DEVELOPMENT POTENTIAL OF SMALLHOLDER LIVESTOCK PRODUCTION SYSTEMS IN ZAMBIA

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EXECUTIVE SUMMARY

The continued increase in the demand for livestock products in Africa presents a development opportunity for smallholder livestock farmers. If this opportunity is harnessed well, it can contribute to rural poverty reduction. However, translating this opportunity into reality requires unlocking smallholder farmers' productivity potential, considering that livestock performs numerous functions beyond just serving as an income source. To support this development opportunity for smallholder livestock farmers, it is essential to enable a large share of small-scale farmers to engage in livestock farming and increase the productivity of smallholder livestock farming systems in an equitable and environmentally sustainable way. Taking Zambia as an example, this thesis aims to identify and analyze factors that have been obstacles to livestock development. Based on two rounds of panel data collected from smallholder farm households in Zambia, it was observed that the share of farmers who keep cattle is limited and that farmers move in and out of cattle production, despite the many benefits that livestock offers. Therefore, there is a need to identify what enables and disables farmers to keep livestock. There is also a need to identify the driving factors of livestock herd growth since small herd size is one factor that prevents farmers from participating in the market for livestock products. To better understand how livestock production systems can be developed equitably, it is also necessary to understand the gender dimensions of livestock farming to ensure that women will not be left out of the growth process. Moreover, to be able to support livestock production effectively, it is also essential to identify the governance challenges that are likely to occur in the implementation of livestock development interventions.

Against this backdrop, the thesis's overall goal was to identify options to promote sustainable livestock production systems. The thesis focused on cattle, which is the most valuable large asset among smallholder farmers in Zambia. The thesis had four specific objectives, which are addressed in separate chapters: (i) To unravel the mystery of moving in and out of cattle keeping; (ii) to identify the factors determining the livestock herd size among smallholder farmers in Zambia; (iii) to understand the gender dimensions in cattle production; and (iv) To uncover the governance challenges of implementing the vaccination campaigns in Zambia

To achieve these objectives, a mixed-method research approach was used, involving both quantitative and qualitative methods. The quantitative analysis was based on an existing household survey data set, which is representative at the national level. Various econometric techniques were applied, including probit, correlated random effect, and zero-one inflated beta regressions. For the qualitative component of the study, a combination of empirical data collection methods was applied, which included focus group discussions, individual household in-depth interviews, key informant interviews, and a participatory mapping method called Process-Net-Map. Analytical methods for the qualitative component of the study included content analysis as well as causal narratives.

The analysis showed that moving in or out of cattle production is influenced by human population growth, climatic variability, livestock population density, male household labor availability, and institutional support. The findings indicate that household-level factors and regional factors and their interaction influence households' ability to take up cattle production and continue this activity over time. One can derive from this analysis that regional incentives, such as an increase in the demand for draft power, are important to encourage cattle production, but household level challenges, such as labor availability, need to be addressed, as well.

The analysis also indicated that loss of cattle due to death, rather than cattle sales, was a major reason for the reduction in herd size. Mortality rates were found to be responsive to animal health interventions, which underlines the need for effective animal health services as a precondition for improved productivity in livestock production. The analysis also showed that farmers mainly increased their herd size by keeping the off-spring of their herd rather than by buying animals. Low conception rates due to limited feed resources during the dry season were identified as a major obstacle to a faster increase in herd size. Farmers who were able to enter into cattle production typically used their income from crop farming to acquire the first stock. This finding indicates that, in the absence of well-functioning rural financial markets, smallholders who cannot generate a surplus from crop farming will not be able to move into cattle production.

The analysis also threw light on the factors that enable women to own cattle. These factors included financial independence and the accumulation of other assets. Women were also more likely to own cattle in households with larger herd sizes. Perceived intra-household conflicts were identified as an obstacle to female cattle ownership.

Considering the important role of livestock support programs, an in-depth analysis of a program was carried out that supported livestock vaccination campaigns. The Process Net-Map method served to identify the governance challenges faced by the program. The findings established that the complexity of the procurement procedure, the limited capacity of the central actors, and a lack of urgency from influential actors resulted in procurement delays, and a diversion of funds caused delays in the release of funds. Lack of influence by the farmers also contributed to the inefficiency of the implementation procedure. The findings are likely to be relevant for implementing other livestock development programs that involve the distribution of publicly procured inputs.

Overall, it was concluded that the problems identified in the thesis need to be addressed. Otherwise, smallholder livestock farmers will not be able to exploit the opportunity of rising demand for livestock products. A number of policy recommendations were derived from the findings. These include the provision of institutional and technical support for the intensification of smallholder cattle production, strategies to bridge the gender gap in cattle production in a way that does not result in household conflicts; and innovative approaches to improve the efficiency in the implementation of livestock development programs.

ZUSAMMENFASSUNG

Der anhaltende Anstieg der Nachfrage nach Tierprodukten in Afrika bietet Kleinbauern eine Entwicklungsmöglichkeit. Wenn diese Gelegenheit gut genutzt wird, kann sie zur Verringerung der ländlichen Armut beitragen. Um diese Chance in die Realität umzusetzen, muss jedoch das Produktivitätspotenzial der Kleinbauern freigesetzt werden, wobei zu berücksichtigen ist, dass das Vieh zahlreiche Funktionen erfüllt, die über die reine Einkommensquelle hinausgehen. Um diese Entwicklungschance für Kleinbauern unterstützen zu können, ist es unerlässlich, einen großen Teil der Kleinbauern in die Lage zu versetzen, Viehzucht zu betreiben und die Produktivität von Kleinbauern auf gender-gerechte und umweltverträgliche Weise zu steigern. Am Beispiel Sambias sollen in dieser Arbeit Faktoren identifiziert und analysiert werden, welche die Entwicklung des Viehaltungssektores behindern. Basierend auf der Analyse von zwei Runden einer Paneldatenerhebung unter Kleinbauernhaushalten in Sambia, wurde festgestellt, dass der Anteil der Landwirte, die Rinder halten, begrenzt ist und die Landwirte trotz der vielen Vorteile, die das Vieh bietet, regelmäßig aus der Rinderproduktion aus- und einsteigen. Daher muss ermittelt werden, was Landwirte in die Lage versetzt oder behindert, Nutztiere zu halten. Die treibenden Faktoren für das Herdenwachstum müssen ebenfalls ermittelt werden, da eine geringe Herdengröße einen der Faktoren darstellt, die die Landwirte davon abhalten, am Markt für tierische Erzeugnisse teilzunehmen. Um besser zu verstehen, wie Tierproduktionssysteme auf gerechte Weise entwickelt werden können, ist es auch erforderlich, die geschlechtsspezifischen Dimensionen der Tierhaltung zu kennen, um sicherzustellen, dass Frauen nicht vom Wachstumsprozess ausgeschlossen werden. Um die Tierproduktion effektiv unterstützen zu können, ist es außerdem unerlässlich, die Governance-Herausforderungen zu ermitteln, die bei der Umsetzung von Maßnahmen zur Weiterentwicklung der Tierproduktion zu erwarten sind.

Vor diesem Hintergrund bestand das übergeordnete Ziel der Arbeit darin, Optionen zu identifizieren, die nachhaltige Tierhaltungssysteme fördern. Die Dissertation konzentrierte sich auf Rinder, die eines der wertvollsten Anlagegüter unter Kleinbauern in Sambia sind. Die Dissertation hatte vier spezifische Ziele, die in separaten Kapiteln behandelt werden: (i) das Rätsel des Ein- und Austiegs aus der Viehhaltung zu lösen; ii) die Faktoren, die die Tierbestandsgröße der Kleinbauern in Sambia bestimmen zu ermitteln; (iii) die geschlechtsspezifischen Dimensionen bei der Rinderproduktion zu verstehen; und (iv) die Governance-Herausforderungen bei der Durchführung von Impfkampagnen in Sambia aufzudecken.

Um diese Ziele zu erreichen, wurde ein Forschungsansatz mit gemischten Methoden verwendet, der sowohl quantitative als auch qualitative Methoden umfasste. Die quantitative Analyse basierte auf vorhandenen Daten einer national respräsentativen Haushaltserhebung. Verschiedene ökonometrische Techniken wurden angewendet, einschließlich probit, correlated random effects and zero-one inflated beta-regressions. Für die qualitative Komponente der Studie wurde eine Kombination empirischer Datenerhebungsmethoden angewendet, die Fokusgruppendiskussionen, Tiefeninterviews mit Haushalten, Key Informat Interviews und sogenannten partizipative „Process-Net-Maps“ umfasste. Zu den Analysemethoden für die qualitative Komponente der Studie gehörten die Inhaltsanalyse (Content Analyse) sowie kausale Narrative (Causal Narratives).

Die Analyse ergab, dass der Ein- und Austieg in die Rinderproduktion durch das Bevölkerungswachstum, die klimatische Variabilität, die Tierdichte die Verfügbarkeit von männlicher Arbeitskraft und die institutionelle Unterstützung beeinflusst wird. Die Ergebnisse zeigen, dass Faktoren auf Haushaltsebene sowie regionale Faktoren und deren Wechselwirkungen die Fähigkeit der Haushalte beeinflussen, die Rinderproduktion

aufzunehmen und diese Aktivität im Laufe der Zeit fortzusetzen. Aus dieser Analyse lässt sich ableiten, dass regionale Anreize, wie z. B. eine Erhöhung des Bedarfs an tierischer Anspannung, wichtig sind, um die Viehproduktion zu fördern, aber auch Herausforderungen auf Haushaltsebene, wie z. B. die Verfügbarkeit von Arbeitskräften, müssen angegangen werden.

Die Analyse ergab auch, dass der Verlust von Rindern aufgrund des Todes und nicht der Verkauf von Rindern ein Hauptgrund für die Verringerung der Herdengröße war. Es wurde festgestellt, dass die Sterblichkeitsraten von Tiergesundheitsmaßnahmen abhängen, was die Notwendigkeit wirksamer Tiergesundheitsdienste als Voraussetzung für eine verbesserte Produktivität in der Tierproduktion unterstreicht. Die Analyse ergab auch, dass die Landwirte ihre Herde hauptsächlich dadurch vergrößerten, dass sie die Nachkommen ihrer Herde behielten, anstatt Tiere zu kaufen. Niedrige Empfängnisraten aufgrund begrenzter Futterressourcen während der Trockenzeit wurden als Haupthindernis für eine schnellere Zunahme der Herdengröße identifiziert. Landwirte, die in der Lage waren, Vieh zu produzieren, verwendeten ihr Einkommen aus dem Ackerbau normalerweise, um den ersten Bestand zu erwerben. Dieser Befund deutet darauf hin, dass Kleinbauern, die keinen Überschuss aus dem Ackerbau erwirtschaften können, mangels gut funktionierender ländlicher Finanzmärkte nicht in die Viehzucht einsteigen können.

Die Analyse beleuchtete auch die Faktoren, die es Frauen ermöglichen, Rinder zu besitzen. Zu diesen Faktoren gehörten die finanzielle Unabhängigkeit und die Akkumulation anderer Vermögenswerte. Frauen besaßen mit größerer Wahrscheinlichkeit auch Rinder in Haushalten mit größerer Herde. Wahrgenommene haushaltsinterne Konflikte wurden als Hindernis für den Besitz von Rindern durch Frauen identifiziert.

In Anbetracht der wichtigen Rolle von Viehprudktionsförderprogrammen wurde eine eingehende Analyse eines Programms durchgeführt, das Viehimpfkampagnen unterstützte. Die Process Net-Map-Methode diente dazu, die Governance-Herausforderungen des Programms zu identifizieren. Die Ergebnisse zeigten, dass die Komplexität des Beschaffungsverfahrens, die begrenzte Kapazität der zentralen Akteure und das mangelnde Prioritätsempfingen einflussreicher Akteure zu Verzögerungen bei der Beschaffung und eine Umleitung der Mittel zu Verzögerungen bei der Mittelfreigabe führten. Die mangelnde Einflussnahme der Landwirte trug ebenfalls zur Ineffizienz des Umsetzungsverfahrens bei. Die Ergebnisse dürften für die Durchführung anderer Programme zur Entwicklung des Viehbestands relevant sein, bei denen öffentlich beschaffte Betriebsmittel verteilt werden.

Insgesamt wurde der Schluss gezogen, dass die in der Arbeit identifizierten Probleme angegangen werden müssen. Andernfalls können Kleinbauern die Chance einer steigenden Nachfrage nach tierischen Erzeugnissen nicht nutzen. Aus den Ergebnissen wurde eine Reihe politischer Empfehlungen abgeleitet. Dazu gehört die Bereitstellung institutioneller und technischer Unterstützung für die Intensivierung der kleinbäuerlichen Rinderproduktion; Strategien zur Verringerung der geschlechtsspezifischen Kluft in der Viehzucht auf eine Weise, die nicht zu Haushaltskonflikten führt; und innovative Ansätze zur Verbesserung der Effizienz bei der Durchführung von Entwicklungsprogrammen im Viehhaltungsbereich.

LIST OF ACRONYMS

ADP:	Animal Draft Power
AU-IBAR:	African Union - Inter-African Bureau for Animal Resources
BVI:	Botswana Veterinary Institute
CAADP:	Comprehensive Africa Agriculture Development Program
CBAHW:	Community-Based Animal Health Workers
CBPP:	Contagious Bovine Pleural Pneumonia
CSO:	Central Statistical Office
CTTBD:	Centre for Ticks and Tick-Borne Diseases
DAAD:	Germany Academy Exchange Service
ECF:	East Coast Fever
FAO:	Food and Agricultural Organization
FGD:	Focus Group Discussion
FMD:	Foot and Mouth Disease
FSRP:	Food Security Research Project
GAAP:	Gender, Assets, and Agricultural Programs
GDP:	Gross Domestic Production
Ha:	Hectare
HH:	Household
IAPRI:	Indaba Agricultural Policy Research Institute
IFAD:	International Fund for Agricultural Development
Kg:	Kilogram
LDAHP:	Livestock Development Animal Health Project
MAL:	Ministry of Agriculture and Livestock
MoA:	Ministry of Agriculture
NGO:	Non Governmental Organization
OIE:	World Organization for Animal Health
OLS:	Ordinary Least Squares
PCRE:	Pooled Correlated Random Effect
PS:	Permanent Secretary
PSU:	Procurement and Supplies Unit
RALS:	Rural Agricultural Livelihood Survey
SS:	Supplemental Survey
TLU:	Tropical Livestock Unit
UNZA:	University of Zambia
USD:	United States Dollar
ZMK:	Zambian Kwacha
ZOIB:	Zero-One Inflated Beta

1.0 INTRODUCTION

1.1. Motivation

In recent years, the developing countries have witnessed a structural transformation of the agri-food systems due to the changes in the demographic and social-economic landscape. The first manifestation of the growing human population, urbanization coupled with the sustained increase in incomes, is the increase in demand for high-value agricultural products, especially of animal origin (Reardon et al., 2014; Schneider, 2013; Muhammad et al., 2011; Rae and Nayga, 2010; Seale et al., 2003; Delgado, 2003). The most significant growth in demand for livestock products is in Africa, and this growth is expected to continue rising in the near future (Table 1.1). In Africa, the projected estimates presented in Table 1.1 show that meat consumption will increase to 34.8 million tons by 2050 from 10.5 million tons in 2005/07, resulting in a nearly 3% annual growth rate. Equally, milk consumption is projected to grow by 2.3% per annum.

Table 1.1. Estimated and projected size of meat markets in major world regions

Estimated consumption 2005/07, million tonnes		Growth, million tonnes		Estimated consumption million tonnes	Annual growth rate
		2005/07–2030	2030–50	2050	2005/07–2050
Developed	108.1	16.8	6.6	131.5	0.4%
Africa	10.5	10.3	13.9	34.8	2.8%
Near East	7.1	7.0	6.1	20.2	2.4%
Latin America	33.9	17.0	9.7	60.6	1.3%
South Asia	6.7	12.8	21.0	40.4	4.1%
East Southeast Asia	86.6	50.8	22.8	160.3	1.4%

Source: Pica-Ciamarra et al., 2014, p 7

Meeting this demand is an assumed development opportunity for smallholder farmers. However, literature and policy debate cast both hopes and fears of linking smallholder farmers to this growth process. On the one hand, there is fear that smallholder livestock producers will be excluded from the growth process, as posit by Gerber et al. (2010). For example, in China and India, where large-scale industrial livestock production has rapidly grown, present evidence of smallholder farmers' exclusion from the sector's growth. On the other hand, smallholder livestock producers will continue to be prominent in the rural areas, and they tend to have a comparative advantage in ruminant production systems because of the availability of family labor, and ruminants have the potential to exploit feed resources of lower quality (McDermott et al., 2010). Therefore, the development opportunity, particularly for the Sub Saharan African smallholder farmers, remains high.

If this opportunity is harnessed well, it can serve as a vehicle for rural poverty reduction, given that about 60% of the rural households in Africa derive at least part of their livelihood from livestock (FAO, 2009). Additionally, the assumed opportunity can reduce the livestock import bill provided that local supply sustains the growing demand. Reduced imports, coupled with increased productivity, can translate into a series of positive ripple effects such as lower food prices, a clear benefit for families that buy animal protein. It can also stimulate the development and growth of other value chain stages, thus generating employment. However, translating this opportunity into reality depends mainly on unlocking smallholder farmers' productivity potential in Africa.

The ability to address this question depends on the profitability and performance of the production systems. However, a sizeable proportion of smallholder farmers are not commercially oriented. Beyond merely as an income source, their livestock performs numerous functions such as the provision of manure and animal draft power (Devendra and Thomas, 2002; Houssou et al., 2013). Livestock also acts as security against contingencies, gives social status (leadership) and, cements relationships through bride price payments (Thys et al., 2005; Ouma et al., 2003; Bennison et al., 1997). Another benefit of livestock is its contribution to household food nutrition and security through the consumption of meat and meat products (Randolph et al., 2007; Smith et al., 2013). Therefore, in the face of the assumed productivity potential and the many benefits that livestock offers to smallholder livelihoods, the debates throughout Africa revolve around the creation of a sustainable livestock sector through improved production, increased competitiveness, and market access (Steinfeld et al., 2013; McDermott et al., 2010; AU-IBAR, 2015).

Despite the many benefits that livestock offers, we observed the phenomena of moving in and out of cattle production based on the two rounds of panel data set that was collected from 7 254 smallholder farm households. Therefore, if we are to promote a sustainable livestock production system, we first need to identify what enables and disables farmers to keep livestock and the context under which these factors are likely to occur. It is also essential to establish the kind of interrelationship that exists among different factors and how they are likely to contribute to the development of sustainable production systems. Second, we need to identify the livestock herd growth's driving factors since several studies have concluded that small herd size is one of the factors limiting commercialization (Lubungu et al., 2015, Lubungu 2016, Sikhweni and Hassan, 2014). Therefore, understating what it takes to build and maintain a healthy herd size is critical in ensuring that smallholder farmers take full advantage of the growing demand.

Third, to better understand these production systems, gender is also important as women, in many instances, tend to be left out from the growth process. Studies have shown that fewer women own livestock in many developing countries. For example, in Nicaragua, only 13.5% of women own cattle (Deere et al., 2012). They also own only a smaller fraction of livestock. In Zambia, for instance, women own about 20% of the national cattle population (Lubungu and Mofya-Mukuka, 2012). In order to identify specific strategies that will enhance female participation in livestock production and safeguarding their livestock, it is essential to have a clear understanding of the gender dimension in livestock production.

Lastly, the outbreak of livestock diseases in Sub-Saharan African countries is the most critical challenge affecting the development potential of the livestock sector (Perry and Randolph, 2003; Vosloo et al., 2002). Though vaccination campaigns are one of the most important strategies to deal with this challenge, such campaigns are diffcult to implement in reality because schedules are rarely followed. Therefore, it is important to identify the problems that occur when implementing such interventions for the betterment of the sector.

1.2. Justification of the thesis

Addressing this knowledge gap is essential since there is a renewed interest in developing the livestock sector (AU-IBAR, 2015). First of all, knowing why farmers move in or out of livestock production can help identify policy levers that could deal with the problems stymieing the development of sustainable smallholder livestock production systems. Second, it is vital to estimate the livestock production parameters because they reflect the herd structures' stability. Understanding the past trends associated with population growth can help identify problems stifling the smallholder livestock sector's development and potential solutions to guide future investments that would address the bottlenecks.

Furthermore, understanding the gender dimensions in livestock production is relevant for the development programs that tend to focus on women as the results have implications for program design. Lastly, identifying the governance challenges in the implementation of vaccination campaigns helps to identify where to direct reform efforts that would improve the implementation of future programs of this nature. Improvement in governance is likely to attract more aid for further strengthening the provision of veterinary services as per the World Organization for Animal Health (OIE) solidarity principles (Msellati et al., 2012).

1.3. Objectives of the thesis

The overall goal of this thesis was to identify options that would promote sustainable livestock production systems. The thesis focused on cattle, which is the most valuable large asset among smallholder farmers in Zambia. The thesis used a case of Zambia to address the four specific objectives, which constitute a separate empirical chapter of the thesis.

i) To unravel the mystery of moving in and out of cattle keeping
ii) To identify the factors determining the livestock herd size among smallholder farmers in Zambia
iii) To understand the gender dimensions in cattle production
iv) To uncover the governance challenges of implementing the vaccination campaigns in Zambia

Given that each of the four objectives forms a standalone chapter, they also had specific objectives or research questions.

To unravel the mystery of moving in and out of cattle keeping, the following three objectives were addressed

i) To determine whether the households moving in differ systemically from those that move out.
ii) To explore and describe the contextual factors that lead farmers to move in and out of keeping cattle
iii) To develop a process theory that describes and explains the moving in and out of the smallholder cattle production.

Determining the factors affecting the livestock herd size among smallholder farmers addressed the following objectives

i) To examine the factors driving the inflows and outflows of livestock herd.
ii) To identify the factors that explain the changes in the estimated livestock demographics indicators (mortality, growth, and offtake rates)

The following addressed the gender dimensions in cattle production

i) To identify the pathways through which female household members acquire cattle and define cattle ownership from a gender perspective.
ii) To determine the factors associated with the proportion of cattle owned by female household members; and
iii) To determine if the share of cattle owned by female household members is correlated with cattle herd productivity and female empowerment.

To uncover the governance challenges of implementing the vaccination campaigns in Zambia, the following research questions were addressed

i) What is the exact implementation mechanisms of vaccination campaigns?
ii) What type of stakeholders, including government officials, donor agencies, and companies, are involved in the implementation process?
iii) How are the farmers involved in the implementation process?
iv) What incentive and capacity problems lead to the observed governance challenges?

1.4. Study context

1.4.1. Overview of the livestock sector in Zambia

Livestock is an important sector in the Zambian economy, as evidenced by its contribution at the national and household levels. It contributes about 3.2% to Zambia's national gross domestic production (GDP) and over 30% to the agricultural GDP (MAL et al., 2011). The sector also supports over 80% of smallholder farmers' livelihood, and its contribution to household income can be as high as 30%, depending on the livestock species and production area (Lubungu and Mofya, 2012)[1]. In addition, livestock is one of the valuable productive assets, and on average, it accounts for about 20% of the smallholder productive assets whose relative importance varies from province to province. For instance, in the Eastern and Southern provinces, the livestock share of productive assets is as high as 40%. More importantly, livestock, in particular cattle, is a useful resource in the farming community as they provide animal draft power (ADP) and manure. In Zambia, over 70% of smallholder farmers who own cattle use ADP (Lubungu et al., 2015). Furthermore, livestock products significantly contribute to the animal protein in Zambians' diets (Hichaambwa, 2012).
With the current income and human population growth estimates, the demand growth for meat is expected to create a supply deficit of about 320,000 metric tons of meat with the existing investment in production (Figure 1.1). The supply deficit is equally eminent for milk production. Therefore, Zambia provides a suitable case of identifying strategies that can enable livestock owners to benefit from growth opportunities.

[1] The most important livestock owned by smallholder households include cattle, goats, pigs, chicken and to some extent sheep.

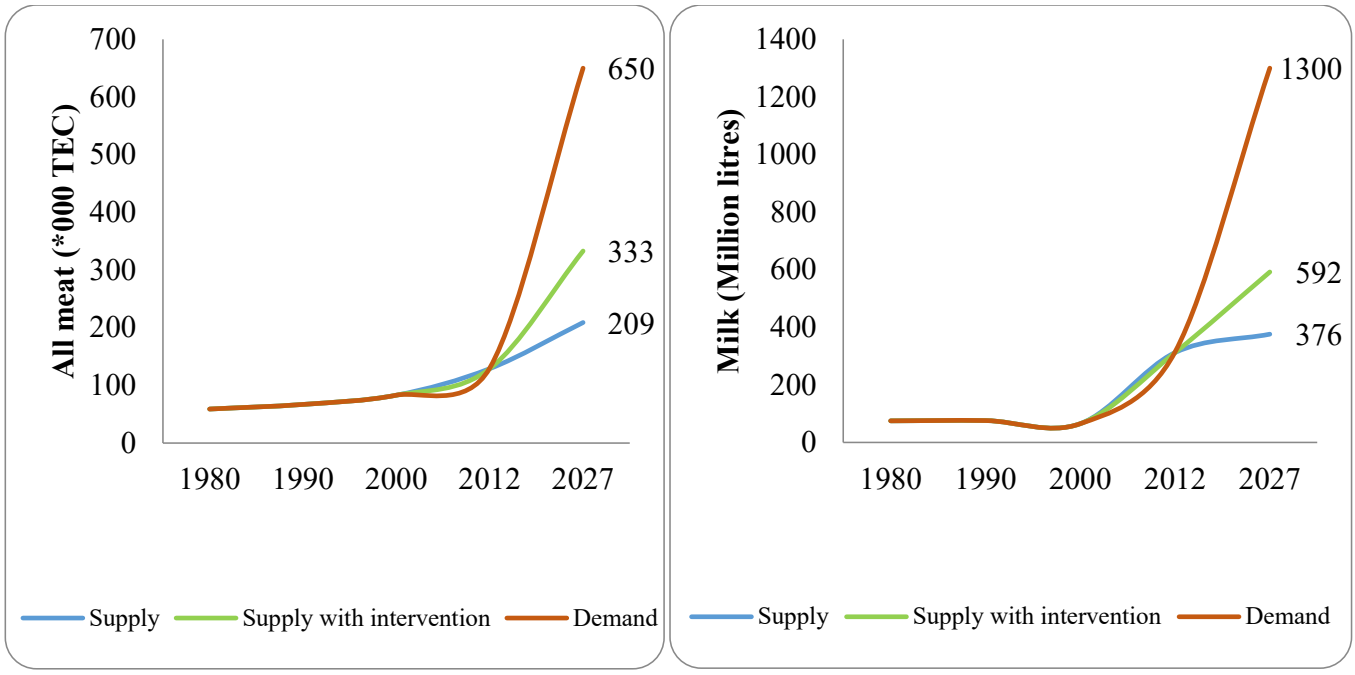

Figure 1.1. Projected meat and milk supply and demand

Source: MAL et al., 2012

1.4.2. Cattle production in Zambia

In Zambia, though both the commercial and smallholder farmers produce cattle, the smallholder farmers raise about 80% of the total population with a large share of the national herd located in Southern, Western, Eastern, and Central Provinces. However, most farmers own less than ten cattle, with only 10% of households owning more than 20 animals (Figure 1.2). The small herd sizes limit cattle commercialization, as shown in Figure 1.3.

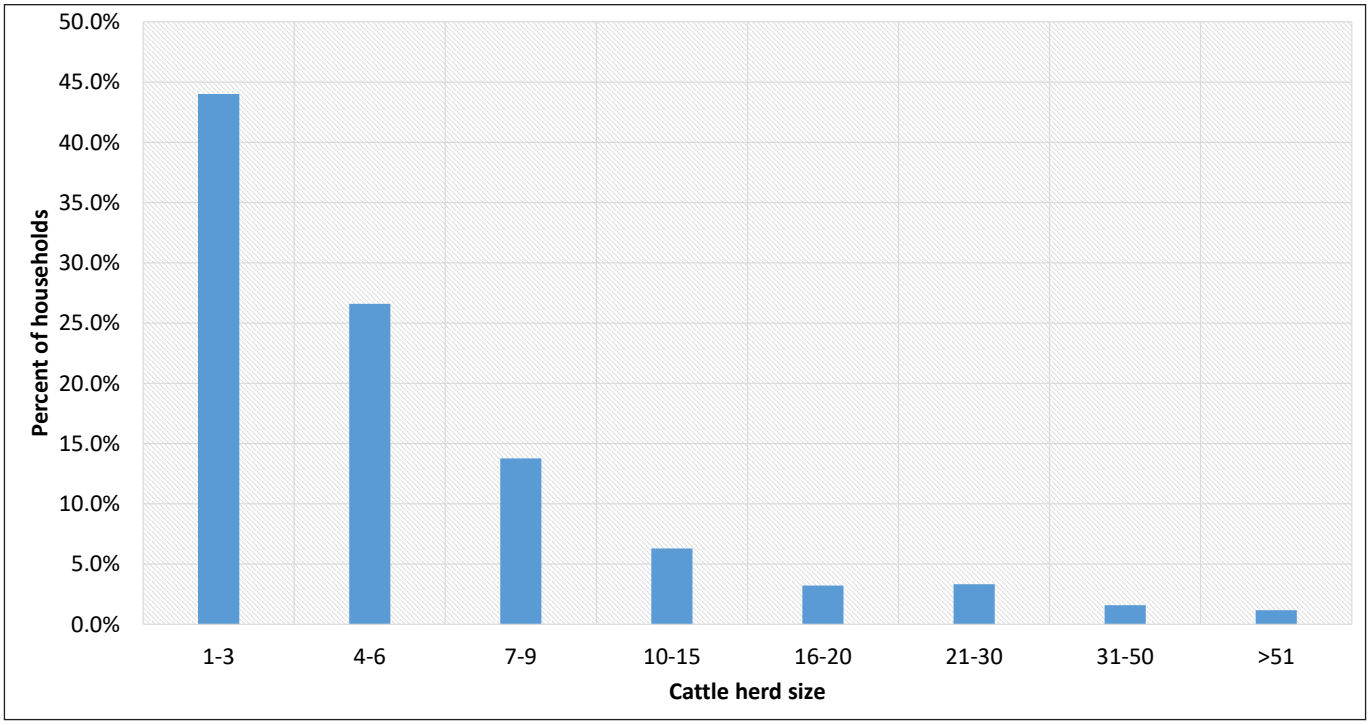

Figure 1.2 Cattle herd size among smallholder households raising cattle

Source: Lubungu and Mofya-Mukuka, 2012.

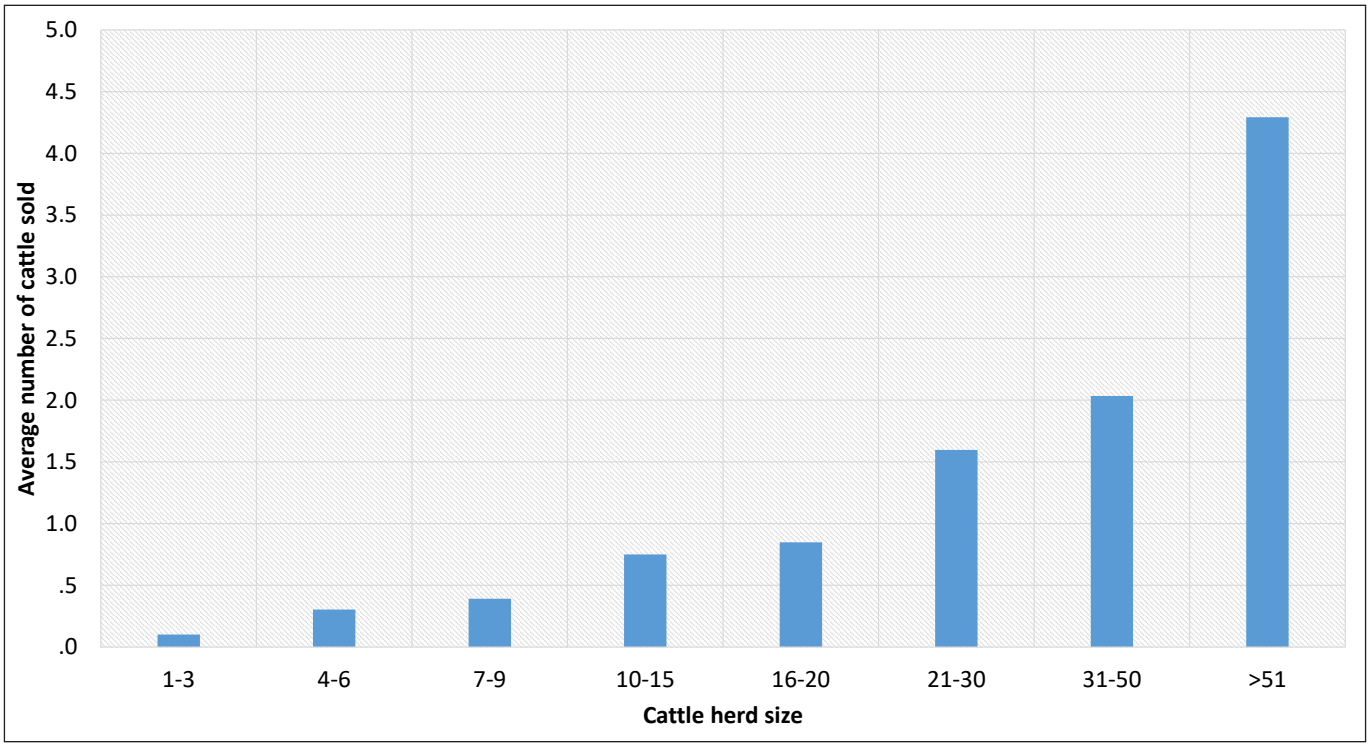

Figure 1.3. Herd size and cattle commercialization

Source: Lubungu et al., 2015

Women's participation in cattle production is very low. In general, Chapoto and Zulu-Mbata (2016) found a higher proportion of male-headed households owning cattle compared to female-headed households. Even regarding the average number of cattle owned, they found that male-headed households on average had more cattle than female-headed households. The disaggregated results based on the gendered household type, as shown by Machina and Lubungu (2018), revealed that the proportion of households owning cattle is least among the households with only female adults suggesting higher gender gaps.

