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Case of Zambian Farmers**

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Working Paper 66

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

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EXECUTIVE SUMMARY

Livestock production and associated products offer significant opportunities for economic growth and poverty reduction, especially among the rural farmers in Zambia and other developing countries. However, smallholder livestock producers are characterized by low levels of market participation (Negassa, Rashid, and Gebremedhin 2011). Among many reasons cited in the literature, smallholder farmers do not participate in livestock markets because of remoteness of livestock producers from the main urban market centers, and poor road infrastructure that result in high transport costs. Understanding the determinants and livestock marketing behavior of smallholder farmers will contribute to the knowledge gap in the country regarding why poverty remains high even among households owning livestock.

Using a three-year panel survey data of 5,907 livestock owners in rural Zambia, this study provides empirical evidence on why there are low levels of livestock market participation in Zambia. In addition, the study examines the factors influencing cattle market dynamics in the survey period. In particular, we look at four cattle marketing groups, consistently sellers, two time sellers, one time sellers, and non-sellers.

The study highlights the following findings:

First, livestock population had been increasing over the seven year survey period from 2001 to 2008. In 2001, the population of livestock was estimated at 1.5 million cattle, 1.2 million goats, 492 thousand pigs, and 51 thousand sheep. The population of livestock in 2008 increased to about 2.8 million cattle, 2.4 million goats, 1 million pigs, and 157 thousand sheep.

Second, livestock population for all types is unevenly distributed across the ten provinces. About half of cattle, more than a third of goats and close to 40% of sheep are found in Southern Province while Eastern Province accounts for more than 60% of all pigs. Luapula, Lusaka, Northwestern, and Copperbelt Provinces have generally low populations of all livestock species. Over the seven-year period, there have been very minimal changes of head size owned and sold. On average, households owned nine cattle selling two, seven goats selling four, and owning four pigs selling three during the 2008 marketing year.

Third, education of the household head has an influence on the likelihood of participation in cattle and pig markets. This suggests the importance of education in increasing the ability of households to utilize market information and thereby utilizing market opportunities. Conversely, education is not very important in explaining participation in goat markets.

Fourth, the results show that gender of household head does not matter in influencing the likelihood of the household selling cattle, goats, and pigs.

Fifth, households' crop commercialization position and participation in off-farm activities tends to affect the likelihood of participating in livestock markets especially for cattle. For example, the proportion of households selling cattle is higher among households who have a lower crop commercialization index compared to households who are more commercialized. The results show a similar pattern for households having off-farm income from business activities and/or salary and wage activities. There are no differences among households participating in small livestock markets by household commercialization position or participation in non-farm activities.

Sixth, livestock mortality increases the likelihood of households selling cattle, goats, and pigs. A recent discussion with livestock farmers in Chongwe District revealed that households sell diseased animals as one of the coping strategies in a situation where the animal fails to respond to treatment or when the risk of spreading the disease is high.

Lastly, the market dynamics analysis show that, of the 524 households who owned cattle in all the survey years 2001, 2004, and 2008, the number of households participating in cattle markets was 20.2% in 2001 and increased to 34.8% in 2008. About 54.4% of 524 households moved into and out of the markets, while 37.4% sold once and 17% sold twice. Of the 524 households, only 4.3% participated consistently in cattle markets with 41.3% not participating in the market between 2001 and 2008. The results show that consistently sellers are less crop market oriented compared to other groups and they had about four times more income compared to the non-sellers. Among households who consistently sold cattle in all the survey years, livestock income contributed about 50% to total household income suggesting the importance of livestock in reducing poverty levels among the rural households.

Evidence presented in this paper raises several critical issues that need to be considered in addressing the challenges of livestock marketing in Zambia. Key public investments are required that may serve to increase participation in livestock markets include investments in rural education, and building institutional and infrastructural capacities that allow smallholder farmers to successfully compete and integrate within the developing livestock industry. Provision of an enabling environment through public sector investment to allow livestock producers to increase production through improved efficiency and productivity is another area that needs attention. However, given the limited government resources as well as uneven distribution of livestock development interventions such as improved disease control or reproductive management, infrastructural development such as construction of abattoirs and gene banks could be prioritized in the major producing areas. There have been discussions among agricultural stakeholders for government to consider including livestock vaccinations into the farmer input support program to allow livestock farmers to access subsidized medicines. This is a good idea as long as the subsidy is linked to encouraging Zambian farmers to think of livestock production as a business.

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ACRONYMS

ANOVA	Analysis of Variance
CGIAR	Consultative Group on International Agricultural Research
CSO	Central Statistical Office
ESSP	Ethiopia Strategy Support Program
FSRP	Food Security Research Project
FGD	Focus Group Discussion
ha	hectares
HCI	Household Crop Commercialization Index
HH	Households
IAPRI	Indaba Agricultural Policy Research Institute
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
LDAH	Livestock Development and Animal Health
MSU	Michigan State University
PHS	Post Harvest Survey
SNDP	Sixth National Development Plan
USAID	United States Agency for International Development
SIDA	Swedish International Development Agency

1. INTRODUCTION

With the predicted increase in livestock and livestock products consumption in most developing countries (Delgado et al. 1999; Jabbar, Baker, and Fadiga 2010), the livestock sector offers significant opportunities for economic growth and poverty reduction, especially among the rural farmers. The increase in demand is expected to stem from human population growth, increased urbanization, and rising income, a process that Delgado et al. (1999) term 'Livestock Revolution'. However, despite the increasing opportunity offered by the rapid growth of demand for livestock, smallholder livestock producers are often characterized by low levels of participation in the markets coupled with a very low market off-take rate (Negassa, Rashid, and Gebremedhin 2011). Off-take rates of less than 5% for cattle and about 17% for goats have been reported (Nkonde 2008) compared to 25% in the commercial sector (Nkhori 2004). Understanding the reasons why smallholder farmers in Zambia and other developing countries do not actively participate in livestock markets may help policy makers come up with innovations to deal with the problem and help reduce poverty among the rural farm households.

A number of studies using household data have attempted to understand the factors affecting smallholder decisions to participate in livestock markets (for example, Musemwa et al. 2010; Nkonde 2008; Ehui, Benin, and Paulos 2003; Lapar, Holloway, and Ehui 2003). A review of the literature reveals mixed evidence of factors affecting participation in livestock markets, such as physical, financial, human, and institutional factors. Physical constraints on marketing include low population densities in rural areas (Nkonde 2008), remoteness of livestock producers from the main urban market centers, and poor road infrastructure that result in high transport costs (Gabre-Madhin 2009). Improved road networks and marketing infrastructure such as holding facilities may encourage farmers' participation in livestock markets (Ouma, Obare, and Staal 2003), though the effects in some country studies are not significant (Ehui, Benin, and Paulos 2003). Goetz (1992); Key, Sadoulet, and de Janvry (2000); and Makhura, Kirsten, and Delgado (2001) have isolated high transaction costs to be one of the key reasons for smallholder farmers' failure to participate in markets.¹ Since, the majority of the smallholder farmers are located in remote areas with poor road network and market infrastructure, transaction costs rise not only due to high transport costs, but also due to the increased costs of searching, screening, bargaining with, and monitoring distant trading partners. Increased transaction costs also stem from failure to access market information such as grades and standards (Gabre-Madhin 2009). Lack of market information increases the transaction costs incurred by smallholder farmers and thus inhibits participation in markets (Costales et al. 2007; Nkhori 2004; Ehui, Benin, and Paulos 2003; Lapar, Holloway, and Ehui 2003; Makhura, Kirsten, and Delgado 2001). The effect of information asymmetry thus puts smallholder farmers in a weak negotiating position when dealing with larger buyers and reduces their competitiveness when dealing with supply chains that are becoming increasingly formalized and upgraded.

The purpose of keeping livestock has also been identified to have an effect on the likelihood of participating in livestock markets (Musemwa et al. 2010). Smallholder farmers in developing countries have multiple goals for their livestock enterprise. Apart from cash benefits, livestock are closely linked to the social and cultural lives of smallholder farmers for whom animal ownership ensures varying degrees of household economic stability. For

¹ Transaction costs are the costs of exchanging goods and services, which can arise in three broad areas: a) gaining information on or searching for marketing and trading partners (potential buyers or sellers); b) negotiating contracts; and c) monitoring and enforcing the implementation of the agreement.

instance, cattle are kept for different purposes such as meat, milk, manure, draught power, and ceremonies apart from being a source of cash. They are also considered a common means of demonstrating wealth, cementing relationships through bride price payment, and a social link (Ouma, Obare, and Staal 2004). Therefore, farmers who attach more value to non-cash benefits, tend not to commercialize their livestock production.

Zambia's Sixth National Development Plan (SNDP) recognizes the importance of addressing livestock marketing challenges as a way of ensuring food security, employment creation, and increased incomes. However, the lack of knowledge about smallholder livestock market constraints, marketing dynamics, and factors influencing the movement into and out of markets often lead to misguided interventions that have little impact on improving household welfare. This study uses a three-period panel household dataset – 2001, 2004, and 2008 to analyze the factors that drive farmers to participate in livestock markets as well as to identify and understand the important factors associated with market dynamics among the Zambian smallholder cattle owners.

The findings from this study will provide relevant information to identify policy options for improving market participation and addressing the marketing concerns that surround the livestock sector in Zambia. Panel data provide a unique opportunity to trace the dynamics of behaviors and identifying the influence of past conditions on current behavior.

The remainder of this paper is organized as follows. Section two presents the underlying theoretical framework on which we base our empirical models and estimation approaches. Section three describes the data and methods used in the analysis. Section four presents descriptive and econometric results. The last section presents the main conclusions and policy implications.

2. DATA AND METHODS

2.1. Theoretical Framework

Discrete choice decisions are frequently modeled using a random utility framework. The random utility model assumes that the decision maker has a perfect discrimination capability and is faced with M levels of utilities from which choices are made with the goal of maximizing expected utility. According to the choice theory of economics (Becker 1962), the decision is determined by the utility level (U_{ij}) that household i derives from choosing alternative j . A livestock-rearing household will choose whether or not to participate in livestock markets depending on the relative utility levels associated with the two choices. Thus, the probability that alternative j will be chosen is given by,

$$P(y_i = j) = p(U_{ij} \geq U_{ik} \mid X, \forall k \neq j) = P(\varepsilon_{ik} - \varepsilon_{ij} \leq X'_{ij}\beta_j - X'_{ik}\beta_k \mid X, \forall k \neq j) \quad (1)$$

where y_i is the observed outcome for the i^{th} observation, $i = 1, \dots, N$ indexes the household, $j = 1, \dots, J$ and $k = 1, \dots, K$ are the alternatives being considered and ε is a random error. Even though the difference in the utilities of participation and non-participation decisions,

$$V_i = U_{ij} - U_{ik}, \quad (2)$$

is not observed, the decision of a household is taken as a binary outcome such that

$$J_i \in j = \begin{cases} 1 & \text{if } V > 0 \\ 0 & \text{otherwise.} \end{cases} \quad (3)$$

Other things being equal, the household is assumed to select the alternative that provides the greatest utility. Thus, the utility derived from participation will motivate the household to participate in livestock markets only if it is greater than that derived from the other alternative, non-participation. If households choose to participate over non-participation, the choice is assumed to depend on the attributes of the alternative and some attributes of the household (Parson 2001). However, the attributes of the alternative are not observed and thus captured in the random error term as shown in equation 4:

$$U_{ij} = X'_{ij}\beta_j + \varepsilon_{ij}, \quad (4)$$

where X is a vector of observed exogenous explanatory variables, β is a vector of unknown parameters to be estimated, and ε_{ij} is a random error term assumed to be normally distributed.

