



Zambian Smallholder Livestock Herd Dynamics: What Are the Policy Implications?

by

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Key Points

- Livestock production and marketing has the potential of improving the smallholder farmer's livelihood, but small herd size limits smallholder livestock commercialization. Thus understanding the herd dynamics is a pragmatic initial step in addressing this problem and providing solutions to building and maintaining the herd size.
- Births are the primary source of building the herd size while deaths as reflected by high mortality rates are the major outflow channel.
- It is encouraging that cattle mortality rates have reduced and the population growth rates increased between 2012 and 2015 though more still needs to be done.
- Population growth rates for goats are negative and the picture is worse for pigs.
- Provision of adequate animal husbandry extension and animal health services are key in addressing the high mortality rates that could be translated into more sales especially for small livestock thereby improving the income base of farmers.
- Interventions that address the reproduction rates such as adequate feeding on good quality feed is one of the main strategies to facilitate the growth of the young livestock into mature breeding and commercial slaughter animals.
- In addition, both public and private sector supporting livestock development should provide training to farmers on the importance of strategic feeding to address the dry season feeding challenges.
- All in all, there is urgent need to scale up the current interventions targeted at improving cattle

INTRODUCTION: The livestock sector has the great potential to contribute to rural poverty reduction in Sub-Saharan Africa and particular Zambia. However, this potential is often underutilized mainly due to the numerous factors that limit smallholder production and commercialization. Of the several factors that limit smallholder commercialization, studies in Zambia have shown that the livestock herd size plays a significant role (Lubungu, Sitko, and Hichaambwa 2015; Lubungu 2016). Therefore, building and maintaining a healthy herd size is key if livestock farmers are to take full advantage of benefiting from the growth of the sector.

This policy paper provides information on the ways of improving the smallholder livestock sector by identifying the primary inflows and outflows, as well as providing the livestock demographics indicators. Understanding the herd dynamics is important, as it reflects the stability of the herd or flock structures over time. In addition, knowledge about different livestock species population indicators is essential in understanding a range of attributes that could be unique for different livestock value chains (Desta and Coppok 2002), since herd dynamics differ across livestock species (Mwanyumba et al. 2015). Furthermore, information on the livestock demographics is of importance for defining problems and

understanding the past trends associated with the livestock population growth. This will help to identify potential solutions and prepare for the future interventions and policies that address issues stifling the growth of the smallholder livestock sector. Against this background, five cross-sectional national wide data were used to generate information on the parameters that affect the livestock herd size for cattle, goats, and pigs in Zambia and how these have changed over time.

DATA AND METHODS: The data used in the analysis come from five national representative surveys—the 2001, 2004, and 2008 Supplemental Surveys (SS) and the 2012 and 2015 Rural Agricultural Livelihood Surveys (RALS). The surveys were implemented by Indaba Agricultural Policy Research Institute (IAPRI) in collaboration with the Zambia Central Statistical Office, and Ministry of Agriculture. The SS covered 6,922, 5,420, and 8,094 agricultural households in 2001, 2004, and 2008 respectively. The 2012 RALS covered 8,840 farm households. In 2015, the same households were followed, and 7,254 households were successfully re-interviewed. In addition to 7,254 households, 660 new households were sampled and interviewed bringing the total households surveyed in 2015 to 7,934. With the additional households, the two surveys can be treated as independent cross sections. For more details on the sampling procedures of SS see Megill (2004 and 2009) and for RALS see IAPRI (2016).

The analysis highlights the primary sources and outflows of three livestock species (cattle, goats, and pigs). The analysis looks at the significance of the three sources of livestock inflows (the births, purchases, and gifts or dowry) and five channels of outflows (deaths, sales, home consumption, gifts, and theft). Also, the analysis provides information about the livestock demographic indicators (population growth, mortality rates, and offtake rates).