One of the constraining factors affecting sustainable cattle production systems is the outbreak of disease. In Zambia, more than 60% of smallholder cattle owners have their cattle affected by diseases (Lubungu and Mofya-Mukuka, 2012). Even though all the major cattle-producing regions are affected by outbreaks, as shown in Figure 1.4, Lubungu et al. (2015) found that the type and severity of disease outbreaks are regionally specific. For example, they found that FMD and Corridor are prevalent in Southern Province, while anthrax is a significant disease in Western Province. However, the livestock development policy stipulates that the government's mandate is to support the control of diseases that are of national economic importance, such as FMD and CBPP. These are diseases of an epidemic nature and have transboundary significance. Transboundary diseases are epidemic diseases that are highly contagious and spread rapidly irrespective of national borders. They can also have a negative impact on the socio-economic of farmers and possibly have severe repercussions for public health. However, interventions to address the disease burden are often confronted with governance challenges.

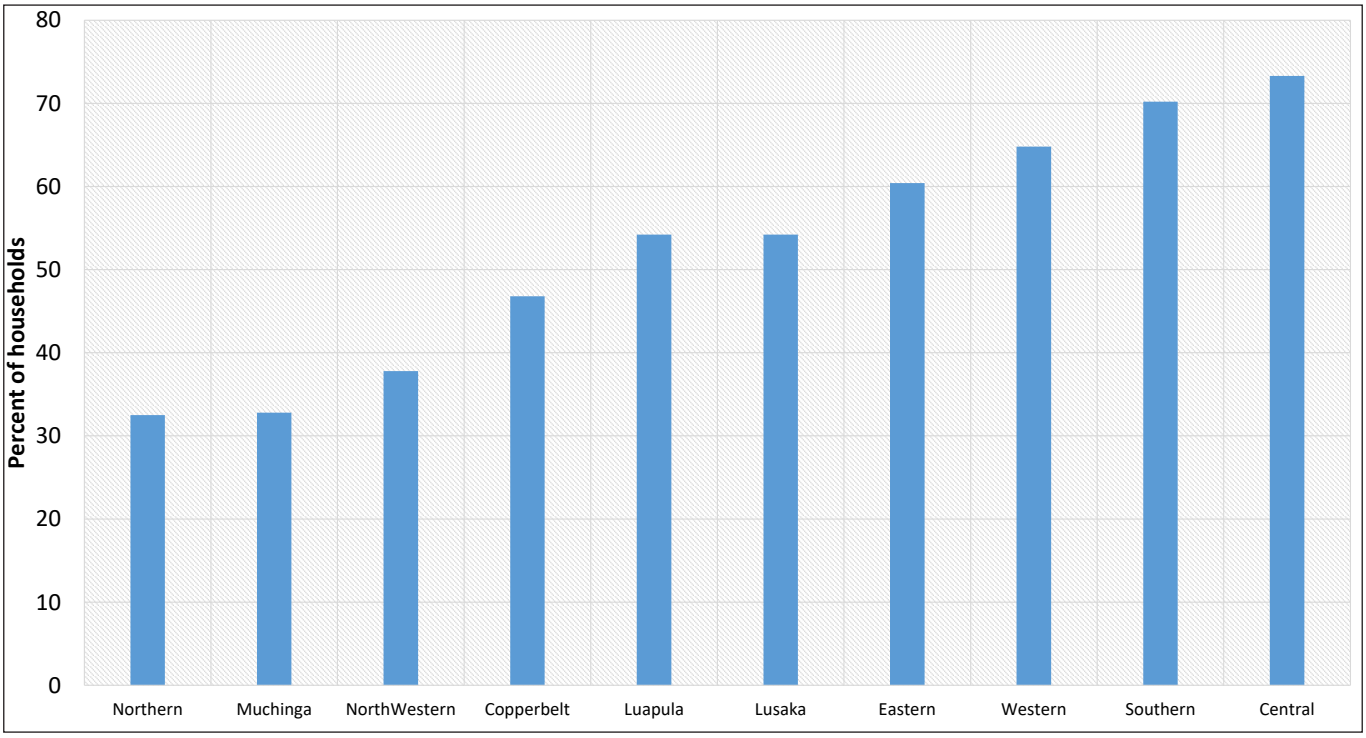

Figure 1.4. Geographical distribution of households reporting cattle diseases

Source: Lubungu et al., 2015

1.5. Materials and methods

A mixed methods research approach involving qualitative and quantitative techniques were employed in this thesis. A combination of different data collection methods that include focus group discussions (FGD), individual household in-depth interviews, key informant interviews, and process-net maps were used. In addition, rich household national data sets were used. The rest of this section highlights the methods that were used to address each objective

Objective 1- To unravel the mystery of moving in and out of cattle keeping

For the first objective, the national representative panel Rural Agricultural Livelihood Survey (RALS) data collected in 2012 and 2015 was used. The survey included 7, 254-panel households. The surveys covered the 2010/11 and 2013/14 agricultural production seasons and 2011/12 and 2014/15 agricultural marketing seasons. Information about households' income, cropping patterns, landholdings, livestock production, and ownership of other assets was collected. Additionally, data on socio-demographic information on all household members were captured. The Central Statistical Office (CSO), together with the Indaba Agricultural Policy Research Institute (IAPRI) and the Ministry of Agriculture and Livestock (MAL), implemented the surveys. For more details on the sampling techniques, see IAPRI 2015 survey report (Chapoto and Zulu-Mbata, 2016). Based on these two rounds of data set, we observed the phenomena of moving in and out of cattle production, and we analyzed this phenomenon statistically using a probit model. In addition, the study adopted a qualitative, grounded theory approach (see Glaser and Strauss, 1967; Glaser, 1965; Strauss and Corbin, 1990). The qualitative data collection was conducted in six districts of Zambia, namely: Chipata and Petauke in Eastern province; Chibombo in Central province; Mbala in Northern province; and Kalomo and Namwala in Southern province. The districts were selected based on

the proportion of households with at least more than 15% of households who either moved in or out of cattle production. The data were collected between August and November 2016. In each district, we selected four households for the individual in-depth interviews. Theoretical sampling was employed in the selection of additional participants after the concepts began to emerge.

A historical timeline method was used to collect information from individual households. The timeline of livestock involved a discussion of how households acquired their initial stock of cattle and the significant events related to the increase or decrease of the herd size from the initial stock till the time of the interviews. To increase the data's validity, the critical issues and concerns raised during individual household interviews were further explored through a total of 12 Focus Group Discussions (FGD), each comprising between five and ten farmers. Separate discussions were held with six men's groups and six women's groups as part of triangulation. In addition, key informant interviews were conducted with six traditional leaders and the six district-level officials of the Ministry of Fisheries and Livestock to validate the data collected during FGDs. The interviews were either conducted in English or the local Zambian language, and each interview took about 60 to 120 minutes.

The analysis of the qualitative data occurred concurrently with data collection. The emerging data were examined according to an iterative process that served both to inform the next interviews and establish concepts for subsequent analysis. In order to establish causal links among different categories and make the conceptual linkages more specific, we employed a causal narrative approach. This technique is a sequential analysis of events and the causal processes that connect them from a set of initial conditions to the outcome in question.

Objective 2-To identify the factors determining the livestock herd size among smallholder farmers in Zambia

Different data sets drawn from five nationally representative surveys conducted by IAPRI, together with the Zambia CSO and the MoA in Zambia, were used to address this objective. The surveys included three supplemental surveys (SS) carried out in 2001, 2004, and 2008, and two RALS implemented in 2012 and 2015. The SS—2001, 2004, and 2008 covered 6,922, 5,420, and 8,094 rural households in survey years, respectively, while the 2012 and 2015 RALS covered 8,840 and 7,934 farm households, respectively. For more details on the sampling techniques, the reader is referred to see Megill (2004 and 2009) for SS and Chapoto and Zulu-Mbata (2016) for RALS. Using these rich datasets, the livestock demographic parameters (annual population growth rate, annual mortality rate, and commercial offtake rates) were computed.

The study also collected qualitative data through five FGDs with farmers in five districts, namely, Chibombo, Mbala, Petauke, Kalomo, and Namwala, to inform the discussion. Each FGD included about 5–8 livestock producers. Also, interviews with five personnel in the Ministry of Fisheries and Livestock were conducted to gather more information about the significant events that happened in the sector. This information helped in explaining the observed trends in estimated demographic parameters. The qualitative data were collected between September and December 2016.

Objective 3-To understand the gender dimensions in cattle production

To achieve this objective, a mixed methods research approach was used. Qualitative data were collected in eight districts of Zambia. The percentage of households keeping cattle guided the selection of the districts. In each area, four households were selected using theoretical sampling for in-depth interviews on how female households member acquired cattle and their involvement in the management and control decisions. Insights from the individual interviews were cross-checked during the FGDs. Additional information was obtained from a chairperson of a women's club involved in livestock production and key informant interviews who included traditional leaders and veterinary officers. The interviews were carried out in October and November 2016. In each district, we spent at least a week-long visit.

The qualitative data were analyzed using content and causal narrative analysis. Content analysis was employed to interpret the meaning of qualitative data. For more insights about the method, the reader is referred to Hsieh et al. (2005). While the content analysis helped classify the data, the causal narrative analysis helped to understand the reasons behind the observations in the data.

To address the quantitative part of this objective, the national longitudinal representative RALS discussed earlier were used. In addition to the RALS data, we collected additional information on decision making and cattle-related activities from 271 households who participated in the 2015 RALS. This supplementary information was collected during a cattle household survey conducted in 2016 in Chibombo, Mbala, Kalomo, Namwala, and Petauke districts.

A zero-one inflated beta model was estimated to determine the factors associated with female cattle ownership. This approach allows the coefficients of exogenous variables to differ in their effect on whether or not the proportion of cattle owned is equal to 0 from whether or not the proportions lies between 0 and 1 and from whether the proportion is equal to 1. Pooled Correlated Random Effect (PCRE) approach was estimated to determine the correlation between female cattle ownership and herd productivity. The PCRE probit model was estimated to determine the association between female ownership and decision making, while PCRE was used to estimate the association between female cattle ownership and control of crop income.

Objective 4-To uncover the governance challenges of implementing the vaccination campaigns in Zambia

The study used a qualitative case study approach, which aims at contributing to a better understanding of where and why the governance challenges occur in the implementation of the livestock vaccination programs. The respondents were selected based on their extensive knowledge and experience with the vaccination program. Five professionals were selected using snowball sampling, and each was interviewed with the Process Net-Map.

Process Net-Map was used to map out the entire implementation process of the vaccination campaign of east coast fever (ECF), foot and mouth disease (FMD), and contagious bovine pleural pneumonia (CBPP) until the point where the vaccines were administered to the animal in a step-by-step procedure. The map was used to determine the perceived level of influence that each actor had on achieving the ultimate outcome (successful vaccination). Lastly, the Process Net-Map with influence towers as a three-dimensional sketch was used to structure the qualitative discussion on the governance challenges. The focus was placed on

eliciting the main governance problems related to delays in the procurement and release of funds as well as other problems that arose during the implementation process.

In addition to the Process Net-Maps, the study used triangulation and crossed checked the Process Net-Map with other interviews. In-depth interviews with ten professionals prior to and after the Process Net-Map exercise was conducted. Additional information was also collected from five FGDs comprising 5 to 10 farmers with livestock farmers in five districts to gather information about the institutional challenges regarding animal health services. The entire data collection process was conducted in seven districts of Zambia between October 2016 and January 2017.

The study employed content analysis, an analytical approach used to interpret the meaning of the qualitative data. The critical feature of the content analysis is that the many words of the text are classified into much smaller content categories (Elo and Kyngäs, 2008). The content analysis was combined with the causal narrative analysis because the study also identified why the problems occurred.

1.6. Thesis organization

The rest of the thesis is organized as follows. Following this introductory chapter, Chapter 2 presents insights into the process governing smallholder farmers' moving into and out of cattle production using quantitative and qualitative data. Chapter 3 identifies the factors affecting the smallholder livestock herd size, while Chapter 4 analyses the gender dimension in smallholder cattle production. Chapter 5 presents an empirical case study of the governance challenges of implementation of the livestock vaccination campaigns. Finally, the last chapter presents a synthesis of the findings from the preceding four chapters and a general discussion of key findings. The chapter also presents the study limitations and ends with the overall conclusions and recommendations for promoting sustainable livestock production systems.

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2.0 THE MYSTERY OF MOVING IN AND OUT OF KEEPING CATTLE: A CASE STUDY FROM ZAMBIA

Mary Lubungu, and Regina Birner

Abstract

Despite cattle being a resourceful asset in mixed farming systems, a limited proportion of households keep cattle, and that some farmers tend to keep cattle in some years and not in other years. While the perceived benefits of raising cattle can push farmers into cattle production as per rational choice theory, the conditions under which farmers acquire cattle are not well documented. On the other hand, though the challenges associated with cattle production can push farmers out of cattle keeping, the presence of these limiting factors can in themselves stimulate innovations, as argued in the induced innovation literature. Therefore, we add to these existing theories by looking at this particular case of moving in or out of cattle production, which has not been studied before. Specifically, we explore how the existing theories can explain the phenomenon and what additional elements we need to consider for the sustainable development of the smallholder livestock production system. We used a case of Zambian smallholder cattle farmers to study in detail and develop a theoretical framework that describes and explains the moving in and out of the smallholder cattle production. A mixed-method approach was employed to reveal the contextual factors and construct a theoretical research model that links these factors. The analysis showed that human population growth, climatic variability, livestock population density, household composition, and institutional support are the primary drivers affecting the farmers to move in or out of cattle production. The findings further revealed that household-level factors and regional factors and their interaction influence households' ability to take up cattle production and continue this activity over time. One can derive from this analysis that regional incentives, such as an increase in the demand for draft power, are important to encourage cattle production, but household level challenges, such as labor availability, need to be addressed, too. We also draw some recommendations that will contribute to the sustainable development of the cattle production system.

Keywords: Cattle production, contextual factors, grounded theory, Zambia

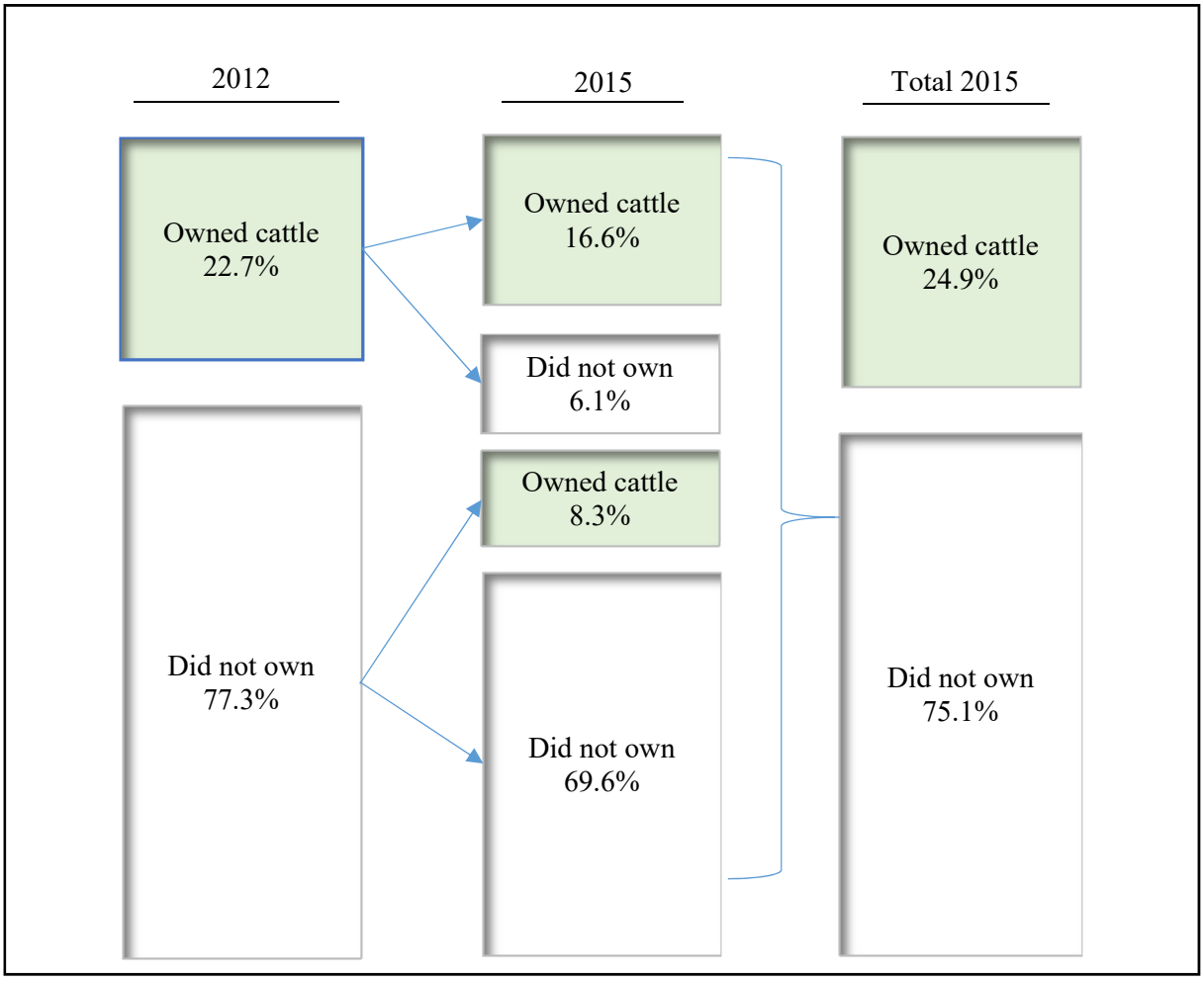
2.1. Introduction

Cattle will continue to serve as a resourceful asset in the smallholder mixed farming systems because of its perceived social and economic benefits. Apart from being a source of income, cattle is considered as a conventional means of demonstrating wealth, acts as security against contingencies, gives social status (leadership) and, cements relationships through bride price payments (Thys et al., 2005; Ouma et al., 2003; Bennison et al. 1997). Cattle contribute to household food nutrition and security through the consumption of meat and milk (Randolph et al., 2007; Smith et al., 2013) though smallholder farmers rarely slaughter such big animals unless for exceptional occasions such as ceremonies (Scoones, 1992; Dovie et al., 2006; Lubungu, 2017). Furthermore, cattle are particularly useful in the crop-livestock integrated farming system as the inputs from one enterprise are supplied to the other (Devendra and Thomas, 2002). While crop residues provide a relatively cheap source of animal feed, cattle are useful in the provision of draught power and manure. Animal draught power (ADP) is the most affordable source of power among smallholder farmers, especially in farming systems that are isolated from infrastructure and have a high land to human population ratio (Devendra and Thomas, 2002; Houssou et al., 2013). Animal traction is also suitable for

small fragmented and stumped farmland as animals can maneuver around trees, which tractors cannot (Binswanger and Pingali, 1988; Houssou et al., 2013). Moreover, it is relatively affordable for smallholder farmers to acquire animal-drawn implements than tractor-drawn implements.

Despite the many benefits of keeping cattle, we observed the phenomena of moving in and out of cattle production based on the two rounds of nationally representative panel data set that was collected from 7 254 smallholder farm households during the Zambia Rural Agricultural Livelihoods Survey (RALS). This pattern is reflected in Figure 2.1, and it shows the overall proportion of households owning cattle and those that transitioned into and out of cattle production between 2012 and 2015 survey years. Over this period, the proportion of smallholder cattle keepers increased by 2.2%, from 22.7% in 2012 to 24.9% in 2015. Despite the overall marginal increase, some households moved in and out of cattle production. For instance, of the 22.7% of smallholder households that owned cattle in 2012, 6.1% moved out by 2015.

On the other hand, of the 77.3% that did not keep cattle in 2012, 8.3% moved into cattle production by 2015. Over the three years, 69.9% of the smallholder households never owned cattle, while 16.6% consistently kept cattle. The remaining 14.4% of smallholder households moved in or out of cattle production. Based on these observations, we use a case of Zambian smallholder cattle farmers to study in detail and identify the factors that enable and disable farmers to keep cattle.



The analysis was based on the survey data of about 7,254-panel households. The details of the survey data are presented in section 2.2

Figure 2.1. Cattle ownership dynamics

Source: CSO/MAL/IAPRI's RALS 2012 and 2015 survey data, Author's computations

Several factors could explain the observed pattern shown in Figure 2.1. On the one hand, the rational household choice theory could explain why households would move in because individuals always choose an alternative that gives them maximum benefits. Therefore, a potential motivation for moving in could be related to the perceived benefits of keeping cattle highlighted earlier. On the other hand, farmers can move out due to the challenges associated with cattle production, such as outbreaks of diseases, lack of feed, scarcity of water, and theft (Solomon et al., 2007; Thys et al., 2005; Seifu, 2011; Amadou et al., 2012). However, the presence of these limiting factors can in themselves stimulate innovations, as argued in the induced innovation literature (see Hayami and Ruttan, 1970). Therefore, we add to these existing theories by looking at this particular case of moving in or out of cattle production, which has not been studied before. Specifically, we explore how the existing theories can explain the phenomenon and what additional elements we need to consider. Against this backdrop, the following are the objectives of the study.

1. To determine whether the households moving in differ systemically from those that move out and identify the factors that significantly associate with moving in or moving out of cattle production.
2. To explore and describe the contextual factors that lead farmers to move in and out of keeping cattle and how they are interrelated with each other.

Addressing this knowledge gap requires a comprehensive understanding of both current and historical perspectives of household cattle production. In this regard, simple hypothesis testing and conventional survey data are not sufficient and thus the need to complement the quantitative analysis with qualitative interpretative research methods. The study, therefore, lends itself to the application of a mixed-methods approach. For a qualitative part, we adopted the grounded theory approach as an ideal method of textual investigation to reveal the contextual factors and build a theoretical research model that links these factors (Glaser and Strauss, 1967). The details on how to implement this approach are presented in section 2.2.
It is essential to address this knowledge gap, especially that there is a renewed interest in developing the sustainable livestock sector as stipulated in the livestock development strategy for Africa 2015 to 2030, supported by the Comprehensive Africa Agriculture Development Program (CAADP). The study will help identify policy levers that could deal with the problems stifling the development of sustainable smallholder cattle production systems.

The rest of this paper is organized as follows. Section 2.2 describes the research approach, data collection, and analytical methods. The results are presented in section 2.3, while the proposed theoretical model is presented in section 2.4. The last section of the paper presents the main conclusions and recommendations.

2.2. Materials and methods

This section discusses the research approach (see 2.2.1.) and research design (see 2.2.2). We also present how the data were collected (see 2.2.3.) and the techniques employed to analyze the data (see 2.2.4.).

2.2.1. Research approach

The study employed a mixed-methods approach involving both quantitative and qualitative data. The quantitative methods were used to explore the household level data to examine the characteristics of the households moving in or out of cattle production and factors associated with moving in or out. The qualitative approach was used to investigate further the contextual elements that enable or disable farmers

to keep cattle and eventually build a theoretical model. The grounded theory approach, a highly systematic set of procedures used to develop substantive theories, was employed.

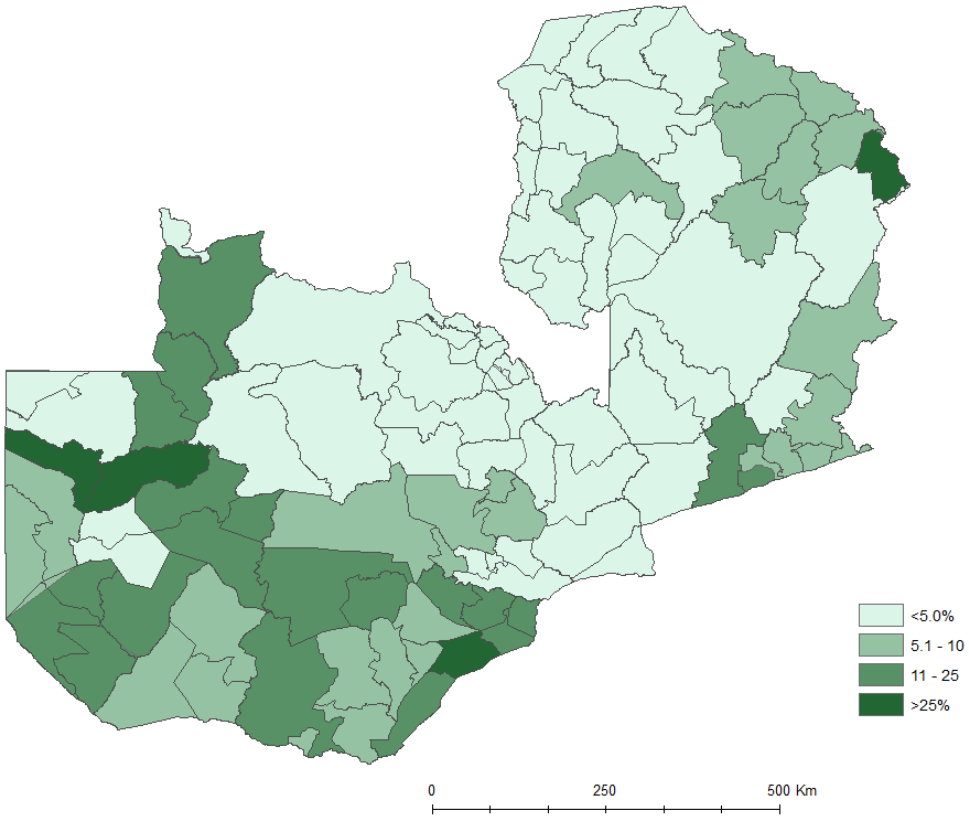
2.2.2. Research design

We first explored the national representative Rural Agricultural Livelihood Survey (RALS) conducted in 2012 and 2015. The survey covered 7,254-panel households in Zambia. The Central Statistical Office (CSO), together with the Indaba Agricultural Policy Research Institute (IAPRI) and the Ministry of Agricultural and Livestock (MAL), implemented the surveys. The 2012 survey covered 8,839 households, and only 7,254 households were successfully re-interviewed in 2015. The surveys covered the 2010/11 and 2013/14 agricultural production seasons and 2011/12 and 2014/15 agricultural marketing seasons. Information about households' income, cropping patterns, landholdings, livestock production, and ownership of other assets was collected. Additionally, data on socio-demographic information on all household members were captured. For more details on the sampling techniques, see IAPRI 2015 survey report (Chapoto and Zulu-Mbata, 2016). Based on these two rounds of data set, we observed the phenomena of moving in and out of cattle production presented in Figure 2.1, and we analyzed this phenomenon statistically.

In addition, to answer the second objective, we adopted a qualitative grounded theory approach (see Glaser and Strauss, 1967; Glaser, 1965; Strauss and Corbin, 1990). The qualitative data collection was conducted in six districts of Zambia, namely: Chipata and Petauke in Eastern province; Chibombo in Central province; Mbala in Muchinga province; and Kalomo and Namwala in Southern province. The districts were selected based on the proportion of households with at least more than 15% of households who either moved in or out of cattle production (Figure 2.2). The data were collected between August and November 2016.

To collect the qualitative data, we used a theoretical sampling whereby the insights from the previously collected data guided the subsequent data collection and choice of respondents (Glaser and Strauss, 1967; Cho and Lee, 2014). This constant comparative analysis is the central feature of the grounded theory approach (Charmaz, 2011). At the initial stage of data collection, we employed selective sampling. Households who participated in the 2012 and 2015 RALS and either moved in or out of cattle production formed the population of interest.

Moved out of cattle production in 2015



Moved into cattle production in 2015

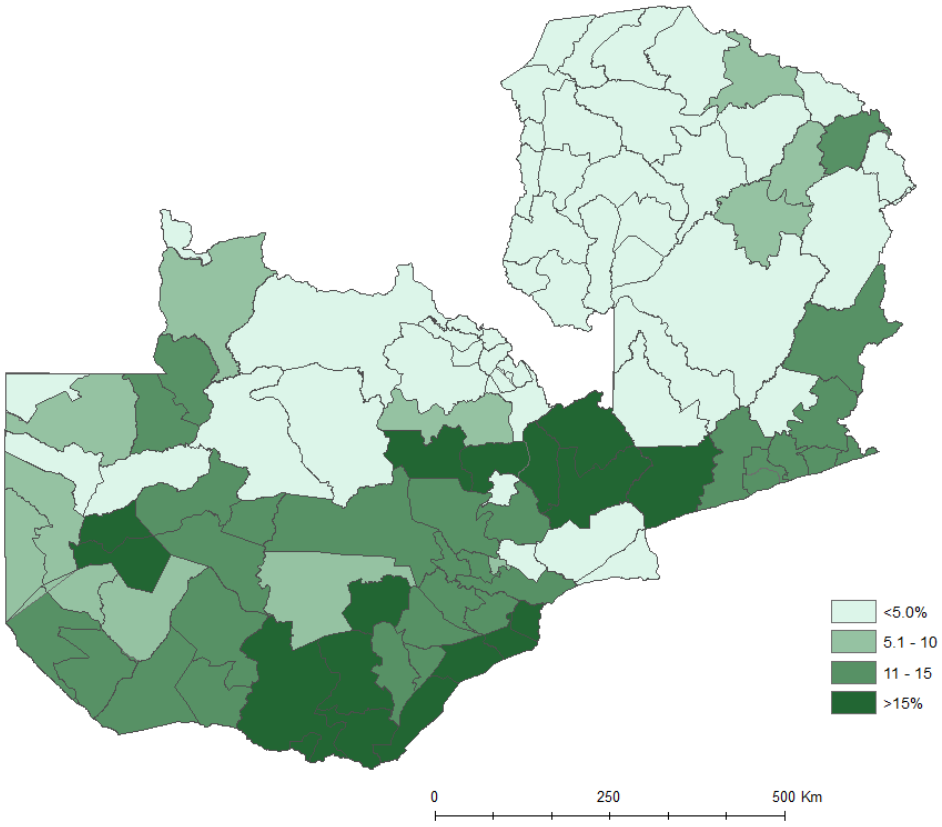


Figure 2.2. Geographic distribution of households that moved in or out of cattle production

Source: CSO/MAL/IAPRI's RALS 2012 and 2015 survey data, Author´s compilation

In each district, we selected four households for the individual in-depth interviews. In the first district, the four households were selected based on the proximity to the central district town. Two households were selected within a radius of 16kms, while the other two were within a radius of more than 30km. The first four households were part of the pilot interviews and aimed at identifying the key themes that favored moving in or out of cattle production. Later, we employed theoretical sampling in the selection of additional participants after the concepts began to emerge. The explanatory adequacy of the theoretical constructs was constantly compared with the additional empirical indicators, and this process went on until theoretical saturation was reached (additional information no longer contributed anything new to the study). In this way, the resulting theoretical framework is considered conceptually dense and grounded in the data.

2.2.3. Data collection methods

In addition to using data from the two rounds of the RALS, the study employed various data collection methods. A historical timeline method was used to collect information from individual households. The timeline of livestock involved a discussion of how households acquired their initial stock of cattle and the significant events related to the increase or decrease of the herd size from the initial stock till the time of the interviews. To increase the data's validity, the critical issues and concerns raised during individual household interviews were further explored through a total of 12 Focus Group Discussions (FGD), each comprising between five and ten farmers.

During FGDs, village-level information was solicited, and a historical timeline tool was applied. Group participants were asked to list all the households in that particular locality. The participants were then asked to indicate which household had cattle and the number of cattle they had during the year of the interview. The same question was posed to solicit information about ownership in the previous years to the point where the participants could remember (see, for example, Table 2.1). In addition to ownership questions, we asked questions about how the initial stock of cattle was acquired, whether the households had small livestock and if the households used ADP as well as practiced conservation farming. More questions were raised based on previous interviews. The information about the number of households owning cattle and the population of cattle was then mapped out as shown in Figure 2.3 to visualize the village population growth or decline for both cattle and the number of households keeping cattle. The visual representations were then used to facilitate a discussion on the observed trend. During the discussion, the participants narrated different events that led to an increase or decrease in cattle stock and the number of households keeping cattle. The political timeline (Table 2.2) was also used during the discussions to capture institutional aspects related to cattle production and how they affected cattle production. It was easier for the respondents to relate the discussion to the political regime.

In addition, key informant interviews were conducted with six traditional leaders as well as the six district-level officials of the Ministry of Fisheries and Livestock as part of validating the data collected during FGDs. The interviews were either conducted in English or the local Zambian language, and each interview took about 60 to 120 minutes. Some interviews were digitally recorded with the consent of the respondents.