2.2. Empirical Model

Using the utility theory outlined above, we estimate probit models to examine how different household characteristics and context-specific factors influence the livestock market participation decision. Because of the limited relevant sample size, probit is expected to be superior to logit. The probit model is given as:

$$\text{Prob}(w = 1) = \Phi(\beta + \delta' \mathbf{x} + \varepsilon), \quad (5)$$

where w is a dichotomous variable equal to one if the household sold cattle and zero otherwise; \mathbf{x} is a vector of household and community attributes or covariates which are postulated to influence participation. These factors include: proxies to measure transaction costs; human capital variables; assets and physical capital; institutional factors and financial capital as detailed below. Φ is a normal cumulative distribution function (CDF), ε is the error term, β and δ are parameter and vector of parameters to be estimated.

To test the robustness of the results, we estimate and present three econometric results for each livestock type. The first two models treat each survey as independent cross sectional data while the third model is estimated on pooled cross-sections data.

2.3. Data

This study uses nationally representative longitudinal survey data collected from small and medium scale rural farmers in Zambia in 2001, 2004, and 2008. The three waves of the survey were implemented by the Central Statistical Office (CSO) in collaboration with Michigan State University's Food Security Research Project (FSRP). The surveys followed the same households that were interviewed during the 1999/2000 Post-Harvest Survey (PHS). Each wave collected data on the households' cropping patterns, crop and livestock production and marketing, asset ownership, income sources, and various retrospective/current socio-demographic information on the household members.

Of the 6,922 households interviewed in the first wave of the panel survey (2001), 5,419 were successfully re-interviewed in May/June 2004, of which 5,454 and 4,419 raised livestock, respectively. In the 2008 survey, a total of 8,094 households were interviewed, of these, 4,300 were panel households, and the rest were new households randomly selected from the same population of small- and medium-scale farm holdings with total of 5,907 households raising cattle from the expanded sample in 2008. For more details about survey design and sampling procedures, the reader is referred to Megill (2004).

Using data from the survey in 2001 and 2008 as separate pooled cross sectional data, this paper, examines the factors influencing farmers' participation in livestock markets by combining descriptive and econometric analysis. The factors examined included provincial/tribal groups, education level and gender of household head, landholding size, and household crop commercialization. In addition, we use the panel data to examine the dynamics of cattle marketing in Zambia. To help in interpreting the econometric results, we also collected information about production and marketing of livestock through the Focus Group Discussion with livestock farmers in Chongwe District in 2012.

The three surveys are treated as independent cross sectional data for descriptive analysis. To identify the factors influencing market participation, we pool two independent cross section datasets collected in 2001 and 2008 surveys together. We eliminated the 2004 due to attrition as 2004 survey data was a sub-sample of 2001 data. The paper looks at four key livestock types – cattle, goats, pigs, and sheep. However, for econometric analysis we focus on the most predominant livestock types in Zambia – cattle, goats, and pigs. In order to understand the dynamics of market participation, we limited our sample to households that owned cattle in all three panel survey years. Of the 6,922 households interviewed in 2001, 1,217 owned cattle. Out of 1,217 households that owned cattle in 2001, 750 (62%) reported to have raised cattle in 2004 and only 524 (43%) had cattle in all the survey years. The 524 households grouped into 4 categories based on their frequency of participation as follows:

- Consistently non-sellers (those who did not sell in any of the survey waves);
- One-time sellers (those who sold in any one of the survey waves only);
- Two-time sellers (those who sold in any two of the three survey waves only); and
- Consistently sellers (those who sold in all three survey waves).

Of the 524 households, 200 were non-sellers, 203 were one-time sellers, 96 were two-time sellers, and only 25 households sold cattle consistently in all the three waves. The one- and two-time seller groups capture those households who moved into and out of cattle markets. All descriptive statistics were weighted with population weights in order to account for the complex nature of the sampling.

2.4. Explanatory Variables

Previous studies suggest that participation in livestock markets is influenced by transaction costs, human capital, physical capital, institutional factors, and financial capital (Ehui, Benin, and Paulos 2003; Costales et al. 2007). It is hypothesized that higher transaction costs discourage smallholder livestock farmers to participate in markets. Therefore, households with lower transaction costs are more likely to participate in markets since they are more likely to recover their production and marketing costs. This study uses two proxies to represent transaction costs – distance to the nearest town and a binary variable equal to one if the household is in a district along the line of rail, and zero otherwise. It is expected that households close to towns and in districts that are along the line of rail are more likely to participate in livestock markets. However, the effects may also be negative. For instance, accessibility to towns may provide better alternatives with higher pay offs than livestock marketing.

Human capital variables included in the empirical model are age, sex, and education level of the household head and household size in adult equivalents. Education level of household head is hypothesized to increase the household's ability to utilize market information, thereby utilizing market opportunities.

Exposure to extension services on animal husbandry was used as a proxy for institutional support. Access to extension services may translate into adoption of improved livestock production practices which could in turn increase livestock productivity. Increased livestock productivity may entail more marketable surplus. We also included a household crop commercialization index (HCI) as a proxy for marketable surplus and the extent to which the household is market oriented and/or their linked to the market economy (Chapoto et al 2011). Households with higher HCI are less likely to participate in livestock markets as they are likely to meet the household need through crop proceeds. In addition, to capture the effects of livestock composition on livestock market participation, we included the number of livestock owned by type. It is hypothesized that households selling small livestock are less likely to sale cattle.

To capture the influence of mortality shocks in the household, we included lagged dummy variables for death of household head or spouse and death of other adult members in the family. Studies have shown that households experiencing mortality shocks tend to deplete their asset base which includes livestock (see Chapoto et al. 2011; Muyanga, Jayne, and Burke 2010). Mortality shocks are expected to increase the likelihood for households to dispose of some of their livestock to take care of the short term funeral expenses

We also included a binary variable for households' social capital in the village proxied by whether the household is considered local. A household is considered local if it belongs to a clan which originally occupied the village. This may have on one hand a positive effect on the likelihood of participation due to the social network that is built within the communities. It may be assumed that social network may have greater impact in facilitating transmission of market information. On the other hand, it may reduce the likelihood as locals may be complacent about taking up entrepreneurial ventures such as selling livestock.

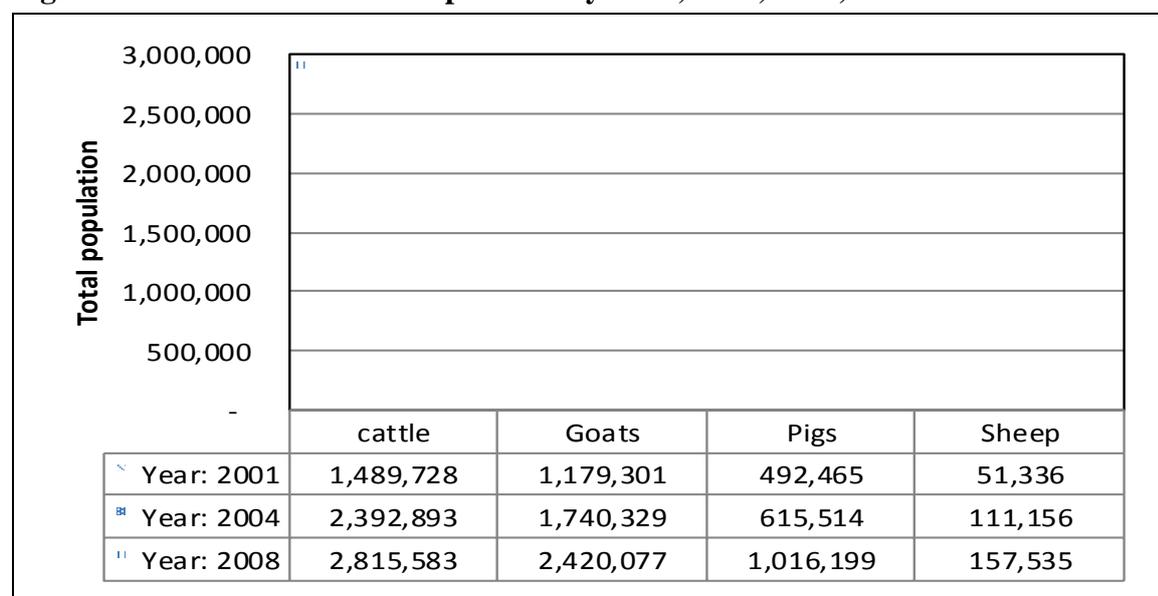
To account for geographical distribution of livestock and location of households, a set of provincial dummies was included. To avoid colinearity problems by including tribal groups as separate variables in the model, we use the provincial binary variables as proxies to capture the effect of belonging to a particular tribal group on market participation. This is because specific tribal groups come from particular provinces, for example, the Tongas reign from the Southern Province, Nyanjas from Eastern Province and the Lozis from Western province. Livestock market participation may be influenced by cultural norms and beliefs which are different by tribes. For example, it is believed that the Tongas keep livestock as a wealth status symbol rather for sale and it would be normal to find households with fifty or more cattle not participating in livestock markets. However, this remains an empirical question that we test in this study.

3. RESULTS AND DISCUSSIONS

3.1. Livestock Population

Livestock population among the smallholder sector has increased over time. Figure 1 shows that in 2001, the livestock population was estimated at 1.5 million cattle, 1.2 million goats, 500,000 pigs, and 51,000 sheep. By 2008, the population of livestock had grown to about 2.8 million cattle, 2.4 million goats, 1 million pigs, and 157,000 sheep. However, these increases have been spatially uneven with livestock populations even decreasing or remaining stagnant in some provinces (Figures 2a and 2b). It is evident that about half of cattle, over a third of goats and close to 40% of sheep are found in Southern Province, while Eastern Province accounts for more than 60% of all pigs. For all the livestock species, Luapula, Lusaka, North-western, and Copperbelt Provinces have relatively low populations. With such an uneven geographic distribution of livestock, interventions to do with livestock infrastructural developments outlined in the SNDP should be area specific taking into account the livestock composition by Province.

