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What factors influence smallholder farmers' decision to select a milk marketing channel in Zambia?

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ABSTRACT

Farmers are faced with computational and informational limitations when making marketing decisions. This holds true for Zambian dairy farmers. This study examined the factors that influence the choice of milk marketing channels among 251 smallholder farmers in Zambia participating in milk production and marketing using a multinomial logit model approach. Three milk marketing channels were identified: direct, traditional, and modern. Relative to the base category (direct), the results indicate that gender and volume of milk produced positively influenced participation in the traditional marketing channel. However, off-farm income had a negative influence on the selection of the traditional marketing channel. Gender, education, distance to major markets, and volumes of milk produced influenced the decision to participate in the modern marketing channel. There seems to be an underutilisation of the modern marketing channel. The study identified the following factors to stimulate participation in the modern marketing channel: (i) concerted value chain investments, (ii) government intervention in the form of policy changes, (iii) increased access to market information, (iv) support services, and (v) transparency in the milk value-chain. Understanding the factors that influence farmers' participation in the informal channels enables tailored policies to support the formalisation of existing structures in the informal sector.

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1. Introduction

Classical theories of economics pose human subjects as rational and utility maximisers (Aleskerov, Bouyssou, and Monjardet 2007). Theory on utility assumes that humans are methodical and consistent in their choices (Simon 1990). According to Becker (1962), rationality seems to “imply some consistent maximisation of a well-ordered function, such as a utility or profit function.” However, rationality and maximisation seem too demanding on human decision-makers as they present some computational burden. Decisions are, therefore, not always consistent with the economic theory of rationality and maximisation (Simon 1972). Behavioural economics relaxes this assumption with the concept of “bounded rationality”. Bounded rationality assumes that human subjects do not always have all the necessary information and cognitive abilities to make decisions consistent with economic theory (Simon 1990). Therefore, the theory of bounded rationality aims to understand the decision processes in the presence of these limitations. According to Coase (1992), transactions

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always occur in some environment where friction is present (also referred to as transaction costs). Transaction costs are costs incurred in gathering information relevant to the decision; contacting, contracting, and controlling the transaction (North 1990; de Bruyn et al. 2001). According to Williamson (1991), bounded rational decision-makers will choose an arrangement that minimises transaction cost given the attributes of the transaction, inclusive of both present and future potential risks and benefits.

When making a marketing channel decision, farmers have several marketing channel alternatives influenced by a myriad of factors, both innate and exogenous. The same holds for farmers in the Zambian dairy sector. Literature suggests that household characteristics, demographic variables, and socio-economic variables, as well as exogenous factors, ranging from existing government policies, prices, and access to support infrastructure and facilities, play a significant role in farmers' decisions when selecting marketing channels (Mburu, Wakhungu, and Gitu 2007; Kiwanuka and Machethe 2016; Ishaq et al. 2017; Neven et al. 2017). Smallholder farmers will choose a marketing channel that maximises their utility and minimises transaction costs, using the available information. Informational and computational limitations present themselves during the decision-making process when deciding to participate in milk production.

Despite the Zambian dairy sector's potential to bring about economic development, it is facing challenges. In Zambia, as in most developing countries (such as those in South Asia, sub-Saharan Africa and Latin America), the dairy sector can be separated into two major categories: the informal and formal sectors (Kumar and Staal 2010). The formal sector is highly formalised and structured, often requiring formal contracts between actors. In Zambia, the formal sector includes 3,000–4,000 commercial and smallholder farmers who have access to the formal markets (Mumba, Pandey, and van der Jagt 2013; ZEF et al. 2017; Houwers and van der Lee 2018). According to the Ministry of Livestock and Fisheries (2019) livestock census, an average commercial farmer owned about 223 heads of cattle and a smallholder owned about 10 heads as at January 2018. Although commercial farmers are the major suppliers in the formal marketing channel, usually directly to processors (Iskandarani and Ekanayake 2013), several smallholder farmers also participate in the formal marketing channel, either through Milk Collection Centres (MCC) or by supplying milk directly to processors. With smallholders in mind, Neven et al. (2017) characterised the modern or formal channels in Zambia as those marketing channels that are operated through MCCs, while the others channels are all classified as traditional marketing channels.