Table 2.1 Example of the focus group discussion information table

#	Name-withheld	Number of cattle owned by year			ownership of small livestock	the source of initial cattle	practicing Conservation Farming	Use ADP
		2016	2010	1990				
1		19	3	0		bought	yes	yes
2		12	4	0	pigs/goats	bought	yes	yes
3		8	6	0		bought		yes
4		15	4	0	goats	bought		yes
5		4	0	0	goats	bought	yes	
6		4	0	0	goats	bought		yes
7		20	8	0		given		yes
8		30	6	0	goats	given	yes	yes
9		1	0	0	goats	dowry		
10		4	0	0	goats	bought	yes	
11		4	0	0	goats	bought		
12		4	0	0	goats	bought		
13		30	7	0	goats	given	yes	yes
14		5	0	0	goats	dowry	yes	
15		25	6	0	goats	given		yes
16		12	0	0		bought		yes
17		4	2	0		bought		yes
18	deceased	0	2	0		bought		yes
19	deceased	0	7	8		bought		yes
20	deceased	0	9	2		bought		yes
21	deceased	0	15	8		bought		yes
22	deceased	0	6	12		bought		yes
23	deceased	0	15	35		bought		yes
24	deceased	0	8	6		bought		yes
Total Cattle		201	108	71				
Number of households with cattle		17	16	6				
Total number of households in the village		31						

The names are withheld for reasons of anonymity

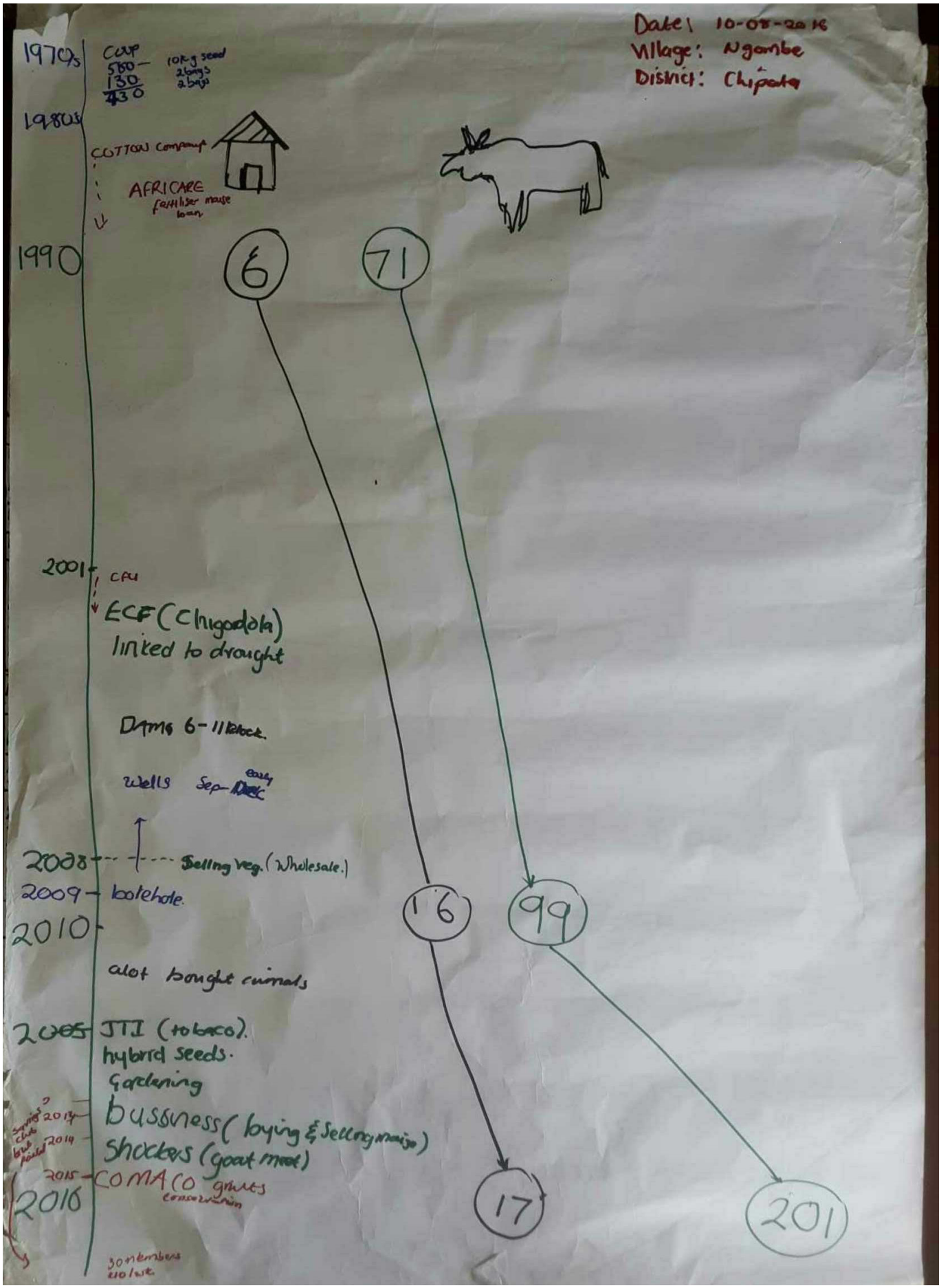


Figure 2.3. A visual representation of Table 1

Table 2.2. Example of the political regime timeline of events related to livestock production

President	period	Activities related to cattle	Cattle population
David Kaunda	1964-1991		Relatively increased
	1964-1974	Free vaccines for corridor and FMD	
	1975	Inadequate water	
	1980's	Windmill-driven water pumps installed	
		Water pumps become non-functional	
		Dug water wells	
		Selling maize, sunflower, and groundnuts to NAMBOARD	
		Long rain season -between October-June	
Titus J. Chiluba	1991-2001	Privatization period-free vaccines were scrapped off	Reduction
		No training on dosage (sometimes used less or more)	
		Continued using water wells	
		Market development-some farmers sold cattle in Kitwe district on the Copperbelt province	
		Small livestock trading in Lusaka	
		Marketing of cattle became challenging as farmers traveled long distances	
	1992	Prolonged drought spell	
		Low crop production	
		Low water in wells	
		Cattle disease outbreaks resulting in more deaths	
Levy Mwanawasa	2001-2008	Free FMD vaccine reintroduced	Increase
		Private sector investment in abattoirs-e.g. Zambeef in Namwala district	
		Food Reserve Agency buying maize from farmers	
		Dunavant, a cotton company, supported cotton farmers	
		Too much rainfall in 2001/02 ag season	
		Outbreak of diseases	
		Problems of grazing land-pop increase, more crop fields	
Rupia Banda	2008-2011	Free FMD vaccine continued	Increase
		World Vision drilled a borehole	
Michael Sata	2011-2014	Free FMD vaccine continued	Increase
		Another abattoir opened up	
Edgar Lungu	2015-2016	Free FMD vaccine continued	Increase

2.2.4 Data analysis

To address the first objective, we employed descriptive statistics (mean differences) to determine any systematic differences between households moving in and out. A probit regression was estimated to identify the factors associated with moving in or out of cattle production. The probit model is given as:

$$\textbf{Prob}\left(w=1\right)=\Phi\left(\beta+\ddot{\mathbf{a}}'\mathbf{x}+\varepsilon\right)$$

Where w is a discrete dependent variable denoting either the household that moved in or out of cattle keeping, x is a vector of household and farm attributes, Φ is a normal cumulative distribution function (CDF), ε is the error term, β and $\ddot{\mathbf{a}}$ are parameter and vector of parameters to be estimated. A full list of variables used in our analysis is presented in Table 2.3.

Table 2.3. Summary statistics of the variables used in the empirical analysis

Variables	N	Mean	Std. Dev.	Min	Max
Household size in adult equivalent	14508	4.96	2.26	0	23.42
Male-headed households	14508	0.8	0.4	0	1
Age of household head (years)	14505	47.58	14.8	18	105
Education level of household head (years)	14508	6.03	3.68	0	19
Land cultivated (hectares)	14508	2.43	2.39	0	45.25
HHs cultivating maize (=1, 0 otherwise)	14508	0.45	0.5	0	1
HHs using draft power (= 1, 0 otherwise)	14508	0.41	0.49	0	1
HHs using manure (=1, 0 otherwise)	14508	0.11	0.31	0	1
HHs using mechanical power (=1, 0 otherwise)	14508	0.02	0.12	0	1
HHs participating in off-farm activities (=1, 0 otherwise)	14508	0.74	0.44	0	1
HHs reporting cattle death (=1, 0 otherwise)	14508	0.08	0.28	0	1
Tribe of the household head					
Bemba (=1, 0 otherwise)	14508	0.32	0.47	0	1
Kaonde (=1, 0 otherwise)	14508	0.12	0.32	0	1
Tonga (=1, 0 otherwise)	14508	0.18	0.38	0	1
Lozi (=1, 0 otherwise)	14508	0.08	0.28	0	1
Nyanja (=1, 0 otherwise)	14508	0.29	0.45	0	1
Other tribes (=1, 0 otherwise)	14508	0.02	0.13	0	1

HH=household

The second objective was addressed using qualitative data. The analysis of the qualitative data occurred concurrently with data collection. The emerging data were examined according to an iterative process that served both to inform the next interviews and establish concepts for subsequent analysis. The study adopted the three steps for a grounded theory approach presented in the Strauss and Corbin (1980) paper. In the first stage (open coding), we scanned through the data to obtain a broader picture and establish broad themes. Under each theme, we listed different categories that emerged from the data. The codes were categorized according to the type of content to which they were related. Single-instance codes that were thematically unrelated to the rest were excluded. In the second stage (axial coding), we used the codes established in the first step to show how different categories relate to each other. The last stage involved selective coding, which explains the theoretical model of moving in or out of cattle keeping. In order to establish causal links among different categories and make the conceptual linkages more specific, we also employed a causal narrative approach. This technique is a sequential analysis of events and the causal processes that connect them from a set of initial conditions to the outcome in question.

2.3. Results

This section presents the findings of the study. We first present the bivariate difference between the households that moved in and those that moved out of cattle production to examine any systematic differences between them. Then we present the findings from the econometric estimation, and lastly, we present the qualitative research results.

2.3.1. Characteristics of households move in or out of cattle keeping

Table 2.4 presents the mean differences of various attributes between the households that moved in and those that moved out in cattle production. The statistics are presented for both the 2012 and 2015 survey years. The moving out households had cattle in the year 2012 but not in 2015, and the opposite applies for the moving in households.

Table 2.4. Characteristics of farmers moving in or out of cattle production

	Year of survey	Ownership category		
		Moving out households	**Moving in households**	
Demographic characteristics				
Age of household head (years)	2012	48.16	43.03	***
	2015	50.55	45.98	***
Education level of household head (years)	2012	5.7	6.01	
	2015	5.52	5.87	
Household size in adult equivalent	2012	4.92	4.64	**
	2015	5	5.08	
Farm characteristics and income sources				
Land cultivated (ha)	2012	2.92	2.35	***
	2015	2.28	2.85	***
Proportion of HHs using ADP	2012	0.62	0.55	**
	2015	0.59	0.7	***
Proportion of HHs using manure	2012	0.15	0.06	***
	2015	0.12	0.16	*
Proportion of HHs cultivating maize	2012	0.94	0.91	
	2015	0.95	0.95	
Maize yield (kg/ha)	2012	2,047	1,900	*
	2015	1,869	2,104	**
Gross income(ZMK)	2012	19,812	11,314	**
	2015	14,931	20,715	***
Share of crop income (%)	2012	64.4	68.65	**
	2015	63.1	57.24	***
Share of off-farm income (%)	2012	22.84	27.05	**
	2015	32.76	33.82	
Share of livestock income (%)	2012	12.76	4.3	***
	2015	4.14	8.94	***
Number of observation	2012	441	566	
	2015	441	566	

The household that moved out had cattle in the year 2012 but not in 2015, while those that moved in did not have cattle in 2012 but had in 2015; *** p<0.01, ** p<0.05, * p<0.1

The results show some significant differences regarding demographic characteristics between the two groups. The household that moved out had, on average older household heads in both years than their counterpart. They also had a bigger family size in 2012. We observe no differences in the level of education of the household head.

Concerning farming characteristics, the results show significant differences in land size cultivated with the household moving out, exhibiting a reduction between the two years while those moving in had an increase in land cultivated in 2015. The results also show that the percentage of households that used animal draft power increased among those that moved in while the proportion of households reduced among those that moved out. Though both groups had less than 20% of households using manure, the proportion of households using manure increased among those that moved in cattle production. Lastly, under farming attributes, we considered maize cultivation given that it is a staple crop in Zambia, and the results show that all farmers nearly cultivate this crop; as such, there are no notable differences between the two groups. However, we observe significant differences in the maize yields. While the household that moved in had an increase in the maize yield, a significant reduction was observed among those that moved out of cattle keeping.

We also analyzed the household income as it is one of the indicators of the wealthy. The income is an aggregate of the value of crop production, off-farm, and livestock income. The results showed a significant increase in the average gross income among households that moved in cattle production with a notable increase in livestock contribution towards household income. However, a reduction in average gross income was recorded among those that moved out. It is worthwhile to note that the share of livestock income also significantly reduced for moving out households. This finding confirms the importance of livestock toward household welfare. In summary, we conclude that there are significant systematic differences in most of the attributes except the education of the household head and maize cultivation.

2.3.2. Factors associated with moving in or out of cattle keeping

Results in Table 2.5 confirms some of the findings emerging from the bivariate analysis. In particular, we find that older household heads are more likely to move out while younger heads are more likely to move in cattle production. Educated household heads are less likely to move out. Likewise, households cultivating maize are likely to move out. The use of draft power is significantly and positively associated with both groups, but more importantly, it is likely to push farmers into cattle production. Cattle deaths are more likely to push farmers out of cattle production.

Table 2.5. Factors associated with moving in or out of cattle production

VARIABLES	Moving out	Moving in
Household characteristics		
Household size in adult equivalent	-0.001	-0.002
	(0.001)	(0.001)
Male headed household (= 1, 0 otherwise)	-0.004	0.005
	(0.005)	(0.006)
Age of household head in years	0.000*	-0.001***
	(0.000)	(0.000)
Level of education household head in years	-0.001**	-0.001
	(0.001)	(0.001)
Farm characteristics		
Land cultivated (hectares)	-0.001	-0.000
	(0.001)	(0.001)
Households cultivating maize (=1, 0 otherwise)	0.034***	-0.005
	(0.012)	(0.011)
Households using draft power (= 1, 0 otherwise)	0.027***	0.044***
	(0.005)	(0.006)
Households using manure (=1, 0 otherwise)	-0.004	-0.017***
	(0.006)	(0.006)
Households using mechanical power (=1, 0 otherwise)	-0.015	0.005
	(0.015)	(0.020)
Households participating in off-farm activities (=1, 0 otherwise)	-0.009*	-0.002
	(0.005)	(0.005)
Households reporting cattle death (=1, 0 otherwise)	0.031***	-0.041***
	(0.006)	(0.009)
Tribe of the household head		
Bemba (=1, 0 otherwise)	-0.043***	-0.032**
	(0.011)	(0.015)
Kaonde (=1, 0 otherwise)	-0.042***	-0.004
	(0.008)	(0.018)
Tonga (=1, 0 otherwise)	-0.025**	0.039*
	(0.011)	(0.022)
Lozi (=1, 0 otherwise)	0.012	0.020
	(0.015)	(0.021)
Nyanja (=1, 0 otherwise)	-0.038***	0.030
	(0.011)	(0.019)
Year 2015 (=1, 0 otherwise)	0.032***	-0.003
	(0.011)	(0.011)
Observations	14,505	14,505

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

2.3.3. Results of qualitative research

The qualitative research findings were classified into five broad themes: human population growth, livestock population density, household labor availability, climatic conditions, and institutional factors.
Human population growth

In all the sampled districts, respondents related the moving in or out of cattle production to human population growth. They mentioned that as the human population increases in rural areas, the newly established households require dwelling places as well as fields for crop cultivation. Because of the limited land availability, some new households establish their homesteads on cropland and encroach the grazing areas, thereby limiting the available communal grazing areas. This problem further worsens during the cropping period as crop fields are considered forbidden areas for animals. Another challenge associated with human population growth that respondents alluded to was the cultivation along the streams, suitable areas for grazing, and livestock watering points. This brings about conflicts that are further discussed under livestock population density. Thus, animals move long distances in search of pasture and water, resulting in less water and feed intake. This challenge's resultant effects are slow growth and poor performance of animals, leading to death and ultimately reducing the herd size. This problem was so pronounced in areas that are close to district centers.

The respondents, especially in the northern part of the country, claimed that the cattle population and the number of households keeping cattle in a particular locality contribute to moving in or out of cattle production. They associated cattle population density with draft power availability, which tends to affect how cattle owning households and non-cattle owners, especially those who cultivate along the streams, relate.

On the one hand, communities with low cattle population density face limited availability of draft power animals. The short supply of these animals causes social conflicts as there are limited incentives for vegetable growers who cultivate along the streams to protect their gardens by way of fencing. If the animal strays and causes any crop damage, the livestock owners are fined the same animal. This type of penalty fuels jealousy within the communities and acts as counterproductive to would-be cattle keepers as there is less motivation to move in cattle production. One farmer narrated how he lost his animal after it trespassed in someone's garden, and since then, he has been afraid to invest in cattle for fear of losing them. Even though low cattle population density may have adverse effects in some parts, it increases the prices of ADP services in other areas. The high prices, therefore, incentivize some farmers to move in cattle production.

On the other hand, we found that highly cattle populated areas have fewer social conflicts emanating from the protection of vegetable fields due to ADP's availability. The farmers tend to secure their gardens. Moreover, non-cattle owners offer their labor to herd the animals in return for using the ADP during crop field preparation. The use of ADP helps farmers increase the land cultivated, partly contributing to increased production and crop income. Based on the timeline information collected from individual households, most farmers used crop income (mainly from other crops other than maize) to purchase cattle's initial stock. Additionally, non-cattle keeping households are also motivated to start keeping cattle in areas where more households have cattle. The motivation stems from the fact that non-cattle-keeping households view their counterparts as better off than them since they can cultivate big fields.

Availability of household labor

Labor for herding cattle was one of the critical aspects that farmers also indicated to contribute to moving in or out of cattle keeping. Many of the farmers face challenges of herding cattle since a herder is required to be with the animals at all times due to the escalating of animal theft and to avoid crop damages. To circumvent this bottleneck, farmers employ different herd management depending on the locality. For

example, in the northern part of the country (Mbala district), farmers employed a group rotational herding. In this management style, 10 to 15 households bring their cattle together, and each household is tasked to herd cattle for a week. The household in charge will make sure that all the animals are taken for grazing and watering. Households felt that participating in the rotational group herding alleviates the household labor constraint since it is costly to pay a herder. In the eastern part of the country, the household also brings their animals together but hires a herder to care for the animals. Each household contributes towards the herder's payment, and in most cases, the payment is made at the end of each year. The critical aspect of this availability of labor in the context of this research is when households engage small boys between the age of 10 and 13 years who are not in school as herders. These boys work on a 3 to 4-year contract basis, after which they are paid a cow, which is one way through which some households can acquire cattle. Even though there are concerns about child labor, most of the respondents felt that this was the cheapest way of acquiring cattle. During the process of herding cattle, respondents said that the boys also gain experience, which acts as a motivating factor. Later in life, these herders tend to move in cattle production because of prior experience. Indeed the majority of the farmers interviewed had some prior knowledge when they were still young.

Climatic conditions

Climate variability was another factor that farmers identified to contribute to moving in or out of cattle keeping. The results of the recurrent drought are threefold:

First, drought affects crop production leading to reduced yields. Low yields have a negative impact on household income, and as such, farmers who own cattle sell their animals to cushion the household income shock. The distress selling of animals reduces the herd size and ultimately may force some farmers out of cattle keeping if this process continues. Respondents cited the drought of 1992/93 and the 2014/15 agricultural season that the country experienced. During this season, the crop production was low, and as such, farmers had few crops in stock from which they draw to attend to household emergency needs. In the same periods, there was an outbreak of corridor and blackleg diseases in some districts of the southern province. Since most farmers mainly use crop sales proceeds to buy drugs for cattle, they could not contain the outbreak partly because their crop reserves were low. Most of the animals died, and some farmers ended up selling the cattle that were at risk to avoid further losses. This incident forced some farmers out of cattle production.

Second, drought affects the availability and quality of pasture. Poor pasture leads to increased disease pressure, especially the blackleg. Since the drought also affects the crop income through reduced crop yield, most farmers said they had no choice other than selling the same diseased animals to avoid a total loss of income should the animals die. Therefore, distress sales ultimately reduce the herd size, which may eventually push some farmers out of cattle production.

Third, drought also affects water availability because it reduces water points as some streams dry up. This ends up putting more pressure on the available boreholes. Since the boreholes serve both humans and animals, the communities tend to either ration the water or charge a fee for drawing water for animals. Therefore, many animals take in less water, which affects their growth and performance. In instances where the borehole water is not enough to cater for both animals and people, animals are forced to move long distances in search of water. During this process, some animals are stolen or die.

On the contrary, in a good rainfall year, farmers expect a good harvest. If the market conditions are favorable, then the farmer's household crop income is expected to increase. The respondents' timeline information showed that most farmers invested the surplus revenue from crop sales to acquire the initial stock of about 1 or 2 cattle. Also, a good harvest entails that farmers will have enough crop reserves since most of the respondents said they use the crop income to buy drugs for their cattle during emergency cases such as disease outbreaks.

Institutional factors

In all the focus group discussions, farmers talked about how institutional support contributed to moving in and out of cattle production. The provision of veterinary services, specifically vaccination programs, was one aspect of institutional support that farmers highlighted. Farmers noted that during the periods when the public sector provided the vaccination services for free, the cattle population also increased in some areas while it dwindled when mass vaccinations were no longer implemented. Restocking programs was another aspect of support the respondents mentioned. Some farmers benefited from the pass on the gift programs promoted by non-governmental organizations such as Heifer International and World Vision. However, most of the recipients under the World Vision program lost their animals, which respondents attributed to a lack of technical support on disease management.

2.4. Discussion and construction of the conceptual framework

This section discusses the research findings and how different factors enables or disables farmers to keep cattle. We refer to the existing empirical literature to discuss our results. In addition, the discussion brings out how these factors interact by constructing a theoretical framework.

2.4.1. Discussion

From the quantitative analysis, we identified age and education of household head, maize cultivation, use of draft power, participation in off-farm activities, and cattle deaths as the factors significantly associated with moving in or out. More contextual factors such as the effects of human population growth, climate change, livestock population density, household composition, and institution support came out from the qualitative analyses. These factors additionally play a role in understanding the mystery of moving in or out.

The results show that the increase in settlement densities brings about the competition to access the best arable land, and this tends to put more pressure on land. Because of this pressure, there are changes in land use where the grazing areas are turned into human dwelling places. This finding as a contributing factor to moving out of cattle production is also supported by other studies (Powell et al. 2004: Desta and Coppock, 2002; Boserup, 2011). In addition, other studies show that crop cultivation, especially in the pastoral systems, results in fragmented grazing land causing high rates of stocking densities on a given piece of grazing area (Tache and Oba, 2010; Tolera and Abebe, 2007). Boserup (2011) also notes that the population pressure results in agricultural intensification, which creates serious grazing problems for livestock. This problem arises due to reduced fallow periods, and animals tend to overcrowd the remaining permanent grazing areas. Because of high stocking densities, the grazing sites' carrying capacity becomes insufficient to sustain cattle's productivity, resulting in cattle losses.

In addition to the human population's effect on the moving in or out of cattle production, our findings show that climate variability is also a critical concern. The results show that the effects of climate variability on cattle production are multi-dimensional. As suggested by the respondents, the most evident and essential impacts are mediated through changes in pasture productivity, water sources, and crop production. Our results show that changes in the quality of feed resources and water availability also contribute to cattle disease pressure. This finding is in line with the works of Abule et al. (2005) and Solomon et al. (2007). They found that climate change results in an increasing water shortage, feed shortages, and an increase in animal diseases in the East African pastoral production system.

Climate variability also affects crop yields and thus affecting the households' incomes. Given that crop income is a vital source of financial capital that facilitates cattle's initial stock acquisition, it emphasizes the importance of crop-livestock synergies. The finding of increased land cultivated, the proportion of households using manure, and maize productivity noted in the quantitative analysis also reaffirm the importance of cattle in integrated farming systems. Indeed many studies have highlighted the crop-livestock interactions in mixed farming systems. For a comprehensive review (see, for example, Devendra and Thomas, 2002 and Tipraqsa et al., 2007). However, while these studies mainly pinpoint the complementarity in the use of resources with inputs from one sector being supplied to others, our analysis shows the importance of crop income in livestock acquisition. Because of this linkage's significance, it is, therefore, necessary to address the challenges associated with low crop productivity taking into account the climate variability, which has continued to affect the rural livelihood in many developing countries negatively.

Another key finding is how crop damages caused by grazing cattle constitutes an essential obstacle to cattle production. However, one interesting observation from our results is how cattle population density serves as a catalyst to resolve social conflicts arising from crop damages caused by grazing cattle. While Birner and Gunaweera (2001) concludes that collective action and bargaining between organized interest groups serve as an alternative solution to the crop-livestock conflict, our study suggests that the availability of animal draft power serves as an instrument to settle disputes. This instrument is useful because the lack of ADP, to some extent, does not allow non-cattle owning households to expand the sizes of their cultivated plots. In their study, Powell et al. (2004) also pointed out the importance of ADP in increasing the cultivated land.
The study also shows that male labor availability within a family structure plays a pivotal role in acquiring cattle. More often than not, young males engage in cattle herding and are responsible for fetching feed and water for their animals (Kassahun et al., 2008; Machina and Lubungu, 2018). Apart from playing this critical role, our study shows that young male household members are also a conduit through which households can acquire cattle. Though it takes 3 to 4 years to get the reward of their labor, and others may regard this as child labor, this approach might be the cheapest mean of acquiring cattle for some households. Another perceptible aspect of our finding is the experience that is gained through the process of herding cattle. This finding confirms the econometric results that showed that education pushes farmers into cattle production. The literature from West Africa, where the crop farmers first give their cattle to the herdsmen for management to gain experience before assuming the role of manager, supports this finding (Okoruwa et al., 1996). This suggests that training, either informal or formal in cattle production, should be part of the development programs to promote sustainable cattle production at the household level more, especially for new entrants.

Lastly, we find that the provision of veterinary services, specifically vaccines, helps build a healthy herd size and reduces mortality. The quantitative results also show that mortality pushes farmers out of cattle production, suggesting that farmers should be equipped with preventative disease messages.

As highlighted in section 2.1, the induced innovation theory could help in explaining some of the observations. This theory predicts that we expect livestock farmers to move towards integrated production systems under increasing population density. This integration could be the use of draft power or manure. One would also expect farmers to reduce the numbers and intensify the production by increasing meat productivity as well as the supply of milk. However, livestock intensification is bound to result in additional costs associated with feeding. Chapoto and Zulu-Mbata (2015) show that less than 10% of smallholder livestock farmers in Zambia grow their pasture. Thus, supplementary feeding and training farmers in fodder management are necessary to address the feeding problem. The rational choice household model is another theory that could explain the observation. Households consider cattle as an asset and, therefore, would want to maximize the benefits from it. Though cattle provides multiple benefits, in Zambia, ADP seems to be a driving force for households to own cattle because it reduces labor demands during land preparation for field crops.

2.4.2. Construction of the theoretical model

Combining our research findings with the existing literature, we unfold the mystery of moving in and out of cattle production. Our analysis eventually leads to constructing a conceptual framework (Figure 2.4), which shows the factors that push farmers to move in or out of cattle keeping. We have identified institutional support, climatic conditions, human population growth, livestock population density, household composition, farm level, and household head characteristics as the factors that enable or disable farmers to keep cattle. Some of the elements are household-level characteristics, while others are village and regional attributes. To further develop this theory, though regional factors would incentivize the households to move in cattle production, we have some interaction among regional, village, and household-level characteristics. Even if there are village incentives to move in cattle production, for example, an increase in the demand for draft power, it does not mean that all the households are likely to move in because of household-level challenges such as limited household labor availability.

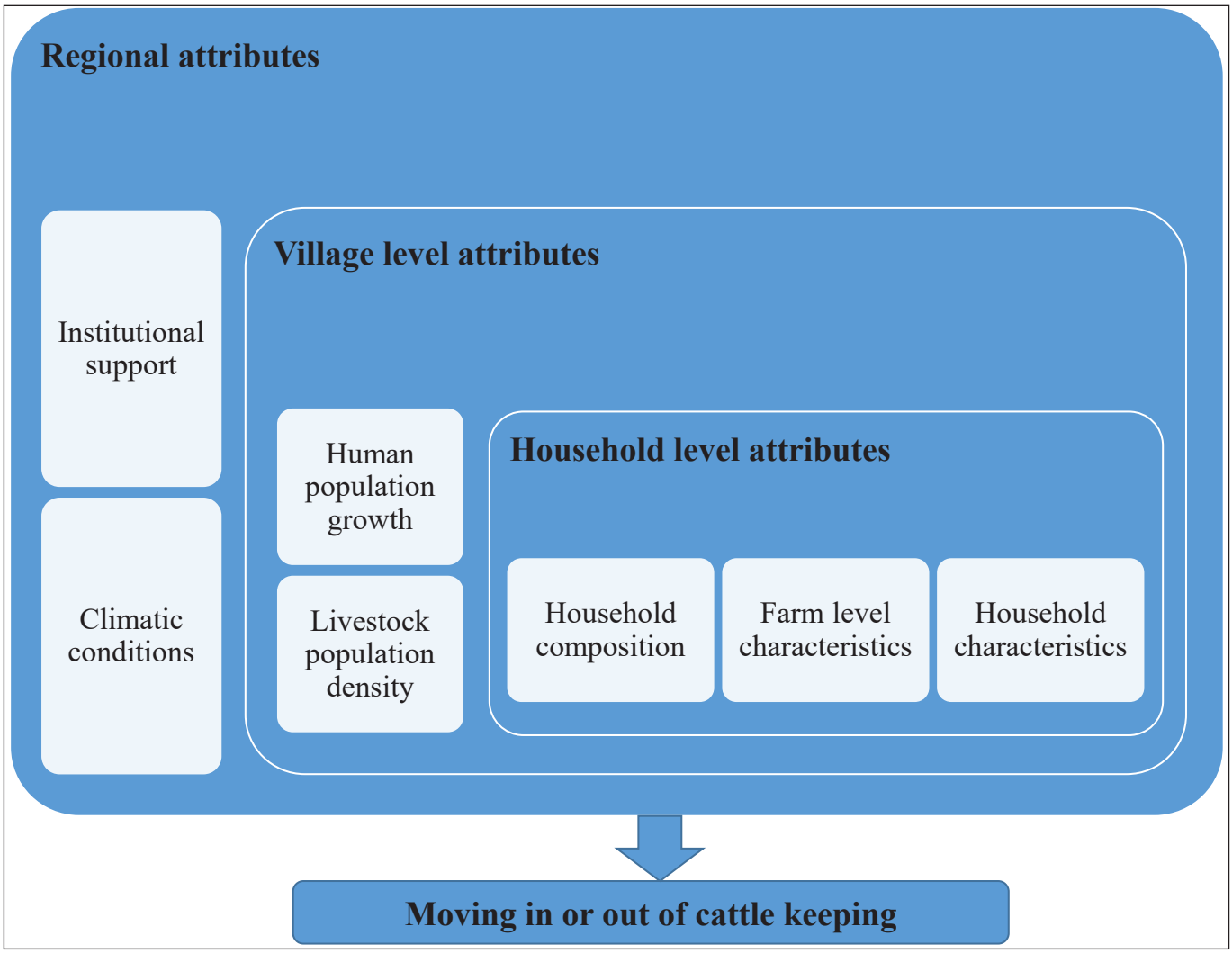


Figure 2.4. The theoretical model of moving in and out of cattle keeping

2.5. Conclusions and recommendations

To promote a sustainable livestock production system, we first need to identify what enables and disables farmers to keep livestock and the context under which these factors are likely to occur. It is also essential to establish the kind of interrelationship that exists among different factors and how they are likely to contribute to the development of sustainable production systems. Using a mixed-method approach and review of related literature on cattle production, we unraveled the conundrum of moving in out and of cattle keeping and suggested a theoretical model. The proposed model consists of multi-dimensional factors that show how different contextual factors explain the phenomenon. More precisely, regional attributes (institutional support and climatic conditions), village-level factors (human population growth, livestock population density), and household level factors (household composition, farm, and household head characteristics) were identified as enablers and disablers of cattle keeping. There exist also some interactions among these factors such that even if there are regional incentives to move in cattle production may not mean that all the households are likely to move in.

Although the findings are not generalizable to all potential cattle producers, the following recommendations could still improve smallholder cattle production.

i. Given that the factors that enable farmers to move into cattle production are intertwined suggests that addressing only one component without addressing others may not contribute to sustainable cattle production. There is a need to identify sustainable ways of raising cattle to address the challenges of human population growth, high stocking densities, and climate change.
ii. Our findings also reaffirm the importance of crop-livestock synergies and how crop income finances the acquisition of cattle's initial stock. In the absence of well functioning rural finance, smallholder farmers who cannot generate a surplus income from crop production may not be able to move into cattle production. It is, therefore, essential to address the challenges associated with low crop productivity and market access.
iii. Since experience and institutional support are imperative to cattle acquisition and building the herd size, farmers need to acquire cattle management skills. This also calls for development programs that support farmers to incorporate disease management training in their plans, especially to new entrants in cattle production.

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3.0 FACTORS AFFECTING THE LIVESTOCK HERD SIZE AMONG SMALLHOLDER FARMERS IN ZAMBIA

Mary Lubungu

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Abstract

Structural changes in the economic and demographic landscapes in the developing countries create a host of opportunities for smallholder livestock producers to tap into the economic growth from which they have largely been excluded. However, small livestock herd sizes limit farmers' commercialization opportunities to benefit from the growing demand for livestock and livestock products. Therefore, understanding what it takes to build and maintain the herd size is a critical step in addressing low market participation. The study used five cross-sectional nationally representative data sets to arrive at the following conclusions. While purchases are a primary source for the initial stock, births are the principal way of increasing the herd size. As reflected by high mortality rates, Livestock deaths are the major outflow channel through which livestock leaves the herd, and reducing the mortality rates has a positive effect on the livestock population, as evidenced within the cattle sub-sector. Thus, the provision of adequate animal health services is key to addressing the high mortality rates, leading to increased herd size. As births are the primary means of increasing the herd size, it is necessary to implement interventions that address the reproduction rates. The interventions include adequate feeding of livestock on high-quality feed and strategic feeding to address the dry season challenges. These interventions can facilitate the growth of the young livestock into mature breeding stock and thus increase the herd size.

Keywords: Cross-sectional data, Demographic indicators, Herd size, Zambia

3.1 Introduction

Structural changes in the economic and demographic landscapes in the developing countries (McCullough et al., 2008; Reardon et al., 2014) create a host of opportunities for smallholder livestock producers to participate in the economic growth from which they have largely been excluded (Steinfeld et al., 2013). These opportunities emanate from the changes in the consumption patterns due to increasing population growth and sustained income growth of the urban population (Delgado et al., 1999; Delgado, 2003; Rae and Nayga, 2010). As these structural changes take place, people tend to consume more of the foods of animal origin (Hichaambwa, 2012), and hence the livestock production has a great potential to act as the engine growth for smallholder farmers in Sub-Saharan Africa and particular in Zambia. However, this potential is often not realized, mainly due to the numerous challenges that limit smallholder production and market participation. Among the several factors that limit commercialization, studies have concluded that the small livestock herd size is one of the major limiting factors (Lubungu et al., 2015; Lubungu, 2016, Sikhweni and Hassan, 2014). Therefore, building a healthy herd size is key to the growth of the sector and ensuring that farmers take full advantage of the livestock sector's growth. The study's primary

objective is to contribute to the discourse on livestock herd size growth by examining the factors driving the inflows and outflows of livestock herd. The study also estimates the livestock demographics indicators (mortality, growth, and offtake rates) and identifies the factors that have contributed to changes in these parameters over time. Estimating these parameters is important because they reflect the stability of the herd structures. Also, knowing about population indicators of different livestock species is necessary as these attributes differ across different livestock value chains (Mwanyumba et al., 2015; Desta and Coppock, 2002). Furthermore, understanding the past trends associated with population growth can help identify problems stifling the smallholder livestock sector's growth and potential solutions that can guide future interventions and policies to address the bottlenecks. Against this background, the study used five national cross-sectional data to understand what it takes to build and maintain the herd size

3.2 Materials and methods

The data utilized in this study was drawn from five nationally representative surveys conducted by the Indaba Agricultural Policy Research Institute (IAPRI) together with the Zambia Central Statistical Office (CSO) and the Ministry of Agriculture (MoA) in Zambia. The surveys included three supplemental surveys (SS) carried out in 2001, 2004, and 2008, and two rural agricultural livelihood surveys (RALS) implemented in 2012 and 2015. The SS—2001, 2004, and 2008 covered 6922, 5420, and 8094 rural households in survey years, respectively, while the 2012 and 2015 RALS covered 8840 and 7934 farm households, respectively. For more details on the sampling techniques, the reader is referred to see Megill (2004 and 2009) for SS and IAPRI (2016) for RALS. The analysis adopts the methods presented by Lesnoff et al. (2011) and Mwanyumba et al. (2015) to compute the demographic parameter of the three livestock species-cattle, goats, and pigs. The parameters have been calculated using the following equations;

Annual populationgrowth rate=(annual multiplication rate-1)*100

Annual multiplication rate=(closing stock)/(opening stock)

Annual mortality rate=((number died in 12 months)/(openeing stock))*100

Commercial offtake rate=(sales/(herd size 12 months ago))*100

The study further analyzed the primary sources and outflows of the three species. The analysis focuses on the significance of the three sources of livestock inflows (the births, purchases, and gifts or dowry) and five outflow channels (deaths, sales, home consumption, gifts, and theft) in building and maintaining the herd size.