RESULTS:

Herd and Flock Dynamics: The results in Figures 1 and 2 highlight the primary sources

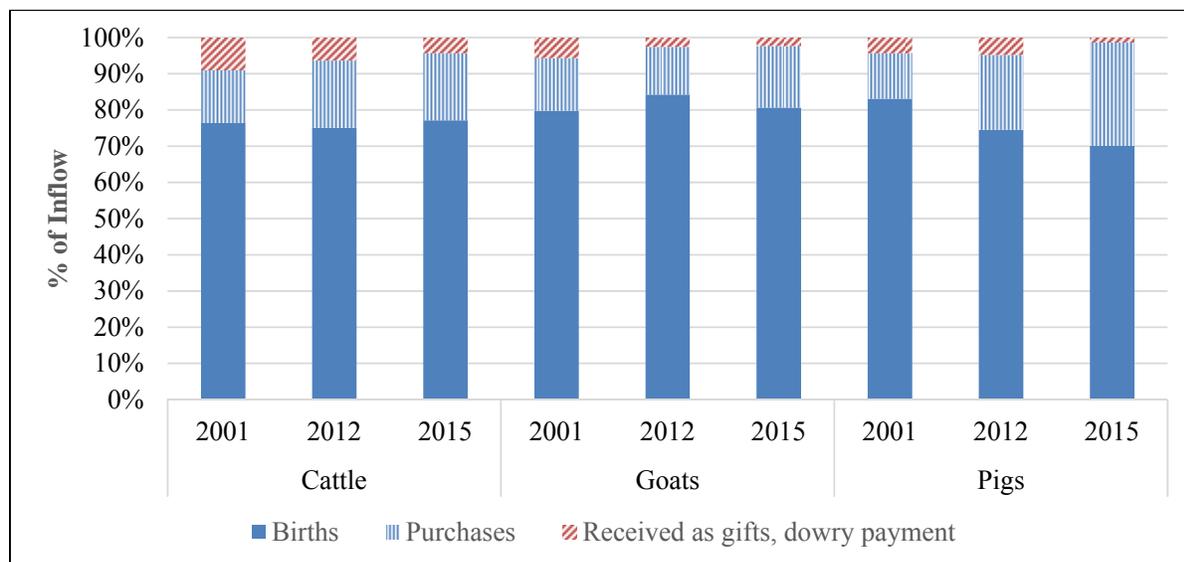
of three livestock species over the four time periods.

Cattle: The results show that births, which account for more than 75% of the total entries, are the primary source of building and maintaining the cattle herd size. Purchases, to some extent, are also an important source especially to farmers who are just starting cattle production. On the other hand, deaths accounted for the major cattle outflows though the proportion reduced from 60% in 2001 to 50% in 2015 a sign of improved management (Table 1 in the Appendix). Sales are the second most important means of disposing of cattle (Figure 1), and a slight increase was notable in 2015 (Appendix Table 1). The size of home consumption, gifts, and theft are minimal. However, compared to other livestock species, households are more likely to give away cattle as dowry payment than goats or pigs. It is worthy to note that cattle are the most preferred form of dowry payment in some cultures.

Goats: Of the three sources of goat entries, births were the primary source of building and maintaining the flock (Figure 1), while sales accounted for the greater proportion of goat outflow, followed by deaths (Figure 2). Goats were consumed within the household more often than cattle, probably due to their size; cattle are mainly slaughtered for exceptional functions such as weddings, funerals, or traditional ceremonies.

Pigs: Similar to other livestock species, births were a primary source of pig inflows. Compared to goat and cattle production, purchases are relatively important sources of building the pig herd size and as of 2015, they accounted for close to 30% (Figure 1). Despite pigs having a shorter gestation period and generation interval, as well as producing a large litter, the higher rates of purchases could be attributed to high mortality rates. The principal source of outflows is deaths followed by sales. Pigs are also equally consumed within the household just as goats. Compared to other livestock species, pigs were prone to theft.

Figure 1. Livestock Inflow Channels by Year



Source: author using data from CSO/MAL/FSRP 2001, 2004, and 2008 and IAPRI 2016 to generate all tables and figures.