The informal dairy sector in Zambia consists of over 300,000 traditional cattle-owning households who also produce milk but have limited or no access to modern milk marketing channels to sell their milk (CSO 2019; ZEF et al. 2017; Houwers and van der Lee 2018). The informal marketing channel involves non-sophisticated approaches to milk marketing, either directly to the consumer in the local community or local traders, stores, and restaurants. According to Kawambwa et al. (2014), at least 80% of the milk produced in Zambia is produced by smallholder farmers, which amounts to about USD 80 million per year. Of the 80% produced by the smallholder farmers, about 90% is traded informally and does not reach the formal sector. This poor access to the modern marketing channel can be attributed to poor infrastructure, lack of access to finance to aid in business operations, underutilisation of support services, and low milk yields (Kawambwa et al. 2014). Unfortunately, because of smallholder farmers' poor access to formal marketing channels, Zambia's dairy sector makes a small contribution to the formal sector. As a result, Zambia remains a net importer of milk and milk products (Moll, Staal, and Ibrahim 2007; ACF 2012). Unlocking this potential would significantly impact the country's balance of payment by reducing net outflow and increasing inflows of foreign exchange. Also, it would utilise the excess capacity of dairy processing firms and further increasing employment opportunities and value in the dairy value chain.

In the Zambian dairy sector, the informal marketing channels are further sub-divided into direct and traditional marketing channels to comprehend the intrinsic characteristics of the households that utilise these channels (see Ishaq et al. 2017 for a similar categorisation). Consequently, the study analyses three milk marketing channels, namely (1) the direct marketing channel, (2) the

traditional marketing channel, and (3) the modern marketing channel. Operationally, these are defined as follows.

The direct marketing channel refers to the sale of milk directly to consumers within the local community. This includes milk sales at farm-gate or another location but directly from the producing farmer to end consumers.

The traditional marketing channel refers to the sale of milk to other informal players: local milk resellers, kiosks, restaurants, and others. The milk is sold in either fresh or sour form without any processing done to it.

The modern marketing channel refers to the sale of milk through formalised market channels, either directly to processors or to other intermediaries such as milk collection centre, which later supply to processors for further processing and value addition.

This study aimed to identify the factors influencing the decisions of smallholder milk farmers in choosing a milk marketing channel in Zambia. It is the authors' view that understanding the factors that influence farmers' participation in the informal channels would enable tailored policies to enhance the transition from the informal to the formal sector and the formalisation of the existing structures in the informal sector. Thus, this study contributes to filling the apparent absence in the literature on the Zambian dairy sector. Furthermore, through policy recommendations, it feeds into the National Agriculture Policy (NAP) objectives and the National Agriculture Investment Plan (NAIP). In Zambia, the agricultural sector caters for around 92% of the rural workforce and over 67% of the country's labour force. As a result, in 2017, the Zambian Government, in its 7th National Development Plan (7NDP), identified agriculture as a priority sector to drive the Zambian economy (Mulemba 2009; ZEFF et al. 2017). Particularly, the dairy sector has been identified as a key agricultural sub-sector to drive growth and spur economic development. It offers potential for commercialisation that could lead to an increased contribution to Gross Domestic Product (GDP) (World Bank 2011; Williams 2016).

Figure 1 presents a conceptual framework for this study and highlights the key variables to be analysed.

2. Data discussion

This study utilised quantitative cross-section household data collected in 2015 in Zambia as part of the Rural Agricultural Livelihoods Survey (RALS). The survey was implemented by Indaba for Agricultural Policy Research Institute (IAPRI), in partnership with Zambia's Central Statistical Office (CSO), to obtain a comprehensive picture of the Zambian Agricultural sector. RALS is nationally representative as it covers all ten provinces of Zambia.