The study also collected qualitative data through five focus group discussions (FDG) with farmers in five districts, namely, Chibombo, Mbala, Petauke, Kalomo, and Namwala, to inform the discussion. The five areas were selected based on the livestock population and number of households owning livestock (Lubungu et al., 2015; Namonje-Kapembwa et al., 2016). Each FGD included about 5–8 livestock producers. Also, interviews with five personnel in the Ministry of Fisheries and Livestock were conducted to gather more information about the major events that happened in the sector. This information helped in explaining the observed trends in estimated demographic parameters. The qualitative data were collected between September and December 2016

3.3 Results

This section presents the results of the estimated demographic parameters for cattle, goats, and pigs. The analysis of the major inflows and outflows for the three livestock species is also presented.

3.3.1 Demographic indicators

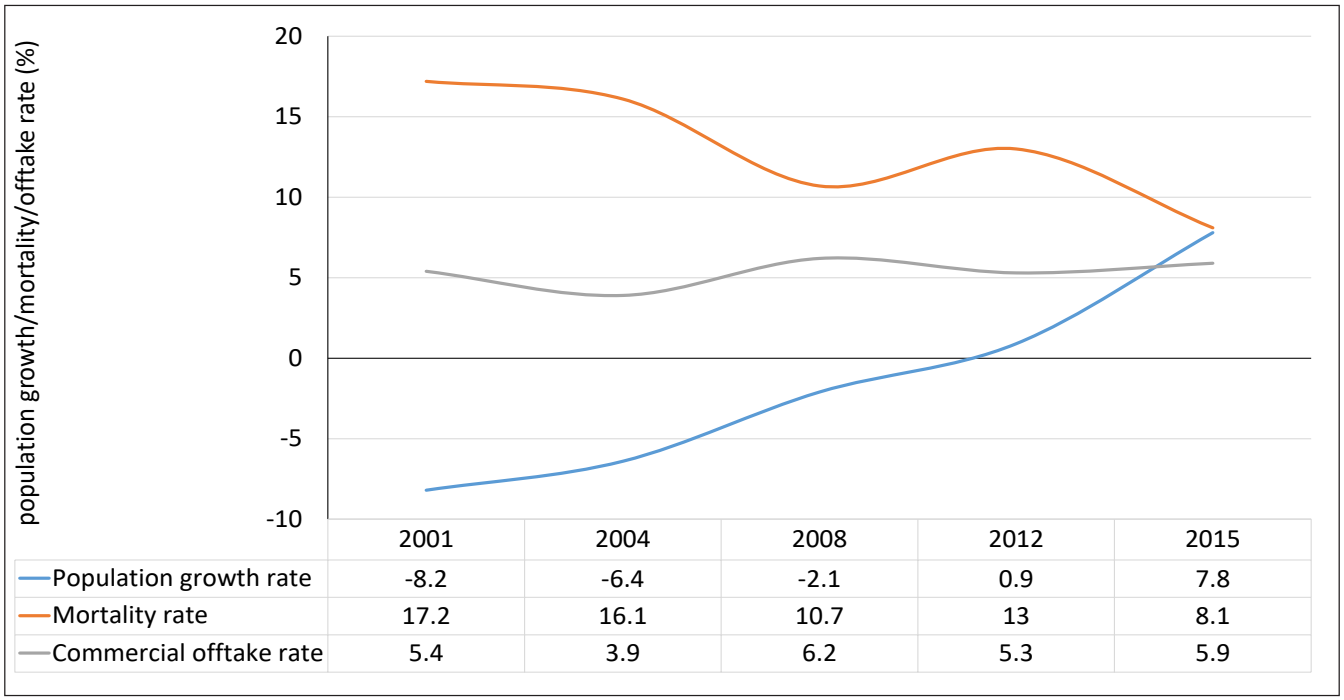
Table 3.1 shows the national livestock status for the three livestock species from 2001 to 2015. This information formed the basis for computing the population parameter presented in Figure. 3.1, 3.2, and 3.3.

Table 3.1. Smallholder Livestock production status by the year

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

Source: Author, using various survey data

The demographic indicators presented in Figure 3.1 show an upward trend of the cattle population growth, while the annual mortality rate shows a cyclic pattern. The mortality rates were high between 2001 and 2004 as well as in 2012.

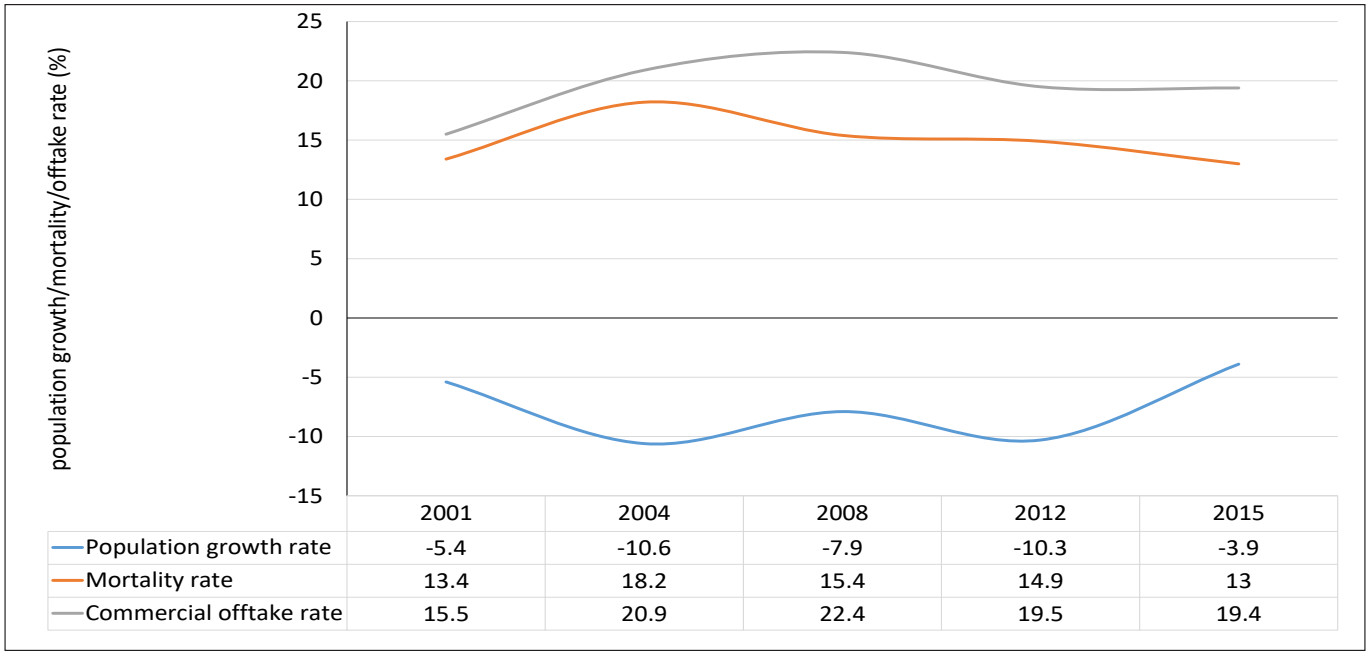


	2001	2004	2008	2012	2015
Population growth rate	-8.2	-6.4	-2.1	0.9	7.8
Mortality rate	17.2	16.1	10.7	13	8.1
Commercial offtake rate	5.4	3.9	6.2	5.3	5.9

Figure 3.1. Cattle demographic parameters

Source: Author, using survey data

For goats, Figure 3.2 indicates negative population growth between 2001 and 2015. However, since 2012, there was an improvement in the population growth rates, though still negative. During these 14 years, the goat mortality rates had consistently been high (above 13%).

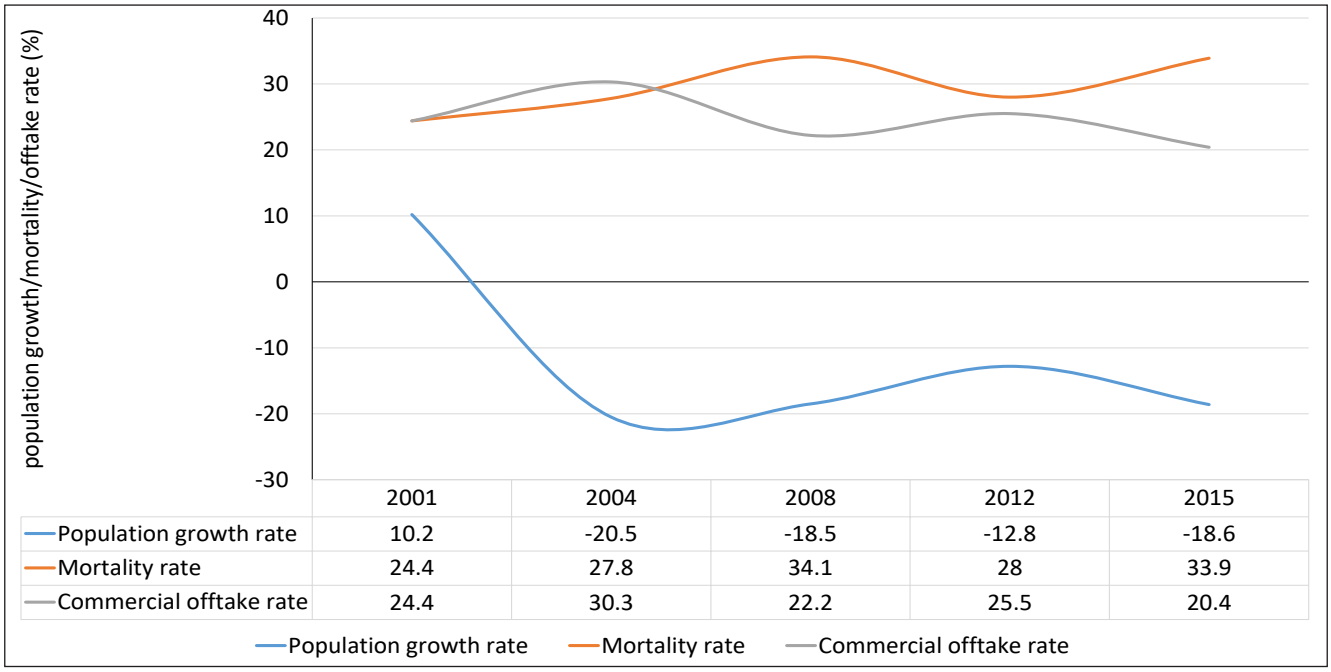


	2001	2004	2008	2012	2015
Population growth rate	-5.4	-10.6	-7.9	-10.3	-3.9
Mortality rate	13.4	18.2	15.4	14.9	13
Commercial offtake rate	15.5	20.9	22.4	19.5	19.4

Figure 3.2. Goat demographic parameters

Source: Author, using survey data

The pig production had also continued to record a negative population growth rate with a persistently high mortality rate of over 25% (Figure 3.3). The offtake rates for pigs are greater than are for goats and cattle. The pig's sales also seem to respond to population growth and mortality rates.



	2001	2004	2008	2012	2015
Population growth rate	10.2	-20.5	-18.5	-12.8	-18.6
Mortality rate	24.4	27.8	34.1	28	33.9
Commercial offtake rate	24.4	30.3	22.2	25.5	20.4

Figure 3.3. Demographic parameters

Source: Author, using survey data

3.3.2. Inflow and outflow channels

Figures 3.4 and 3.5 present the primary sources of three livestock species over the three-time periods. Figure 3.4 shows that births, which accounted for more than 75% of the total entries, were the primary source through which cattle entered the herd. Purchases were the second most important while gifts or dowry were the least. On the other hand, the major channel through which cattle left the herd were deaths, which accounted for over 60% in 2001 and reduced to 50% in 2015 (Figure 3.5). Sales were the second most important means of disposing of cattle, and a slight increase was notable in 2015. The proportion of cattle that were given away or consumed at home was minimal. Despite this being marginal, the percentage of cattle leaving the herd through this channel was higher compared to that of goats and pigs.

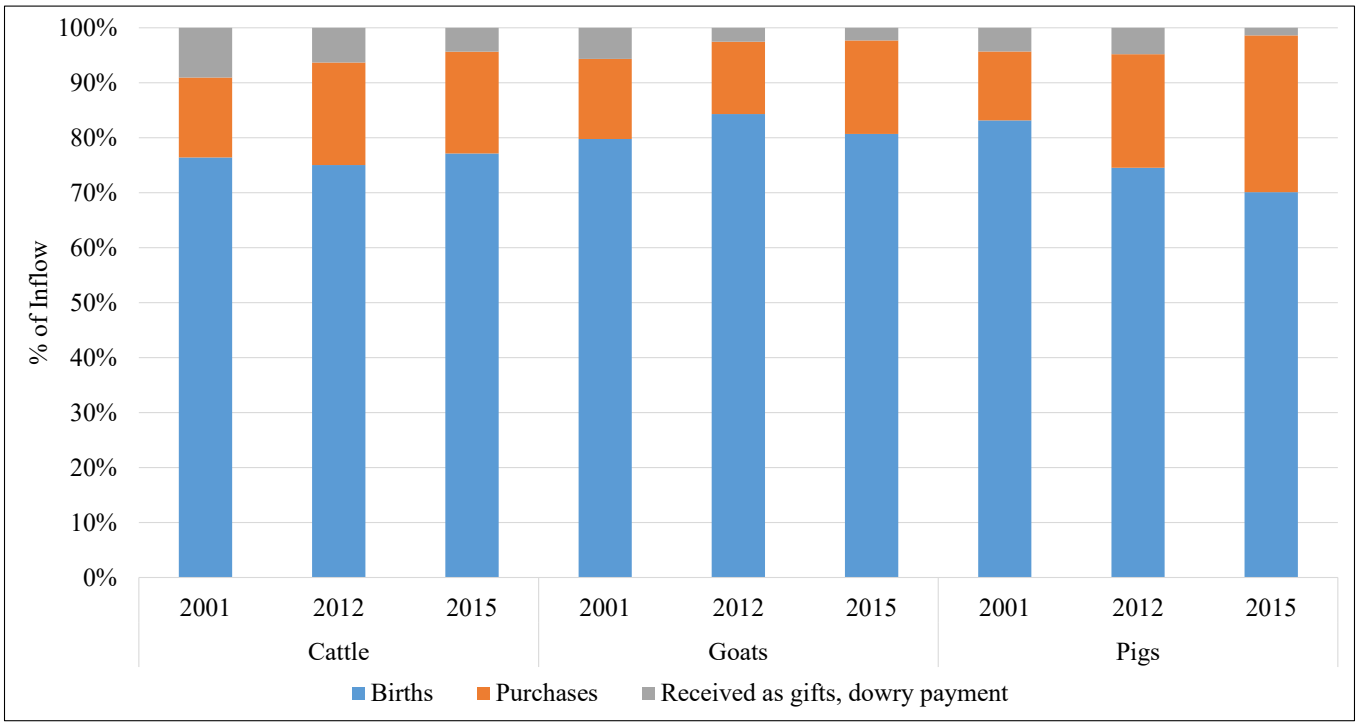


Figure 3.4. Livestock Inflow Channels by Year

Source: Author, using survey data

Similar to cattle, births were the primary source through which goats entered the herd. However, sales were the most means through which goats left the herd. The proportion of goats that left the herd through home consumption were greater compared to those of cattle. Compared to pigs and cattle, goats were prone to theft. Likewise, births were a primary inflow channel for pigs. Pig purchases were relatively important sources of building the pig herd size, and as of 2015, they accounted for close to 30% (Figure 3.4). The main channel of pig outflows was deaths, then followed by sales. Like goats, home consumption was also equally an important channel through which the pigs left the herd (Figure 3.5).

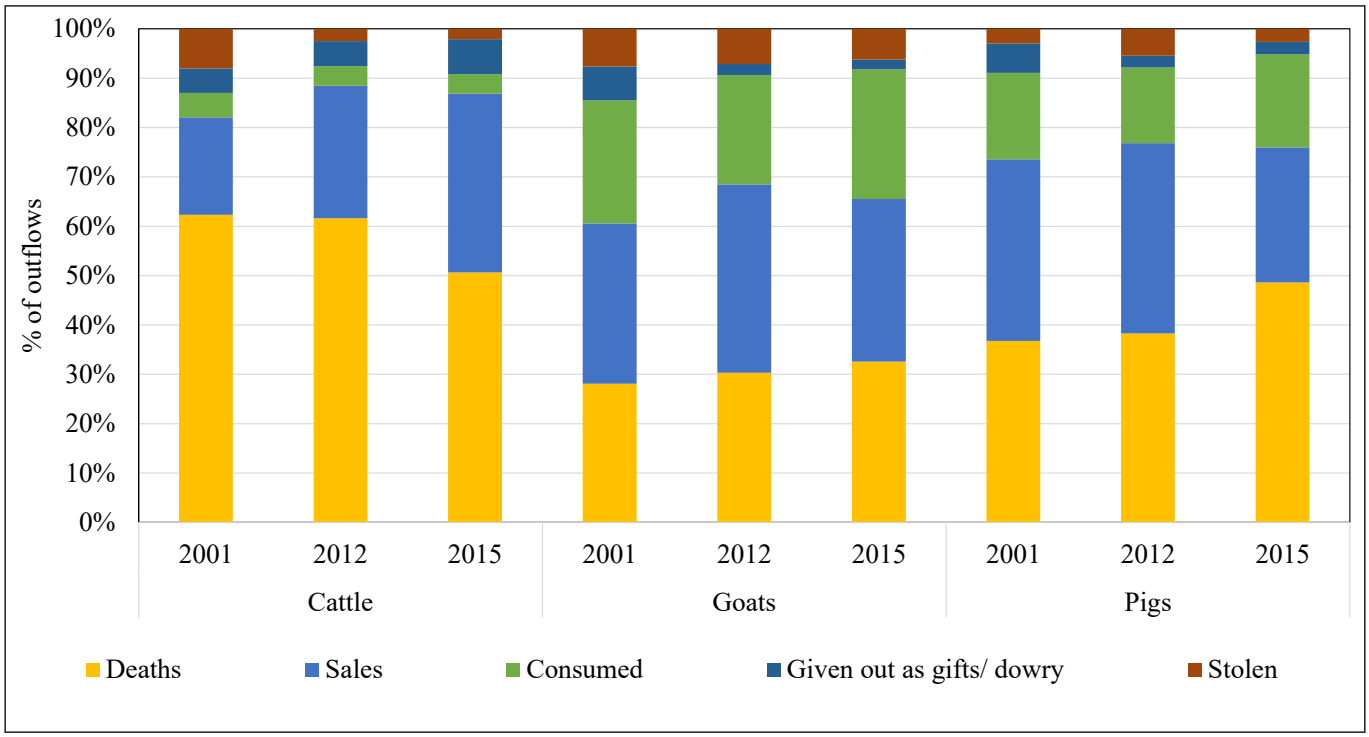


Figure 3.5. Livestock outflow channels, 2015

Source: Author, using survey data

3.4. Discussion and conclusions

The results showed positive up and down swings in population growth rates of cattle and decreased mortality rates over the years, while negative population growths were observed for goats and pigs. However, the observed trends can be explained by the major developments in cattle production during this period. Based on the discussions and information obtained from experts within the Ministry of Fisheries and Livestock, the cattle mortality rate was at its peak between 2001 and 2004 due to the contagious bovine pleural pneumonia (CBPP) outbreak in some parts of the country experienced. In response to the epidemic, the Livestock Development Trust conducted the vaccination campaigns under the Danish project in conjunction with the then Ministry of Agriculture and Cooperatives in 2005. These interventions partly contributed to a reduction in the mortality rates. The project was phased out in 2008, and the International Fund for Agricultural Development came on board and provided support to contain the disease outbreaks through a restocking program under the smallholder livestock investment program. This project ran from 2010 to 2012. From 2012, the Ministry of Fisheries and Livestock received support from the World Bank to conduct the vaccination/ immunization campaigns under the Livestock Development and Animal Health Project. The project has been addressing foot and mouth disease (FMD), east coast fever ECF, and CBPP in highly disease-endemic areas (World Bank, 2012).

In addition to the government programs, the private and non-governmental organizations have taken a keen interest in providing support to cattle farmers in recent years. For example, Musika, a non-governmental organization, has been assisting the private veterinary companies that provide preventive health care to the smallholder livestock producers. Heifer International has also been instrumental in supporting cattle smallholder farmers with animal husbandry management in selected areas. The reduction in cattle mortality during periods of interventions suggests that animal health programs are key in building the herd size,

especially that livestock deaths are the primary channels through which livestock leave the herd. Therefore, such programs can also be extended to support small livestock such as goats and pigs, which have received little support from both the public and private sectors (Namonje-Kapembwa et al., 2016).

Given that births are the primary source of building the herd size, it is necessary to implement interventions that address the reproduction rates, such as adequate feeding of livestock on high-quality feed and strategic feeding to address the dry season challenges. Research shows that the provision of proper nutrition has positive effects on the estrous cycle (Khlil et al., 2017). These interventions can facilitate the growth of the herd size and growth of young ones into mature breeding stock and commercial slaughter animals. Artificial insemination using high-quality bulls is another alternative that would significantly contribute to building the herd sizes. However, this aspect has received little attention in developing countries, and thus, more research is required to explore various alternatives through which farmers can access artificial insemination services.

Purchases are also essential in building the herd size. Interviews with farmers revealed that farmers mainly acquire first stock through purchases. Incomes from crops are used to finance the acquisition of the first stock and, after that, rely on births to build up and maintain the herd size. This finding highlights the importance of crop-livestock synergies. Thus, addressing the low crop productivity and market access, which have been on the policy agenda in many developing countries, is likely to impact on the livestock herd sizes positively.

Pigs and goats are more prone to theft than cattle because of two main reasons. First, the FGDs revealed that, because of their small size, pigs and goats were easier to steal than cattle. Second, the majority of the farmers who have brand marks usually use them only on cattle leaving goats and pigs unbranded because they value cattle more than small livestock. Research indeed shows that the identification mark makes it easier for farmers to trace their animals in case of theft (Bowling et al., 2008). Despite the importance of animal branding in preventing thievery, some farmers are unaware of its significance, making it difficult for them to report lost animals to law enforcement agencies such as the anti-stock theft unit. Therefore, educating smallholder farmers on the importance of animal identification as a tool for production management and as a mechanism for tracing stolen animals can also help maintain the herd sizes. Lastly, home consumption and sales of goats and pigs were significantly higher than those of cattle because farmers keep cattle mainly for draft power, transport, as well as dowry payment. As such, farmers slaughter cattle only during special events such as weddings and traditional ceremonies, whereas small livestock are also slaughtered to meet household nutrition needs. Small livestock sales were high as farmers sell cattle to address specific household needs that require substantial cash and these needs are highly seasonal (Lubungu et al., 2015) while they sell small livestock to address household needs that require less cash.

Furthermore, households tend to sell small livestock to pay for their cattle's drugs and veterinary services. Though consumption and sales reduce small livestock's herd size, they are critical in addressing households' cash and nutrition needs. Thus, dealing with the challenges associated with high mortality rates and low reproduction rates can in part contribute to the well- being of the smallholder farmers through increased income and improved nutrition from the sale and consumption of small livestock, respectively.

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Compliance with ethical standards

Conflict of interest: The author declares that she has no conflict of interest.

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4.0 GENDER RELATIONS IN CATTLE PRODUCTION IN ZAMBIA

Mary Lubungu, and Regina Birner

Abstract

In recent years, women's empowerment has been a topical issue on the global development agenda, and evidence suggests that ownership of assets leads to intra-household empowerment. In smallholder rural households, large assets such as cattle are considered valuable assets as they provide multiple benefits. Therefore, this study is interested in understanding female ownership of this particular asset since several studies show gender asymmetry in cattle ownership. Addressing this knowledge gap requires first the identification of the pathways through which female household member acquire cattle and understanding what female ownership means from a gender perspective; then determining the factors associated with the proportion of cattle owned by female household members, and lastly determining if the share of cattle owned by female household members is correlated with cattle herd productivity and female empowerment. We used a mixed-methods approach to address the study objectives. Our qualitative findings suggest that though women can acquire cattle through various means, they never have full ownership. The quantitative estimations show that even though females are likely to own cattle, the likelihood to increase the share of cattle is less due to the perceived intrahousehold conflicts that are likely to ensue. This suggests that the cattle ownership gender gap is likely to continue to persist. We also find an insignificant negative correlation between female cattle ownership and cattle herd productivity. However, we find that female headship, education, cattle mortality, and birth rates are the key drivers of productivity. Conversely, women empowerment is positively correlated with female cattle ownership. Finally, we discuss how these findings could help the development programs that focus on women.

Keywords; cattle; female ownership; productivity; empowerment; Zambia

4.1. Introduction

In recent years, the interest in gender mainstreaming in development programs has been a topical issue, and in 1995, governments across the globe and other stakeholders committed themselves to a global agenda of empowering women (United Nations, 1996). Since then, the global goals have continued to further the women empowerment campaign, as evidenced in the fifth sustainable development goal. Achieving this goal is often associated with positive development outcomes at an individual and societal level (Duflo, 2003; Deere and Doss, 2006). Therefore, finding alternative ways of empowering, especially rural women, continue to be at the core of global policy debates.

There are many ways rural women can be empowered, and increasing evidence suggests that building their asset portfolio is one of the means of empowering them. The literature on gender and asset shows that ownership of assets leads to intra-household empowerment (Meinzen-Dick et al., 2011; Deere and Doss, 2006; Valdivia, 2001). Among different farm assets at the disposal of rural households, livestock, particularly large animals such as cattle, are considered valuable farm assets (Tolera and Abebe, 2007; Deere et al., 2012). These animals provide multiple benefits such as manure, draft power, transport, milk, social status, and serve as a store of wealth to rural households. In Zambia, for example, research shows that trained oxen are the most common farm asset rural households own (Chapoto and Zulu-Mbata, 2016).

Because of this asset's importance, this study is particularly interested in understanding female ownership of cattle.

Despite the importance of owning cattle, previous empirical studies on gender and livestock ownership show fewer women own cattle in many developing countries. Sex-disaggregated data on cattle ownership, for example, in Nicaragua, shows that out of 100, 266 cattle owning households, only 13.5% of women had cattle (Deere et al., 2012). In Tanzania, Njuki and Mburu (2013) found that women owned cattle just in 7.4% of the 237 sampled households. Even when the data is disaggregated by the gender of the household head, studies show that fewer female-headed households own cattle than their male-headed counterparts. For instance, in Zambia, 23.4% of female-headed households own cattle against 33.4% of male-headed households (Chapoto and Zulu-Mbata, 2016). Furthermore, despite a few women participating in cattle production, they also own only a smaller cattle fraction. In Zambia, for instance, women own about 20% of the national cattle population (Lubungu and Mofya-Mukuka, 2012). Similar trends are observed even in other countries such as Botswana (Oladele and Monkhei, 2008) and Gambia (Jaitner et al., 2003). Therefore, the observed asymmetry in gender cattle ownership is an essential attention-worthy matter and justifies the need to identify the alternatives that would bridge the gap.

However, addressing this problem requires a better understanding of what cattle ownership means, especially from the gender perspective and the pathways through which women acquire cattle, as this can help them secure, build and safeguard their cattle. According to Johnson et al. (2015), the local definition of assets tends to shape the intra-household distribution of the assets, and this ultimately has a bearing on women's asset ownership. However, Galiè et al. (2015) show that the term ownership is ambiguous because the meaning is constructed according to the geographical location, gendered perception of knowledge, or legal rights.

Second, it is essential to identify the factors that are significantly associated with the share of female cattle ownership in order to identify specific strategies that can enhance female ownership. Though previous empirical studies on this topic provide valuable information, they have examined female ownership as a binary variable identifying only the factors that are likely to affect cattle ownership by female household members and not factors that increases their share (Njuki and Mburu, 2013). As shown in this study, the driving factors for cattle ownership are different from the factors associated with the extent of the share of ownership. In addition, most studies limit their gender analysis to the household headship (Debela, 2017). A potential drawback of this approach is that it partially analyzes gender gaps because women's position in male-headed households is not accounted for (Deere et al., 2012). To deal with this approach's downside, researchers recommend intra-household gender analysis though most of the studies have focused on the women within the male-headed households (Deere et al., 2012; Njuki and Mburu, 2013). Thus to account for women in female-headed households, this study focused on households that have both male and female adults (18+ years) because the presences of male household members also tend to affect the accumulation of assets in the female-headed household (Debela, 2017; Tegebu et al., 2012).

Lastly, though it is widely recognized that female ownership of assets is one of the keys to women's empowerment, it is not clear how female cattle ownership is associated with women's bargaining power in the household. Studies have also shown that as women's status improves, agricultural productivity also increases (Malapit et al., 2014). However, it is not well known if female cattle ownership is correlated with cattle herd productivity.

Against this backdrop, the objectives of the paper are threefold;

i) To identify the pathways through which female household members acquire cattle and define cattle ownership from a gender perspective.
ii) To determine the factors associated with the proportion of cattle owned by female household members; and
iii) To determine if the share of cattle owned by female household members is correlated with cattle herd productivity and female empowerment.

By conducting this study, we contribute to the gender and livestock discourse by unlocking what female cattle ownership mean. Also, we disentangle specific covariates that affect female cattle ownership from those associated with the increase in the proportion of cattle they own. To achieve this, we used the Zero-One Inflated Beta (ZOIB) model, whose detailed exposition is presented in section 4.3. Addressing this knowledge gap is essential, especially for the interventions that focus mainly on female household members, as the results have implications for better designing developmental programs.

The rest of the paper is organized as follows. The next section discusses the conceptual framework, while the subsequent sections present the methods used to collect and analyze the data, the results, and discussions. The last section concludes and provides the recommendations.

4.2. Conceptual framework

This section has two parts. The first part focuses on the theoretical insights and challenges of defining ownership. In the second part, we conceptualize our study using the gendered livelihood framework. Both sections guided the empirical estimations.

4.2.1. Theorizing ownership of cattle

Ownership is defined as the possession of rights over a resource or asset (Sheehan, 2011). In legal terms, ownership is often expressed through a metaphor as bundles of rights. This definition entails that ownership is a collection of rights that define and stipulate the owner's privileges and limitations for using a particular resource/asset (Demsetz, 1974), and this might change over time. Since there are many rights within the bundles of rights, Schlager and Ostrom (1992) distinguish them as the use rights (the ability to benefit from an asset) and decision-making rights (ability to make decisions). Based on this distinction, one can possess the following rights over cattle.

- Right to use (milking the cow, use ADP)
- Right to manage (having input in production decisions)
- Right to the cattle income
- Right to bestow (deciding who inherits the cattle)
- Right to alienate (deciding to sell cattle)

Considering "use or access" rights and "control or decision making" rights together may help to establish the nature of asset ownership. However, within these rights, an individual may possess all or some of the rights for any given asset. Because of the bundles of rights' divisibility, defining the concept of ownership

becomes difficult. Owing to this complexity of defining ownership, Doss et al. (2015) have suggested three ownership measures. The first measure is referred to as reported ownership. This is self-reported ownership as it is based on what the household reports as who owns an asset. This measure is not adequate because different household members can hold different rights over an asset (Meinzen-Dick et al., 2011). The second measure is documented or legal ownership. This definition of ownership implies that an individual has some form of documentation "title," which indicates the rightful owner of an asset. Legal ownership is mainly applicable to assets such as land or vehicles. In the case of cattle ownership, especially among smallholder farmers, there is no legal documentation to show the rightful owner. The last measure is effective ownership, whereby someone can make decisions over the use or sale of an asset. In line with this definition, Marks and Davis (2012) also identify controlling and investing oneself as some of the critical elements that yield a sense of ownership. Thus participation in the decision-making and contribution of female labor can, in part, develop a sense of ownership of cattle.