Figure 2. Livestock Outflow Channels, 2015

	Deaths	Sales	Consumed	Given out/dowry payment	Theft
Cattle					
Goats					
Pigs					

Darker colors represent the most common channels

Demographic Indicators: Results in Table 2 of the appendix show the national livestock status for the three livestock species over the five-year period. This information was used to compute the demographic indicators presented in Figure 3.

Cattle: The demographic indicators presented in Figure 3 show an upward trend of the population growth while annual mortality rate shows a cyclical pattern. The observed trends can be explained by the major developments that have occurred within the cattle production. Between 2001 and 2004, mortality rates were at its peak due to an outbreak of the contagious bovine pleural pneumonia. In 2005, the Livestock Development Trust implemented the vaccination of cattle under the Danish project in collaboration with the Ministry of Agriculture (Chiwawa 2016,

personal communication)¹ This could have led to a reduction in the mortality rates. In 2008, the project phased out, and the International Fund for Agricultural Development came in to address the disease outbreaks and restocking program under the smallholder livestock investment program. This project implemented its activities from 2010 to 2012. From 2012 to date, the Ministry of Fisheries and Livestock has been conducting the vaccination campaigns under the Livestock Development and Animal Health Project funded by The World Bank to contain foot and mouth disease, East Coast Fever, and contagious bovine pleural pneumonia in highly disease-endemic areas (World Bank 2016). Apart from the government programs, the private sector has equally provided support

¹ Chiwawa is a district veterinary officer in the Ministry of Fisheries and Livestock

to cattle farmers in the recent years. For example, programs by Musika have been providing support to cattle smallholder farmers by assisting the private veterinary companies that offer the smallholder livestock preventive health care and genetic improvements. Despite all the developments, cattle sales had remained low even in the years when the population increased and mortality rate reduced. Research has shown that households often keep cattle for animal draft power, transport, and as a moving bank from which farmers draw only in times of need. Also, farmers keep cattle for traditional uses such as payment for dowry (Lubungu, Sitko, and Hichaambwa 2015). Due to these factors, farmers only sell old unproductive animals.

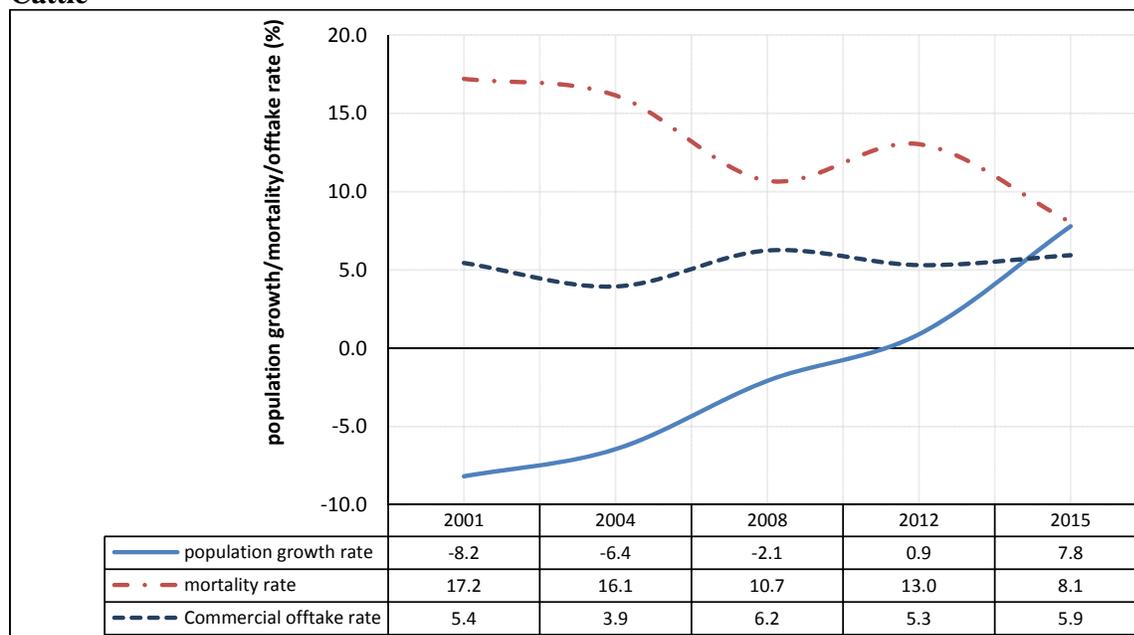
Goats: The population growth rates for goats were negative between 2001 and 2015 though there was an upward trend since 2012. During this 14 year period, the mortality rates had constantly been high, which can be attributed to lack of a deliberate policy to support small livestock. The offtake rates for goats are higher than the mortality rate. Thus the