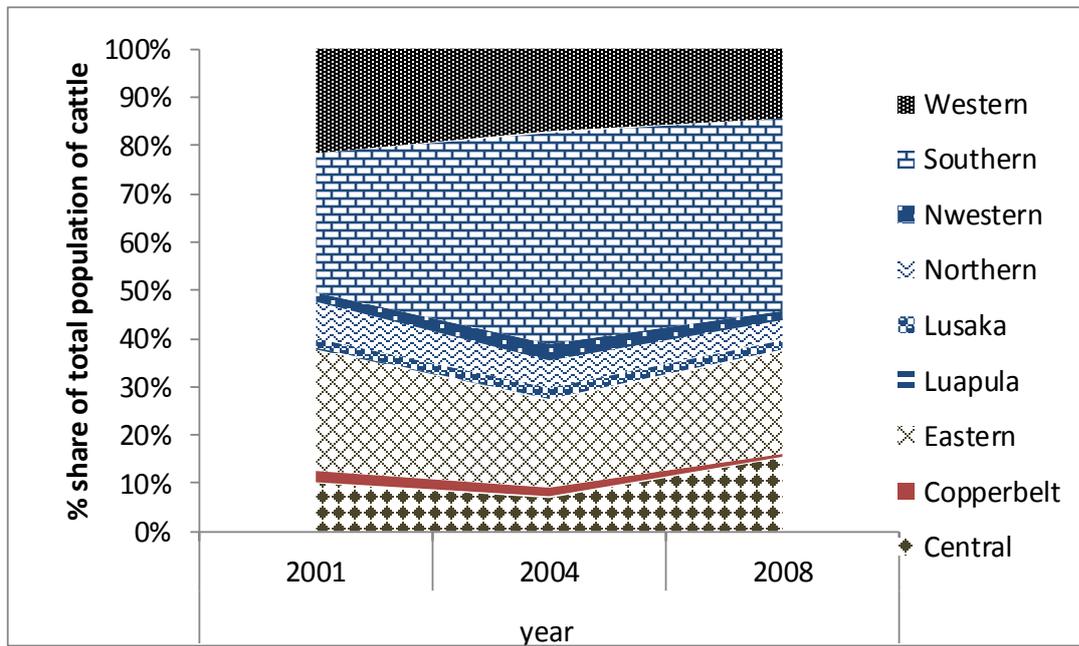
Figure 1. National Livestock Population by Year, 2001, 2004, and 2008



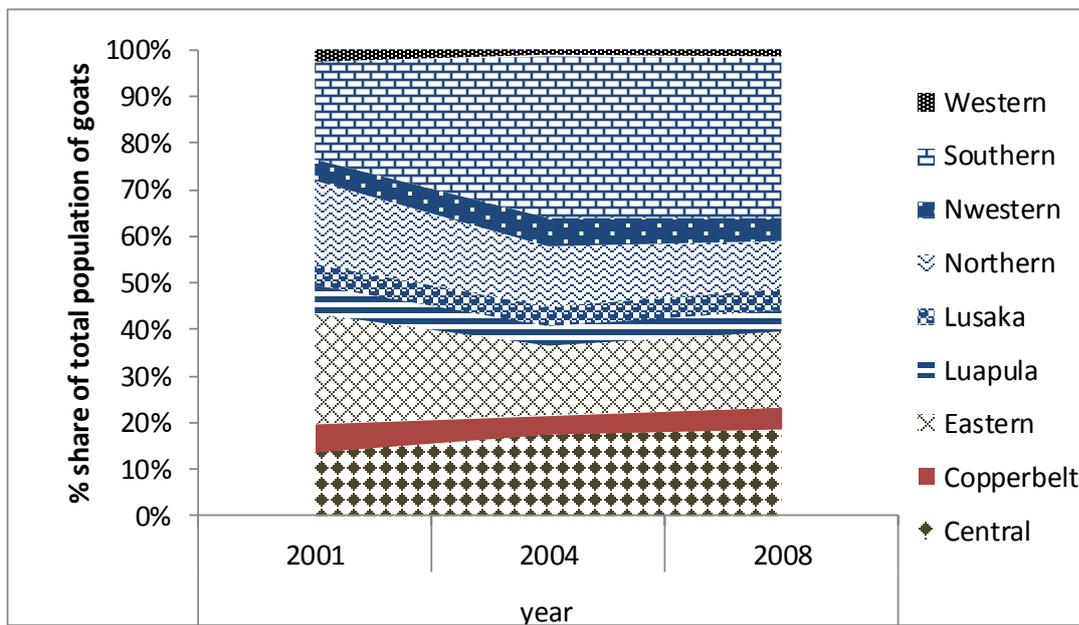
Source: CSO/FSRP Supplemental Surveys (2001, 2004, and 2008).

Figure 2a. Proportion of Cattle and Goats Population over Time by Province, 2001, 2004, and 2008

Cattle



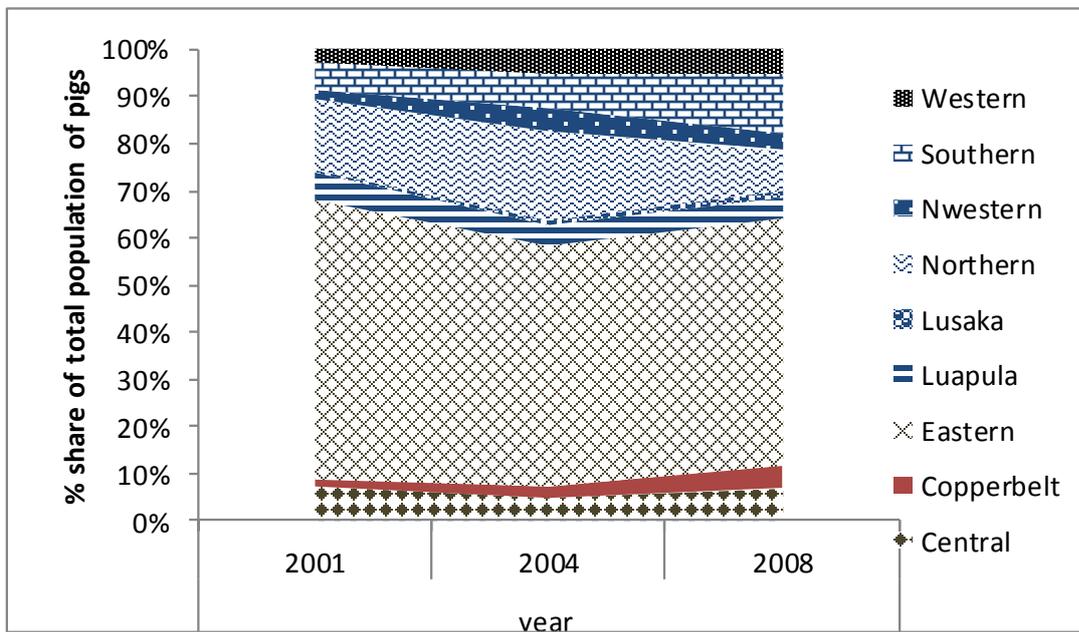
Goats



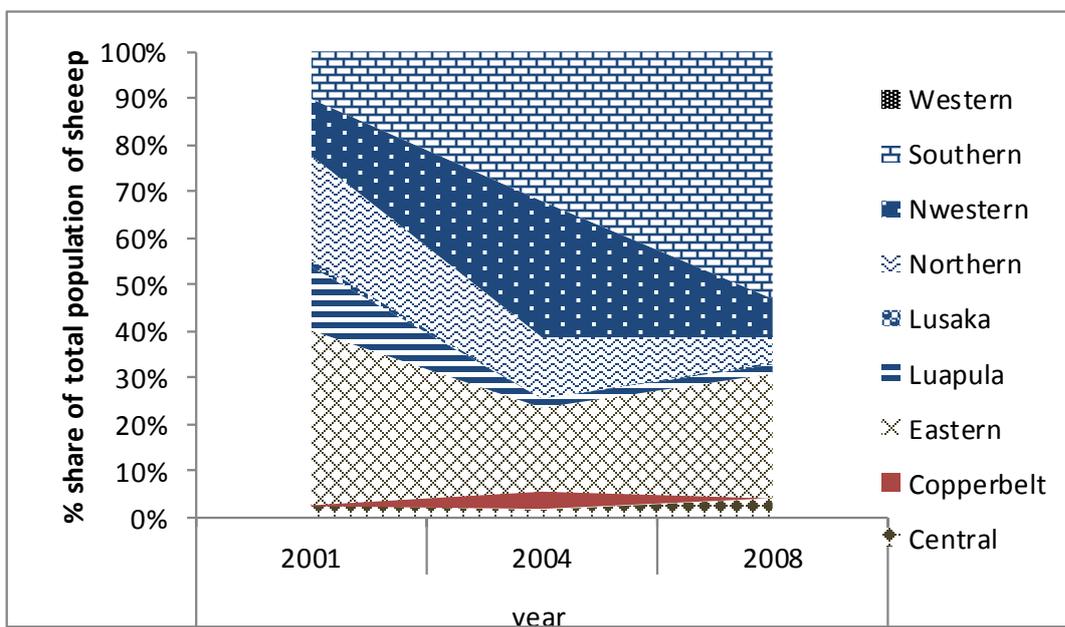
Source: CSO/FSRP Supplemental Surveys (2001, 2004, and 2008).

Figure 2b. Proportion of Pigs and Sheep Population over Time by Province, 2001, 2004, and 2008

Pigs



Sheep



Source: CSO/FSRP Supplemental Surveys (2001, 2004, and 2008).

3.2. Ownership and Marketing among Livestock Owners

The role of livestock in poverty alleviation and its potential for commercialization at household level is largely determined by ownership and the size of the herd. One key question is whether smallholder livestock producers have enough stock that can be tapped into through the emerging opportunities due to the changing market and consumption patterns.

Table 1 presents ownership and herd size figures for the four livestock species under study. The descriptive statistics from the 2008 national rural survey data show that among the smallholder farming sector, 18.5% owned cattle, 22.2% goats, 14.3% pigs and 1.1% sheep. At national level, the average cattle owned per household is 1.7, goats 1.5, pigs 0.6 and 0.1 sheep. However, these numbers are much higher when we consider only livestock rearing households by type. For example, in 2008, among cattle owners, a household owned an average of nine cattle, seven goats, four pigs, and nine sheep. It is worth noting that a significant proportion of households owned between one and six head of cattle. Similarly, the majority of households own less than six head of goats, pigs, and sheep. Thus, the increasing national population does not necessarily mean increased number of livestock owned at household level. With the exception of sheep, the increased national livestock population could be partly explained by the increasing number of households going into livestock keeping as shown in Table 1, suggesting that livestock is becoming more important among rural smallholder farmers. The number of households selling livestock also increased over the seven-year period with the average sales of two cattle, four goats, three pigs, and four sheep in 2008 (Table 1, columns E to H).