For this study, only key milk-producing provinces of Zambia were included in the sample, namely; Lusaka, Central, Eastern, Western and Southern provinces, with a total sample of 3 574 households. Moreover, since the focus of this study is on smallholder milk farmers specifically, only milk producers that sold some milk were included in the study sample. After these filters were applied, 251 households were identified and included in the study sample. Table 1 shows a summary of some of the key selected variables.

The average household size was seven members per household, with the household head having an average of seven years of formal education. Landholding size per household was around eight hectares across all the marketing channels. Overall, only 17% of the farmers were female in the sampled areas (see Table 1).

The majority (80%) of smallholder farmers in the sample utilised the direct marketing channel, followed by the traditional marketing channel (16%) and the modern marketing channel (4%) (see Table 1). Generally, farmers who used the modern marketing channel had better access to production factors than farmers that used the other marketing channels. For example, they generally had a better education, better labour endowment, and more productive assets. As a result, they

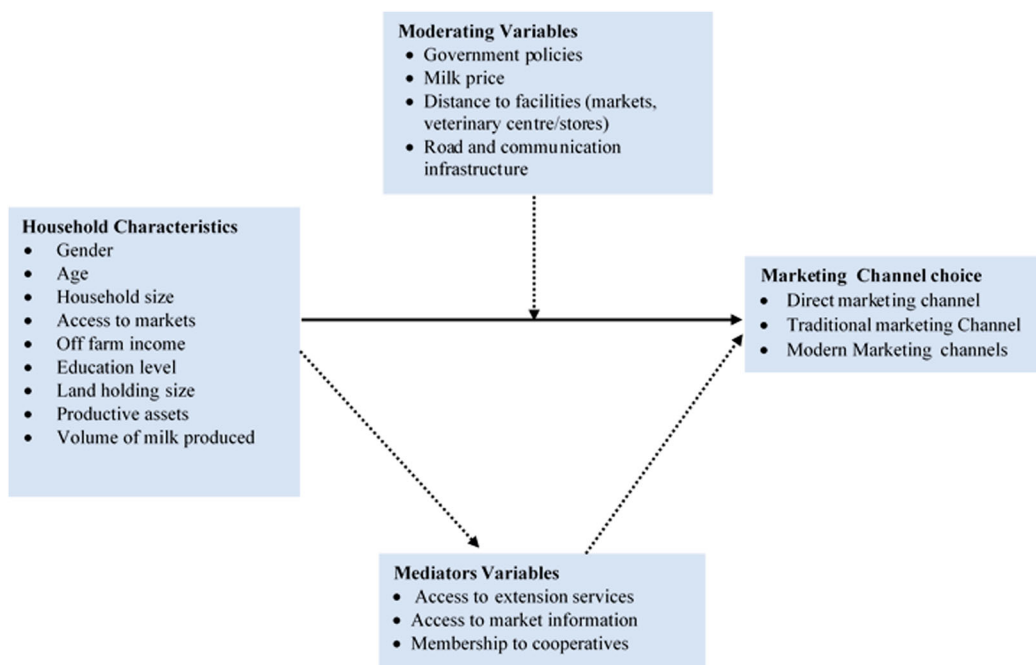


Figure 1. Conceptual Framework.

ultimately produced and sold more milk than farmers who used the other marketing channels. These observations align with the findings by Neven et al. (2017) and Neven et al. (2006).

3. Research methods

The study's central question, "How do smallholder milk farmers select a marketing channel in Zambia?" was answered by applying the multinomial logit model to the data. The multinomial

Table 1. Demographic and socio-economic characteristics of smallholder farmers per milk marketing channel.