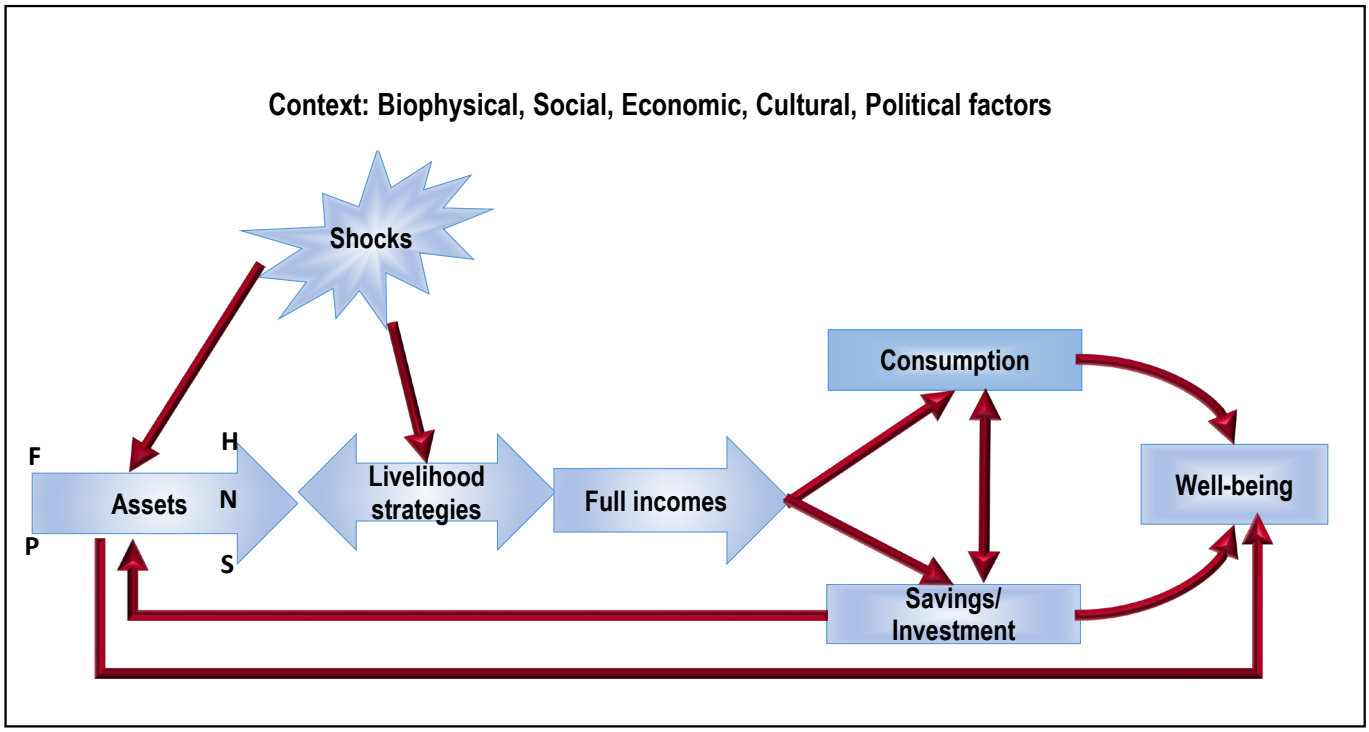
Therefore, in this study, we adopt the first and third definitions since it is not common for smallholder households to have legal documentation of cattle ownership. We go by the two definitions because, even though female household members may own cattle as reported by the households (first definition), they may not have the use and control rights over cattle, as suggested by the third definition.

4.2.2. Gendered sustainable livelihood conceptual framework

In this study, we adopted the gendered sustainable livelihoods framework, which Meinzen-Dick et al. (2011) refer to as the Gender, Assets, and Agricultural Programs (GAAP) framework (Figure 4.1). The integration of gender in the livelihoods framework helps to acknowledge the gender differences in each component of the framework. Therefore, as each element is viewed through a gendered lens, it helps identify the underlying causes of the differences and the possible ways of addressing them.

The logic behind this framework is that households operate in a more dynamic environment that could affect how individual household members acquire productive assets such as cattle and define how the roles and responsibilities are shared within the household. For example, the geographical landscape may affect livestock types that women and men own due to differences in resource endowments. The contextual factors also affect livelihood strategies, which are decisions that individuals or households make about what kind of investments they make concerning their cattle that ultimately contribute to the household's overall well-being.

Owning cattle may directly impact individual household members' well-being through the increased status and empowerment that cattle ownership brings about. Second, cattle ownership is also a key indicator of well-being as it can generate incomes that can be spent either on consumption needs or reinvested in building a productive cattle herd. In particular, female household members' ability to contribute to the household's well-being strengthens their position within the household and can influence women's bargaining power over how the income is spent. It can also empower women in other aspects, such as increased control over other avenues of income, for instance, crop income.



The gradient indicates that all of the key components may be different for men and women
N=natural capital, H=human capital, S=social capital, P=physical capital, F=financial capital

Figure 4.1. The Gender, Assets, and Agricultural Programs (GAAP) framework

Source: Adapted from Meinzen-Dick et al., 2011

While ownership of cattle affects the accumulation of other assets (referred to as capitals in the framework), different assets at the household's disposal can also affect cattle distribution within a household. For example, the presence of male household members (human capital) could influence the accumulation of cattle by female household members since, in many societies, men tend to own large animals (Debela, 2017; Tegebu et al., 2012). In addition, while access to financial capital may facilitate cattle acquisition, skilled human resources may be needed to manage cattle. Lastly, cattle ownership can provide a buffer against different shocks, such as climate variability or a sudden shift in policies that threaten household livelihood strategies.

We used this framework to guide our empirical estimation and test the following hypotheses.

i. The factors that affect female cattle ownership are the same as those affecting the extent of the share owned by female household members. We focus on the following factors - position of female members, the proportion of male household members, the share of crop income controlled by female members, household cattle herd size, and ownership of other livestock species.
ii. Female ownership is not correlated with cattle herd productivity
iii. Female cattle ownership is not associated with the decision over the sale of cattle
iv. There is no association between female cattle ownership and the level of crop income controlled by women.

4.3. Materials and methods

4.3.1. Research design

A mixed-methods research approach was used in this study. We employed the qualitative interpretative approach to explore the different female cattle ownership pathways and what ownership means. The quantitative method was utilized to determine the factors that are significantly associated with the share of female cattle ownership and its association with herd productivity as well as female empowerment. The study used longitudinal household survey data that was collected from smallholder farmers in Zambia.

4.3.2. Data collection methods

To address the first objective, which is what female cattle ownership means and how women acquire cattle, we collected qualitative data in eight districts of Zambia (Figure 4.2). The percentage of households keeping cattle guided the selection of the districts (Figure 4.3). In each of the six district-Chipata, Petauke, Mbala, Chibombo, Namwala, and Kalomo, four households were selected using theoretical sampling for in-depth interviews. These are households that owned cattle and had both male and female members. Both female and male household members were allowed to take part in the interviews. Particularly, information on how female household members acquired cattle and their involvement in the management and control decisions were solicited. Insights from the individual household interviews were cross-checked during the focus group discussions. We conducted ten focus group discussions (FGDs) - five with women and five with men in five districts. Participants of FGDs were chosen based on their knowledge of various aspects of female cattle ownership. Additional information was obtained from key informant interviews, which included four traditional leaders and district veterinary officers. Traditional leaders were interviewed on how cultural issues affected women's cattle ownership, while interviews with veterinary officers pertained to training and their expert opinion on female cattle ownership.

Lastly, we talked to a women's club in Chongwe district. This women group was of particular interest because the club members had previous experience in cattle keeping, even though the current project (as of 2016 when the study was conducted) they were keeping goats. It was interesting to learn from the group why they decided to opt for goats and not cattle after receiving a grant from the World Bank through the Ministry of Agriculture and Livestock under the Livestock Development and Animal Health Project. The interviews were carried out in October and November 2016. In each district, we spent at least a week-long visit.

The second objective was addressed through the use of the national longitudinal representative Rural Agricultural Livelihood Survey (RALS) that was conducted by the Central Statistical Office (CSO), together with the Ministry of Agriculture (MoA) and the Indaba Agricultural Policy Research Institute (IAPRI) in Zambia. The first wave of the survey was conducted in 2012 from 8,039 households. In 2015, the same households were followed, and 7 254 were successfully re-interviewed. Of the 7 254 households, 1, 875 and 1, 991 households owned cattle in 2012 and 2015. These households also had at least both male and female adult members. The crop income and cattle herd size variables were scrutinized for outliers, and seven observations were dropped, leaving a pooled total sample of 3,859 observations. The outliers were eliminated to reduce the white noise in the data. For details on the sampling and data collection procedure, see RALS 2015 survey report by Chapoto and Zulu-Mbata (2016).

In addition to the RALS data, we collected additional information on decision making and cattle-related activities from 271 households who participated in the 2015 RALS. This supplementary information was collected during a cattle household survey, which was conducted in 2016. These households were followed in Chibombo, Mbala, Kalomo, Namwala, and Petauke districts, which were part of the areas we collected the qualitative information.

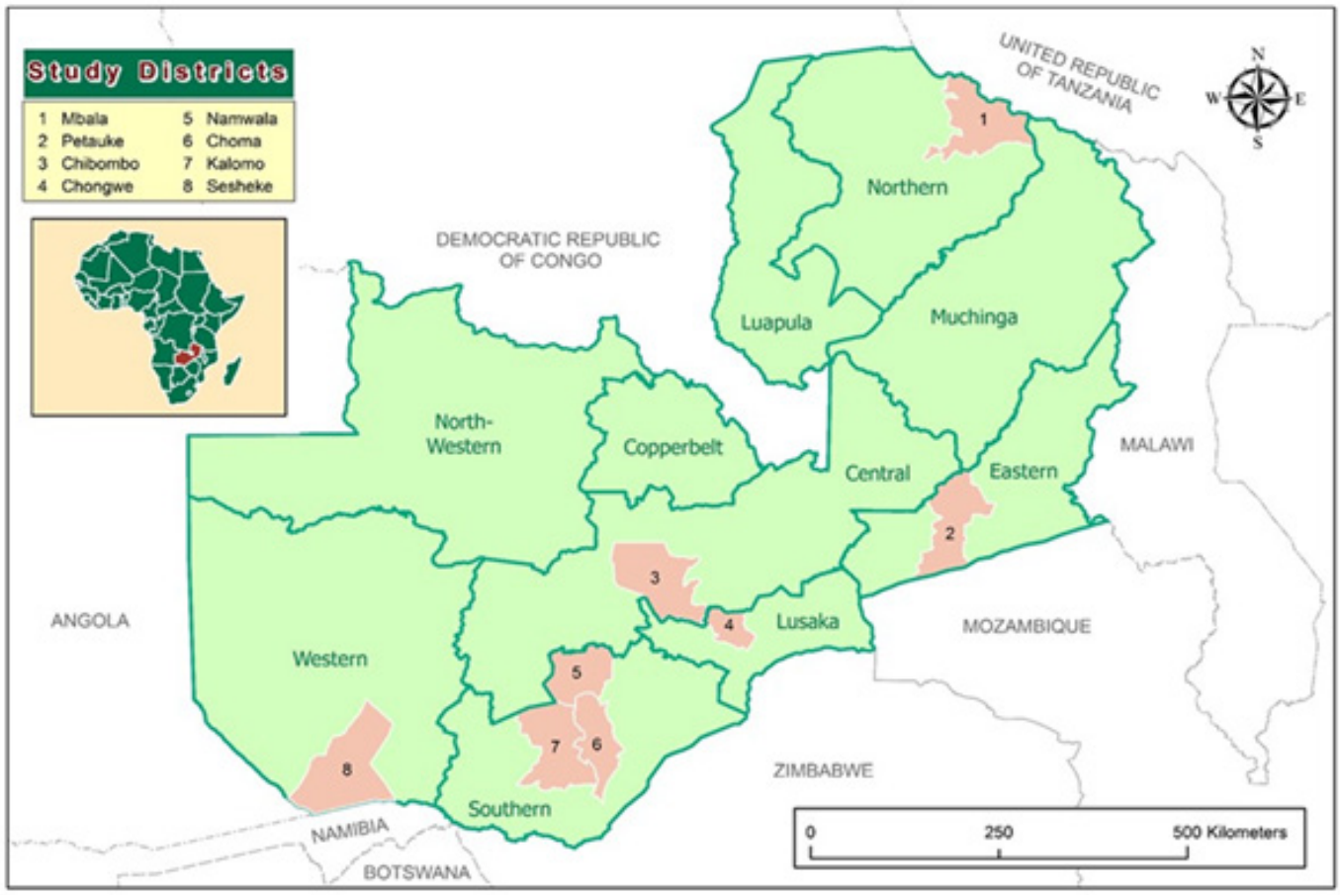


Figure 4.2. Map of the study districts

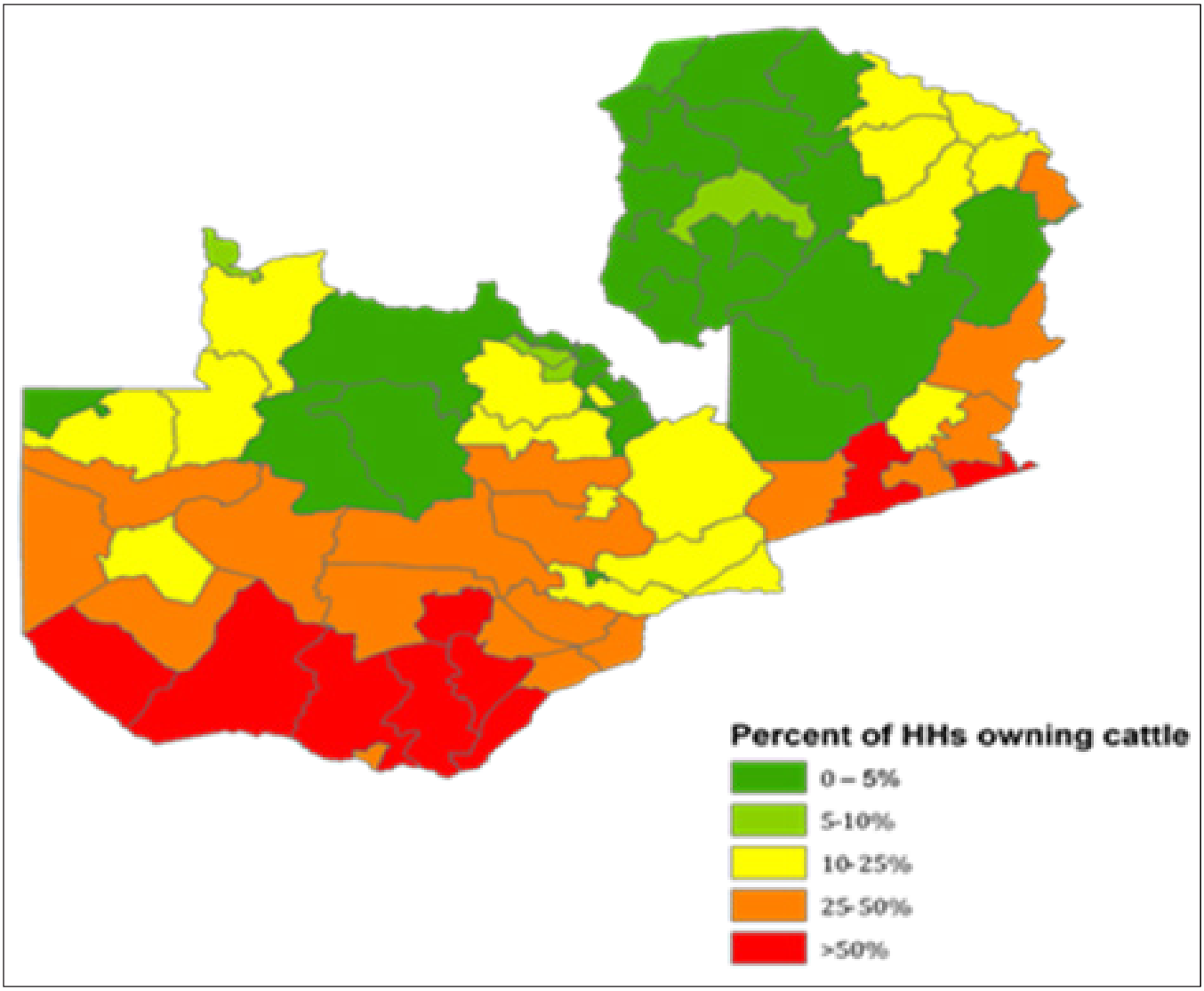


Figure 4.3. Geographical distribution of households owning cattle

Source: Lubungu et al., 2015

4.3.3. Analytical methods

A combination of analytical methods was employed to address the research objectives.

Objective 1

The qualitative data collected through focus group discussions and in-depth interviews were analyzed using content and causal narrative analysis. Content analysis was employed to interpret the meaning of qualitative data. For more insights about the method, the reader is referred to Hsieh and Shannon (2005). The theoretical insights discussed in section 4.2 guided the classification of the information collected from different interviews into much smaller categories. While the content analysis helped classify the data, the causal narrative analysis helped to understand the reasons behind the observations in the data.

Objective 2

To identify the factors associated with the proportion of cattle owned by female household members, we employed quantitative econometric methods. Because the proportion of cattle owned is bounded from 0 to 1 and cannot take on any value outside this interval, it makes it a limited dependent variable.

Several approaches have been suggested and employed to analyze data with a fractional response variable. Some studies have used ordinary least squares (OLS) to estimate the coefficient of the proportional data (Kieschnick and McCullough 2003). However, modeling the proportion of cattle owned by female household members as a linear function of covariates violates the classical linear regression function's assumptions and yields biased, inconsistent estimates (Buis 2010; Kieschnick and McCullough 2003).

A potential solution to address these problems is to perform a logit transformation on the response variable (Eq 1) and then implement the OLS.

$$y^* = \log\left(\frac{y}{1-y}\right) = X\beta + \varepsilon \quad (1)$$

However, the challenge with this transformation is that it is not feasible to transform the observations where the female cattle ownership is 0 or 1 because the logit transformation is not defined for these values. Though some researchers recommend the use of censored normal regression models, such as the Tobit functional form, however, employing a censored regression model in this study can be problematic because the share of female cattle ownership data is not observationally censored but instead are defined only over the interval (0, 1). Thus values outside this interval are not feasible (Baum 2008). Another potential drawback of using the Tobit model is that it is a single mechanism that restricts the factors that influence whether a female household member owns cattle and the extent to be the same.

To remedy the drawbacks of censored regression models, a fractional logit approach was developed to model fractional response data (Papke and Wooldridge 1996). However, this model is limited as it fits a single model even when different factors affect zero or 100% ownership of cattle by female household members. Therefore, fitting a single model would raise the sample selection bias problem and yield inconsistent estimates. Also, given that the visual inspection of the proportion of cattle owned by female household members shows a pile at zero (Figure 4.4) suggests that different factors could affect the observation at the limit points.

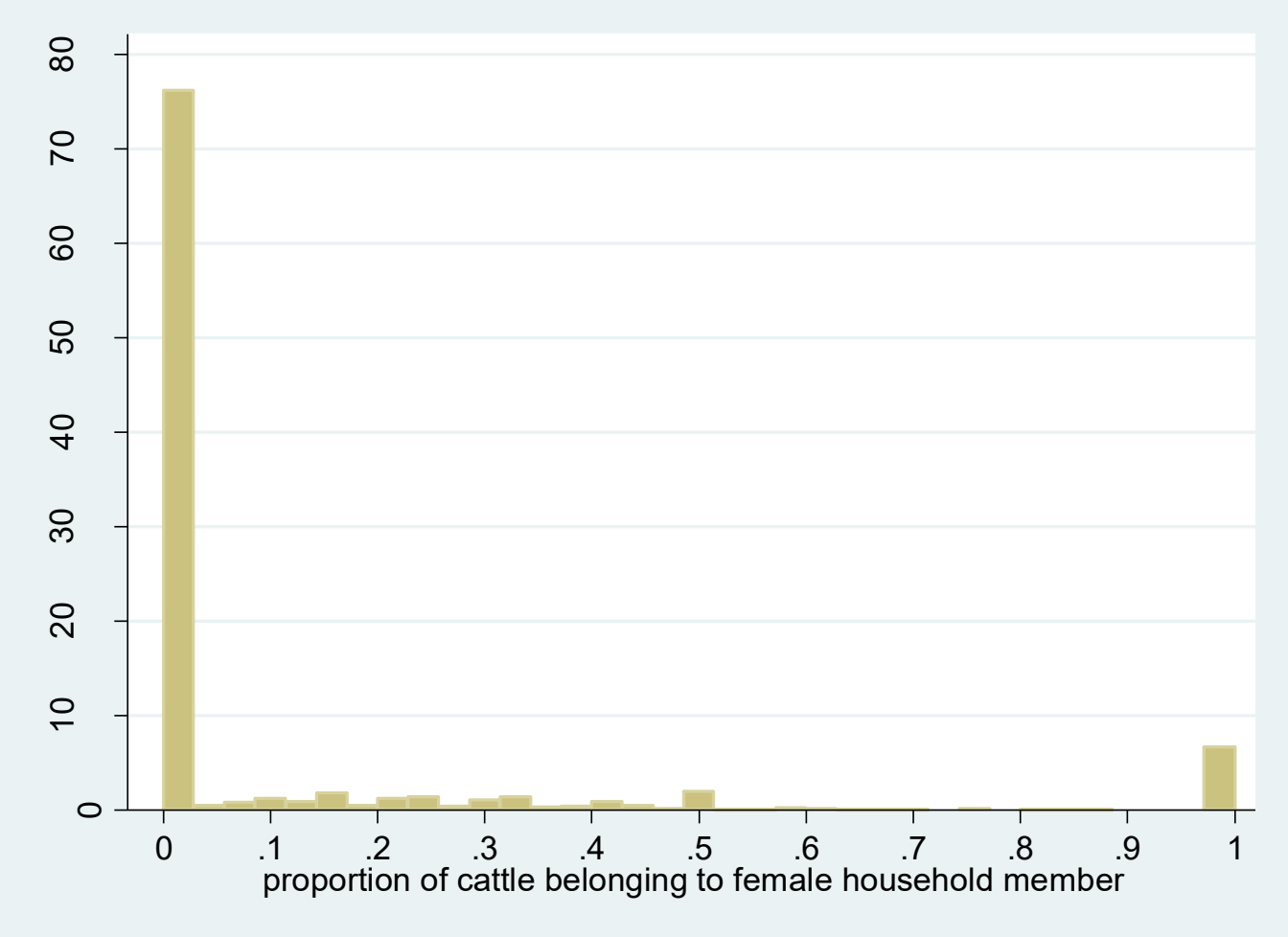


Figure 4.4. The proportion of cattle owned by female household members

Therefore, we employed a mixed discrete-continuous distributional model termed as the zero-inflated beta (ZOIB) model developed by Cook et al. (2008). For more details about this approach, see Ferrari and Cribari-Neto (2004). This approach allows the coefficients of exogenous variables to differ in their effect on whether or not the proportion of cattle owned by female household members is equal to 0 from whether or not the proportion lies between 0 and 1 and whether the proportion is equal to 1.

We specify our zero-one inflated beta regression model as follows

$$logit(\pi_0) = \delta_0 + \boldsymbol{\delta}'\boldsymbol{X} \quad (6)$$

$$logit(\mu) = \beta_0 + \boldsymbol{\beta}'\boldsymbol{X} \quad (7)$$

$$logit(\pi_1) = \alpha_0 + \boldsymbol{\alpha}'\boldsymbol{X} \quad (8)$$

Where equation 6 estimates the probability of female household members having zero share of cattle, equation 7 estimates the probability of female cattle ownership lying between 0 and 1, and equation 8 models the probability of female household members owning 100% of cattle. δ,β,α, are parameter estimates while **X** are covariates defined in section 4.4. To help interpret the coefficients, we computed the marginal effects. The computation of the estimates where performed as a single equation in Stata via Maarten Buis's zoib program.

Objective 3. Determining whether female cattle ownership is associated with cattle herd productivity and female empowerment.

Female cattle ownership and cattle herd productivity

To analyze the association between female ownership and herd productivity, we first compute annual herd size growth as a proxy of cattle herd productivity. Eq. 9 shows the general computation of the annual growth rate proposed by Lesnoff et al. (2011).

$$Annual\ herd\ growth = \frac{closing\ stock - opening\ stock}{opening\ stock} \quad (9)$$

We deviate from Eq. 9 by taking into account the number of cattle sold during the 12 months. We do so based on the assumption that the cattle sold contributed to the household welfare, and if they were not sold, they would still be part of the herd. This yields Eq. 10.

$$Annual\ herd\ growth = \frac{(closing\ stock + number\ sold) - opening\ stock}{opening\ stock} \quad (10)$$

To determine whether female cattle ownership is associated with cattle herd productivity, the following simple regression model (Eq. 11) can be estimated

$$herd\ growth_i = \alpha + \beta_1 X_i + \mu_i \quad (11)$$

Where X is the share of cattle owned by female household members. We cannot interpret β as a causal effect but rather as an association since other factors affect herd productivity. α is the effect of male ownership on cattle productivity while β_1 is the difference in cattle herd productivity between female and male cattle shares. Estimating either Eq.11 yield bias estimator due to omitted variables. We control for this problem by incrementally including the control variables in the model. Inclusion of X_2 (say the age of household head) in Eq. 12, for example, determines whether the effect of β_1 (proportion of cattle owned by female household members) are independent or not of the effect of β_2 (age of household head). If the effect of the share of cattle owned by female members reduces in magnitude by the addition of the variable age of household head, then it merely means a negative correlation exists between the two variables while an increase in the effect of the share of cattle owned by female members means a positive association. If β_1 becomes insignificant, then the difference in herd productivity is associated with X_2. We estimate Eq 12 using the Pooled Correlated Random Effect (PCRE) approach, which allows us to include time averages of time-varying variables as additional regressors. The inclusion of these regressors controls for time-constant omitted variables (unobserved heterogeneity). The advantages of this approach over other panel estimation techniques are documented by Wooldridge (2010).

$$herd\ growth_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \mu_i \quad (12)$$

Female cattle ownership and empowerment

We estimate two models for this part of objective 3. The decision to sell cattle by female household members and the level of crop income they control were used as proxies for empowerment. We use the PCRE probit model to estimate the association between female ownership and decision making, while PCRE was used to estimate the association between female cattle ownership and control of crop income presented in Eq. 13 and 14, respectively.

$$decsion\ marker_i(=1\ female) = \alpha + \omega_1 X_1 + \boldsymbol{\omega'X} + \varepsilon_i \quad (13)$$

$$crop\ income\ controlled\ be\ female_i = \alpha + \gamma_1 X_1 + \boldsymbol{\gamma'X} + e_i \quad (14)$$

Where X_1 the proportion of cattle owned by female household members, $\boldsymbol{X}$ are other covariates, and ω and γ are parameters to be estimated.

4.3.4. Variable definitions

The conceptual framework and qualitative research results guided the selection of covariates to include in the models. These factors included human, financial, physical, and location variables.

Response variables

Female cattle ownership is the share of cattle owned by female household members. Herd productivity is as defined in the preceding section. Female empowerment is the female decision-maker in the sale of cattle and the level of crop income controlled by female household members.

Covariates

Human capital variables are individual female level factors that are expected to influence the ownership of cattle. We include the following variables in our estimation. The age of the oldest female household member is expected to have a positive association as older female household members are expected to make rational decisions. The position of female household members in the household (female head and female spouse) also matters. We expected a positive association between female-headed households and cattle ownership since they are most likely to assume the decision-makers' role in their households.

On the other hand, female spouses are likely to have less share of cattle as their male spouses assume the decision-maker's role. Female household members' highest education level is postulated to positively associate with cattle ownership because education indicates an individual's capability to comprehend and make rational investment decisions. Female household members in polygamous marriages are less likely to own cattle because, in most cases, they have less voice in the households. Household composition (proportion of male household members) is expected to negatively associate with female cattle ownership since, in many cultures, cattle are given to male children.

The financial capital variables included the proportion of crop income controlled by female household members. Based on the qualitative results, crop production incomes mainly finance the acquisition of cattle's initial stock. We postulated a positive association between the level of crop income controlled by female household members and female cattle ownership.

Physical assets include ownership of other livestock, which was expected to associate with female cattle ownership positively. A total Tropical Livestock Unit (TLU) for other livestock (sheep, goats, pigs, and village chicken) belonging to female household members was computed. The asset ladder theory shows that women who own small assets are likely to accumulate larger assets as their bargaining power is strengthened. In addition, we hypothesized that the total cattle herd would have a positive association with the share of female cattle ownership.

To control for spatial effects, we include provincial dummies in the models. We expect that female ownership will be positively associated in provinces where cattle production is high. As such only four provincial dummies that are considered as cattle-producing areas were included in the estimation.

In addition to these variables, we include cattle mortality and birth rates to estimate the association between female ownership and cattle herd productivity. Cattle mortality is computed as cattle death divide by the average of opening and closing stock, while the birth rate is cattle born divided by the average of opening and closing stock.

The summary statistics of the variables used in the estimation are presented in Table 4.1.

Table 4.1. Summary statistics of the variables

Variable	N	Mean	Std deviation	Min	Max
Response variables					
Proportion of cattle owned by female HH members	3859	0.12	0.27	0.00	1.00
Cattle herd productivity	3859	0.19	0.57	-0.93	15.25
Female making decision to sell cattle (women empowerment)	3859	0.07	0.26	0.00	1.00
Level of crop income controlled by female (ZMK)	3859	502.25	2120.73	0.00	43746.40
Human capital					
Female headed HH	3859	0.06	0.23	0.00	1.00
Female spouse	3859	0.84	0.36	0.00	1.00
Females members in polygamous marriage	3859	0.20	0.40	0.00	1.00
Maximum education attained by female members (years)	3859	6.61	3.34	0.00	18.00
Age of oldest female members (years)	3859	43.14	14.24	18.00	102.00
Proportion of male HH members	3859	0.52	0.16	0.10	0.89
Financial capital					
Proportion of crop income controlled by female HH members	3859	0.12	0.29	0.00	1.00
Physical capital					
Cattle herd size	3859	9.74	15.78	1.00	244.00
TLU (excluding cattle)	3859	0.51	1.15	0.00	22.12
Provincial location					
Central (=1, 0 otherwise)	3859	0.12	0.32	0.00	1.00
Copperbelt (=1, 0 otherwise)	3859	0.03	0.17	0.00	1.00
Eastern (=1, 0 otherwise)	3859	0.37	0.48	0.00	1.00
Luapula (=1, 0 otherwise)	3859	0.01	0.07	0.00	1.00
Lusaka (=1, 0 otherwise)	3859	0.02	0.15	0.00	1.00
Muchinga (=1, 0 otherwise)	3859	0.04	0.19	0.00	1.00
Northern (=1, 0 otherwise)	3859	0.03	0.18	0.00	1.00
North western (=1, 0 otherwise)	3859	0.02	0.15	0.00	1.00
Southern (=1, 0 otherwise)	3859	0.26	0.44	0.00	1.00
Western (=1, 0 otherwise)	3859	0.09	0.29	0.00	1.00

HH=household; ZMK=Zambian Kwacha

4.4. Results

This section presents the findings of the study. As a prelude to quantitative estimations, we first present the different pathways through which female household members acquire cattle and how female ownership is defined. This is followed by the empirical evidence of the factors associated with female cattle ownership, the correlation between female ownership and herd productivity, and female empowerment.

4.4.1. Pathways of female cattle ownership

The results from FGDs and individual interviews revealed that female household members acquire cattle through various means, and Figure 4.5 presents these different pathways.

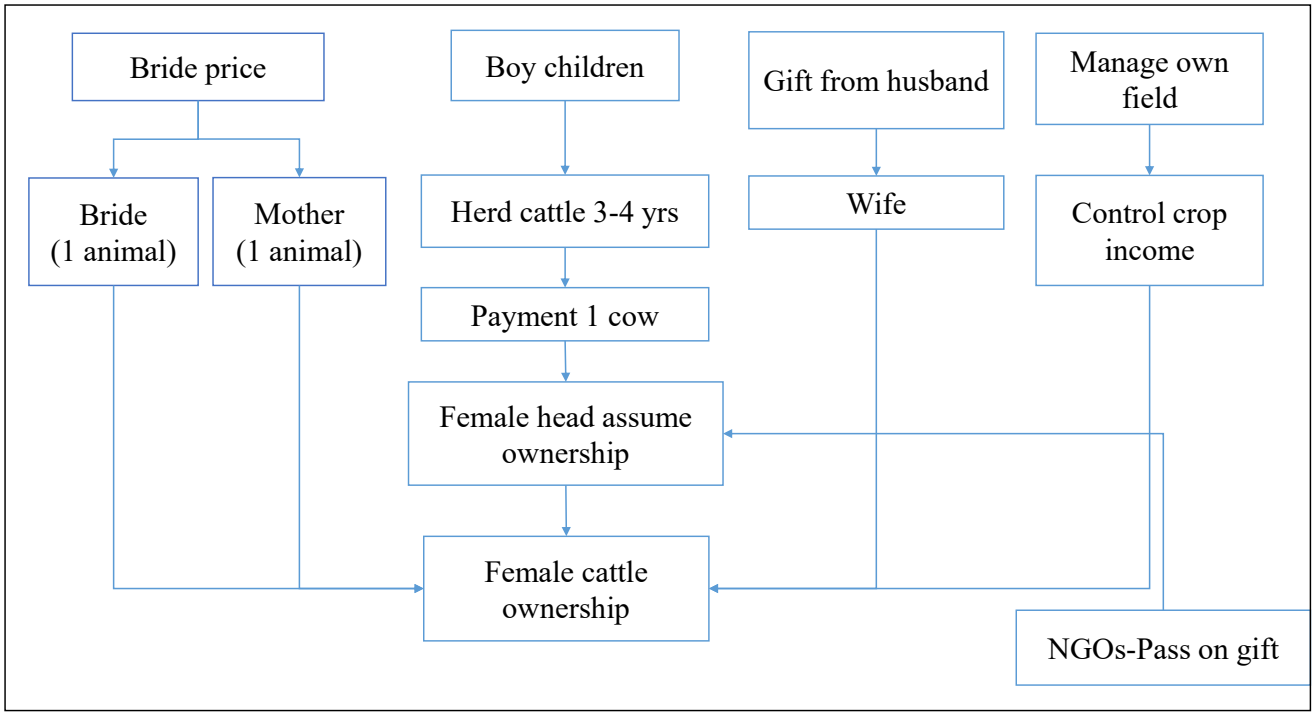


Figure 4.5. Pathways through which female members acquire cattle

Source: Authors construction based on field interviews

First, women can acquire cattle through the bride price payment, especially among the cultures still using cattle as a form of payment. The bride's mother and the bride herself each receive one cow from the bride's price. This practice is shared among the Tonga and Illa speaking people of the southern province[2]. Though cattle are equally important for dowry or "damage" payments in other regions, the female household members do not have any share[3]. For example, in Mbala district, one or two animals are paid as dowry, while Petauke district households request one or two cattle for damage payments.

The other mean of female cattle acquisition is through the boy children who engage in cattle herding. The boys work for other families on a contract basis of 3 to 4 years, and at the end of the contract period, they are paid a cow. In some cases, the female adult may assume ownership. This system is typical in the Petauke District of the Eastern province.