3.3. Livestock Sales by Level of Livestock Owned

As expected, the results show that as the herd size increases the proportion of households selling that particular type of livestock also increases (Figures 3a to 3d). Among the households with herd size between one and three cattle, about 10% of households sold cattle

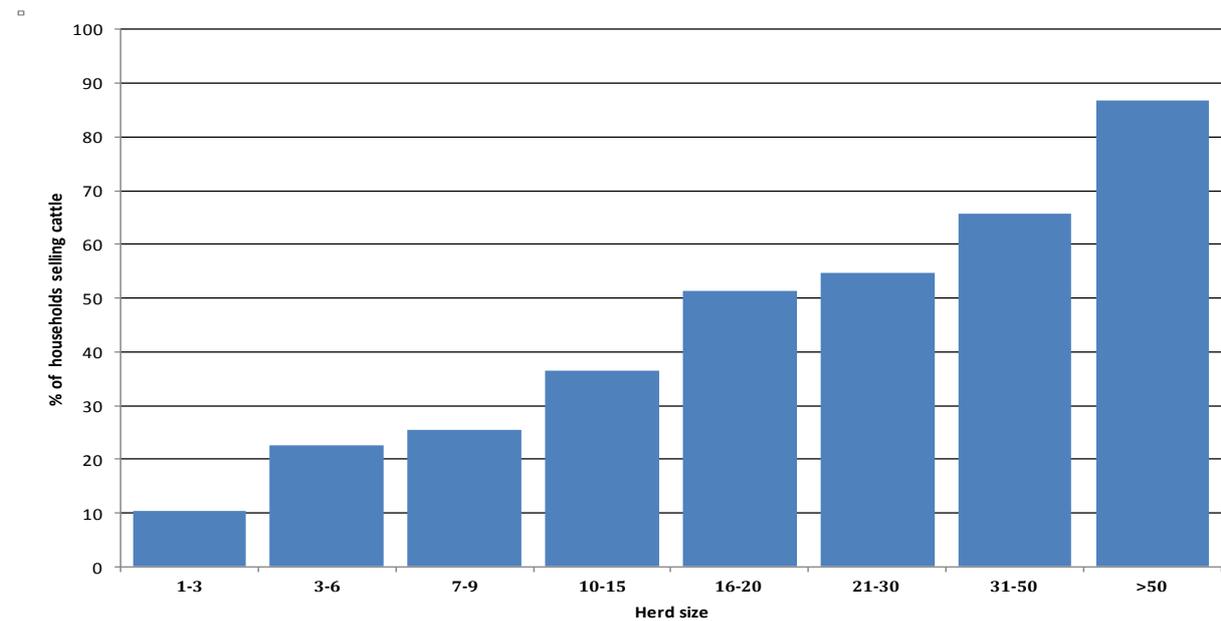
Table 1. Livestock Ownership and Marketing among Livestock Owners over Time

	-----2001-----				-----2008-----			
	Cattle (A)	Goats (B)	Pigs (C)	Sheep (D)	Cattle (E)	Goats (F)	Pigs (G)	Sheep (H)
HHs owning (number)	160,649	187,102	95,217	10,145	309,473	370,279	239,372	18,512
Percent	14.3	16.6	8.4	0.9	18.5	22.2	14.3	1.1
HHs selling (number)	33,528	63,820	29,862	2,229	76,284	165,932	86,023	6,386
Percent	3.0	5.7	2.6	0.2	4.6	9.9	5.2	.4
Average number owned - smallholder farmers	1.3	1.1	0.4	0.1	1.7	1.5	0.6	0.1
Average number owned -Livestock owners	9	6	5	5	9	7	4	9
Average number sold	2	3	3	2	2	4	3	4
% of HHs owning								
0	3.3	1.1	2.4	.5	1.9	3.6	5.8	2.1
1-3	30.0	34.2	46.7	40.2	36.6	37.0	53.9	38.3
4-6	22.4	31.1	22.1	29.8	24.9	25.5	21.3	29.4
7-9	16.6	17.9	18.0	24.3	14.9	18.1	11.8	9.1
10-15	12.1	9.0	6.6	4.2	8.1	8.4	4.5	8.2
16-20	5.9	4.2	2.9	0.0	4.3	3.8	1.5	5.8
21-30	5.4	1.6	1.0	1.0	3.9	2.2	0.9	3.1
31-50	2.6	0.7	0.0	0.0	3.2	1.0	0.1	0.2
>51	1.6	0.1	0.2	0.0	2.3	0.3	0.2	3.8
Total	100	100	100	100	100	100	100	100

Source: CSO/FSRP Supplemental Surveys (2001 and 2008). Note: HH=household.

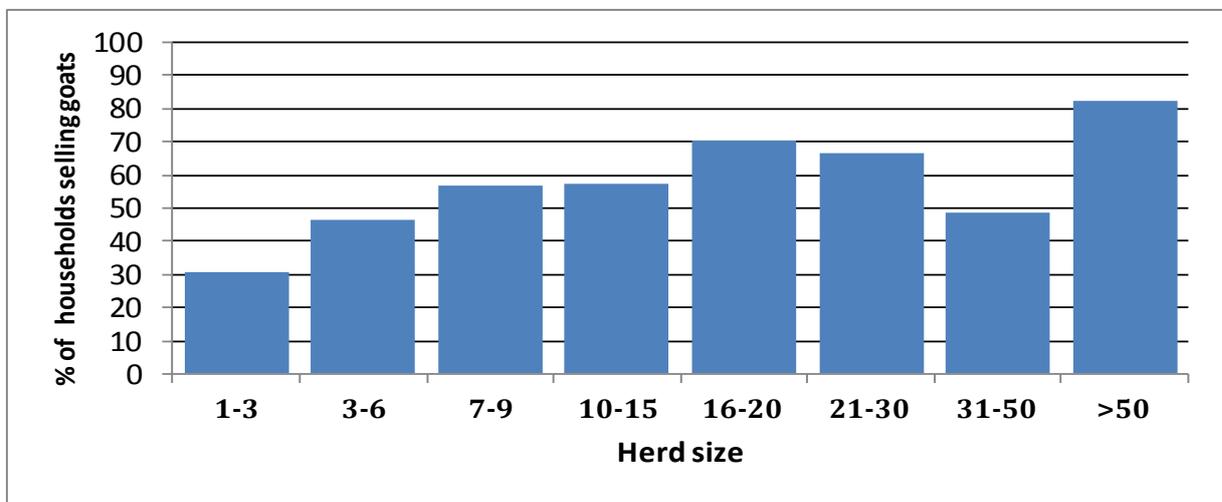
in 2008 while among those with over 50 cattle, close to 90% sold cattle in the same year (Figure 3a). These results are consistent among households owning goats, pigs, and sheep (Figures 3b, 3c, and 3d). These results suggest that households with bigger livestock herd sizes are more likely to sell their livestock than those with smaller herds. The implication of this finding is that the government and private sector have to invest in increasing the herd size, for example, promoting artificial insemination and effective disease control to curb high livestock mortality in the small-scale sector. However, given the limited government resources as well as uneven distribution of livestock, such interventions could be prioritized in the major producing areas. The Livestock Development and Animal Health (LDAH) projects with support from the World Bank could be used to help to alleviate this bottleneck

Figure 3a. Percent of Households Selling Cattle by Herd Size, 2008



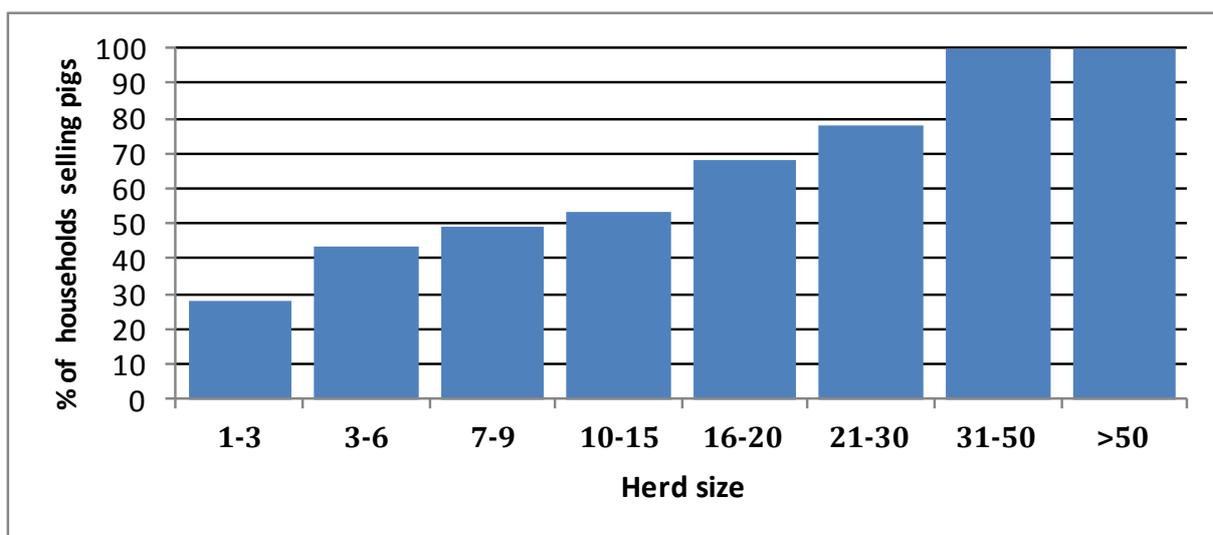
Source: CSO/FSRP Supplemental Survey 2008.

Figure 3b. Percent of Households Selling Goats by Herd Size, 2008



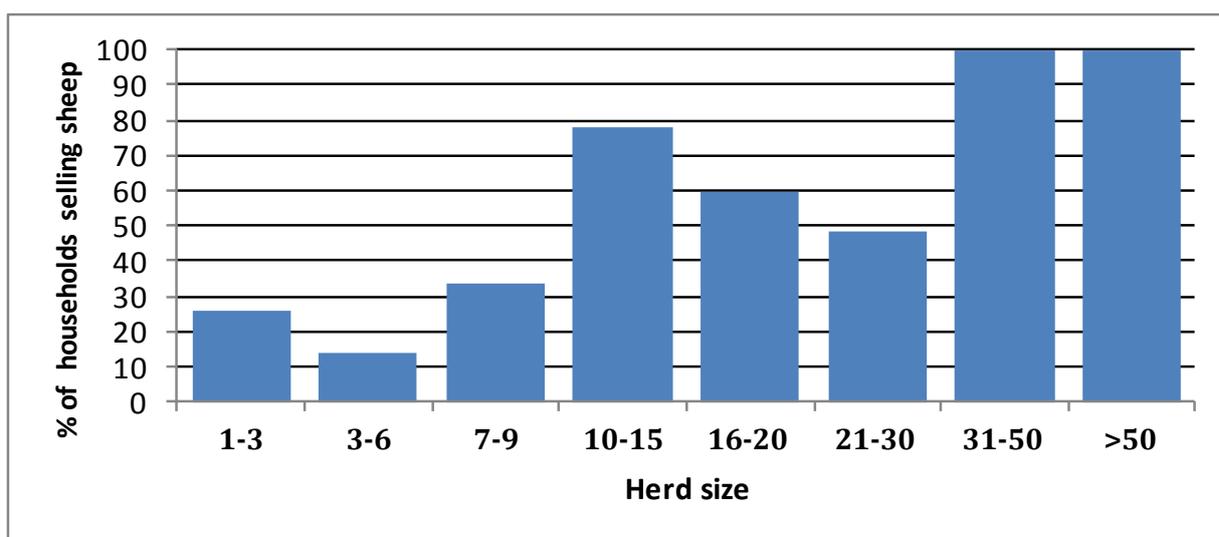
Source: CSO/FSRP Supplemental Survey 2008.

Figure 3c. Percent of Households Selling Pigs by Herd Size, 2008



Source: CSO/FSRP Supplemental Survey 2008.

Figure 3d. Percent of Households Selling Sheep by Herd Size, 2008



Source: CSO/FSRP Supplemental Survey 2008.

