers & Roots
	Tercile	% HHs	# HHS	2010 ZMK	% HH	2010 ZMK	2010 ZMK	Cal AE/Day
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. 1a. Growers of Maize: Sell Only	Low	3.1	45,789	887,199	100	292,851	692,377	2,160
	Med	5.7	84,877	2,434,281	100	637,102	1,298,947	2,862
	High	9.7	145,231	14,419,631	100	2,649,671	4,384,719	4,757
	Sub Total	18.5	275,897	8,486,535	100	1,639,372	2,822,610	3,744
1b. Growers of Mz: Both Buys and Sells (Net Sales > 0)	Low	1.1	16,524	970,163	100	199,249	697,610	2,003
	Med	2.9	42,763	2,430,596	100	373,307	1,212,213	2,819
	High	5.0	74,128	13,268,136	100	1,744,371	3,366,956	3,412
	Sub Total	8.9	133,415	8,271,281	100	1,113,541	2,345,699	3,051
2. 2a. Grower of Maize: Buy Only	Low	13.1	195,653	775,448	100	-262,387	370,302	1,365
	Med	12.0	179,165	2,307,095	100	-300,005	607,974	2,180
	High	9.8	146,657	10,536,093	100	-431,199	881,619	2,989
	Sub Total	34.9	521,475	4,046,715	100	-322,787	595,760	2,102
2b. Grower of Mz: Both Buys and Sells Mz, (Net Sales < 0)	Low	.9	13,806	838,670	100	-183,910	471,262	1,689
	Med	1.5	23,116	2,313,190	100	-212,218	734,277	2,166
	High	1.5	22,763	9,857,256	100	-335,886	1,313,164	3,189
	Sub Total	4.0	59,685	4,849,260	100	-252,834	894,213	2,446
3. 3. Does Not Grow - Maize: Buyer	Low	4.8	70,984	721,748	0	-152,176	0	1,202
	Med	3.3	49,865	2,282,921	0	-201,409	0	2,723
	High	2.6	38,658	9,192,388	0	-461,903	0	3,267
	Sub Total	10.7	159,507	3,262,761	0	-242,633	0	2,235
4. 4. Does Not Sell nor Buy Maize:	Low	10.4	155,041	734,591	64.9	0	268,023	1,911
	Med	7.9	117,703	2,315,716	70.7	0	540,093	3,517
	High	4.7	70,148	11,668,851	82	0	1,213,252	4,856
	Sub Total	23.0	342,892	3,514,237	70.4	0	554,788	3,082
National Level All Cropping HHS	Low	33.3	497,797	773,562	74.8	-96,377	328,934	1,626
	Med	33.3	497,651	2,339,370	83.1	2,693	706,853	2,720
	High	33.3	497,749	12,098,524	89.7	854,608	2,271,684	3,868
	Total	100.0	1,493,197	5,070,524	82.5	253,646	1,102,491	2,751

Table 1.5 likewise gives the characteristics of those in the maize grower and seller market categories (cols 1, 3 and 4). Summing over subcategories 1a and 1b we find approximately 27.4% of all cropping households sold maize: some two thirds of these unambiguously only sell during the marketing season, and an additional one third both sell and buy. Moreover, among these net sellers (subcategory 1b) most are relatively large maize producers and sellers with relatively small purchases. Importantly, the magnitude of their maize sales makes them clearly similar to other grower/seller households in market category 1a.

In conclusion, in this market category background discussion, analysis of SS data reveals that maize grower households in market categories 1a and 1b, as well as those in category 2a and 2b can also be grouped into either a single market category as sellers or buyers. While present, offsetting actions of buying or selling by a minority of these households in categories 1 and 2 can be treated as relatively minor variations to their main thrust as either sellers or buyers. This allows categorization analysis with four main maize market interaction categories instead of six. The analysis is less complicated and hopefully will allow an easier search for common behavioral patterns. Figure 2.1 provides an overview of the basic results for SS 2007/2008 when using the four market categories identified, and puts into perspective the relatively minor role of selling and buying in the same marketing season. Clearly over one-half of all cropping households in Zambia in this and other marketing years are maize buyers.

Figure 1.1 Percent of Cropping Households in Maize Market Categories in 2007/2008 Marketing Season



Format for Yearly Maize Market Category by Income Terciles

Using insights from the above background discussion, let us review the structure and information in the second major table format used in this study. We highlight and discuss selected findings in Table 1.6, using SS 2007/08 data to illustrate the process of not only ranking households by income tercile at the national level, but also of sorting them by income tercile into the 4 main maize market categories shown. Table 1.6, (col 1) contains results for the 4 market categories. Variables (columns) 2 and 3 identify the percent and number of households falling into each market category. For example, 27.4% of maize growing households are sellers while 38.9% are buyers. If you include the additional 10.7% of households who are not growing maize but who are also buyers, then almost 50% of cropping households in this marketing year are net maize buyers to various degrees. Finally, some 23% of households are “not in the market as sellers nor buyers”.