Variable	Traditional		Modern		Direct Milk Sales	
	Mean	SD	Mean	SD	Mean	SD
Age of household head	47.58	10.39	51.67	11.05	49.17	12.10
Youth farmers	0.13	0.33	0.00	0.00	0.13	0.13
Gender of household head (1 = Female)	0.15	0.36	0.00	0.00	0.08	0.27
Education level of household head in years	7.88	3.65	7.78	2.68	7.34	3.53
Household size	7.85	3.21	9.89	5.71	7.97	3.25
Herd size (Cattle)	25.26	30.25	46.11	53.05	23.97	29.07
Land holding	7.34	9.98	8.91	4.00	9.57	22.83
Off-farm income (ZMW)	11,455.38	31,644.42	5,459.67	6,930.50	9,968.74	2,1476.86
Productive assets (ZMW)	12,523.63	20,208.29	25,555.00	41,116.02	13,391.37	27,449.04
Access to Market Information (1 = Yes)	0.83	0.38	1.00	0.00	0.82	0.39
Cooperative membership	0.60	0.50	0.89	0.33	0.63	0.48
Distance to nearest Tarmac	20.35	15.95	23.11	18.90	27.30	28.22
Distance to market	16.30	15.52	37.56	13.72	30.86	29.69
Distance to Livestock center	17.84	14.74	22.78	19.10	27.83	25.55
Volume of milk produced	1,854.50	1,570.51	3,761.11	3,826.37	1,198.61	1,296.04
Milk Sales	1,250.73	1,260.54	2,627.72	3,126.55	7,47.86	990.15
Milk price	4.62	3.84	2.74	0.72	4.17	3.20
Sample Size	N = 40		N = 9		N = 202	

Source: Author's computations from RALs (2015).

logit model is an extension of the binary logit model, with more than two choice dependent variables. The multinomial logit model has gained popularity in market participation studies, compared with models such as; multinomial probit model and Principle Component Analysis (PCA), which could produce similar results because of its attractive properties. The main advantage of using a multinomial logit model over other similar models is that it does not need the assumptions of normality, linearity, and homoscedasticity. These advantages make the model more attractive and thus widely used in applied research (Greene 2012). The multinomial logit model is also widely used in similar studies, including; participation in pineapple marketing channels in Kenya (Geoffrey et al. 2015), participation in sheep and goat marketing channels in Macedonia (Tsourgiannis, Eddison, and Warren 2008), participation in dairy milk marketing channels in Pakistan (Ishaq et al. 2017) and in Kenya (Moturi, Obare, and Kahi 2015).

As mentioned earlier, smallholder farmers have a discrete choice about which of the three marketing channels they want to participate in. The multinomial logit regression uses a maximum likelihood estimation to evaluate the probability of a categorical choice (Greene 2000). The probability that individual i chooses the j^{th} alternative; where $j = 1$ for the direct marketing channel, $j = 2$ for the traditional marketing channel and $j = 3$ for the modern marketing channel, is expressed as follows:

$$P(Y_i = j|X) = G(\beta_0 + X\beta)$$

where:

$$X\beta = \beta_j x_{ij} + \dots + \beta_k x_{ik}$$

β_j is a parameter estimate for a market channel, and X_{ij} is a vector of explanatory variables. G is a cumulative distribution function (CDF) for a standard logistic random variable, that strictly ranges between zero and one; $0 < G(z) < 1$ for all real numbers z (Wooldridge 2016), and is expressed as:

$$G(z) = \frac{\exp(z)}{[1 + \exp(z)]} = \Lambda(z)$$

The probability for the choice of market j , given x_i covariates, is given as (Greene 2000):

$$Prob(Y_i = j) = \frac{e^{\beta_j x_i}}{1 + \sum_{i=1}^{i=n} e^{\beta_j x_i}}, \forall j = 1, 2, 3$$