3.4. Livestock Sales by Location and Tribe

Table 2 presents the proportions of households that sold livestock during the 2007/08 agricultural marketing season by Province. Variations in proportion of households selling each livestock type are discernible across and within the Provinces. For example, comparing across the provinces, Lusaka had the highest proportion of cattle-owning households selling cattle (40%), followed by Southern Province (36%). For goats, the largest proportions of goat-owning households selling goats were found in Copperbelt (57%), Northwestern (51%) and Southern (51%) Provinces. Table 2 shows high commercial pig sales in Lusaka, Copperbelt, Northwestern, Southern, and Luapula Provinces. While Northwestern, Southern, and Luapula Provinces have higher percentages of households selling sheep. A noteworthy feature from these results is that we see more commercial activity among the small

Table 2. Proportion of Households Selling Livestock by Province, 2008

Province	Dominant tribe	Cattle	Goats	Pigs	Sheep
Central	Tonga	30.6	43.6	46.7	36.4
Copperbelt	Kaonde	31.0	56.8	50.0	.0
Eastern	Nyanja	21.1	38.0	31.6	27.3
Luapula	Bemba	.0	42.2	46.3	50.0
Lusaka	Tonga	40.4	44.8	59.1	.0
Northern	Bemba	17.4	39.6	38.5	28.6
Northwestern	Kaonde	17.9	50.9	57.6	54.5
Southern	Tonga	35.8	50.7	41.6	45.2
Western	Lozi	25.4	20.7	28.3	.0

Source: CSO/FSRP 2008 Supplemental Survey.

livestock compared to cattle. For example, in Eastern Province, one of the major producing areas for cattle, pigs, goats, and sheep, had relatively low proportions of households selling cattle compared to the other three livestock types. About 21% of households sold cattle while 38% and 32% sold goats and pigs, respectively. The same applies to households in Central and Southern Provinces. These results seem to suggest that households tend to keep cattle for wealth and other socio-cultural purposes, and not for business. Therefore, the policy question here is, "How can government encourage farmers to produce cattle for business?"

In order to understand the role of ethnic groups with regard to livestock sales, we grouped the 72 tribes into five major categories (Bemba, Kaonde, Tonga, Lozi, and Nyanja)². The results in Figure 4 are consistent with the provincial distribution of households selling livestock. Within each tribal grouping, the proportion of households selling cattle is relatively lower than that of households selling small livestock, with the highest cattle sales among the Tongas (36%), followed by Lozis (24%), and Nyanjas (22%). The results also show that half of the households among the Tonga and Kaonde speaking people sold pigs in 2008 while more than 50% of the goat-owning households sold goats among the Kaonde speaking people.

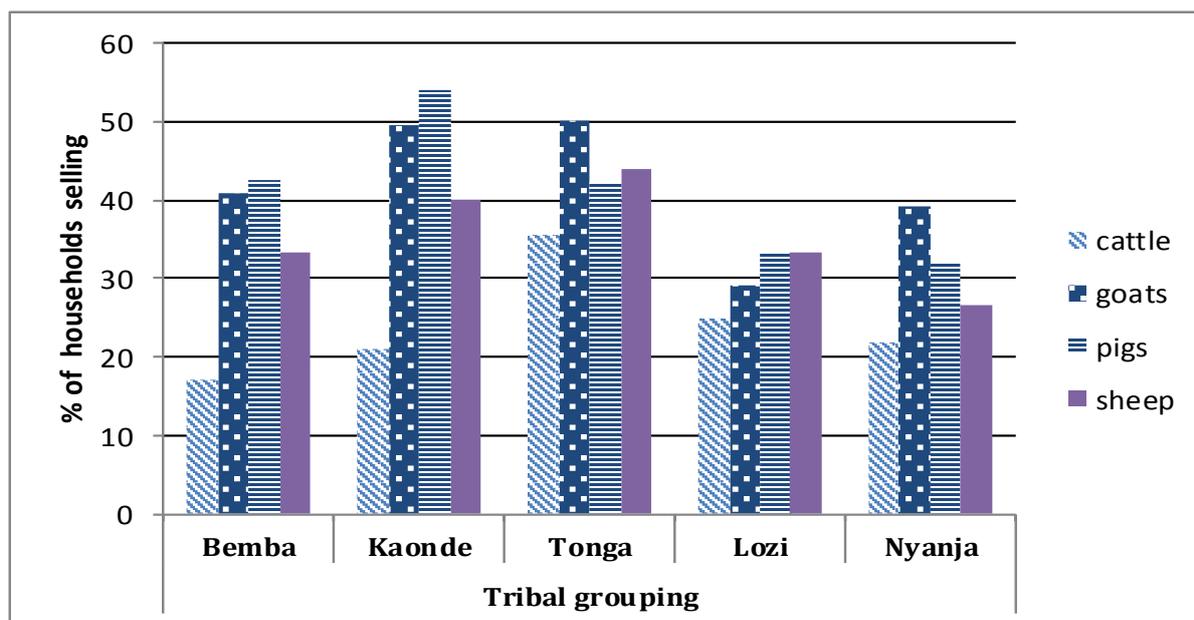
The econometric results in Table 3 supports these bivariate findings analysis, where we find that households in all provinces except Lusaka, Northern, and Western provinces were less likely to sell cattle compared to those in Southern Province, *ceteris paribus*. Likewise, the econometric results show that households on the Copperbelt are more likely to sell goats compared to those in Southern Province, *ceteris paribus*. In contrast, pig-owning households in Central, Copperbelt, Lusaka, and Northwestern Provinces are more likely to sell pigs than their counterparts in Southern Province.

² For example, the Bemba group includes tribes such as Bemba, Lunda-Luapula, Lala, Bisa, Ushi, Chishinga, Ngumbo, Lamba, Kabende, Tabwa, Swaka, and Mukulu, while the Nyanja group includes tribes such as Chewa, Chikunda, Kaunda, Ngoni, Nsenga, Nyanja, Senga, Tumbuka, etc

3.5. Livestock Sales by Gender of Household Head

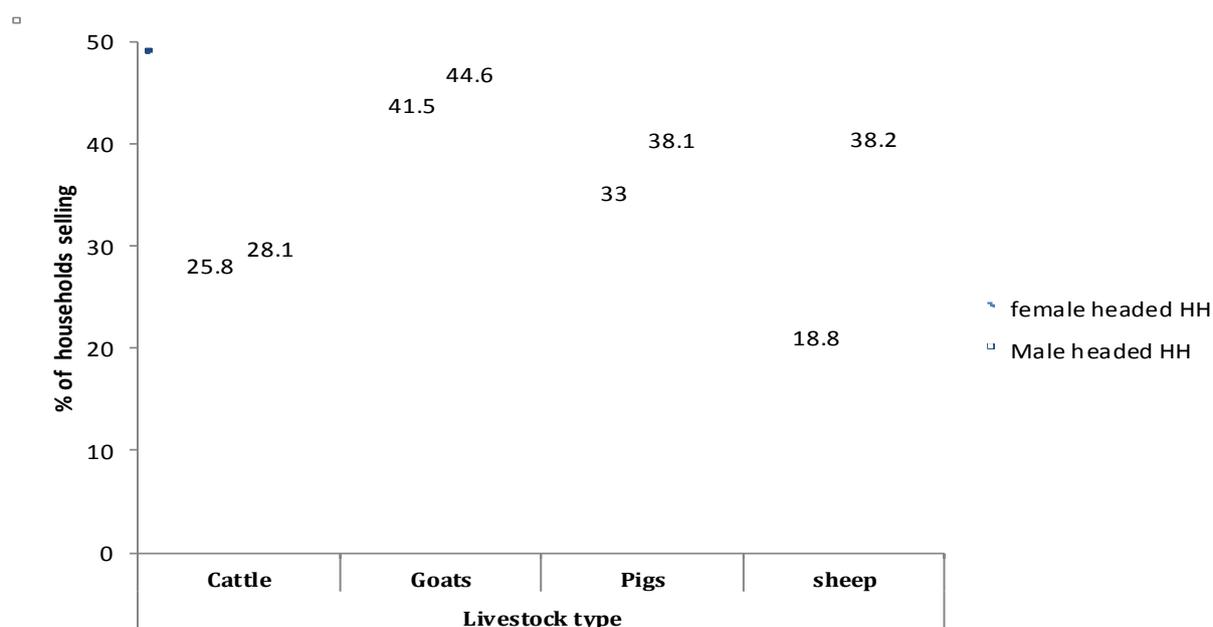
Results in Figure 5 shows marginal differences between male-headed and female-headed livestock-owning households in terms of market participation among all livestock types except sheep, where a larger proportion (38%) of male headed households reported selling sheep compared to 18% among female headed households. These results are supported by the probit model results in Tables 3 that shows that gender of household head does not matter in terms of livestock market participation.

Figure 4. Livestock Sales by Tribal Grouping, 2008



Source: CSO/FSRP Supplemental Survey 2008.

Figure 5. Distribution of Households Selling Livestock by Household Head, 2008



Source: CSO/FSRP Supplemental Survey 2008.

3.6. Livestock Sales by Education Level of the Household Head

Table 4 shows the household head's number of completed years of schooling and livestock market participation. The years of education completed by the head of household are subdivided into for group: no education, primary education (1-7 years), secondary education (8-12 years) and tertiary education (more than 12 years). The results show a positive relationship between formal schooling and livestock market participation. In general, we find that more than fifty percent of households participating in livestock market have secondary and tertiary education. With the exception of goats and pigs, the econometric results in Table 3 support these findings, where we find that one more year of schooling increases the probability of participation in cattle by 0.78%. This finding highlights the importance of education in increasing the ability of households to utilize market information and thereby utilizing market opportunities. It may not be surprising to find that there is no difference for households' participation in goat markets by education, because goats are more prevalent and much more easily reared and sold even by households with heads who have less education.