Also important in this framework is the allocation of households to alternative national income tercile within each maize market-buying category. To illustrate this, each row of data in color red in Table 1.6 represents a proportion of the total number of cropping households contained in the national level low-income tercile. This is completed analytically by allocating each of the 497,797 households in the national low net income tercile into their respective low-income tercile in each buyer category. The single largest portion (209,459 households) or some 42%, of households from the low-income tercile at the national level fall into the maize “grower and seller group” -category 2. The next most significant group of households (155,041) falls into market category 4 – “not selling nor buying”. Of the total number of households in the national low-income tercile, only 62,313 were found to be in maize category 1 “grower and seller”.

The same set of other base variables used in Table 1.6 are used, as in the three-year income tercile format applied to Table 1.3, to allow characterization of key household features associated with being in any of the maize market and income tercile categories.

Table 1.6 Explanation of Format: Base Variables: National Rural Household-Level Net Yearly Income and Related Food Security Categorization Indicators by Income Terciles, 2007/2008 Marketing Year. All Values Reported in Constant 2009/2010 ZMK

Maize Market Category (Includes maize grain and meal)	Ranking Variables - Household-Level Net National Income				Values in 2009/2010 ZMK							Family Size & Labor/HH		Qty Maize Grain Retained On-Farm Median (kgs)	Calories/AE /Day Retained On-Farm From Cereals & Tubers	
	Tercile	% of HHs (Col. %)	Number of HHs	Total Household Income	% of HH Growing Maize (Row %)	Net maize + Mealies Sales. Or -Purchase	Value of Maize Production	Agricultural Production (Crop & Animal Net Revenue)	Off-Farm Income	Value of Productive Assets	Land Size Area Cropped (Ha)	Family Size (Adult Equivalents)	Prime-Age Adults Per HH			Highest Level of Education for a Member (Years)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1. Grower Seller of Maize*	Low	4.2	62,313	909,199	100	268,030	693,765	755,874	153,325	837,715	1.0	4.6	2	7	1,157	2,120
	Med	8.5	127,641	2,433,046	100	548,723	1,269,889	1,897,503	535,544	1,808,518	1.7	5.7	3	7	1,488	2,848
	High	14.7	219,359	14,030,504	100	2,343,741	4,040,785	7,359,922	6,670,582	7,047,058	3.0	7.0	4	9	2,227	4,306
	Sub Total	27.4	409,313	8,416,373	100	1,467,978	2,667,161	4,651,126	3,765,248	4,468,165	2.3	6.2	3	8	1,854	3,520
2. Grower and Buyer **	Low	14	209,459	779,615	100	-257,214	376,957	557,123	222,492	756,078	0.9	5.3	2	6	886	1,387
	Med	13.5	202,281	2,307,791	100	-289,973	622,408	1,445,972	861,820	1,654,696	1.4	6.1	3	7	1,244	2,178
	High	11.3	169,420	10,444,887	100	-418,393	939,600	3,791,971	6,652,916	5,211,695	1.5	6.9	4	9	1,184	3,016
	Sub Total	38.9	581,160	4,129,137	100	-315,603	626,411	1,809,522	2,319,615	2,367,755	1.3	6.1	3	7	1,092	2,137
3. Does not Grow but Buyer	Low	4.8	70,984	721,748	0	-152,176	0	400,392	321,355	138,351	0.7	5.1	2	6	.	1,202
	Med	3.3	49,865	2,282,921	0	-201,409	0	1,149,635	1,133,286	248,534	1.0	5.4	3	7	.	2,723
	High	2.6	38,658	9,192,388	0	-461,903	0	2,555,332	6,637,057	1,695,670	1.1	6.6	3	8	.	3,267
	Sub Total	10.7	159,507	3,262,761	0	-242,633	0	1,156,895	2,105,866	550,232	0.9	5.6	3	7	.	2,235
4. Does not Sell nor Buy	Low	10.4	155,041	734,591	64.9	0	268,023	556,990	177,601	591,034	0.9	4.4	2	6	1,182	1,911
	Med	7.9	117,864	2,316,001	70.8	0	541,091	1,719,972	596,029	1,221,642	1.3	5.5	3	7	1,666	3,519
	High	4.7	70,312	11,653,485	82.0	0	1,211,167	4,770,417	6,883,068	6,026,918	2.0	6.5	3	9	2,320	4,846
	Sub Total	23	343,217	3,514,513	70.4	0	555,010	1,819,534	1,694,978	1,921,189	1.2	5.2	3	7	1,531	3,082
Total Sample	Low	33.3	497,797	773,562	74.8	-96,377	328,934	559,612	213,950	626,808	0.9	4.9	2	6	1,013	1,626
	Med	33.3	497,651	2,339,370	83.1	2,693	706,853	1,596,985	742,385	1,450,686	1.4	5.8	3	7	1,381	2,720
	High	33.3	497,749	12,098,524	89.7	854,608	2,271,684	5,406,543	6,691,981	5,862,623	2.2	6.9	4	9	1,860	3,868
National Average	Total	100	1,493,197	5,070,524	82.5	253,646	1,102,491	2,521,043	2,549,481	2,646,718	1.5	5.9	3	7	1,367	2,751