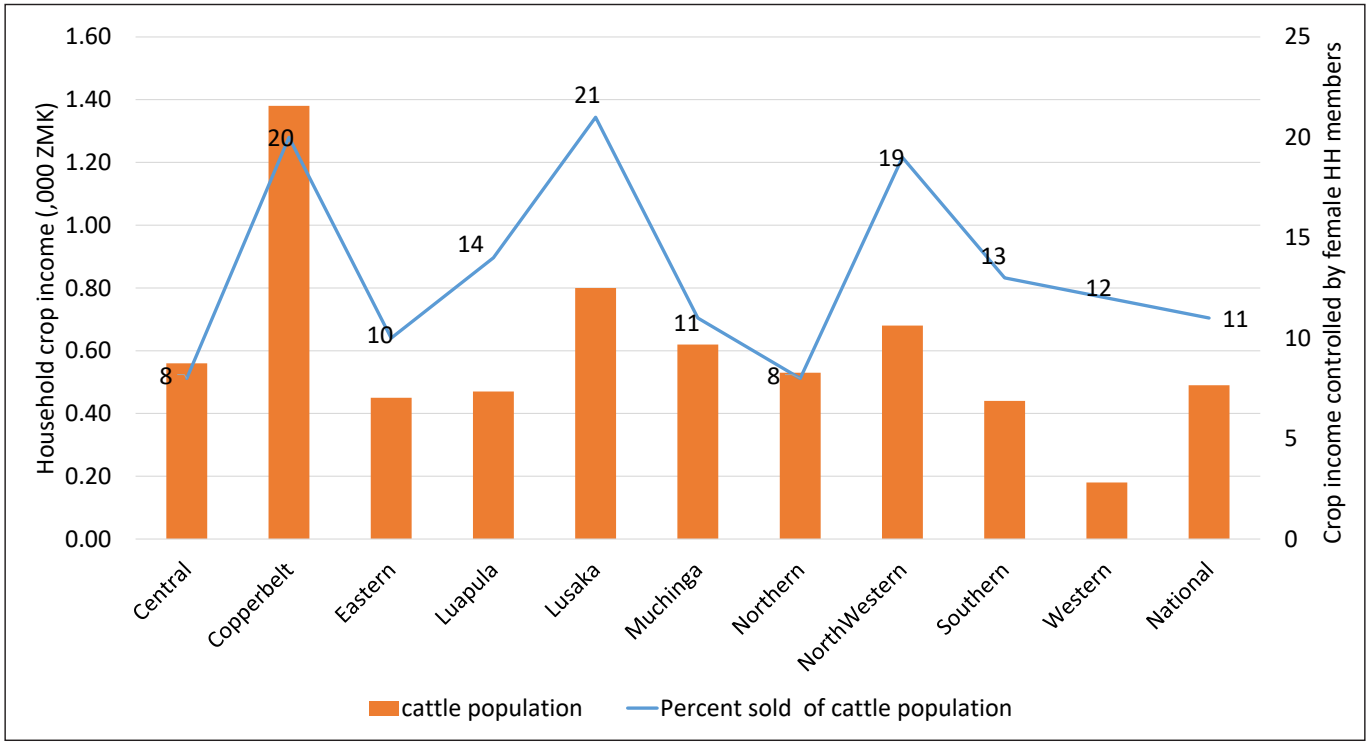
[2] In Namwala district, for example, dowry payments attract a minimum of eight cattle while in Kalomo district, at least four animals are paid. Both districts are in Southern province

[3] The man pays damage to the woman's family if he impregnates her before marriage.

Cattle given as a gift to a spouse is another way female household members acquired them. According to male respondents, the husband would only give cattle to a submissive wife to appreciate her, which is done mainly after the herd has increased to a reasonable number.

Female household members also acquire cattle through grants and funded projects as pass on gifts. These are mainly projects that support women to improve their household income and nutrition. Some of the projects that have benefited the women include pass-on gift under Heifer International and World Vision.

Lastly, purchases are another channel through which women can acquire cattle. Crop proceeds mainly finance the acquisition of the initial stock of cattle. Insights from FGDs and individual interviews revealed that crop income could only contribute to female cattle ownership if women cultivated their field and controlled their income. However, most households have at least one field in which all households' members contribute to their labor. Male members primarily provide labor activities for land preparations, while female members mostly do the planting, weeding, and harvesting. Despite this labor division, the control of proceeds is not proportionally shared as women have less control over the earnings from crop income. In the 2015 RALS survey, respondents were asked about who made decisions on how to use the crop income, and the result in Figure 4.6 shows that female household members controlled less than a quarter of the total household crop income across the provinces. If men choose to purchase cattle, they also assume ownership. During FGDs and individual interviews, when participants were asked whom the animals belonged to, both males and females said: "the cattle belong to the man." Further probing revealed that women often responded in such a way because men are the head of the households, and women have little to say because they respect their husbands.



ZMK=Zambian Kwacha; HH=household

Figure 4.6. The proportion of crop income controlled by female household members by province

Sources: Author's analysis based on 2015 RALS data

4.4.2. Understanding female cattle ownership

In this section, we present the conception of female cattle ownership from the respondents' perspective and to the extent they possess different rights. According to the individual household in-depth interviews, the respondents referred ownership as cattle belonging to a particular household member, which fits the self-reported ownership definition discussed in Section 4.2. Both male and female household members were able to identify the cattle that belonged to women regardless of the pathway through which they acquired them. The following quote provides an example of self-reported ownership.

Male respondents: We have 12 cattle in our kraal. Last year, we married off our daughter and received four cows as dowry payments. Out of these, my wife and my daughter have each a cow.

Because they were able to self-report ownership, the male respondents had a general view that women should not be allowed to own more cattle than their husbands. Though they could not substantiate their claims with concrete examples, the male respondents categorically stated that women who have more cattle tend to lose respect for their husbands and become less submissive, which is a recipe of tension and conflict in the household. However, women respondents were of the view that men feel intimidated when they are progressing. In this context, progressing meant having more valuable assets than men. Even though there were notable differences in the number of cattle owned by women across the different districts, both women and men expressed the same sentiments about women having more animals than their spouses.

The majority of the respondents also referred ownership to as the ability to make decisions. Table 4.2 shows that women have limited rights because they have to consult their husbands on all aspects of decisions. Though they can initiate the discussion of what to do with their animals, their husbands' ultimate decision is made. On the contrary, women respondents mentioned that men can still decide what to do with their cattle without consulting them. However, men insisted that they consult their women, but further probing from women respondents revealed that men only inform and not necessarily consulting their wives. They referred to informing because women have to accept the decision as it is.

Table 4.2. Female ownership in reference to bundles of rights

	Pathways of female cattle ownership					
Bundles of Rights	Bride price		Boy child	Pass on gift	Purchases	Gift from husband
	Bride	Mother				
Right to use						
Right to manage						
Right to sale						
Right to income						
Right to bestow						

Red no rights; orange limited rights; green have rights

Right to use

Ownership can be associated with one's ability to use cattle (milking, draft power, or transport). The respondents stated that the bride rarely takes the cattle to her husband upon marriage, as she feared to lose it to the husband's relatives upon separation or death of the husband. This practice implies that her relatives manage her cattle, and sometimes her male relatives may assume ownership. Since the animal is left at her parent's place, the bride has no right to use the animal. However, female household members acquiring cattle through other channels have the right to use their cattle, but the male household members mainly do most of such activities. One of the male respondents said;

My wife has a cow, and she always tells me whenever she needs some milk for home consumption. My boys or I milk the animal. In this community, we do not allow our women to milk the animal because the animals can, at times, be crazy and may end up endangering the lives of women.

Right to manage

The majority of the respondents' associated female cattle ownership with a household member's ability to make decisions about and provide labor for cattle management. The activities related to cattle management are presented in Figure 4.7 based on the 271 households interviewed. According to the field interviews, regardless of the channel of acquiring cattle, female respondents said they have limited cattle management rights because men perform most activities. Women felt that they lack technical skills such that they cannot make any meaningful contribution to cattle management. The following quote provides an example of how female members said when asked about cattle management.

Interviewer: What disease preventative measures have you put in place?
Female respondent: I cannot say much, but please let me call my son. He is the one who manages my animals. I only give him the money if the activity requires financial resources.

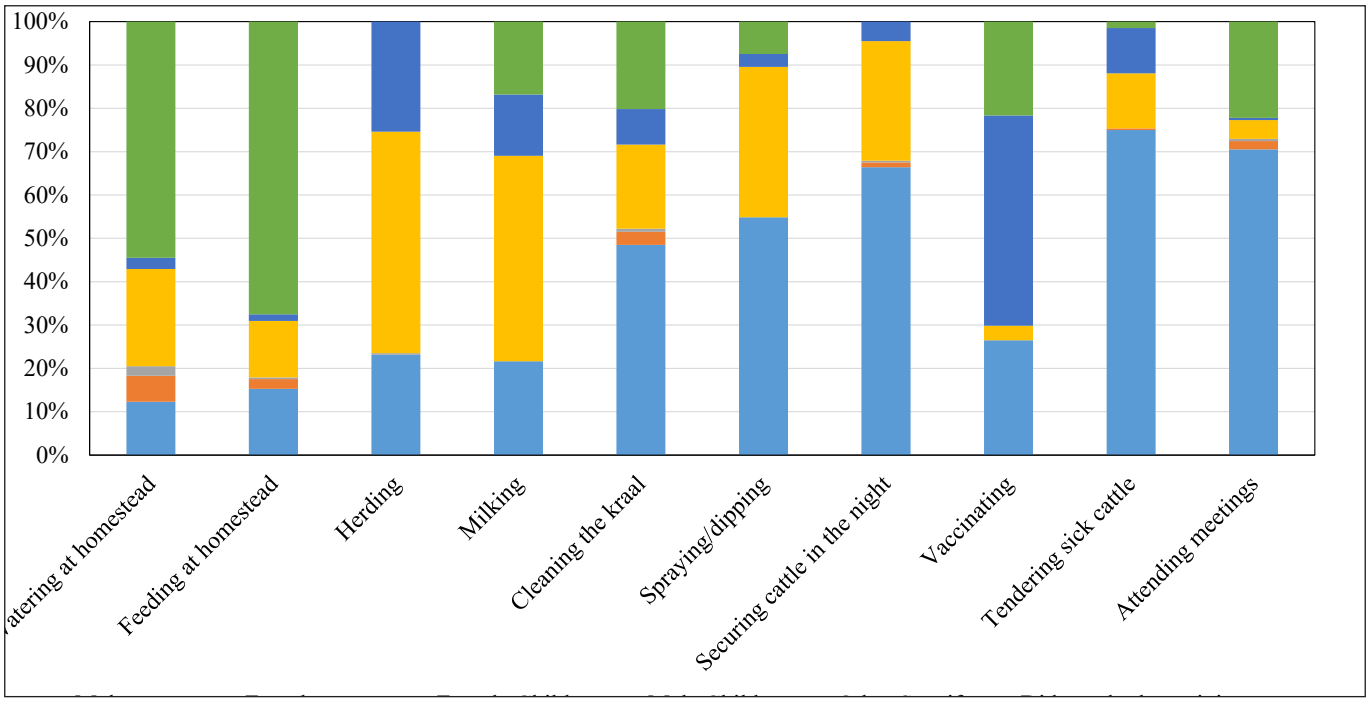


Figure 4.7. Who provides most of the labor in cattle management?

Source: 2016 Cattle household survey data, author's computations

The gender disparities in the allocation of livestock rearing activities reflect what most respondents in the study areas perceived as 'the physical nature' of women and the demand for distinct cattle production roles. Across all the respondents, both male and female, considered raising cattle as a masculine sector because of the nature of the activities involved. In the opinion of some male respondents, they do risky activities such as herding cattle to far-flung areas in search of water and pasture during the dry season, which very few women can perform. Some respondents in Namwala and Chibombo districts said that

We take our cattle to the plains for grazing from May to December each year when there is less pasture on the uplands. It takes us two days to reach the grazing area where we camp and leave our animals to graze for weeks. In this regard, this activity may be inappropriate for women and girls considering their safety.

Female household members do not only provide less labor, but they also have less decision making power regarding who should do which activities (Figure 4.8). Across all the interviews, women argued that most men are more knowledgeable than them, and it is this knowledge that gives men a stronger ability to make decisions about cattle management. Women felt that by virtue of men attending capacity building meetings or training gives them an upper hand in cattle production. Indeed the discussion with the women group that is involved in goat production also echoed the same sentiments. The women's group chairperson said,

Goats do not require complicated management practices and are easier to manage than cattle. Even women who have less knowledge about livestock production can keep goats. However, as for cattle, we need more training, especially that cattle are prone to diseases. We have received cattle before, but most of our cattle died because we lacked technical skills. After all, the program did not include the training component.

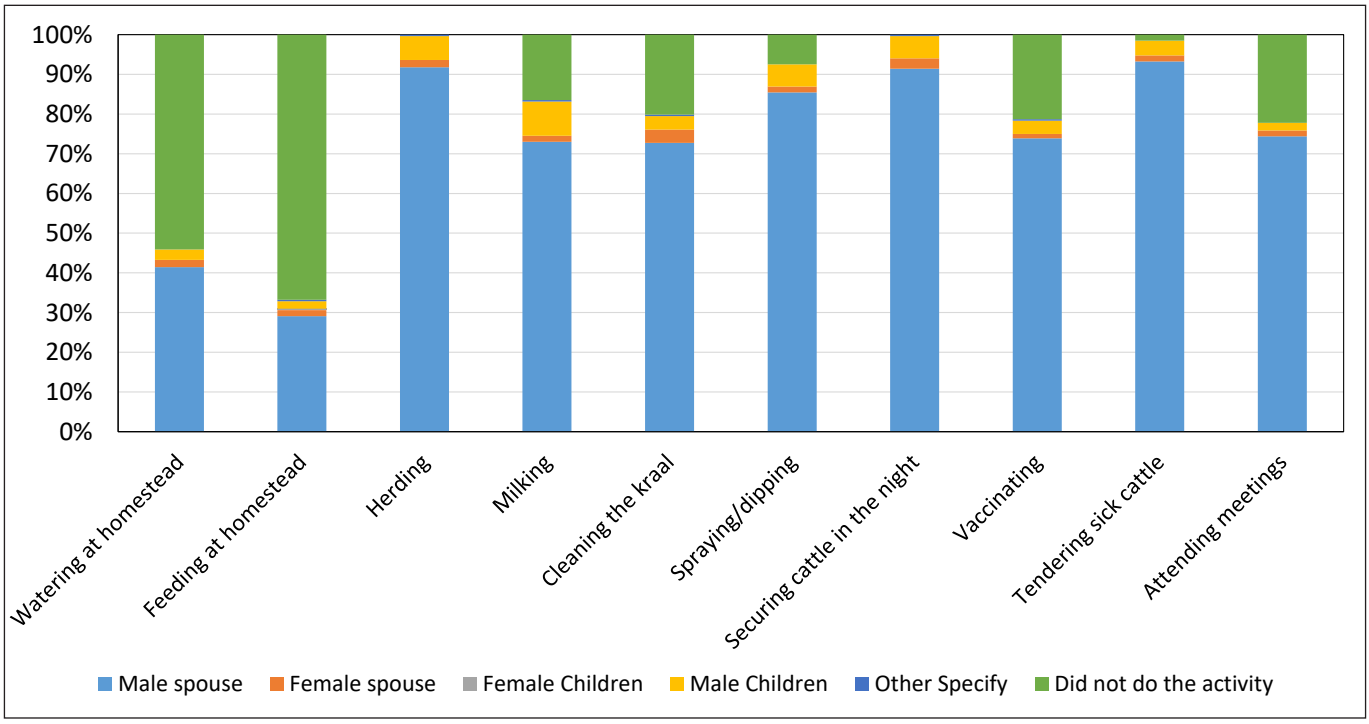


Figure 4. 8. Who decides which member should do the activity?

Source: Author's computations based on 2016 Cattle household survey data

Right to sale

The field discussion revealed that female household members have limited rights to sell cattle because they have to seek their husbands' approval. Some women argued that not having the power to make decisions over the sale of cattle dampens their ownership rights. However, on the other hand, men claimed that if women were left to make decisions, it would demean their headship.

Right to income

Like the right to sale, female household members have limited rights to income because the income is mainly used to finance major expenditures such as children's school fees and the purchase of agricultural inputs. In-depth interviews revealed that decisions on the use of the income are made when the decision to sell is made.

Right to bestow (deciding who inherits)

Parents pass on their cattle to their children while they are still alive or through inheritance upon death. Culturally, cattle are passed on to male children. Though women can decide whom to give or inherit their cattle, they have to seek approval from their husbands or male relatives.

4.4.3. Factors associated with female cattle ownership

Table 4.3 presents how different covariates are associated with the proportion of cattle owned by female household members. The variation in the proportion of female cattle ownership is positively and significantly correlated with women empowerment, female-headed households, education level, the age of the oldest female member, level of crop income controlled by female household members, and TLU (excluding cattle) owned by female household members. While there is a weak negative association between cattle herd size and the proportion of cattle owned by female household members, a significant and negative correlation is observed between female spouses, females in polygamous marriages, and female cattle ownership. Though the correlations provide valuable information, conclusions cannot be drawn based on the bivariate analysis, and therefore, we turn to the econometric estimation results presented in Table 4.4.

Table 4.3. Correlation coefficients

Covariates	Proportion of cattle owned by female household members
Cattle productivity	-0.024
Female making decision to sell cattle (empowerment indicator)	0,599***
Crop income controlled by female (empowerment indicator)	0.219***
Female headed household (=1, 0 otherwise)	0.508***
Female spouse (=1, 0 otherwise)	-0.247***
Females members in a polygamous marriage (=1, 0 otherwise)	-0.048***
Maximum education attained by female members (years)	0.041***
Age of oldest female members (years)	0.178**
Proportion of male household members	0.005
Crop income controlled by female members in ZMK	0.247***
TLU (excluding cattle) owned by female members	0.227***
Cattle herd size	-0.015
Central province (=1, 0 otherwise)	-0.007
Copperbelt province (=1, 0 otherwise)	0.058**
Eastern province (=1, 0 otherwise)	-0.093***
Luapula province (=1, 0 otherwise)	0.019
Lusaka province (=1, 0 otherwise)	0.021
Muchinga province (=1, 0 otherwise)	-0.025
Northern province (=1, 0 otherwise)	-0.037**
North western province (=1, 0 otherwise)	0.006
Southern province (=1, 0 otherwise)	0.054***
Western province (=1, 0 otherwise)	0.067***

Significance of the correlation (2-tailed): *** p<0.01, ** p<0.05, * p<0.1: ZMK=Zambian kwacha

Table 4.4. Factors associated with female cattle ownership (Marginal effects after zoib)

VARIABLES	(1) Zero-inflate	(2) proportion	(3) One-inflate
Female headed household (=1, 0 otherwise)	0.020	0.127*	0.785***
	(0.46)	(2.00)	(17.61)
Female spouse (=1, 0 otherwise)	-0.013	-0.014	0.062
	(-0.48)	(-0.39)	(1.09)
Females members in a polygamous marriage (=1, 0 otherwise)	0.051***	-0.030*	0.024
	(3.79)	(-2.21)	(0.56)
Maximum education attained by female members (years)	-0.003	-0.003	-0.002
	(-1.46)	(-1.32)	(-0.54)
Age of oldest female members (years)	-0.002***	0.001	0.000
	(-5.53)	(1.39)	(0.35)
Proportion of male household members	-0.042	-0.086*	-0.189*
	(-1.05)	(-2.01)	(-2.00)

VARIABLES	(1) Zero-inflate	(2) proportion	(3) One-inflate
Log crop income controlled by female members in ZMK	-0.007***	-0.001	0.007
	(-3.46)	(-0.40)	(1.63)
TLU (excluding cattle) owned by female members	-0.048***	0.008*	0.017*
	(-5.51)	(1.97)	(2.02)
Cattle herd size	-0.003***	-0.004***	-0.019***
	(-5.26)	(-7.86)	(-4.66)
Year 2015 (=1, 0 otherwise)	-0.004	0.014	0.027
	(-0.32)	(1.10)	(0.85)
Central province (=1, 0 otherwise)	-0.044	-0.048*	-0.097*
	(-1.67)	(-2.22)	(-2.36)
Eastern province (=1, 0 otherwise)	0.075***	-0.034	-0.013
	(3.76)	(-1.35)	(-0.28)
Southern province (=1, 0 otherwise)	-0.110***	-0.035	-0.082*
	(-4.63)	(-1.76)	(-2.12)
Western province (=1, 0 otherwise)	-0.171***	0.043	-0.060
	(-4.64)	(1.64)	(-1.34)
Observations	3,859	3,859	3,859
Wald chi2(17)	116.5***	116.5***	116.5***

The response variable is the proportion of cattle belonging to female household members; Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1: Model 1 estimates the probability of having zero cattle; model 2 the probability of having between 0 and 1; model 3 shows the probability of having 100% of cattle

Factors associated with the probability of zero cattle ownership

Model 1 in Table 4.4 shows a positive association between female household members in polygamous marriages and zero cattle ownership. This means that females in polygamous marriages are more likely not to own any cattle. A negative association coefficient of age implies that households with older female members are less likely to have zero cattle. In other words, older female household members are more likely to own cattle. Other attributes that are likely to increase the probability of females owning cattle significantly include an increase in crop income controlled by female household members, increased female ownership of other livestock species excluding cattle, and large herd size. Provincial dummies show that in the southern and western provinces, the females are more likely to have cattle, while in the eastern province, the likelihood of female cattle ownership is less.

Factors associated with the proportion conditional on not having value 0 or 1 (Model 2)

Model 2 shows that only households headed by females are more likely to increase the proportion of cattle owned by female household members. Females in polygamous marriages, a higher proportion of male household members, and ownership of other livestock assets large cattle herd size are likely to dampen the likelihood of increasing the share of cattle owned by female members.

Factors associated with the probability of having 100% cattle ownership (model 3)

The positive and significant factors associated with 100% female cattle ownership are female headship and ownership of other livestock species (excluding cattle). However, increases in the proportion of male household members and large cattle herd size are negatively associated with 100% female cattle ownership. In all the provinces, females' likelihood to own 100% cattle is less though only central and southern provinces are statistically significant.

4.4.4. Association between Female cattle ownership and cattle herd productivity

Results in Table 4.5 presents various models of the estimated effect of the proportion of cattle owned by female household members on the cattle herd productivity after controlling for different factors. The coefficient in model 1 cannot be interpreted as a causal effect since we have not controlled for other confounding factors. The constant (19.1%) captures the effect of the proportion of cattle owned by male members on herd productivity, while the estimated coefficient on female ownership (5%) is the difference in the herd productivity between an increase in proportion owned by male and the increase in the proportion owned by female members. This difference in productivity between male and female members ownership is about 26%.

Table 4.5. Estimated effect of female cattle ownership on herd productivity

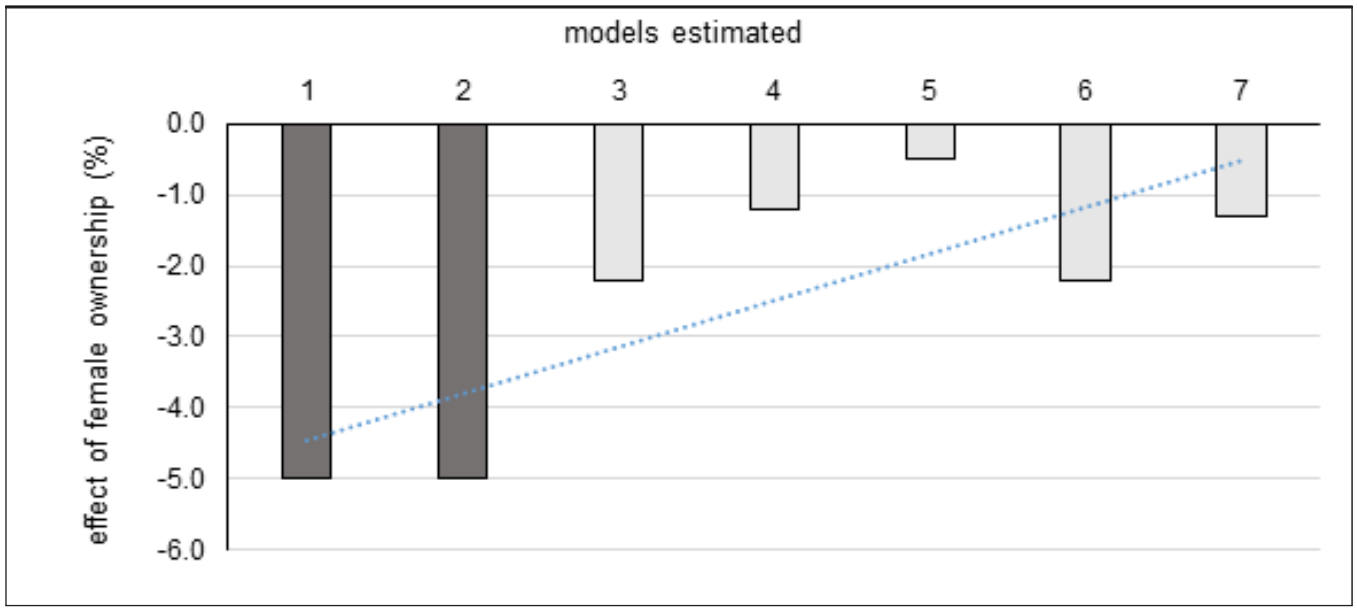
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Proportion of female cattle owership	-0.050	-0.050*	-0.022	-0.004	-0.002	-0.015	-0.013
	(0.034)	(0.028)	(0.035)	(0.035)	(0.032)	(0.026)	(0.027)
2015 year dummy		-0.002	-0.001	0.004	-0.034*	-0.032**	-0.032*
		(0.019)	(0.019)	(0.019)	(0.018)	(0.016)	(0.016)
Provincial FE		Yes	Yes	Yes	Yes***	Yes***	Yes***
Female-headed household			-0.066*	-0.041	-0.036	-0.011	-0.154
			(0.037)	(0.037)	(0.033)	(0.025)	(0.232)
Age of HH head				-0.003***	-0.002***	-0.002***	-0.002***
				(0.001)	(0.001)	(0.001)	(0.001)
Number of male HH members				-0.004	-0.006	-0.007*	-0.007*
				(0.005)	(0.005)	(0.004)	(0.004)
Education of household head				0.008**	0.006*	0.005	0.005
				(0.003)	(0.003)	(0.003)	(0.003)
Cattle mortality rate					-0.902***	-0.868***	-0.867***
					(0.033)	(0.029)	(0.058)
Cattle birth rate						1.036***	0.874***
						(0.184)	(0.242)
Time average X							Yes
Constant	0.191***	0.140***	0.138***	0.264***	0.350***	0.226***	0.217***
	(0.010)	(0.026)	(0.026)	(0.055)	(0.052)	(0.050)	(0.049)
Observations	3,746	3,746	3,746	3,746	3,746	3,746	3,746
R-squared	0.001	0.005	0.005	0.020	0.144	0.312	0.309

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

In model 2, we control for time and spatial effects. We performed a joint significance test of the provincial dummies, and the test was statistically insignificant at any level, suggesting that there are no differences in the herd productivity across the provinces. The inclusion of time and provincial dummies does not change the coefficient estimates of the variable of interest, suggesting that female ownership is not correlated with location and time.

Model 3 to 7 controls for household headship, other household characteristics, cattle mortality rate, cattle birth rates, and time averages for the time-varying covariates. In all five models, the effect of female ownership on herd productivity is insignificant, and it reduces in magnitude compared to the initial estimate. However, we note that having a female household head has a negative effect on herd productivity (model 3). Controlling for other household characteristics (model 4) shows a positive effect of education on herd productivity and a negative effect of the household's age. Model 5 shows that the mortality rate has a significant negative effect on herd productivity, while the birth rate has a significant positive effect (model 6), as expected. The significant joint test for time-varying variables was statistically insignificant, suggesting that the unobserved heterogeneity does not affect herd productivity.

Figure 4.9 visually summarizes the association between herd productivity and female ownership. The evidence from various models shows a positive but declining association between herd productivity and female cattle ownership.



Models 2 to 6 control for other factors. Darker shades indicate significant differences, while lighter shades indicate an insignificant effect on cattle productivity

Figure 4.9.Visual representation of the estimated effect of female cattle ownership on cattle herd productivity

4.4.5. Association between female cattle ownership and female empowerment

We find a positive association between female cattle ownership and female empowerment (Table 4.6). If the proportion of cattle owned by female household members increases, the females are more likely to have a say in cattle sales. Similarly, an increase in the proportion of female cattle ownership is more likely to increase the crop income they control.

Table 4.6. Factors associated with female empowerment

	Female decision maker to sell cattle (Marginal effect)	Level of crop income controlled by female
Proportion of cattle belonging to female household members	0.067***	0.282***
	(0.009)	(0.098)
Female headed household (=1, 0 otherwise)	0.463*	5.576***
	(0.259)	(0.543)
Female spouse (=1, 0 otherwise)	-0.019	-0.413***
	(0.019)	(0.134)
Females members in a polygamous marriage (=1, 0 otherwise)	-0.011***	0.070
	(0.004)	(0.068)
Maximum education attained by female members (years)	-0.002	0.045*
	(0.002)	(0.026)
Age of oldest female household members (years)	-0.001**	-0.002
	(0.001)	(0.011)
Proportion of male household members	0.023	0.141
	(0.032)	(0.661)
TLU (excluding cattle) female members own	-0.003*	0.136**
	(0.002)	(0.006)
Control of provincial location	Yes	Yes
Constant		-0.027
		(0.171)
Observations	3,856	3,856

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

4.5. Discussion

This study identified various channels through which female household members can acquire cattle and how female cattle ownership is construed. We also found that different factors are associated with female cattle ownership, increased share of cattle owned by female members, and 100% cattle ownership. Furthermore, we established that female cattle ownership was negatively associated with herd productivity, though not statistically significant, while female empowerment was positively correlated with female cattle ownership. In this section, we discuss these findings.

4.5.1. Defining female cattle ownership

Despite women having opportunities to own cattle, the findings show that they do not possess all their cattle's rights. This result suggests that female members never have full cattle ownership. Partiality ownership arises because women have to consult and seek their husbands' approval if they needed to do anything with their cattle. The men demand that their women do so to avoid demeaning their authority. The majority of the women also lack the technical know-how and thus tend to depend on men. It is clear that men acquire technical knowledge through attending meetings and training, implying that providing necessary training in cattle production and management should be an entry point in securing female cattle ownership.

4.5.2. Factors associated with female household members owning cattle

The results identified various factors that are associated with female ownership. Older female household members, more crop income controlled by female household members, large cattle herd size, more TLU (excluding cattle) owned by female members increases the probability of female to own cattle while being in a polygamous marriage reduces the likelihood of owning cattle. While female headship and ownership of other livestock species are positively associated with 100% female cattle ownership, a high proportion of male household members and large cattle herds reduces the likelihood of owning 100% cattle. When female household members own cattle, but ownership is not 100%, households with female-heads are likely to increase the share of cattle owned. Women in polygamous marriages, a higher proportion of male household members, and large cattle herd size are less likely to increase the proportion of cattle owned by female members.

Human capital

The results show that female heads are more likely to own cattle, and their proportion is likely to increase because they are the primary decision-makers. Another important finding of this study is that females in polygamous marriages are more likely not to own cattle, and if they happen to own, their share of cattle is less likely to increase. The plausible explanation for this finding is that females in polygamous marriages have less decision making power. Though this implies that deliberate effort should be directed at women in a polygamous marriage, there is a need to explore this matter further since the wives' position might also matter. For example, the husband might spend more resources on the second wife since she is a new catch. We also find a higher probability of older female members to own cattle. This implies that older female house members are expected to make rational decisions and can contribute to household decision making. These findings contradict Njuki and Mburu (2013), who found that the female spouse's age did not have any effect on the probability of owning livestock. However, the age of female household members does not significantly affect the level of female cattle share.

The finding of female cattle acquisition through the boy children who engage in cattle herding suggests that differences in household composition and male labor availability can facilitate female cattle ownership. This observation is supported by the econometric estimation, which shows a high probability of females having cattle as the proportion of male household members increases. Debela (2017) also found similar results in Ethiopia though his focus was on the female-headed household. He found that lower endowment of male labor (age 6-14) in female-headed households contributed to lower livestock accumulation levels. While the male household members can facilitate women's acquisition of cattle, the likelihood of the female cattle share to increase is less as the proportion of male members increases. This is because the male household members are given priority in the inheritance of cattle, and in cultures where cattle still function as a form of dowry payment, the animals are given to male household members to pay dowry. Another possible explanation is that male household members assume the management and control decisions as per evidence gathered through in-depth interviews.

Financial capital

The qualitative findings showed that purchases are one way to acquire cattle, and mainly crop income finance the initial stock. This means that not only does livestock contribute to crop production, but crop income also plays an essential role in cattle acquisition, suggesting the importance of crop-livestock interactions. The econometric results also show that the higher the crop income the female household members control, the more they are likely to own cattle. This finding implies that economic freedom and access to finance can contribute to female cattle ownership. Tegebu et al. (2012) also found that crop income contributes to the household savings that are later invested in livestock. Equaly, Ayoade et al. (2019) conclude that access to finance increases the level of female participation in livestock production. However, access to and control over crop income is a significant constraint to the market acquisition pathway mainly because female members have less decision-making power to use crop income, as shown earlier.

Physical capital

The findings of ownership of other livestock assets (excluding) increasing the probability of female cattle ownership suggests that the accumulation of other assets strengthens their bargaining power within the household. Other studies also found that poor people typically start with smaller livestock such as chickens and goats before progressing to the accumulation of larger animals such as cattle (Njuk and Sanginga, 2013).

A zero-inflated result shows that as the cattle herd size increases, females' likelihood of owning cattle is high. This implies that investments in cattle herd improvement can help female members to own cattle. Given that cattle births are the primary factor contributing to the increase in the cattle herd size (Lubungu, 2017), addressing the constraints associated with cattle reproductive parameters such as nutrition, water, pasture, and disease management are vital in increasing the herd size and thus facilitating female cattle ownership. However, the herd size increase does not increase the proportion of cattle owned by female members implying that the cattle gender gaps within the household are likely to persist. One reason for this observation is that females do not manage their cattle because they lack technical skills. The perceived household conflicts that are likely to ensue if women owned more livestock can also explain this result. The majority of the men believed that if women own more cattle than their male counterparts, that would be a recipe of tension in their households as men feel that they can be at par with women, thus making it difficult for women to submit. Aberman et al. (2018) also found that men's greater endowment and control of physical capital is central to male domination.

Location variables

The qualitative results suggest that female household members acquired cattle through various means. Acquiring cattle through bride price payment indicates that differences in cultural patterns contribute to female cattle ownership patterns. Due to the differences in the cultures, Machina and Lubungu (2019) show that the proportion of female household members in Namwala district in Southern province owning cattle is higher than in other areas. This finding is also consistent with the econometric results, which show that the female members are more likely to own cattle in the Southern province. Oladele and Monkhei (2008) also found that differences in cultural and inheritance patterns contributed to differences in ownership patterns between males and females in Botswana.