Table 3. Factors Affecting Participation in Cattle, Goat, and Pig Markets

Attributes	Marginal effects, pooled sample 2001 and 2008		
	Cattle (1)	Goats (2)	Pigs (3)
Human capital			
Female headed HH (=1, 0 otherwise)	0.0142 (0.0263)	-0.0190 (0.0255)	0.0009 (0.0337)
Age of HH head (years)	0.0017*** (0.0006)	0.0002 (0.0007)	-0.0012 (0.0008)
Adult equivalent	0.0070*** (0.0026)	0.0075** (0.0031)	0.0114*** (0.0043)
Year of schooling of HH	0.0078*** (0.0024)	0.0025 (0.0028)	0.0030 (0.0037)
Commercialization and non-farm			
HH crop commercialization index	-0.0684** (0.0294)	-0.0371 (0.0312)	0.0157 (0.0399)
HH participating in non-farm activities (=1, 0 otherwise)	0.0518*** (0.0169)	0.0106 (0.0195)	0.0230 (0.0244)
Shocks			
HH with head/spouse mortality (=1, 0 otherwise)	-0.0343 (0.0547)	-0.0070 (0.0674)	0.0426 (0.0901)
HH with mortality of member (=1, 0 otherwise)	0.0316 (0.0312)	-0.0135 (0.0343)	0.0247 (0.0548)
Cattle mortality due to diseases (number)	0.0053*** (0.0014)	- -	- -
Goats mortality due to diseases (number)	- -	0.0057** (0.0028)	- -
Pigs mortality due to diseases (number)	- -	- -	0.0092*** (0.0033)
Physical assets			
Landholding size (ha)	0.0065*** (0.0018)	0.0012 (0.0024)	0.0057* (0.0034)
Number of cattle owned	- -	-0.0012 (0.0008)	0.0002 (0.0012)
Number of goats owned	0.0021* -	- -	0.0003 -

Attributes	Marginal effects, pooled sample 2001 and 2008		
	Cattle (1)	Goats (2)	Pigs (3)
Number of pigs owned	(0.0011) 0.0003 (0.0018)	- -0.0034 (0.0024)	(0.0020) - -
Market access and social capital			
Distance to nearest main road (5 km)	0.0002 (0.0014)	-0.0010 (0.0017)	0.0020 (0.0015)
HH in districts on the line of rail (=1, 0 otherwise)	0.0143 (0.0188)	0.0621*** (0.0205)	0.0435 (0.0272)
Households considered local (=1, 0 otherwise)	-0.0081 (0.0207)	0.0579*** (0.0211)	0.0427 (0.0295)
Provincial dummies (the base is Southern)			
Central	-0.0631** (0.0254)	-0.0500 (0.0310)	0.1377** (0.0615)
Copperbelt	-0.0644 (0.0524)	0.0913* (0.0472)	0.1588** (0.0710)
Eastern	-0.0804*** (0.0219)	-0.1092*** (0.0269)	-0.0645* (0.0379)
Luapula	-0.1141 (0.0906)	-0.0444 (0.0366)	0.0902 (0.0607)
Lusaka	0.0024 (0.0485)	-0.0467 (0.0477)	0.2729*** (0.1052)
Northern	0.0095 (0.0346)	-0.1188*** (0.0276)	0.0129 (0.0435)
Northwestern	-0.1346*** (0.0403)	0.0120 (0.0465)	0.2422*** (0.0857)
Western	0.0200 (0.0315)	-0.1776*** (0.0590)	-0.0218 (0.0683)
Observations	3,002	3,296	1,953

Source: CSO/FSRP Supplemental Surveys (2001 and 2008).

Notes: Robust standard errors in parentheses; significance level *** p<0.01, ** p<0.05, * p<0.1; HH=household. Dependent variable: column 1, HH selling cattle (=1, 0 otherwise); column 2, HH selling goats (=1, 0 otherwise); column 3, HH selling pigs (=1, 0 otherwise).

Table 4. Distribution of Households Selling Livestock by Education Level of Household Head

	Cattle	Goats	Pigs	Sheep
Completed years of schooling (mean)	7	6	6	7
Household head completed years of schooling category				
No education	25.3	39.2	33.9	22.2
Primary (1-7yrs)	24.8	44.4	35.9	35.6
Secondary (7-12yrs)	33.0	46.6	41.6	38.7
Tertiary (above 12yrs)	39.0	27.1	50.0	40.0

Source: CSO/FSRP Supplemental Survey (2008).

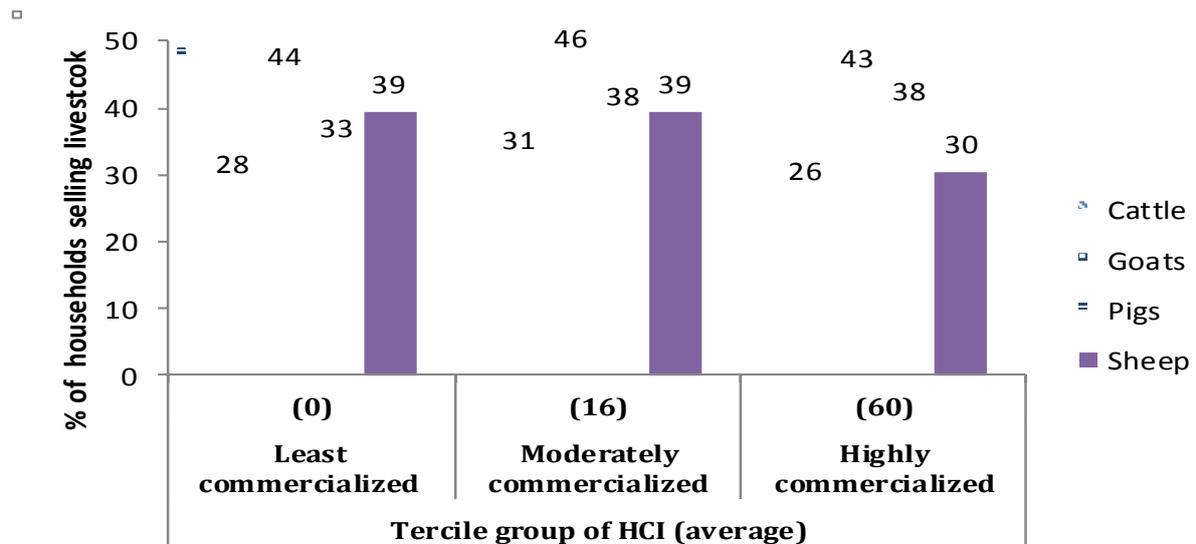
3.7. Livestock Sales by Household Crop Commercialization and Participation in Off-farm Activities

Figure 6 ranks the households by crop commercialization index and then stratify them into three equally sized groups (terciles). Thus, the three groups are defined as: i) least commercialized (bottom 33%); ii) moderately commercialized (middle 33%); and iii) highly commercialized (top 33%).

The household crop commercialization index is a proxy for the household's degree of crop commercialization. Generally, Figure 6 shows that the proportion of households selling cattle and goats is relatively lower among highly crop commercialized households compared to the least and moderately commercialized ones. This is supported by the econometric results in Table 3, which show that crop commercialization dampens the likelihood of participation in cattle and goat markets though not significant in goat markets. Thus, a one percent increase in HCI results in 6.8% decrease in the likelihood of selling cattle and 3.7% decrease for selling goats. However, we find positive and insignificant effects of crop commercialization on the likelihood of participation in pig markets.

Figure 7 shows that households selling livestock do also engage in off-farm activities, salary and wage activities, as well as formal and informal businesses. More specifically, we find that about half of the households selling sheep are engaged in off-farm employment while about 20% of the cattle selling households do businesses or are employed. However, econometric results in Table 3 show positive relationship between participation in off-farm activities and households' likelihood to sell cattle. Results for goats and pigs are positive but not statistically significant. Generally, the positive relationship between off-farm activities and livestock market participation seem to suggest that engaging in off-farm activities provide greater opportunities to interact with would-be buyers of livestock.

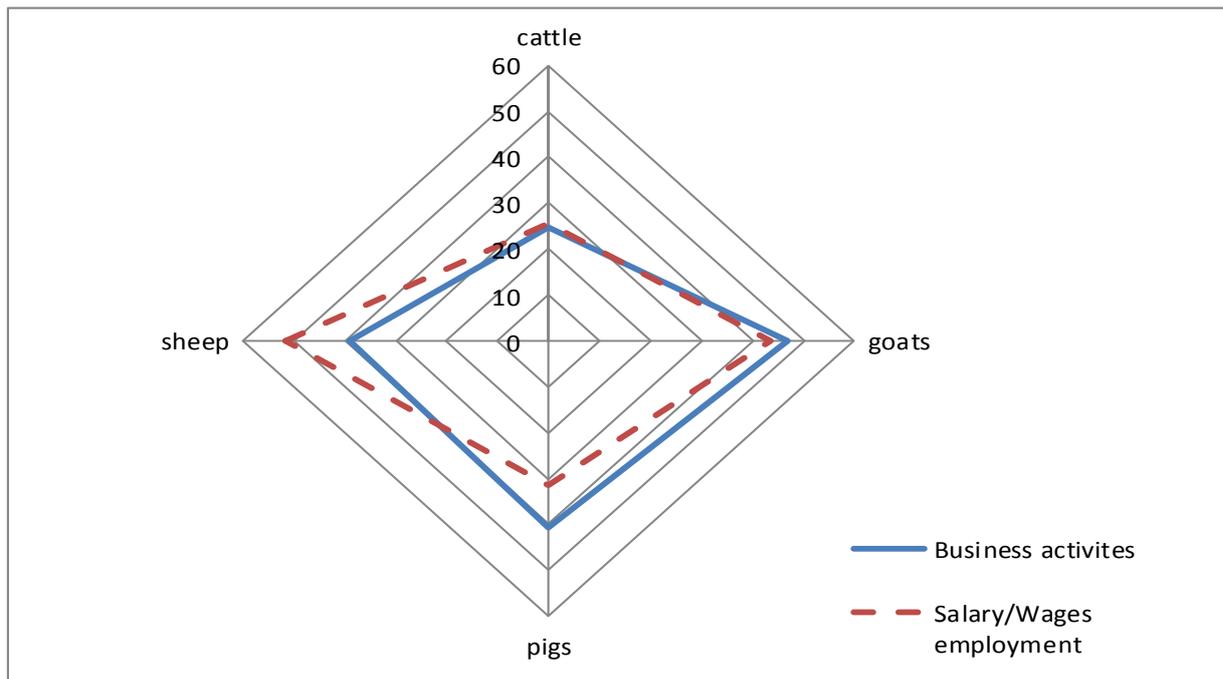
Figure 6. Participation in Livestock Market by Household Crop Commercialization Index



Source: CSO/FSRP Supplemental Survey 2008.

HCI=household crop commercialization index defined as (gross value of crop sales/gross value of crop production)*100.

Figure 7. Proportion of Households Selling Livestock by Off-farm Activities

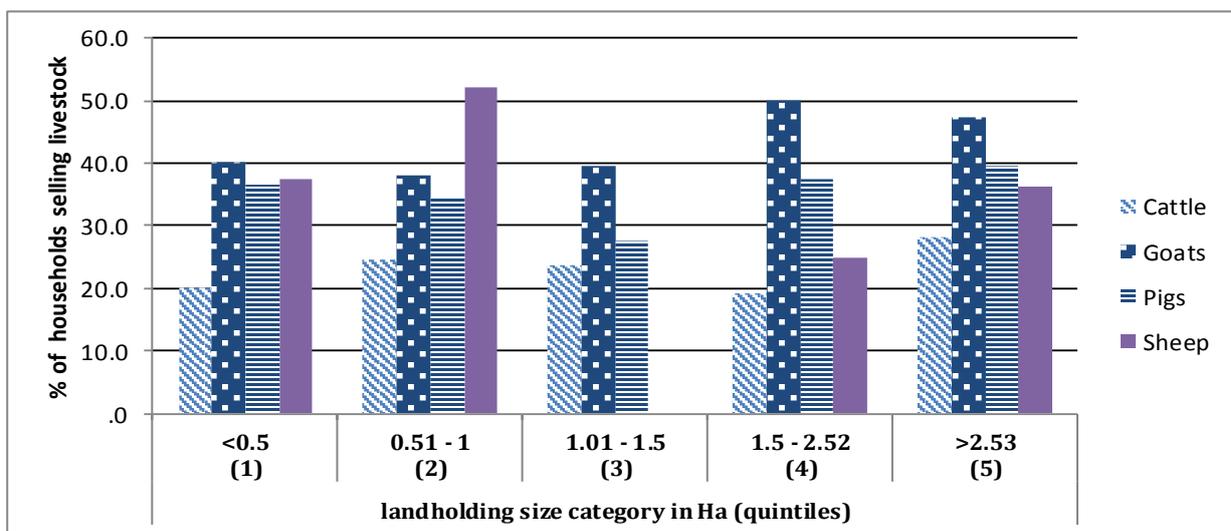


Source: CSO/FSRP Supplemental Survey 2008.