Source: Supplemental Survey to the 1999/2000 Post Harvest Survey, Central Statistical Office, 2007/2008 Marketing Season. Productive assets include those that match 2003/2004.

* 1/3 of this category do buy small amounts of maize or maize meal, but in net terms are sellers, similar to other hhs in this category.

** 1/10 of this category of households do sell small amounts of grain, but in net terms are buyers, similar to other hhs in this category.

*** A very small number < 1% buys and sells but on net sales is zero.

1.5 Statistical Tests of Significant Differences Measured in Tables

A One-Way ANOVA (Analysis of Variance) is used in this study to measure for statistically significant differences between group means in each of the categories shown in all tables. A One-Way ANOVA is a statistical technique, which is used to test equality of three or more means at one time. This test was chosen in order to compare the means of income groups and maize market categories to see whether the means were significantly different among groups, and within a given category.

Before data analysis, we made sure our sample was tested for all assumptions associated with ANOVA to avoid the risk of drawing false conclusions from the results. ANOVA has three major assumptions that were tested before analysis was carried out. These are independence of observations within and between samples, normality of sampling distribution and equal variances for all groups. Levene's test was used to verify the assumption of equal variance. Equal variance across the sample is called homogeneity of variance. Analysis of variance assumes that variances are equal across groups. Whenever homogeneity of variance assumption was found to have been violated, we employed the "Games-Howell Post Hoc Multiple Comparisons Test" which does not assume equal variances.

In this paper, we used $p < 0.05$ for all post-hoc comparisons as a minimum level of acceptable significance. Levene's statistic test revealed violation of homogeneity assumption for dependent variables and thus we rejected the H_0 that the variances are equal. In this case then we applied the "Games-Howell" test method.

In all tables, within-year subcategory results that are not statistically different from each other are noted with super script ^a. All unnoted results were tested and found to be statistically different at the .05 or the .01 level. Significance test of mean differences among yearly results were also completed where relevant, and results are discussed in the text as appropriate and needed.

ANNEX 1

Table 1.7 Annex 1: Test for Allocation in Maize Market Categories and Related Household Indicators for Smallholder Households in SS 2003/04 Marketing Year

Maize Market Category (For Maize Grain and Meal)	Households-Level National Income Terciles			Value of Net Household Income	Percent Of HHS Growing Maize	Value of Net Maize or Maize Meal Sales (-Purchase)	Value of Maize Production	Calories Retained On-Farm From Cereals, Tubers & Roots
	Tercile	% HHS	# HHS	2010 ZMK				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. 1a. Grower of Maize: Sell Only	Low	2.5	31,697	1,056,528	100	189,830	636,999	2,067
	Med	6.9	86,065	2,575,805	100	400,796	1,083,133	2,828
	High	11.2	139,399	14,585,131	100	2,034,477	4,082,355	5,200
	Sub Total	20.7	257,160	8,898,435	100	1,260,362	2,653,931	4,023
1b. Grower of Mz: Both Buys and Sells (Net Sales > 0)	Low	.6	7,767	930,414	100	148,616	696,218	1,630
	Med	1.8	22,042	2,606,530	100	331,988	1,226,537	2,857
	High	2.5	30,792	10,799,631	100	1,206,144	2,915,858	3,816
	Sub Total	4.9	60,601	6,554,697	100	752,653	2,016,926	3,187
2. 2. Grower of Maize: Buy Only	Low	10.1	125,293	804,333	100	-254,932	413,281	1,308
	Med	7.7	95,553	2,437,265	100	-296,920	778,929	2,219
	High	7.6	94,678	13,104,476	100	-509,357	1,165,059	2,459
	Sub Total	25.4	315,524	4,989,705	100	-343,992	749,596	1,929
2b. Grower of Mz: Both Buys and Sells Mz, (Net Sales < 0)	Low	.9	11,521	1,059,700	100	-184,920	636,756	1,548
	Med	1.1	13,874	2,590,389	100	-250,345	938,093	1,878
	High	1.3	16,218	8,942,426	100	-335,834	1,064,844	2,152
	Sub Total	3.3	41,613	4,642,220	100	-265,550	904,066	1,894
3. 3. Does Not Grow Maize: Buyer	Low	3.8	47,174	753,274	0	-176,442	0	997
	Med	2.7	34,155	2,489,143	0	-188,599	0	2,120
	High	1.8	22,212	9,058,281	0	-328,252	0	3,187
	Sub Total	8.3	103,541	3,107,483	0	-213,019	0	1,858
4. 4. Does Not Sell nor Buy Maize:	Low	15.3	190,140	816,972	67.9	0	305,210	1,864
	Med	13.1	163,434	2,515,018	70.6	0	669,435	3,393
	High	8.9	111,282	9,500,010	83.6	0	1,461,528	4,431
	Sub Total	37.4	464,855	3,492,609	72.6	0	710,076	3,030
National Level All Cropping HHS	Low	33.3	413,918	833,036	73.8	-85,099	345,117	1,604
	Med	33.4	415,312	2,515,196	80.2	8,489	764,190	2,825
	High	33.3	414,581	12,084,034	90.2	626,610	2,289,246	4,039
	Total	100.0	1,243,811	5,144,841	81.5	183,374	1,133,054	2,833