negative growth rates can also be attributed to high offtake rates apart from the high mortality rates. Given that more than 80% of goat's inflows are through births, therefore, addressing the factors that affect the reproduction rates will increase the population and improve the smallholder livelihood through increased sales.

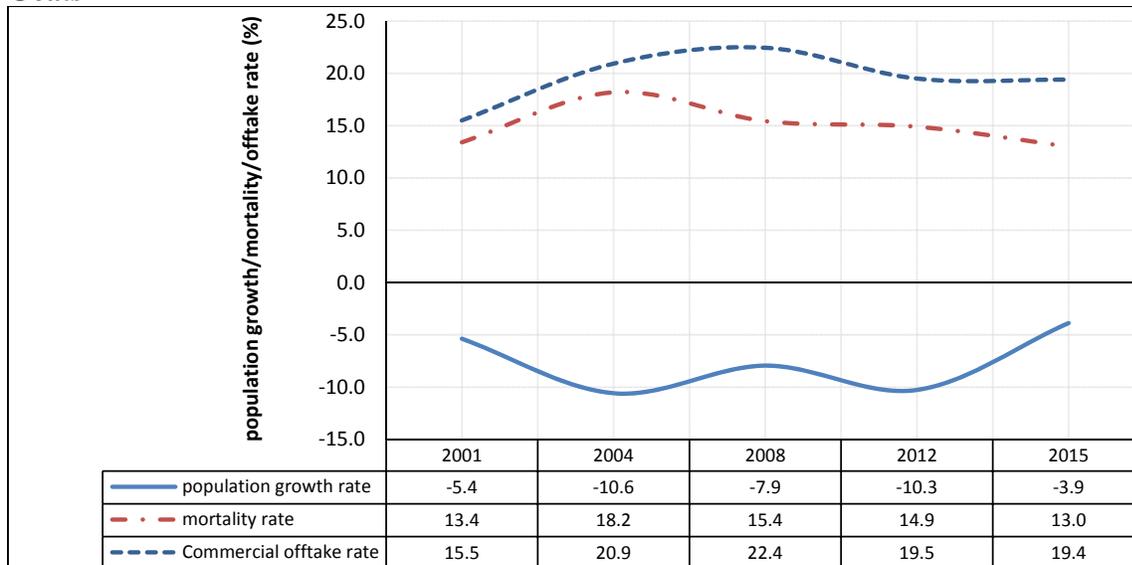
Pigs: The pig production has continued to record a negative population growth rate with a mortality rate of over 25%. Compared to goats and cattle, the commercial offtake rates are higher for pigs. Research attribute higher offtake rates for pigs to shorter production cycles, suitability of meat for processing and flexibility to marketing due to their small size (Bruinsma 2003). It is also worth to note that pig sales seem to respond to the population growth and mortality rates. The sales increase when mortality rates decline (Figure 3). Therefore, addressing the mortality rates is likely to increase pig commercialisation, and subsequently, improve the household's income base.