3.8. Livestock Sales by Land Holding Size Owned

To examine the role of landholding size in livestock marketing, we divided the landholding size into five equal groups (quintiles). Figure 8 shows the distribution of households selling livestock in each landholding size quintile for the four livestock types (cattle, goats, pigs, and sheep). Among households with less than 0.5 hectares of land, about 20% of the households sold cattle in 2006/07 marketing season, while approximately 40% sold goats, pigs, and sheep. Although the highest proportion of sellers is found in the largest landholding size quintile, there is no clear relationship between landholding size and selling goats and pigs.

Figure 8. Distribution of Households Selling Livestock by Landholding Size, 2008



Source: CSO/FSRPCSO/FSRP Supplemental Survey 2008.

The bivariate results are supported by the econometric results in Table 3, which show insignificant results for goats. While cattle and pig regression models indicate significant effects of landholding size, the coefficient sign suggests an enhancing effect. The results for cattle and pigs support Tuner (2004) who found land to be an important asset that supports production of livestock.

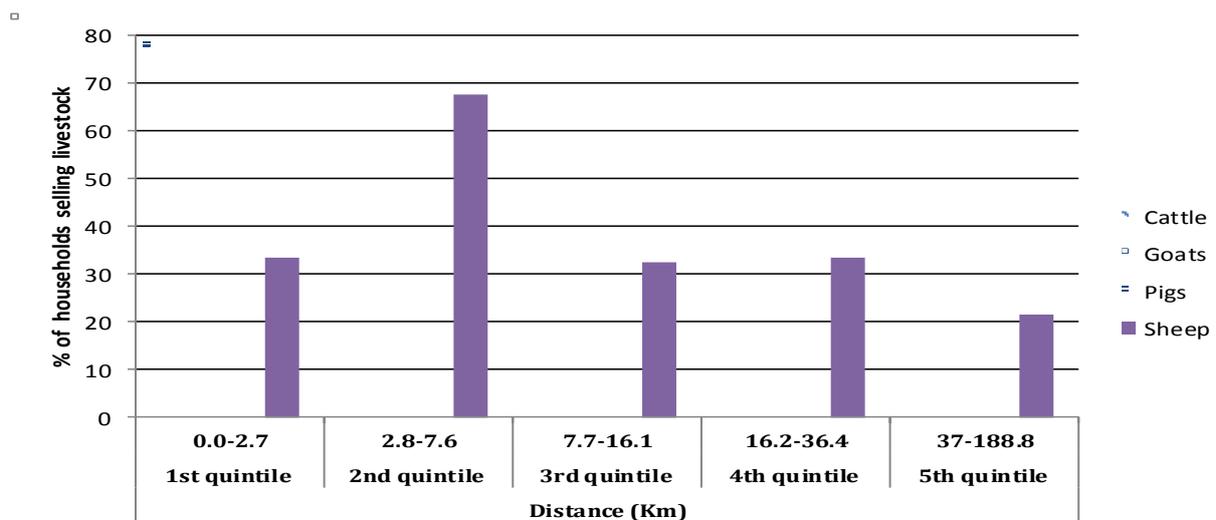
3.9. Market Access and Social Capital

Using the distance to nearest main road as a proxy for accessibility to markets we examine the relationship between rural households' participation in livestock markets and market access. Distance to nearest main roads was grouped into quintiles: the first quintile represents areas closest to main roads while the fifth quintile represents the remotest areas (far from main road) (Figure 9). Figure 9 shows that there is no clear pattern between livestock sales and market access. The econometric results in Table 3 supports these results as evidenced by the insignificant coefficient on distance to nearest main road.

3.10. Effects of Livestock Disease Outbreaks on Livestock Sales

The econometric results presented in Table 3 show that livestock mortality increases the likelihood of households selling cattle, goats, and pigs. This may seem strange as the government, through the department of veterinary services, restricts movements of animals into and out of the affected areas. In some cases, the government may destroy the entire herd to curb the risk of spreading the disease to unaffected areas (Chongwe 2011 (personal communication)).³ However, a visit to a lumpy skin disease affected area in Chongwe District revealed that households are able to dispose of diseased animals without attracting

Figure 9. Households Market Participation and Market Access (Distance to Main Road), 2008



Source: CSO/FSRP Supplemental Surveys 2008.

³ Mr Chongwe is a livestock production expert in the Zambia Ministry of Agriculture and Livestock.

the veterinary officer's attention.⁴ Farmers reported that one of the strategies they employ to avoid total loss in case the animal fails to respond to treatment is to sell the diseased animal before it dies and that animal sales increase during times of outbreaks. The proceeds are in part used to purchase the vaccines and medicines used to treat other animals that might be exposed to the risk of contracting the infection. Due to the restriction of livestock movements, farmers opt to sell to local butcheries and to fellow farmers in their communities at reduced prices.⁵

3.11. Cattle Marketing Dynamics

This section presents the cattle marketing dynamics in Zambia for the period 2001 to 2008. In order to understand the movement into and out the market, we limit our sample to the 524 households who consistently owned cattle in all the surveys, 2001, 2004, and 2008.

3.11.1. Participation Rates

Figure 10 presents the overall cattle market participation rates and transition into and out of cattle markets during the survey years 2001, 2004, and 2008. The number of households participating in cattle markets increased over the study period. Of the 524 households that owned cattle in all the survey years, 20.2% of the households sold their cattle in 2001 and 34.8% in 2008. However, despite the increase in the number of households participating in cattle market, a greater percentage of households moved into and out of the markets during the period of study. For instance, of the 20.2% of the households who sold cattle in 2001, only 8.4% sold cattle in 2004 and 20.8% of cattle market participants in 2004 did not participate in 2001. Between 2001 and 2008, less than 5% participated consistently in cattle markets with over 40% not participating at all. Close to 55% of the households moved into and out of markets over time. The results point to the need for further analysis in order to understand the reasons behind such low levels of participation in cattle markets and the factors pushing households to sell cattle in one year but not the other.

3.11.2. Market Dynamics by Income Sources and Assets

The changes in HCI by market dynamics and year are presented in Figure 11. The results show that the HCI increased between 2001 and 2008 among the one-time seller and two-time seller households. In general, the results show that households that sold in all the three years (consistently sellers) were less crop market oriented compared to other groups. To understand these results further, we examine the sources of income for the four groups. Results in Table show that consistently sellers had about four times more income from all sources compared to the non-sellers in 2004 and 2008. The observed increase in income in 2004 and 2008 is largely due to the sale of livestock which accounted for about 53% and 48% respectively.

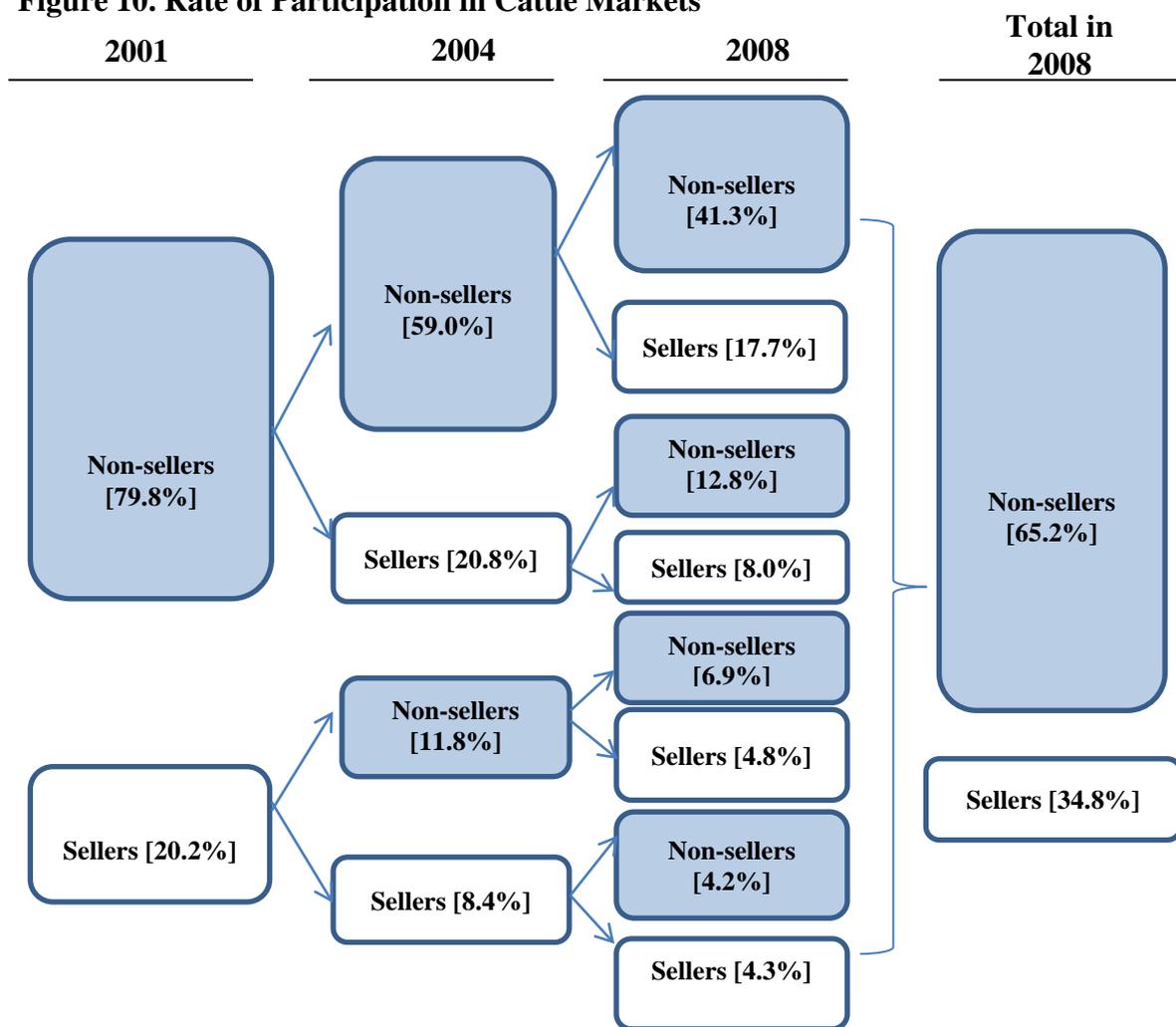
⁴ There is an outbreak of lumpy skin disease in many parts of the country. The disease as in the case of Chongwe District last occurred in 1979. The disease has affected over 1,000 animals and about 24,000 are at risk. This is according to the livestock department in Chongwe District. Currently, the farmers are being advised to have their animal injected with penicillin and vaccinate the one that are not affected.