4.5.3. Female cattle ownership, herd productivity, and female empowerment

Overall, we find a negative association between female cattle ownership and herd productivity. Arguments for this observation are that women have fewer opportunities to expand their herd because they are disadvantaged in many ways of not having resources. Another argument why the herd productivity gap arises is the lack of ability among females. Our qualitative research revealed that men have better cattle management skills because they can access livestock information and extension services, while women have less access to such services. Education is also reflected in the ability as it influences the assimilation and utilization of information. However, the majority of rural women are less educated. Because of these reasons, females may be constrained and not able to take care of their cattle.

Despite female cattle ownership having a negative association with herd productivity, we find a positive correlation between female ownership and decision making. Women who own cattle are also likely to be empowered in other aspects, such as increasing the level of crop income they control. This empowerment can contribute to their economic freedom, which makes men feel that their headship is threatened. Because of this, other studies have found that women often manage income from small livestock such as chicken, goats, and pigs (Njuki et al., 2013).

4.6. Conclusions and recommendations

Women empowerment has been a topical issue on the global agenda in recent years, and ownership of assets is identified as a pathway that leads to intra-household empowerment. Among the smallholder rural households, ownership of large assets such as cattle is considered valuable assets as they provide multiple benefits. As such, we were interested in understanding female ownership of this particular asset since several studies show a significant gender gap in cattle ownership. To address this knowledge gap, the following were study objectives (i) to identify the pathways through which female household member acquire cattle and what female ownership means from a gender perspective; (ii) to determine the factors associated with the proportion of cattle owned by female household members; and (iii) to determine if the share of cattle owned by female household members is correlated with cattle herd productivity and female empowerment. The following are the main conclusions we draw from the study.

Women acquire cattle through various means. However, despite the female household members having opportunities to acquire cattle through different pathways, they never have full ownership as they cannot decide without consulting and seeking approval from their spouses or male household members. Women also lack cattle management skills due to limited participation in training. We also find that factors that are associated with female owning cattle are not likely to increase the share of cattle they own. While financial independence, accumulation of other assets, and improvement in the cattle herd size can help women acquire cattle, these factors dampen the likelihood of increasing their share. Women are likely to have a lower share of cattle because of the perceived conflicts that are likely to ensue in the households should their share increases. Thus, gender gaps will continue to prevail if these perceptions are not addressed. Lastly, we conclude that female cattle ownership is negatively associated with herd productivity because women are disadvantaged in many ways. Despite this negative correlation, we find that increasing female cattle ownership improves women's bargaining power as they have a voice in decision making.

Therefore, developmental programs aiming to promote female cattle ownership should ensure that such interventions do not result in household conflicts by deliberately sensitizing men on the importance of female cattle ownership and its importance on household welfare. However, changing their perception is a goal that requires long term efforts. There is also a need to provide technical training on cattle management as an entry point to secure women's cattle.

Conflict of Interest: The authors declare that they have no conflict of interest.

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5.0 USING PROCESS NET-MAP TO ANALYSE GOVERNANCE CHALLENGES: A CASE STUDY OF LIVESTOCK VACCINATION CAMPAIGNS IN ZAMBIA

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Abstract

The outbreak of livestock diseases in Sub-Saharan African countries is the most critical challenge affecting the development potential of the livestock sector. Vaccination campaigns are one of the most important strategies to deal with this challenge. However, such campaigns are difficult to implement due to major governance challenges, such as delays in the procurement of vaccines and the disbursement of funds. This paper presents an in-depth analysis of these governance challenges, based on a case study of a Livestock Development Animal Health Project in Zambia. The goal was to examine in detail why these problems occur and how they are linked to the implementation procedure. A novel qualitative research tool called Process Net-Map, which is a visual participatory mapping technique, was applied. The tool made it possible to understand the exact implementation mechanism and identify the different actors involved, including government officials, private sector companies, and farmers. The study revealed that the complex design of the procurement procedure, the limited capacity of the procuring entity, and a lack of urgency among the actors involved resulted in the procurement delays. The findings also indicate that the delay in the release of funds arises because of a diversion of funds. Some strategies to improve the efficiency of the procurement process were identified, such as increasing the sense of urgency, building staff capacity, using e-procurement, and entering into framework contracts with suppliers. Building sustainable financial capacity in the overall management of public funds seems essential to deal with the challenge of fund diversion. Use of Citizen Report Cards and lobbying political decision-makers are mechanisms that farmers can employ to increase their capacity to hold the animal health service providers accountable and demand better services. The problems identified are relevant for vaccination programs and general implementation challenges encountered in developmental programs that involve the distribution of publicly procured inputs.
Keywords: livestock; vaccines; process net-map; procurement; funds flow; Zambia

5.1. Introduction

The outbreak of diseases is the most critical problem affecting the livestock sector's production and productivity in Sub-Saharan African countries (Perry and Randolph, 2003; Vosloo et al., 2002). Though different strategies such as stamping out, quarantine, movement restrictions, and treatment are implemented to control the outbreaks, vaccinations are the most important disease control measure employed, especially in under-resourced agricultural systems (Knight-Jones, and Rushton, 2013; OIE, 1995; Romero et al.,

1993; Roeder et al., 2013; Orsel et al., 2005; Taylor et al., 2002)[4]. In addition, vaccinations are the only economically viable option for certain diseases because once there is an outbreak, the economic losses are high. For instance, Tambi et al. (2006) found that a loss of 30 million euros could have been avoided by investing only half of the amount to control Contagious Bovine Pleural Pneumonia (CBPP) in 12 African countries. Similarly, Rast et al. (2010) found that in Lao People's Democratic Republic, areas without vaccination against Foot and Mouth Disease (FMD) incurred significantly higher losses than areas with vaccination. Furthermore, vaccinations against zoonotic diseases do not only reduce financial losses within the livestock sector but also contribute to cost savings in the human health sector (Zinsstag et al., 2007). Therefore, investing in vaccination programs can save millions of dollars that could be potentially lost in the event of an outbreak.

To effectively control diseases like FMD and CBPP, livestock experts recommend conducting five years of annual or biannual vaccination followed by three years of surveillance during which no single clinical case should be reported (Masiga and Domenech, 1995). This strategy seems good in theory but difficult in practice because, in many developing countries, vaccination schedules are rarely followed. For example, in Zambia, vaccinations were found to be conducted three months after the scheduled time (Chifungula, 2015). Failure to follow vaccination schedules makes vaccination campaigns less effective because the previously injected vaccine only provides sufficient cover until the next scheduled vaccination (Van Savage et al., 1990; Chifungula, 2015). Delays in conducting vaccinations have been attributed to delays in the disbursement of funds and procurement of vaccines (Chifungula, 2015; IFAD, 2014). Additionally, financial and structural constraints related to the production, distribution, and administration of vaccines have been cited to contribute to the unsuccessful implementation of vaccination campaigns (Ilukor et al., 2015b; Rweyemamu et al., 2002; Thomson, 2005).

Though it is well known that vaccination campaigns are difficult to implement in reality, it is not well known why exactly these problems occur and how they are linked to the implementation procedures of such vaccination campaigns. To overcome these governance challenges, better implementation strategies need to be designed. For this purpose, it is essential to better understand the exact implementation mechanisms of vaccination campaigns and identify, where, and why the observed governance challenges occur in the implementation process. In this context, it is also necessary to examine what type of stakeholders, including government officials, donor agencies, and companies, are involved in the implementation process and, importantly, how the farmers are involved. It is also necessary to better understand the incentive and capacity problems that lead to the observed governance challenges. Studies that provide such a detailed analysis have not been published for vaccination campaigns so far. Against this background, the objectives of this paper are;

i. To identify the governance challenges of implementing the vaccination campaigns.
ii. To develop recommendations to improve the implementation process.

To address this knowledge gap, we conducted a case study of the Livestock Development Animal Health Project (LDAHP), under which the Ministry of Fisheries and Livestock (MFL) in Zambia has conducted vaccination campaigns since 2012. The project is expected to end in 2018. The campaigns have been conducted with financial assistance in the form of a loan provided by the World Bank to contain FMD,

[4]Stamping out involves the testing and destruction of all positive and in contact herds in a particular grazing unit and requires compensation of farmers. Movement control is the prescribed livestock movements in a defined locality which entails setting up check points.

CBPP, and East Coast Fever (ECF) in highly disease-affected areas. While the provision of FMD and CBPP vaccines to farmers is free, farmers have to pay 15 Zambian Kwacha (ZMK) per animal for ECF vaccine[5]. The goal of the program is to improve the productivity of cattle among smallholder producers in Zambia (World Bank, 2012). As of 2015, the project had recorded some success. Vaccination coverage increased from 85% (baseline) to 89% in 2015, and CBPP was contained in the Southern Province (Mwanakasale, 2015). In the first three years of implementation, the project also reached out to 60,000 out of the targeted 190,000 farmers[6]. In addition, Lubungu (2017) shows that at the national level, cattle mortality rates reduced by 5.2% between 2012 and 2015. Despite these successes, the program faced important governance challenges, especially delays in procurement and release of funds (Mwanakasale, 2014). Therefore, the program is suitable as a case to study in detail why these problems occur. By conducting this study, we expect that the implementation of future programs of this nature can be improved because the results are expected to help to identify where to direct reform efforts. Additionally, as per the World Organization for Animal Health (OIE) solidarity principles, countries that demonstrate improvement in governance are likely to attract more foreign funds for further strengthening of the provision of veterinary services. (Msellati et al., 2012).

To analyze in detail why the governance problems indicated above occur, we used a novel research method called Process Net-Map. This method is a variant of the Net-Map method developed by Schiffer (2007). While Net-Map focuses on the analysis of social networks between actors, Process Net-Map was specifically developed to analyze governance challenges that arise in the implementation of publicly funded programs (Birner et al., 2010; Birner and Sekher, 2018). Therefore, Process Net-Map focuses on mapping the consecutive steps of a program implementation process. A detailed description is presented in Section 3.2.

The paper is organized as follows. The next section presents the conceptual framework developed for this study. Section 5.3 describes the methods used to collect and analyze the data. Section 5.4 presents the results, which are discussed in Section 5.5. The last section concludes and derives recommendations.

5.2. Conceptual Framework

This section consists of two parts: The first sub-section outlines the potential governance challenges that can be expected if the public sector, the private sector, or the third sector (i.e., non-governmental organizations and community-based organizations) provide vaccination services. We refer to the existing literature to substantiate these governance challenges. In the second part, we link these challenges to a framework for improving governance in the implementation of the vaccination campaigns. Both parts of the framework were used to guide the empirical case study.

5.2.1. Governance challenges in vaccination campaigns: Theoretical considerations

Prior to the structural adjustment period of the 1980s, the public sector funded, managed, and provided livestock health services in most developing countries. However, the high costs and limited effectiveness that characterized public sector activities led to the privatization of the provision of animal services (Umali et al., 1994). Though the private-led approach had its own merits, it also failed in some areas. The failures

[5]This is equivalent to USD 1.55 at the exchange rate of 1USD=9.69899ZMW as of April 2017

[6]The statistics include both beneficiaries of vaccination program and matching grant to finance on farm productive livestock investments. We could not isolate the vaccination beneficiaries.

of both the private and the public sector led to new reforms that focused on the third sector approach – community animal-based health workers (see, e.g., Mockshell et al., 2014). In the subsequent sub-sections, the underlying reasons for failures in the provision of preventative animal services are identified for the three basic types of governance structures: the private, the public, and the third sector.

Market failure in vaccination services

The market fails when the production and provision of goods or services are not optimal from the society's perspective. Several reasons can lead to market failures in the provision of preventative animal services. First, though the provision of vaccination services can be classified as a private good (Umali et al., 1994), it is usually difficult to restrict the benefits only to farmers who pay for the service. This is primarily the case for vaccination against contagious diseases such as FMD (Ekboir, 1999) because such vaccinations result in positive externalities in the form of reducing the risk of infection of animals owned by other livestock keepers. Therefore, other livestock farmers will have the incentives to free-ride and save costs by not vaccinating their animals. Due to the free-rider problem, it may not be economically viable for the private sector to provide vaccination services. Therefore, it becomes necessary for the government to intervene.

Exclusion is another market failure that arises in vaccination campaigns due to the high transaction costs of serving a large number of small-scale farmers who own a small livestock herd. This problem is aggravated in marginalized areas and among livestock keepers with low commercial orientation (Turkson and Brownie, 1999). Because of high transaction costs and low aggregate demand for animal health services from small-scale farmers (Ahuja, 2004), private veterinarians tend to serve the large and medium scale farmers and concentrate in urban and peri-urban areas. Where preventative measures are necessary but unprofitable for the private sector, it is justified for the public sector to intervene.

Another challenge that the private sector is likely to face is the information asymmetry problem. The farmer has difficulty in assessing the quality of the vaccine provided, which results in the provision of substandard services because the providers face the typical "moral hazard" problem that results from information asymmetry (cf. Akerlof, 1970). Because of this problem, the government may intervene by establishing quality standards and performing quality control activities.

Government failure in providing vaccination services

Due to the market failure identified above, it is economically justified for the government to engage in the provision of vaccination services (Wolf, 2005; Leonard, 1987). However, government interventions are confronted with their own governance challenges, which may be referred to as "government failure" or "state failure" (cf. Birner and Anderson, 2007).

Lack or delay of the government funding necessary to provide such services is a frequent problem in developing countries and as such, development assistance in the form of grants or loans helps to address this problem. Since assistance is increasingly provided as budget support or at least channeled through official government accounts, the emphasis is now placed on the efficient use of all public resources, not just those funded by development agencies (Development Assistance Committee, 2008). Therefore, ineffective public financial management and procurement systems remain critical concerns for governments and development practitioners if the public sector provides the services (Development Assistance Committee, 2008).

The public financial management systems in developing countries quite often face similar problems that prevent budgets from working efficiently and delivering the desired outcomes. These problems include weak institutions, capacity constraints (regarding financial, technical, human resources), lack of accountability, and insufficient budgeting skills (Porter et al., 2011; Haque et al., 2015). Lack of transparency, enforcement, accountability, and value for money in the application of a procurement budget result in ineffective public procurement systems (Agaba and Shipman, 2007; Basheka, 2008; Hunja, 2003). Critical problems contributing to ineffective public procurement also include delays in decision-making, entrenched corruption and political interference in the tendering process, and incompetent staff handling public procurements (Thai, 2004; Søreide, 2002; Osei-Tutu et al., 2010). Therefore, improving public financial management and procurement is vital to ensuring government effectiveness.

In addition to these problems, inappropriate information technology also slows down the flow of information. Hence, timely decision making at different levels of management is negatively affected (Balogun, 2001). Public sector governance is also affected when state efforts are not complemented with the efforts of non-state actors such as civil society, media, and citizens. Governance systems that exclude citizen participation are not accountable to their citizens. In many cases, citizens learn of important public policy decisions long after they have been made, and attempts by media organizations to publish or discuss information on abuse are in some countries even treated as a criminal case (Olowu, 1999). Thus improved information flow is a necessary condition for improved public service delivery.

The role of the third sector in providing vaccination services

Communities can organize themselves to overcome the market and the state failures in serving the poor farmers. Prominent examples are Community-Based Animal Health Workers (CBAHW), which have been promoted in many countries. However, as service providers, they also face various problems, including the challenge of information asymmetry, similar to the case of the private sector. Although CBAHW can overcome the problem of high transaction costs because they live in rural areas (Umali et al., 1994), they often have little formal training in animal health management (Irungu et al., 2006). Thus, they are likely to offer low-quality animal health services, as has been shown in empirical studies (see, e.g., Ilukor and Birner, 2014; Mockshell et al., 2014; K'Oloo et al., 2014). Furthermore, the community-based service providers are equally likely to face the free-rider problem of collective action if the community is expected to fund health workers collectively. The problem of financial sustainability is likely to arise if non-governmental organizations or donors initially support the CBAHW and expect communities to take over the funding later.

The literature shows that all three types of governance structures are prone to their own governance challenges in the provision of veterinary services. Therefore, it is essential to identify the strategies that aim at addressing these challenges from both the service providers and end the users' perspective. To do so, we apply the conceptual framework for improving governance discussed in the next section.

5.2.2. Applying the framework of supply and demand-side approaches for improving governance

Based on the theoretical insights highlighted in section 5.2.1, we applied a modified version of the framework developed by Birner (2009) for identifying strategies that aim at improving the governance challenges (Figure 5.1). This framework was selected because it is compatible with the theoretical considerations presented above, and it has the advantage that it classifies the different strategies that one can use to solve the governance problems. The framework includes both strategies that service providers can apply (supply-side strategies) and strategies to improve service provision by empowering the service users; in this case, the livestock farmers (demand-side strategies). Moreover, the framework has been specifically developed to analyze governance reform strategies in the agricultural sector and was adopted, e.g., in the World Bank's World Development Report of 2008 on "Agriculture for Development" (World Bank, 2007).

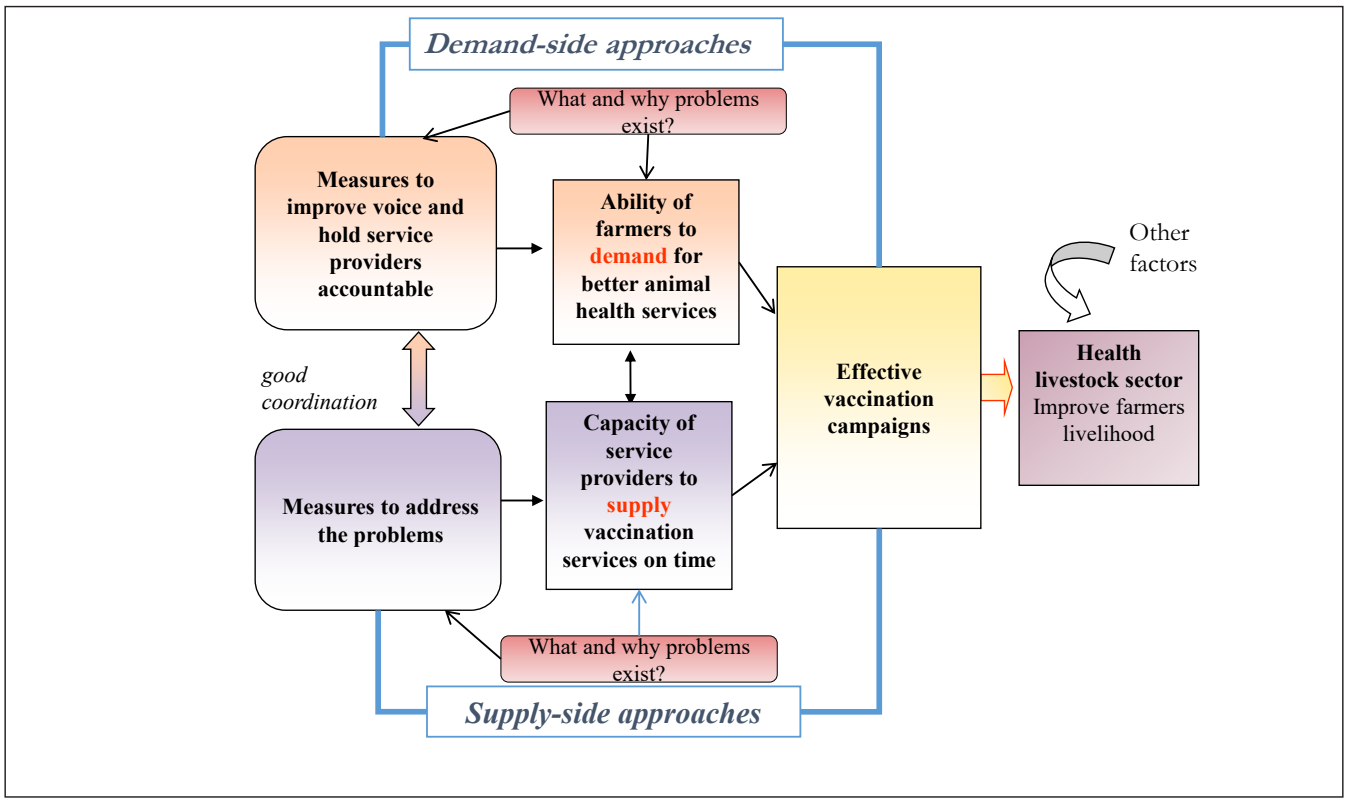


Figure 5.1. Framework for improving governance in the implementation of vaccination campaign

Source: adapted from Birner, 2009 and modified by the author

The underlying logic of this framework is to illustrate how an effective vaccination campaign can contribute to the production potential of the livestock sector and ultimately improve the livelihood of livestock producers. While vaccination campaigns are vital to achieving a healthy livestock sector, other factors also matter. These factors include strengthened disease diagnostic and surveillance systems (Salman et al., 2003), adoption of improved animal husbandry practices such as improved housing, and fodder production (Tadesse et al., 2014). Access to infrastructure, such as dip tanks, and livestock service centers, are equally important.

In the context of this study, we focus on how to improve the governance of conducting vaccination campaigns using both the supply and demand-side approaches. Supply-side approaches focus on the strategies that improve the capacity of the service providers to provide the vaccination services on time, and thus the need to identify the problems that hinder the provision of such services and why they occur. The framework

suggests that supply-side approaches need to be combined with demand-side approaches, i.e., strategies that empower farmers to demand better services by holding the service providers accountable. To assess the feasibility of demand-side approaches, there is a need to understand the problems that limit the political voice of livestock farmers to demand better animal services so as to devise appropriate mechanisms that can increase their voice.

To improve the governance for implementing vaccination campaign, it is essential to distinguish demand-side approaches from supply-side approaches and to identify combinations of approaches that are feasible and fit for a country's specific conditions. However, given that implementing these campaigns potentially comprises a multitude of multifaceted governance challenges and different actors from both supply and demand sides makes it complicated to understand institutional aspects from a methodological perspective. Because of this complexity, qualitative approaches are suitable as they allow understanding of complicated processes. Against this backdrop, a novel qualitative, explorative research approach described in Section 5.3, which focuses on understanding the implementation process, was applied to analyze in detail the governance challenges of implementing vaccination campaigns.

5.3. Materials and Methods

The first part of this section outlines the research design used in this study. The second and last part describes the methods used for data collection and analysis, respectively.

5.3.1. Research design

The study used a qualitative case study approach, which aims at contributing to a better understanding of where and why the governance challenges occur in the implementation of the livestock vaccination programs. For reasons of anonymity and given that the nature of the study and information gathered was potentially sensitive, the institutional affiliation of the respondents is not reported in this study. However, the selection criteria of the respondents were based on their extensive knowledge and experience about the vaccination program. Five professionals were selected using snowball sampling, and each was interviewed with the Process Net-Map[7] . The respondents included donors and representatives of the public administration holding different portfolios. In addition to the Process Net-Maps, the study used triangulation and crossed checked the Process Net-Map with other interviews. In-depth interviews with ten professionals prior to and after the Process Net-Map exercise was conducted. Prior interviews were undertaken to gain insights into vaccination campaigns in various districts, while subsequent interviews were held to cross-check and validate the information generated from the Process Net-Map exercise. Additional information was also collected from five focus group discussions with livestock farmers in five districts to gather information from the demand side. The focus group discussion comprised of 5 to 10 farmers. The entire data collection process was conducted in seven districts of Zambia between October 2016 and January 2017.

5.3.2. Data collection methods

A novel qualitative research method known as Process Net-Map introduced in Section 1 was employed. For our particular knowledge gap, it is essential to understand the process and to do so, Process Net-Map is

[7]Snowball sampling is a method that yields a study sample through referrals especially when it is difficult to find potential respondents (Biernacki and Waldorf, 1981). The respondents recommend the people who should be part of the sample. The method is well suited for this study because the study focused on a sensitive issue, and thus required the knowledge of insiders to locate people for the study

particularly useful because it focuses on how the process is implemented in a step-by-step manner. It has the advantage of visualization in the three-dimensional space of using influence towers. Though this approach takes over the essential feature of the influence towers and visualization of the Net-Map, Process Net-Map is not designed to analyze social relations. The Process Net-Map also helps to understand the challenges in the implementation of complex processes in reality and elicit explicit knowledge (Raabe et al., 2010; Birner et al., 2010). This method was applied to this study to track all the steps involved in the implementation of a successful livestock vaccination campaign.

Process Net-Map involves three main steps. First, the respondents were asked to describe the implementation process of the vaccination campaign of (ECF, FMD, and CBPP) until the point where the vaccines were administered to the animal and identify the actors involved in a step-by-step procedure. The interviewer wrote the names of the actors mentioned on a small card and placed them on a large sheet of paper, and drew arrows between them. The arrows were marked with a number, and the respective implementation step corresponding to each number was noted down. The interviewer asked the respondents for the next steps and continued to add the actors and arrows until the entire process was completed. The arrows were marked with different colors to denote various processes identified by the respondents. The study identified four processes; the flow of funds, procurement of vaccines, handling of vaccines, and flow of information. The respondents were asked to map those aspects of the entire process that they were familiar with.

In step 2, the respondents were asked to determine the perceived level of influence that each actor had on achieving the ultimate outcome (successful vaccination)[8]. To visualize the influence, the interviewer stacked the checker pieces on top of each other next to the actors to denote the influence tower. The influence towers were used to rank the respondent's perceived influence of each actor. The height of the towers denotes the influence level assigned to an actor by the respondent. The ranking was done on a scale of 0-8. The actors considered not to have any influence on the outcome were not assigned any influence towers. Likewise, actors with influence towers comprising eight checker pieces were perceived to be the most influential. While performing this task, respondents were asked to provide the reasons why actors had the influence level attributed to them. Because of too many actors involved in the process, the visualization of the level of influence during the interview serves as a useful tool to elicit more information (Schiffer and Hauck, 2010). In each research method, there is a potential for bias. Thus reflecting on the perceptions of respondents about the process and level of influence might yield a bias. However, triangulation helped in addressing this bias.

Lastly, the interviewer used the Process Net-Map with influence towers as a three-dimensional sketch to structure the qualitative discussion on the governance challenges. The respondents were asked to identify potential problems and where they were likely to occur in the implementation process. The focus was placed on eliciting the main governance problems related to delays in the procurement and release of funds as well as other problems that arose during the implementation process. Also, the interviewer asked the respondents about how they addressed the challenges.

A total of five Process Net-Maps were produced for this study. The first Process Net-Map was conducted to get an overview of the entire process. Afterward, the detailed Process Net-Maps were generated for each process, given that different respondents had an in-depth knowledge of a particular process.

[8]Findng out how much influence various actors have in achieving a successful vaccination campaign is important because influential actors are responsible for the success or failure of implementing developmental programs.

In addition to Net-Maps, we conducted focus group discussions with livestock farmers. Farmers were allowed to mention all the institutional challenges they perceived as most important regarding animal health services. After that, the respondents were asked to elaborate more on specific challenges related to the vaccination campaigns and what strategies could be applied to deal with the problems.

The data collected included the Process Net-Maps, perceived influences, and narratives of challenges.

5.3.3. Data Analysis

The different maps for each process that were collected were in the end combined using Microsoft Powerpoint to generate one complete map for the entire vaccination campaign. For actors that appeared in more than one map, the average value of the perceived influence was taken and rounded off to get the round figure though there were no major differences in the rating.

The study employed content analysis, which is an analytical approach used to interpret the meaning of the qualitative data (Hsieh et al., 2005). The critical feature of the content analysis is that the many words of the text are classified into much smaller content categories (Elo and Kyngäs, 2008). Therefore, the conceptual framework presented in section 2 guided the identification of common themes with a particular focus on governance challenges. The study looked into different interviews (narratives) to tease out the common challenges that were identified by different respondents during the Process Net-Map exercise and FGDs. The content analysis was combined with the causal narrative analysis because the study also identified why the problems occurred.

5.4. Results

This section begins with a brief background on the initial steps of the project before presenting a detailed description of the Process Net-Map of the vaccination campaigns. It then presents the level of influence of different actors in ensuring that vaccinations are successful. Lastly, it points out the challenges that arose during the different processes identified – the flow of funds, procurement, and handling process.

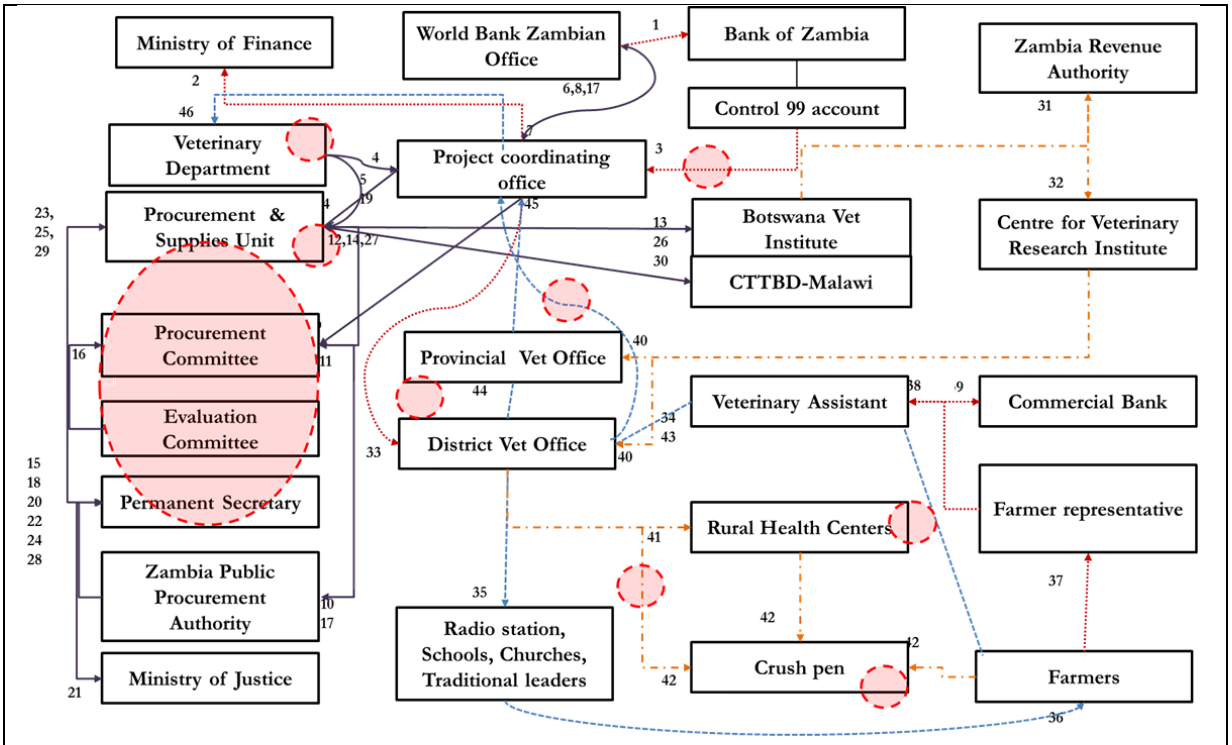
5.4.1. Background information about the project

Due to the high prevalence of livestock disease, the country was experiencing, the Ministry of Agriculture and Livestock requested funding from the Ministry of Finance to contain the outbreaks. The Ministry of Finance advised the Ministry of Agriculture and Livestock to submit a proposal to the World Bank for possible funding. Upon approval of the proposal, the Ministry of Finance and the World Bank signed a financing agreement. After that, the Ministry of Agriculture and Livestock submitted the global work plan and the budget to the World Bank for approval[9]. Once these documents were approved, the project's national coordinating office was set up, and employees from within the Ministry of Fisheries and Livestock (MFL) were appointed to take up some positions while other positions were advertised.

5.4.2. Description of the process of the vaccination campaign

Figure 5.2 presents an aggregation of the five Process Net-Maps depicting the steps involved in ensuring that the animals are vaccinated. A total of 23 actors with 46 steps were identified in this process.

[9]During the initial stages of the project, Livestock and Agriculture fell under one ministry-Ministry of Agriculture and Livestock. The two became separate ministries in 2015 and henceforth the discussion will refer to the Ministry of Fisheries and Livestock (MFL).



1. World Bank released funds to Bank of Zambia, control 99 account	21. PS sends draft contracts to Ministry of Justice for clearance
2. Ministry of Fisheries and Livestock through the project office request for funds from Ministry of Finance	22. Ministry of Justice sends the approved contracts to PS
3. Funds released to the project account	23. PS sends the draft documents to PSU to finalize the letters and contracts
4. Veterinary department submitted the annual procurement plan	24. PSU Sends the letters to PS for signing
5. Project coordinating office and Procurement and Supplies Unit (PSU) review procurement plan	25. Back to PSU
6. Project office submitted procurement plan to World Bank (WB) for prior approval	26. PSU sends contracts to suppliers for signing
7. WB sends the approved procurement plan to project office	27. Suppliers send the performance guarantee and signed contract to PSU
8. Project office submitted draft bidding documents to WB	28. PSU sends to PS for signing
9. Project office submitted draft bidding documents to the ministry procurement committee	29. Back to PSU
10. Procurement Committees seeks for no objections from Zambian Public Procurement Authority (ZPPA)	30. PSU sends a copy of signed contract to the supplier
11. ZPPA sent approved documents to procurement committee	31. Supplier export vaccines and cleared by Zambia Revenue Authority
12. Procurement committee sends to PSU	32. Vaccines transported to Centre for Veterinary Research Institute for storage
13. PSU request for bids from the supplier	33. Funds transferred into districts accounts
14. Suppliers submitted the bids to PSU	34. District Veterinary Office meet with Veterinary Assistant to strategize
15. PSU writes Permanent Secretary (PS) to appoint evaluation committee	35. Awareness campaign
16. Evaluation committee submitted the recommendation to procurement committee	36. Farmers receive the information
17. Procurement Committee sends evaluation report to ZPPA and WB	37. Farmers pay ZMK15 for ECF vaccine
18. ZPPA send approved documents to PS	38. Money deposited with Veterinary Assistant
19. PSU and Project office draft the letters and contracts	39. Veterinary Assistant deposit with the commercial bank
20. PSU sends to PS for signing	40. Vaccines transported to provincial/district offices
	41. Vaccines transported to rural health centers
	42. Vaccines transported to centers & farmers bring animals
	43. Veterinary Assistant submit report to District Veterinary Office
	44. District and provincial review and planning meeting
	45. District and province submit report to the Project Office
	46. Project Office submits report to World Bank and MFL

Flow of funds	Point of challenges
Procurement process	
Flow of information	
Handling process	

Figure 5.2. Aggregated Process Net-Map of vaccination campaign in Zambia

The following is a brief description of the step by step implementation process to the point of vaccinating the animals. World Bank released the funds to the Bank of Zambia, denoting the first step in the flow of funds. The funds were deposited into the control account 99, in which all public funds are held. The MFL,

through the project accountant requested the funds from the Ministry of Finance Treasury Department. The managers of the bank account transferred the funds from control account 99 into the project account, which was opened with a donor code.