Figure 3. Livestock Demographic Indicators by Year

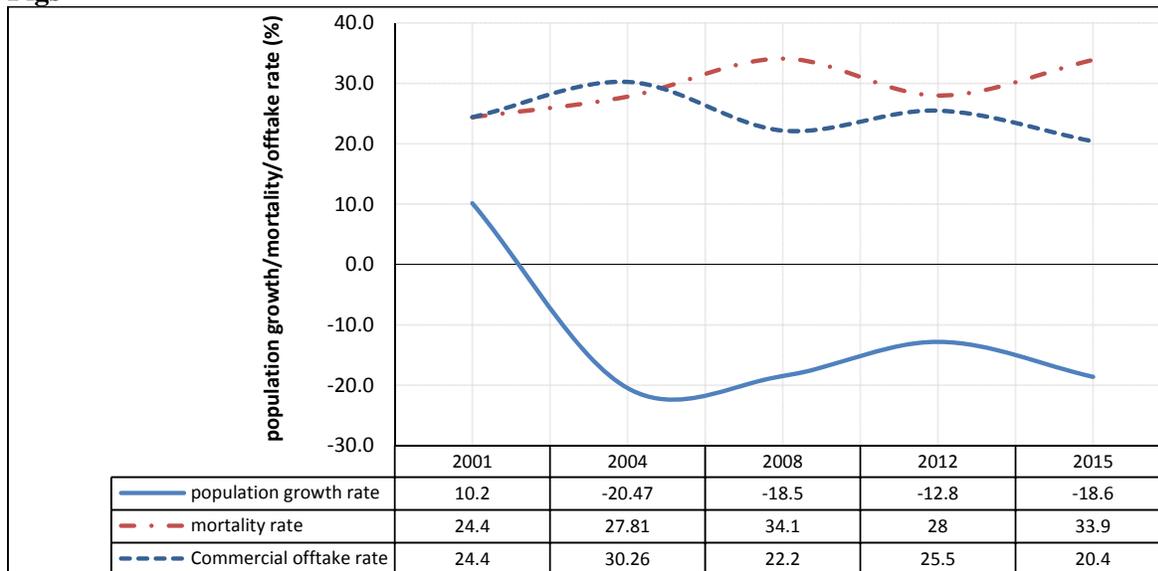
Cattle



Goats



Pigs



The analysis adopts the methods presented by Lesnoff et al. 2011 to compute the demographic indicators.

Annual population growth rate = (annual multiplication rate – 1) * 100.

Annual multiplication rate = closing stock/opening stock.

Annual mortality rate is the probability or hazard rate for an animal to die = (number died in 12 months/opening stock)* 100. Commercial offtake rate = (sales/herd size 12 months ago) * 100

CONCLUSIONS: From the analysis, the following conclusions can be drawn. The livestock births are the primary source of building the herd size for cattle, goats, and pigs. The major outflow channel is death, as reflected by high mortality rates, especially in pig and cattle production. Sales are equally important outflow channel in goat production as reflected by the high commercial offtake rates.

RECOMMENDATIONS: Based on conclusions, the following are the recommendations:

- i. Since births are the primary source of livestock inflow, interventions that address the reproduction rates of livestock can help in building and maintaining the herd size.
 - To achieve high reproductive rates, livestock/veterinary assistants should

educate farmers on the importance of strategic feeding that addresses the seasonal forage shortages, dietary needs of different livestock species, and the nutritional value of the available feed resources. Nutrition has a greater effect on the estrous cycle.

- Second, artificial insemination using bulls of high-quality breeds would significantly contribute to building the herd sizes, therefore, more research is needed to explore different alternatives through which farmers can access artificial insemination services that will promote the genetic improvement of various livestock species. A follow-up study using the choice experiment method will be conducted to determine the willingness of farmers to pay for such services and provide more detailed information on different models that can be utilized to implement this strategy.
- ii. Addressing the problem of high mortality rate, which affects the commercial off-take rates, requires the provision of adequate animal husbandry practices and scaling up on the delivery of animal health services. Different models can be explored in this regard.
- As the findings have shown there was a reduction in cattle mortality rate and increased population growth rates during the periods of interventions. There is a need to scale up the current public interventions targeted at improving the delivery of cattle health service. This model can also be extended to small livestock species.
 - Alternately, the private sector can likewise provide such services. For example, employing the Musika project model of assisting the private veterinary companies that offer the smallholder livestock preventive health care and genetic improvements. However, more research is a need to determine the capacity of the current private animal health service providers and the limiting factors.