⁵ The focus group discussions (FGD) highlighted several challenges that farmer are faced with in relation to disease management. Among the many challenges, the major ones include lack of dip tanks, expensive vaccines, and inadequate veterinary personnel.

These results indicate the importance of livestock in improving the welfare of smallholder farmers. Also, the results show that cattle non-sellers derive much of their income from crop sales. However, dependence on crop income does not necessarily mean more income as shown in Table 5. This may suggest that enterprise diversification that includes livestock production and marketing is likely to improve the welfare of the smallholder farmers in Zambia.

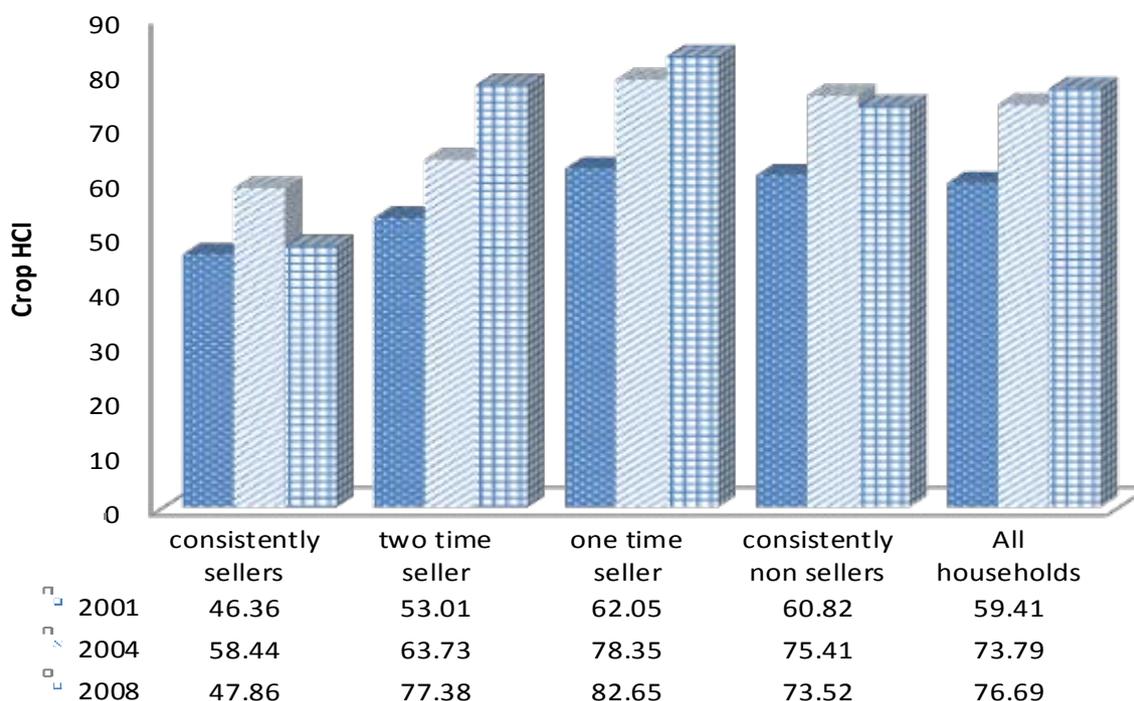
Results in Table 5 show that consistent cattle sellers had on average slightly larger landholding sizes than other market groups. Large landholding sizes may be one way of sustaining large numbers of cattle. They also had more herds of goats but not a lot of pigs. We also find a greater percentage of households with vehicles among consistent sellers than the other groups (Table 6). These results suggest that consistent sellers are better off with respect to asset ownership compared to other groups.

Figure 10. Rate of Participation in Cattle Markets



Source: CSO/FSRP Supplemental Surveys (2001, 2004, and 2008).

Figure 11. Market Dynamics by Crop Household Commercialization Index (HCI)



Source: CSO/FSRP Supplemental Surveys (2001, 2004, and 2008).

Table 5. Income Shares by Market Dynamics Groups

	Year of survey	consistently sellers	Two time seller	One time seller	Non-sellers	All households
Sample size						
Weighted		2,374	9,571	22,287	24,093	58,324
Unweighted		25	96	203	200	524
Total household income per adult equivalent in Kwacha-08 values ('000)	2001	1,973	1,895	1,255	1,036	1,299
	2004	4,301	4,114	1,336	1,589	2,042
	2008	5,087	2,634	1,448	1,088	1,640
Income share (%)						
Crop	2001	36.72	54.85	67.28	76.11	67.65
	2004	35.06	52.20	68.08	80.35	69.00
	2008	26.68	43.16	53.66	66.41	56.09
Livestock	2001	37.54	22.81	14.81	5.18	13.07
	2004	53.31	35.21	18.82	4.71	17.29
	2008	48.29	32.90	26.04	10.49	21.66
Off farm	2001	25.73	22.34	17.91	18.71	19.28
	2004	11.63	12.58	13.10	14.94	13.71
	2008	25.03	23.94	20.30	23.10	22.25

Source: CSO/FSRP Supplemental Surveys (2001, 2004, and 2008).

Table 6. Market Dynamics by Asset Ownership over the Three Panel Years

	Year of survey	Consistently sellers	Two time seller	One time seller	Non-sellers	All households
Sample size						
Weighted		2,374	9,571	22,287	24,093	58,324
Unweighted		25	96	203	200	524
Average land holding size (ha)						
	2001	4.46	4.21	3.79	3.73	3.84
	2004	3.75	4.38	3.53	3.31	3.60
	2008	6.57	5.41	4.03	3.46	4.13
Assets						
HH owning truck/van (%)	2001	16.51	4.54	1.63	3.41	3.39
	2004	1.14	5.63	2.31	.81	2.19
	2008	19.46	1.88	2.95	.30	2.25
Number of goats owned	2001	10	3	4	3	4
	2004	14	5	5	4	5
	2008	12	5	5	6	6
Number of Pigs owned	2001	0	1	1	1	1
	2004	0	1	2	1	1
	2008	1	2	2	2	2
Number of cattle owned	2001	36	20	12	7	13
	2004	62	24	13	7	15
	2008	46	28	15	8	16

Source: CSO/FSRP Supplemental Surveys (2001, 2004, and 2008).

Note: HH = household.

3.12. Basic Characteristics of the Four Cattle Market Participation Groups

Table 7 summarizes household socioeconomic characteristics across the four groups of farmers with respect to livestock market dynamics. The descriptive statistical tests are based on the initial period, 2001. As shown in Table 7, cattle non-sellers had small family sizes in 2001 compared to consistently sellers (seven compared to nine respectively). Also, we find that, on average, household heads in the consistent sellers group had higher formal education than household heads in the other cattle market participation groups.

Furthermore, the proportion of households owning and selling goats is higher among the consistent sellers than among non-sellers as well as those who move in and out of the market. Pig ownership and selling was, however, more common among one and two time sellers. ANOVA results indicate that differences in means are statistically significant across groups for households in polygamous marriages, household size, education level of household's head, and households selling goats and sheep.

Table 7. Household Initial Socioeconomic Characteristics by Cattle Market Participation Groups, 2001

	All households	Cattle market participation group				Sig level
		Consistently seller	Two time seller	One time seller	Consistently non-seller	
Sample size						
Weighted	58,324	2,374	9,571	22,287	24,093	
Unweighted	524	25	96	203	200	
Demographics						
Female headed HH (%)	7.99	8.50	6.42	9.94	6.76	
Polygamous HH (%)	16.68	41.87	19.41	15.44	14.25	***
Mean number of HH members	8	9	9	8	7	***
Mean age of HH head (years)	49.49	48.41	49.18	49.25	49.94	
Mean years of schooling of HH head	6.18	8.24	6.88	6.20	5.67	**
Assets						
HH owns goat(s) (%)	40.33	68.17	32.24	40.36	40.77	
HH sold goat(s) (%)	14.92	41.22	17.64	16.13	10.13	
HH owns pig(s) or sheep (%)	21.84	18.69	22.68	22.63	21.09	
HH sold pig(s) or sheep (%)	5.06	.88	5.74	6.29	4.06	**
Mean landholding size (ha)	3.86	4.46	4.21	3.79	3.73	
HH owns truck/van (%)	3.34	14.78	4.40	1.62	3.39	

Source: CSO/FSRP Supplemental Surveys (2001, 2004, and 2008).

Note: HH = household.

4. CONCLUSION AND POLICY IMPLICATIONS

The government has shown interest in using the livestock sector to accelerate economic growth and poverty reduction especially among rural farmers (Government of Zambia 2011). In most Sub-Saharan African countries, livestock is being integrated into poverty reduction papers and yet, to date little is known why poverty still remains high even among households owning livestock. Information about the factors influencing smallholder participation in livestock markets is often fragmented even though it is essential for effective livestock development planning. This paper estimated probit models and generated descriptive statistics from nationally representative survey data from Zambia to examine the factors that influence participation in livestock markets. The study highlights the following salient findings;

The factors that are likely to positively influence participation in goat markets are goat mortality, proximity to the rail line while household crop commercialization, land holding size, number of cattle owned are likely to dampen participation. Households on the Copperbelt Province are more likely to participate in goat markets than household in Southern Province.

Education level of household head, cattle mortality and ownership of pigs are likely to increase participation in cattle markets, crop commercialization, household head mortality, are likely to reduce participation. Participation in pig markets is likely to be influenced by pig mortality, landholding size, and distance to main roads and proximity to the line of rail. However, age of household head, crop commercialization, and household member mortality are likely to reduce participation in cattle markets.

The study shows that varying household factors influence participation in livestock markets vary by livestock type. For example, while participation in goat, cattle, and pig markets were all influenced by the crop commercialization and livestock mortality, we find that distance to the main road a proxy for market access is key for household participation in pig markets. In addition, there are regional differences when it comes to livestock market participation. For example, the probit models show that households in Northern Province were more likely to sell cattle compared to Southern Province, a province with the highest cattle population. While, households in Northwestern and the Copperbelt were more likely to sell goats, and households from the Copperbelt, Luapula, Lusaka, and Northwestern Provinces were more likely to sell pigs as compared to households in Southern Province. Smallholder farmers in Zambia are constrained by many factors that need the attention of both the private and public sectors in order for the livestock sector to play a meaningful role in economic development.

Evidence presented in this paper raises several critical issues that need to be considered in addressing the challenges of livestock marketing. Key public investments that may serve to increase participation in livestock markets include investments in rural education, and building institutional and infrastructural capacities that allow smallholder farmers to successfully compete and integrate within the developing livestock industry. Provision for a conducive environment through public sector investment that allows livestock producers to increase production through improved efficiency and productivity is another area that needs attention. However, given the limited government resources as well as uneven distribution of livestock development interventions such as improved disease control or reproductive management, infrastructural development such as construction of abattoirs and gene banks could be prioritized in the major producing areas. There have been discussions among

agricultural stakeholders for government to consider including livestock vaccinations into the farmer input support program to allow livestock farmers to access subsidized medicines. This is a good idea as long as the subsidy is linked to encouraging Zambian farmers to think of livestock production as a business.

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