Table 1.8 Annex 1: Test for Allocation in Maize Market Categories and Related Household Indicators for Smallholder Households in SS 2000/01 Marketing Year

Maize Market Category (For Maize Grain and Meal)	Households-Level National Income Terciles			Value of Net Household Income	Percent Of HHs Growing Maize	Value of Net Maize or Maize Meal Sales (-Purchase)	Value of Maize Production	Calories Retained On-Farm From Cereals, Tubers & Roots Cal AE/Day
	Tercile	% HHs	# HHS	2010 ZMK	% HH	2010 ZMK	2010 ZMK	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. 1a. Grower of Maize: Sell Only	Low	3.2	35,097	743,961	100.0	245,835	805,008	2,162
	Med	6.5	72,122	2,030,263	100.0	306,813	1,173,604	3,564
	High	9.9	109,622	10,418,803	100.0	1,339,775	3,222,422	5,156
	Sub Total	19.5	216,841	6,062,835	100.0	819,150	2,149,711	4,152
1b. Grower of Mz: Both Buys and Sells (Net Sales > 0)	Low	.8	8,838	626,872	100.0	130,381	784,621	2,142
	Med	2.2	24,207	1,945,888	100.0	252,122	1,249,392	2,605
	High	3.1	34,385	11,236,963	100.0	1,106,289	2,779,582	3,796
	Sub Total	6.1	67,430	6,510,865	100.0	671,737	1,968,774	3,147
2. 2. Grower of Maize: Buy Only	Low	8.5	94,818	619,189	100.0	-274,751	383,730	1,769
	Med	7.8	86,932	1,931,437	100.0	-314,129	658,379	2,616
	High	8.7	96,537	9,328,509	100.0	-512,701	757,129	2,890
	Sub Total	25.1	278,287	4,050,344	100.0	-369,596	599,056	2,427
2b. Grower of Mz: Both Buys and Sells Mz, (Net Sales < 0)	Low	.6	6,657	699,689	100.0	-177,025	482,187	1,764
	Med	1.2	13,317	1,862,484	100.0	-173,249	920,484	3,277
	High	1.4	15,078	14,341,165	100.0	-339,086	1,097,788	2,596
	Sub Total	3.2	35,052	7,009,413	100.0	-245,302	913,510	2,711
3. 3. Does Not Grow Maize: Buyer	Low	3.6	40,004	536,454	.0	-314,201	0	1,704
	Med	2.4	26,234	1,866,456	.0	-188,185	0	2,620
	High	2.0	22,512	7,773,821	.0	-406,399	0	2,958
	Sub Total	8.0	88,749	2,765,380	.0	-300,337	0	2,314
4. 4. Does Not Sell nor Buy Maize:	Low	16.6	184,609	585,680	59.8	0	266,831	2,285
	Med	13.2	146,724	1,875,672	66.7	0	533,066	3,898
	High	8.3	91,808	7,511,437	80.6	0	1,116,404	5,142
	Sub Total	38.1	423,141	2,535,651	66.7	0	543,478	3,487
National Level All Cropping HHs	Low	33.3	370,023	606,993	69.1	-81,127	335,227	2,069
	Med	33.3	369,933	1,922,005	79.7	-17,087	710,311	3,335
	High	33.3	369,942	9,487,733	89.1	327,493	1,732,607	4,208
	Total	100.0	1,109,898	4,005,343	79.3	76,416	926,007	3,220

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