Finally, in addition to addressing the animal health and husbandry aspects, more research,

(which is underway), is needed to uncover the governance challenges associated with animal health service delivery. Also, research on how these interventions translate into improved productivity such as milk yield/cow is needed. Another measure of productivity worth investigating is biomass food productivity, which is the annual output in protein divided by total biomass in the herd or flock expressed in kilograms (Steinfeld and Opio 2009), quoted in FAO 2009, p.18).

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ACKNOWLEDGEMENTS

The Indaba Agricultural Policy Research Institute is a non-profit company limited by guarantee and collaboratively works with public and private stakeholders. IAPRI exists to carry out agricultural policy research and outreach, serving the agricultural sector in Zambia so as to contribute to sustainable pro-poor agricultural development. We wish to acknowledge the financial and substantive support of the Government of Sweden through Swedish

International Development Agency (Sida) and the United States Agency for International Development (USAID) in Lusaka. We further would like to acknowledge the technical and capacity building support from Michigan State University and its researchers, and Patricia Johannes for her formatting and editorial assistance.

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APPENDIX

Table 1. Livestock Inventory by Year, 2012 and 2015

	Cattle			Goats			Pigs		
	2001	2012	2015	2001	2012	2015	2001	2012	2015
<i>Inflows (average number/household)</i>	2.06	1.43	1.73	2.82	2.32	2.70	3.56	2.73	2.58
Births (%)	76.4	75.0	77.2	79.8	84.3	80.7	83.1	74.5	70.1
Purchases (%)	14.5	18.6	18.5	14.6	13.2	17.0	12.5	20.6	28.5
Received as gifts, dowry payment (%)	9.1	6.3	4.4	5.7	2.5	2.3	4.3	4.8	1.4
<i>Out Flows (average number/household)</i>	2.42	4.89	1.17	2.29	5.11	2.32	2.25	3.52	2.90
Deaths (%)	62.3	61.7	50.7	28.1	30.3	39.6	36.8	38.3	56.1
Sales (%)	19.7	26.9	36.2	32.5	38.2	40.0	36.8	38.6	31.6
Consumed (%)	4.9	4.0	3.9	25.0	22.2	32.0	17.5	15.3	21.8
Given out as gifts/ dowry (%)	5.0	5.1	7.1	6.8	2.2	2.4	5.9	2.4	2.9
Stolen (%)	8.0	2.5	2.1	7.6	7.1	7.6	3.0	5.4	3.1

Table 2. Smallholder Livestock Status by Year

	Cattle					Goats					Pigs				
	2001	2004	2008	2012	2015	2001	2004	2008	2012	2015	2001	2004	2008	2012	2015
Opening stock	1,604,984	2,557,739	2,875,468	2,142,847	2,679,307	1,160,879	1,946,317	2,628,879	2,310,280	3,025,552	423,313	773,899	1,246,536	1,081,256	1,044,321
Closing stock	1,473,714	2,392,893	2,815,583	2,162,357	2,888,114	1,098,453	1,740,329	2,420,077	2,073,493	2,908,466	466,313	615,514	1,016,199	942,349	849,600
Number of Deaths	276,121	412,966	307,627	279,305	215,814	155,734	354,047	405,729	343,807	394,133	103,309	215,259	425,206	303,081	354,304
Number sold	87,389	100,949	179,455	113,669	159,259	179,941	407,401	590,037	449,565	246,125	103,342	234,162	276,675	274,544	93,860

The values in this table reflect the national smallholder livestock sector and are used to compute the demographic indicators presented in Figure 3. Opening and closing stocks are based on ownership and not raising questions.