Step 4 to 30 of Figure 5.2 denotes the procurement process. The procurement process began with the Veterinary Department submitting the procurement plan detailing vaccine specifications to the project procurement officer and the Procurement and Supplies Unit (PSU). The project procurement officer and the PSU reviewed the plan before sending it to World Bank for approval. After the approval, the project procurement officer drafted the bidding documents and submitted them to World Bank for a prior review. The bidding documents were later forwarded to the procurement committee, who sought a no-objection (single sourcing) from the Zambia Public Procurement Authority. Next, the PSU requested the suppliers: Centre for Ticks and Tick-Borne Diseases (CTTBD) based in Malawi and Botswana Veterinary Institute (BVI) to tender in the bids for the supply of ECF and FMD/CBPP vaccines, respectively.

Upon receiving the bids, the PSU requested the Permanent Secretary (PS) to appoint the evaluation committee, which assessed the bids and made recommendations. The assessment report was submitted to the Ministry procurement committee, of which the PS chairs. The procurement committee then submitted the report to the Zambia Public Procurement Authority and World Bank for approval of the award of contracts. Zambian Public Procurement Authority approved the report and returned it to the PS, who then requested the PSU and project procurement officer to draft the contracts and letters, which the PS forwarded to the Ministry of Justice for clearance. The cleared draft contracts were returned to the PS and passed on to PSU to finalized the contracts and prepare letters for the PS to sign before sending out the contracts to the suppliers. At this stage, the suppliers were also requested to submit the performance guarantee, without which the PS could not sign the contracts. Upon receiving the signed contracts and the bonds from the suppliers, the PS signed the contracts, and a signed copy was mailed back to the suppliers.CTTBD and BVI supplied the vaccines and were cleared by Zambia Revenue Authority, denoting the first step in the handling process (step 31). The vaccines were then stored at the Centre for Veterinary Research Insitute before distributing them to the provinces or districts. At this point, the funds were transferred into the districts accounts to help the districts to organize the teams and conduct awareness campaigns (step 32). During these awareness campaigns, the farmers also paid ZMK15 per animal for the ECF vaccines.

After that, vaccines were delivered either directly to the districts or provinces and later to either the rural health center or directly to the vaccination center (crush pen), where farmers brought their animals for vaccinations (steps 40 to 42). Upon completion of vaccinations, the Veterinary Assistants compiled a report on the immunization coverage, the number of animals vaccinated against the population at risk/targets, the number of farmers reached out, commencement and completion dates. The Veterinary Assistants submitted the report to the District Veterinary Officers. Provincial review meetings were held during which the District Veterinary Officers presented the reports and plans for the upcoming vaccinations. The consolidated provincial reports were then submitted to the project coordinating office to prepare a national report and later forwarded to the World Bank and MFL-Veterinary Department (steps 45 and 46).

5.4.3. Level of influence of Actors

As described in the methods section, the respondents were asked to rate the perceived level of influence of the actors they had identified on the ultimate outcome (ensuring a successful vaccination). As shown in

Table 5.1, only actors with some perceived influence are listed. According to the respondents, they perceived the World Bank and Ministry of Finance as the most influential actors (influence level=8). World Bank had this score because they provided the funds, and if they decided to cut back the funding, the program could have collapsed. The respondents assigned a high influence to the Ministry of Finance because they have a control function for handling the public funds in the control 99 account and the ability to withhold as well as decide the timing of the release of funds. Even though the respondents attributed this level of influence to the Ministry of Finance, the influence may lie with the government because the government person also tends to give instructions. The veterinary department and the suppliers were assigned a high score of seven because the department had the responsibility of providing the specifications necessary for the procurement process to begin, while the supplier had to ensure that they produced and supplied the vaccines on time. The supply of vaccines, for example, ECF vaccines, takes close to eight months. Thus, any delays from the two actors could potentially slow down the procurement process and, ultimately, the entire vaccination campaign.

Table 5.1. Level of influence of actors in ensuring that vaccination is successful

Actors	Level of influence
World Bank	8
Ministry of Finance	8
Veterinary Department	7
Permanent Secretary	7
Ministry of Justice	6
Zambia Public Procurement Authority	5
Procurement Unit and Supply	2
Project Coordinating Office	2
Suppliers	7
District Veterinary Office	4
Farmers	6

The level of influence was measured on a scale of 0-8. The influence of 8 means the actor had the highest influence, and 0 entails no influence. Actors with no influence are not included in this table

The PS was associated with a score of seven. The reason given for this was that he is a custodian and final authority of the ministry, and all the documents requiring approval within or outside the ministry passes through this office. Ministry of Justice was given a score of six because they are an independent ministry, and other actors had no command over them. According to the interviews, this was not a sign of power struggle but procedure within each ministry. Another reason given for this score was that the Ministry of Justice had authority over the clearance of the supplier's contracts, without which the procurement process would halt. The Zambian Public Procurement Authority had a rating of four because they have the power to approve or disapprove the tendering documents, and any abuse of power from this end could potentially affect the process. The PSU and the project coordinating office were each given a score of two. Though they have the procurement plan to implement and the frontline actors in the procurement process, they had less influence because they received instructions from other actors. The farmers were assigned a score of six because without them bringing forward their animals, vaccinations could not have taken place. The District Veterinary Officers had a rating of four because they were critical in ensuring that they delivered the vaccines at vaccination centers as well as providing reports on vaccination coverage.

5.4.4. Supply-side challenges faced and strategies employed

The Process Net-Map presented in Figure 5.2 was also used to identify the challenges associated with the procurement and disbursement of funds as well as other problems that arose during the implementation process. We highlight these challenges and the strategies employed to overcome them in the subsequent sections.

Flow of funds

The flow of funds faced two main problems. First, the funds were returned to the control account 99 at the end of the first and second fiscal years of the program implementation (step 3 of Figure 5.2). Even though the project implementing ministry reapplied for the same funds in the subsequent fiscal year, there was no guarantee of a timely approval because it took about three months before the funds were released. Ideally, the funds should not have been returned since the project account had a donor code. All funds held in accounts with a donor code are not returned into control account 99 because projects have a specific timeline. The return of funds and a reminder to the treasury department were attributed to the general bureaucracy problems, some of which are highlighted in the conceptual framework. Also, even if they were referred to as donor funds, in essence, the funds were a loan that the government obtained from the World Bank. This could have also contributed to the returning of funds. The release of funds from the public account depends on the availability of government revenue. In addition, the release of funds is dependant on other factors such as the government meeting its obligations. If the government is meeting obligations such as financing the debts and payment of civil servants' salaries, the release of funds is further delayed.
The second challenge was related to operational funds' disbursement, which corresponds to step 33 in Figure 5.2. According to the district respondents, the release of funds from the province to the district was inconsistent. More often than not, the district personnel spent not less than three days pushing for the release of funds at the provincial level. Sometimes, not all the operational funds were received at districts, and no clear explanation of how the funds were used was offered. One of the respondents said; sometimes, the field staff could work for 21 days and only got allowances for 14 days. The district staff dealt with this problem by voicing out during provincial meetings and requested that the funds be transferred directly to the district. The districts were allowed to open the accounts, and funds were transferred directly to these accounts. As stated by the respondents, the transfer of funds directly into district accounts solved the challenges of delays in the release of funds from provinces to districts, and this in part motivated the district staff to even work beyond the targets. However, some of the provincial staffs were discontented with this process as they claimed that district staffs were no longer accountable to them.

Procurement process

The challenges in the procurement process were threefold. First, the purchasing process of vaccines was slow in the initial stages of the project implementation. Even though a specific procurement specialist within the ministry was assigned to handle the project procurements, the progress was still slow because the capacity to handle the procurement document was not sufficient. The project had to hire an additional procurement specialist to provide additional support to the ministry procurement team.
Second, the end user and requesting entity (department of veterinary) delayed submitting the specifications to the procurement unit (corresponding to step 4 of Figure 5.2). Without this information, the procurement office could not prepare the bidding documents on time. Based on the process net-map presented in Fig. 2,

the district and provincial reports, as well as the review meetings (step 44 and 45), were important sources of the information for the specifications for the next vaccination campaign. However, the vaccination review meetings were not held on time due to the engagement of staff in other ministerial activities. Though the project coordinating office requested the districts to submit the electronic reports directly to the project office even when the review meetings were not held, submission of the electronic reports was equally untimely due to challenges with internet connectivity in some remote districts.

Lastly, the frequent movement of the procuring documents back and forth between the procuring entities (step 5 to 30 of Figure 5.2) and bureaucratic procedural slowed down the process. The process was further delayed by not convening the procurement meetings on time due to the untimely release of funds, unavailability of authorizing officers due to other ministerial commitments and misplacement of files as a result of limited incentive for bribery. Though respondents regarded the misplacement of files or documents as something that typically happens in many organizations, it had an adverse effect on the procuring process. Despite the authorizing officers being engaged in other ministerial activities, some respondents said that the authorizing officers could also deliberately frustrate the entire process through administrative delays, especially if the incentives for corruption are limited.

To overcome the challenges of annual procurement, the project signed a two-year framework contract with the suppliers. This decision was arrived at considering that the production and supply of vaccines take long, coupled with the delays in procurement.

Vaccine handling process

The handling process of vaccines faced the following challenges. First, the vaccinations are conducted by qualified veterinary personnel. However, some veterinary camps are vast and do not have Veterinary Assistants. Thus, the limited number of veterinary personnel within the districts hampered the delivery of the animal health services.

Second, lack of livestock service centers in most rural areas made it difficult to conduct vaccinations centrally (step 42 in Figure 5.2). Even though there was a component of infrastructure development under the LDAHP (World Bank, 2012), this component stalled in some districts due to delays in the procurement of contractors.

Third, due to the procurement delays, the vaccinations schedules were also interrupted, and this created further problems. For example, the campaigns which were planned for September/October (dry season in Zambia) were delayed by two to three months implying that vaccinations were done in January (rainy season). Vaccinations during the rainy season were challenging because many rural areas are inaccessible due to impassable roads. Apart from inaccessibility to vaccination centers, data capturing became a problem too. Although specific data capturing forms were provided to the vaccination teams, most of the teams opted for hardcover notebooks because they were easier to handle in the rainy season given that most of the vaccination centers have no proper shelters. Sometimes the teams would rush the data capturing process without recording all the necessary details such as disaggregating the statistics which were needed for further planning. Furthermore, conducting vaccination in the rainy season resulted in vaccination apathy. Few farmers brought their animals for vaccination because they were busy preparing their crop fields, and the same animals were used for draught power (step 42 of Figure 5.2).

Third, storage of vaccines, particularly in the vaccination center, was equally a significant problem due to a lack of cold storage facilities (step 41 and 42). Ideally, the vaccines from the district were supposed to be kept at the Veterinary Assistant's offices (which are also Veterinary Assistants' residence) before taking them to the vaccination centers. The cold chain at camp level, however, was ineffective due to lack of electricity. To deal with this problem, the District Veterinary Officers used cold boxes (most of which were worn out) loaded with ice packs to deliver the vaccines from districts direct to the vaccination centers. However, the ice packs could only last for two days, and this increased the frequency of trips from the district office to vaccination centers of which the district personnel felt that it affected the operational budget. Though in some areas vaccines were stored at the rural health centers which are solar powered (step 41), this became a challenge as the rural health centers' staff became concerned of cross-contamination of human and animal vaccines. The use of ice packs eventually, remained the only option.

5.4.5. Challenges from the farmer's side

According to the focus group discussions, farmers faced the following challenges. First, farmers were not able to demand the services because of lack of contact between them and veterinary personnel whom farmers claimed were only seen during the vaccination campaign. This limited interaction led to a limited flow of information from the frontline veterinary offices to farmers because the veterinary assistants were uncertain as to when they would actually receive the vaccines (the link between farmers and veterinary assistant in Figure 5.2). Indeed, interviews with farmers revealed that some farmers had already paid up the fees for the ECF vaccines but wondered why the vaccines were late. Farmers could not also approach the district level staff due to social barriers. Social barriers arose because farmers considered themselves less educated than veterinary personnel. As such, they failed to approach the service providers whenever they had concerns that needed to be addressed. The missing link between farmers and frontline officers was also attributed to understaffing in some districts. Another challenge was lack of effective organization among farmers due to the collective action problem. For example, in the first year of program implementation, some livestock that was vaccinated died. Despite some farmers attributing the death of their animals to the vaccination, they could not air out their views partly because they were not organized and lacked adequate information about the cause. Lastly, though the producer organizations such as District Farmer Associations which oversee the concerns of the smallholder farmers exist in Zambia, the majority of the smallholder livestock farmers are not members and are unaware of their existence. The associations are an affiliate of the Zambia National Farmers Union, which supports the development of agriculture by organizing members into an association to create an effective voice on concerns in the agriculture sector.

5.5. Discussion

The results identified the release of funds and the procurement of vaccines as the major governance challenges in the implementation process of vaccination campaigns. In this section, we apply the framework presented in Section 2 to discuss these findings.

5.5.1. Supply side

Flow of Funds

The study finds a considerable delay in the release of funds from the public treasury after the unspent amounts were returned to the public account at the close of the fiscal year. Despite the project implementing ministry reapplying for the same funds in the next fiscal year, there was no guarantee of a timely approval given that the funds were a loan and thus were considered as part of the government coffers. Given that the delays in the approval are linked to the government operations suggests that diversion of funds is imminent. Therefore, fund diversion to other prioritized government activities results in the untimely release, which affects the implementation of projects. Indeed, Keng'ara (2014) also notes that disbursement of funds is the most critical element of any project implementation because this is the only way project activities schedules can translate into measurable outputs. Another challenge was the untimely release of operational funds from the province to the district. One possible reason for this is due to the siphoning of funds as a result of a long process. Hence the elimination of the provincial to district flow of funds suggests that bureaucratic flow of funds can be open to abuse and thus need to be closely examined in future interventions. This finding is in line with Goodsell (2003) who noted that the more hands through which funds pass, the more opportunities arise for misuse.

Procurement process

Procurement also has a significant impact on the management of diseases and thus the need to be well managed. The findings show that the process of procuring of the vaccines was slow. The study finds the following as significant reasons why the problem occurred.

First, results in Table 5.1 shows that the veterinary department and the Permanent Secretary had the highest influence level. This level of influence suggests that the power within the procurement process rests upon these two actors: the veterinary department as the end user and requesting entity, whereas the Permanent Secretary was the authorizing entity. However, the delay in the end user department in submitting the technical specifications, which slowed down the procurement process reflects a lack of urgency. Therefore, actors that have high influence in achieving the outcome but lacking urgency are likely to affect the implementation process of projects negatively. Additionally, a constraint of incentives leads to administrative delays, and corruption usually creates such incentives (Søreide, 2002). Therefore, lack of urgency coupled with administrative delays caused by non-availability of authorizing officials, make the procurement process worse. This finding corresponds to Greenwood et al. (2001), who found administrative reasons as the primary cause of delays in the implementation of public projects in the construction sector.

Another possible cause of the delays is the limited capacity of the procurement unit. Despite the respondents ascribing the lowest perceived level of influence to the PSU, they were a central unit in the procurement process as evidenced by a number of the steps linked to them[10]. Even though they were instrumental in the preparation of procurement plans, bidding documents, and contracts, they lacked capacity as evidenced by the recruitment of additional procurement staff to provide technical support to the procurement unit. Thus, the capacity constraints of the central actors have a negative bearing on the procurement process. The

[10]As present in Fig 5.2, more than half of the steps within the procurement process are linked to the procurement unit. The number of steps is not relavant for influence rating. The influence rating is the perceived influence of the actor on the ultmate outcome. This was perceived to be low because of low descion making power.

situation is even worse if the recruitment of additional staff is done when the project has taken off because it further delays the implementation process. This finding is in line with Ameyaw et al. (2012) and Thai (2004), who also found that professionalism or quality of the procurement workforce affects the ability to accomplish procurement objectives.

Lastly, the various stages of approval of the procuring documents, as shown in Figure 5.2 suggest that the procurement procedure is long and complicated. Therefore, the complexity of the procurement process further contributes to the delays because of the high frequency of back and forth movement of procurement documents. Ahsan and Gunawan (2010) also found that long bid evaluation time and operational delays tend to delay the procurement process.

5.5.2. Demand-side

Deriving from the framework presented in Section 5.2, an improvement on the supply side could also be achieved by creating strong incentives on the demand side. However, despite the farmers being ascribed with the influence level of 6 (Table 5.1) because they cooperated by bringing their animals for vaccinations, there was no much opportunity for interaction between farmers and veterinary personnel due to some social barrier, lack of effective organization among the farmers and understaffing of frontline staff. Lack of information flow from service providers to farmers due to social barriers leads to an inability to hold service providers accountable. Felix et al.(2010) also conclude that accountability in service provision is enhanced if end users have access to information about the delivery process. It is also important to note that the limited interaction is not merely because of a lack of social barriers but also due to limited frontline staff. This finding corresponds to what Mutambara et al. (2013) found in the case of Zimbabwe, where there was limited interaction between the Department of Veterinary and Services and farmers due to understaffing. This system of having one veterinary officer providing health services to many farmers entails that an individual veterinary officer is an important person for the farmer, with an individual farmer being one in a crowd for the veterinary officer. This leads to a systemic power difference and dependency.

The presence of these problems is an indication that there need to think of alternatives ways that would increase the voice of the farmers to demand better services and be able to hold the service providers accountable. Msellati et al. (2012) recommend that implementing social accountability strategies that empower ordinary citizens to exercise their inherent rights is critical to holding service providers accountable for the use of public funds. One such measure is through the use of the Citizen Card Reports (CRC), which initially was developed in Bangalore, India (Ravindra, 2004), and has since been successful in assessing citizens' satisfaction with the delivery of services in various countries and sectors. The basic concept behind the CRC is that citizens as users of public services can provide useful feedback on the quality and adequacy of services, for example, animal health services and the problems they face with the service providers in this case veterinary department. By collecting feedback on the quality and adequacy of public animal health services from livestock farmers, CRC can provide a rigorous basis and a proactive agenda for communities or other stakeholders to engage in a dialogue with the veterinary department. By doing so, can in part, stimulate the supply side response and consequently improve the delivery of livestock health services. For this approach to be successful will, however, require an environment in which citizens are free to express themselves and talk about public services openly.

Another measure is the use of lobbying to induce political decision-makers to take steps to improve the performance of the veterinary service delivery. With the current political slogan in Zambia of "sonta epowabomba" literally meaning "show us what you have done," farmers can use this existing tool to empower themselves to demand better services by holding politicians accountable. This kind of instrument can work even if the people are less organized, as shown in other sectors such as infrastructure development one of the premises on which some Zambian parliamentarians won their seats in 2016 general elections.

Community participation in developmental projects as demonstrated in the eradication of rinderpest disease in east African countries, is also another way of creating a strong incentive from the demand side for the supply side (Leyland, 2010).

5.6. Conclusions

The governance challenges affecting the implementation of vaccination campaigns are linked to the implementation process. The complex design of the procurement procedure, the limited capacity of the government officials in the procuring entity and lack of urgency from the requisition entity, are some of the problems resulting in procurement delays while the diversion of funds caused a delay in the release of funds. Given that the procurement procedure is complicated and cannot be changed, there is need to increase the efficiency of the existing steps by (i) increasing information flow so that procurement documents are adequate when first submitted; (ii) increasing a sense of urgency among the actors involved by high-level commitment and ownership; (iii) building staff capacity by providing technical support, (iv) using of e-procurement to deal with challenges of handling paperwork and administrative delays, and (v) entering into framework contracts with suppliers will overcome the repetitive procurement process. Building a sustainable financial capacity in the overall management of public funds seems essential to deal with the challenge of fund diversion.

Though the highlighted problems mostly arise from the supply side, there is also a lack of power from the demand side (farmers). A mechanism such as Citizen Report Cards and lobbying political decision-makers can increase the voice of farmers to hold the service providers accountable and demand better services.

Finally, the problems identified are not only relevant for vaccination programs, but they can be encountered in any developmental programs that involve the distribution of publicly procured inputs.

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6.0 DISCUSSION AND CONCLUSIONS

This thesis's overall goal was to identify options that would promote sustainable smallholder livestock production systems in Africa using the case of Zambia. We focused on cattle, which are the most valuable large asset among smallholder farmers because of the multiple benefits they offer to smallholder farmers. Specifically, we sought first to unravel the contextual factors that enable and disables farmers to keep cattle. Second, we identified the factors that affect the livestock herd size among smallholder farmers. Third, we analyzed the gender dimensions in cattle production, and lastly, we identified the governance challenges that are likely to occur during the implementation of interventions using vaccination campaigns as an example. In the subsequent sections of this concluding chapter, we summarize the preceding four chapters' empirical findings. We then discuss the implication of the results for meeting the growing demand for livestock and the associated products and harnessing this opportunity for smallholders. The two last subsections outline the methodological limitations and policy recommendations.

6.1. Summary of key results

This subsection summarizes the key findings, which are grouped into four themes.

6.1.1. Factors enabling and disabling farmers to keep cattle

Using the grounded theory approach and literature review on cattle production, we identified and described the contextual factors that lead smallholder farmers to move in or out of cattle keeping in Chapter 2. In addition, we developed a conceptual framework that shows how these factors are interlinked.

The results revealed multi-dimensional factors that contribute to moving in or out of cattle production. Human population growth, climatic variability, livestock population density, availability of male household labor, and institutional support were identified as contextual factors that affect the moving in or out of cattle production. The results show that the increase in settlement densities results in the competition to access the best arable land, which tends to put more pressure on land. Because of this pressure, there are changes in land use where the grazing areas are turned into human dwelling places. This creates a serious grazing problem resulting in high rates of stocking densities on a given piece of grazing area. Because of high stocking densities, the grazing area's carrying capacity becomes insufficient to sustain the productivity of cattle resulting in cattle losses. While conversion of land into crop production, on the one hand, seems to create problems, on the other hand, our findings also show that crop income supports the financing of the purchase of initial stock as well as vaccines and drugs for livestock in the mixed farming systems. This implies that there is a strong synergic effect between the two production enterprises.

In addition to the human population's effect, the results show that climate variability is also a critical concern. The results show that the effects of climate variability on cattle production are mediated through changes in pasture productivity, water sources, and crop production. The changes in the quality of feed resources and water availability, in part, increase cattle disease pressure. Climate variability also affects crop yields and thus affecting the households' incomes. Crop income is an essential source of financial capital that facilitates the acquisition of cattle's initial stock.

Another key finding is how crop damages caused by grazing cattle constitutes an essential obstacle to cattle production. However, one interesting observation from our findings is how cattle population density serves as a catalyst to resolve social conflicts arising from crop damages caused by grazing cattle. The results suggest that the availability of animal draft power serves as an instrument to settle conflicts. This instrument is useful because the lack of ADP, to some extent, does not allow non-cattle owning households to expand the sizes of their cultivated plots.

The study also shows that male labor availability within a family structure plays a pivotal role in acquiring cattle. Apart from providing the labor in cattle production-related activities, we found that young male household members are also channels through which households can acquire cattle. Another perceptible aspect of our finding is the experience that is gained through the process of herding cattle. Lastly, we found access to institutional and technical support such as vaccination and restocking programs helps in building the herd size.

6.1.2. Factors driving the herd growth

In chapter 3, we identified the factors affecting the livestock herd size among smallholder farmers. Using various nationally representative survey data, we examined the factors driving the inflows and outflows of livestock from the herd and estimated the livestock demographics indicators. The interviews with livestock experts were used to explain the observed changes in demographic parameters.

The results showed that cattle deaths were the main channel through which livestock leave the herd. We also found positive fluctuations in population growth rates of cattle and declining mortality rates over the years, while negative population growths were observed for goats and pigs. The observed trends were attributed to the significant developments in cattle production during the period under review. Discussions with experts within the Ministry of Fisheries and Livestock revealed that, during the years when interventions related to animal health service delivery were carried out, cattle population growth rate increased, and the mortality rate reduced. Births were identified as the primary source of building the herd size. However, the main challenge was the low conception rates due to limited feed resources during the dry season. Purchases were identified as essential in acquiring initial stock. Farmers revealed that they mainly acquire first stock through purchases, and incomes from crops are used to finance the acquisition of this stock and, after that, rely on births to build up and maintain the herd size.

6.1.3. Gender dimensions in cattle production

In Chapter 4, we were interested in understanding female cattle ownership. Using the qualitative data collected through various methods, we identified the pathways through which female household members acquire cattle and what female ownership means from the gender perspective. We also determined the factors associated with the proportion of cattle owned by female household members and whether female cattle ownership is correlated with cattle herd productivity and female empowerment using different econometric methods.

We identified various channels through which female household members acquire cattle. However, despite women having the opportunity of owning cattle, the findings showed that they never have full cattle ownership. This is because women have to consult and seek their husbands' approval if they needed to do anything with their cattle. The majority of the women also lacked the technical know-how, and they thus tend to depend on male household members.

In this study, we also found that the factors associated with female cattle ownership do not necessarily increase the share of cattle owned by female members. For example, even though older female household members are more likely to own cattle, the likelihood of their share to increase is insignificant. Also, male household members' presence can facilitate women's acquisition of cattle; however, the possibility of the female cattle share to increase is less as the proportion of male members increases. Further, the results showed that while financial independence, accumulation of other assets, and improvement in the cattle herd size can help women acquire cattle, these factors dampen the likelihood of increasing their share. The share of cattle owned by female household members is less likely to increase because of the perceived conflicts that are likely to arise in the households should their share increases. Another reason for this observation is that females do not manage their cattle because they lack technical skills. Thus, gender gaps will continue to persist if these challenges are not addressed, and women are likely to be left out from benefiting from the growth process.

Lastly, we found that female cattle ownership is negatively associated with herd productivity because women are disadvantaged in many ways, such as limited access to livestock information, extension services, and education. As such, females may be constrained and not able to take care of their cattle productively. Despite this negative correlation, we found that increasing female cattle ownership improves women's bargaining power as they have a say in household decision making.

6.1.4. Governance challenges affecting the implementation of interventions

Chapter 5 presented an in-depth analysis of governance challenges that are likely to occur when interventions are implemented. Using a case study of the vaccination program conducted in Zambia, we examined the challenges associated with the release of funds and procurements and how these problems are linked to the implementation procedure. A novel qualitative research tool called Process Net-Map, a visual participatory mapping technique was applied.

The study found that the governance challenges affecting vaccination campaigns' implementation were linked to the implementation process. The findings show that the process of procuring the vaccines was slow for the following reasons. First, there was a lack of urgency among the influential actors. Additionally, a constraint of incentives led to administrative delays, and corruption usually creates such incentives. Therefore, lack of urgency coupled with administrative delays caused by the non-availability of authorizing officials made the procurement process worse. Another cause of the delays was the limited capacity of the central actors. Lastly, the procurement procedure was long and complicated. Therefore, the complexity of the procurement process further contributes to the delays because of the high frequency of the back and forth movement of procurement documents. Diversion and siphoning of funds caused a considerable delay in the release of funds.

An improvement on the supply side could also be achieved by creating strong incentives on the demand side. However, there was a lack of power from the demand side due to the limited opportunity for interaction between farmers and veterinary personnel. Social barriers, lack of effective organization among the farmers, and understaffing of frontline staff limited the flow of information from service providers to farmers leading to an inability to hold service providers accountable.

6.2. Contribution to the literature and implication for livestock development

In this section, we discuss our work's contribution to livestock development literature and the implication of the results for meeting the growing demand for meat and livestock products. We first highlight the major problems stifling the sector, then the challenges of bridging the gender gap, and the problems associated with the implementations of developmental programs.

6.2.1. Major problems affecting cattle production

In this thesis, we have identified various problems affecting livestock production. We identified human population growth, climatic variability, livestock population density, and institutional support as critical issues that affect livestock production. Other studies have equally identified these factors. See, for example, Boserup (2011) on the effect of human population growth; and Abule et al. (2005) and Solomon et al. (2007) on the climatic effects. However, our findings show that some factors are household-level characteristics, while others are regional attributes.

Further, we found some interaction between regional and household level characteristics such that regional incentives alone, for example, an increase in the demand for draft power, cannot push all the households to move in. Thus addressing one aspect without addressing the others may not sufficiently contribute to the sustainable livestock production systems and ultimately reducing the supply-demand gap. Hence, there is a need to identify viable alternatives that would promote sustainable development of the cattle production system if farmers are to benefit from the growing demand for livestock and its associated products.

Another challenge is how to increase and maintain a healthy herd size so that farmers can have a marketable surplus and take advantage of the development opportunity. While several studies have assessed the effects of the estimated demographic parameters on the herd size, for example, Ba et al. (2011) in Mali, Muma et al. (2009) in Zambia, Ng'ambi et al. (2006) in Lesotho, they limited their analysis to only year of monitoring thus having no leverage of analyzing the inter-annual variations. Therefore, our study contributes to the livestock development literature by tracking the demographic parameters and assessing how interventions affect these parameters. Because of high mortality rates and deaths being the existing primary channel, it seems necessary to increase the herd size by reducing the mortality rates. Our results showed that cattle mortality reduced during periods of interventions suggesting the need for effective animal health services as a precondition for improved livestock production. The analysis also showed that births were a key inflow channel; thus, dealing with the challenges associated with low reproduction rates can contribute to the herd size's growth. Purchases are also essential in building the herd size. Given that farmers mainly acquired the first stock through purchases and crop income, primarily finance such investment indicates that smallholder farmers who cannot generate a surplus from crop production will not be able to move into cattle production. Thus, cattle acquisition seems to require addressing the low crop productivity and market access, which have been on the policy agenda in many developing countries.

6.2.2. Bridging the gender gap

Bridging the gender gaps is also critical if women are to benefit from the growth process. In line with other studies (Debela 2017; Tegebu et al. 2012; Deere et al. 2012; Njuki and Mburu 2013), we conclude that financial independence, accumulation of other assets, and improvement in the cattle herd size can facilitate

women to acquire cattle. However, our study goes beyond these findings by showing that gender gaps will continue to persist since the ownership factors do not necessarily increase the share of cattle owned by female members. This is mainly because of the perceived conflicts that are likely to ensue in the households should their share increase. Thus addressing the gender dimension is an important cross-cutting issue to avoid intra-household conflicts when promoting livestock production.

6.2.3. Implementation challenges of developmental programs

Addressing the issues highlighted in the previous sections will require the implementation of interventions. However, the implementation of developmental programs that involve the distribution of publicly procured inputs, such as vaccination campaigns, encounters many challenges. Chifungula (2015) and IFAD (2014) identified delays in the procurement of inputs and the disbursement of funds as the main challenges affecting the implementation of such programs. In this thesis, we show that the complexity of the procurement procedure, the limited capacity of the central actors, and lack of urgency from the influential actors result in procurement delays while the diversion and siphoning of funds cause a delay in the release of funds. Lack of power from the beneficiaries can also contribute to the inefficiency of the implementation procedure. Therefore, if these problems are not addressed, harnessing the opportunity for the smallholder farmers and reducing the meat supply deficit can be far fetched.

6.3. Limitations of the study

The following were the major limitations of the thesis.

Chapter 2 proposed some hypotheses that need to be empirically tested. However, this was beyond the study objectives as more quantitative data is required to test the hypotheses. Future research should consider dynamic modeling that incorporates all the contextual factors that enable or disables farmers' ownership of cattle over time. This analysis will contribute to the refinement of the proposed theoretical model.

Chapter 4 used a crude estimate of herd productivity due to a lack of sex and age-disaggregated data. The ideal estimate should be based on the number of females that have reached reproductive age.

Lastly, the process net-map requires validation of results from all the actors involved. However, it was not feasible to bring all the actors together due to time and cost implications. This challenge was circumvented through triangulation.

6.4. Policy recommendations

Based on the thesis's empirical findings, the challenges outlined indicate that there is a need to think of policy reforms that will address the problems so that farmers can better be positioned to benefit from the sector's growth. The following are some of the broad policy recommendations that we propose.

6.4.1. Cattle intensification

We identified various problems affecting livestock production. Since the problems associated with the availability of water and grazing land are expected to continue, there is a need to identify viable alternatives

that would contribute to the sustainable development of the cattle production system. Cattle intensification can be one of the options so that farmers can also maximize the benefit of increased milk production given that the demand for milk in Africa and, in particular, Zambia is expected to continue rising in the foreseeable future (Pica-Ciamarra et al., 2014; MAL et al., 2012). However, this option's viability lies in the investments in complementary services and infrastructure development, as McDermott et al. (2010) suggested. We make suggestions on what institutional and technical support are needed in the subsequent section.

6.4.2. Providing institutional and technical support

Cattle intensification requires the promotion and training of farmers in fodder management to alleviate the feeding problems. Moreover, building the herd size also demands implementing interventions that address the reproduction rates, such as strategic feeding of livestock to address the dry season challenges. Such interventions can contribute to the herd size growth from which the young ones can be raised into mature breeding stock and commercial slaughter animals. This intervention is essential, given that farmers mainly increase their herd size by keeping the off-spring of their herd rather than buying animals. Artificial insemination using bulls of high-quality breeds is another alternative that would significantly contribute to building viable herd sizes. However, this aspect has received little attention in developing countries, and thus, more research is required to explore various alternatives through which farmers can access this service.

Given that cattle mortality responds to livestock interventions, it underscores the need for effective provision of animal health services. Farmers should also be keen to acquire necessary technical skills in cattle production and animal health management for the sustainability of livestock production.

Furthermore, we found a strong synergy between cattle acquisition and crop income since most households mainly finance the first stock acquisition using crop incomes. Therefore, it is necessary to address the challenges associated with low crop productivity, which has been on the policy agenda in many developing countries if farmers are to generate a surplus from crop farming.

6.4.3. Bridging the gender gap

While implementing the preceding recommendations can also facilitate women's acquisition of cattle and thus increase their bargaining power, reducing the cattle gender gap will, however, require that such interventions do not result in household conflicts. Therefore there is a need to sensitize men on the importance of female cattle ownership and its implication on household welfare if women are to participate in the growth process. This is a goal that requires long-term efforts by the developmental organizations that promote female cattle ownership.

6.4.4. Improving efficiency in the implementation of programs

Finally, realizing the benefits from the proposed interventions, especially if they involve distributing publicly procured inputs and services, requires addressing the governance challenges associated with procurement and fund release. Some strategies to improve the efficiency of the procurement process include increasing the sense of urgency among the influential actors, building the staff capacity of central actors,

using e-procurement, and entering into framework contracts with suppliers. Building sustainable financial capacity in the overall management of public funds is needed to improve funds flow.

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