Y_i is the observed response for the i th observation (smallholder farmer household) for choosing a marketing channel among the three channels ($j = 1, 2, 3$). x_i are the independent variables that influence the marketing channel choice, n is the sample size, and β_j are the parameters to be estimated. Specifically:

$$Prob(Y_i = 1) = \frac{1}{1 + \sum_{j=1}^{j=3} e^{\beta_j x_i}}$$

The parameters can be estimated by the maximum likelihood procedure as indicated:

$$\ln \left[\frac{P_{ij}}{P_{i1}} \right] = \beta_j x_i$$

The dependent variable is the log-odds that the farmer will choose market j , relative to the base category (Moturi, Obare, and Kahi 2015; Ishaq et al. 2017). Thus, the marginal effects of all explanatory variables for X_{ji} on the choice of milk marketing channels concerning X_{ji} can be calculated by the following equation:

$$\frac{\partial p}{\partial x_i} = \frac{\partial}{\partial x_i} \exp(x, \beta) / (1 + \exp(x, \beta)) = p(1 - p) \frac{\partial x, \beta}{\partial x_i}$$

The multinomial logit model assumes the independence of the dependent choice variable, called the

Independence of Irrelevant Alternatives (IIAs). This assumption postulates that the choice of one alternative is not related to the choice of another. Violation of this assumption would render the statistical inference made invalid. The Hausman-McFadden test was, therefore, conducted to ensure the independence of the outcome choices. The test results (Prob > chi2 = 0.8434) indicated that the outcome choices were independent, signifying that the multinomial logit model was appropriate.

4. Results and discussion

Smallholder farmers' choice of a milk marketing channel was modelled as a function of age, gender and education; labour endowment (household size¹); off-farm income and productive assets; access to markets and market information; and access to business support services and milk price.

$$\begin{aligned} \text{Mktch}_j = & \beta_0 + \beta_1 \text{agehh} + \beta_2 \text{agehh}^2 + \beta_3 \text{sexhh} + \beta_4 \text{educ} + \beta_5 \text{hhsz} + \beta_6 \text{offinc} + \beta_7 \text{asset_valu} \\ & + \beta_8 \text{membr} + \beta_9 \text{kmkt} + \beta_{90} \text{dlstkmkt} + \beta_{11} \text{dtarmac} + \beta_{12} \text{milkprod} + \beta_{13} \text{mktinfo} \\ & + \beta_{14} \text{price} \end{aligned}$$

Mktch_{*j*} represents the marketing channel alternatives available to the farmer, that is, direct, traditional and modern marketing channels. This study analysed the likelihood of using the traditional or modern marketing channel relative to the base category, that is, the direct marketing channel using the multinomial logit model. Table 2 presents the results for the multinomial logit model, highlighting the significant determinants of milk marketing channel decisions.

The consequential determining factors for participating in traditional marketing channels include the gender of the household head (*p*-value = 0.045), off-farm income (*p*-value = 0.070), distance to markets (*p*-value = 0.039), and milk yield (*p*-value = 0.003). For the modern marketing channel, gender of the household head (*p*-value = 0.0000), education (*p*-value = 0.087), distance to markets (*p*-value = 0.095), milk yield (*p*-value = 0.064), and access to market information (0.0000) were the key determining factors.

The results showed that the gender of the household head had a significant influence on the choice of the marketing channel. Being female increased the likelihood of using the traditional market by 25%, and it decreased the likelihood of participation in the modern marketing channel by 36.7%, relative to the direct marketing channel (Table 3). This result was consistent with Ishaq

Table 2. Multinomial logit regression model results.

Independent variables	Traditional			Modern		
	Coefficient	Std. errors	<i>p</i> -value	Coefficient	Std. errors	<i>p</i> -value
Age	0.060	(0.180)	0.739	0.315	(0.443)	0.477
Age squared	-0.001	(0.002)	0.628	-0.002	(0.004)	0.602
Gender of Household Head (1 = Female, 0 = Male)	1.389***	(0.692)	0.045	-13.678***	(1.242)	0.000
Education level of household head (years)	-0.022	(0.067)	0.741	0.228*	(0.133)	0.087
Household size	-0.031	(0.072)	0.667	0.044	(0.196)	0.821
Off-farm Income (logged)	-0.230*	(0.127)	0.070	-0.126	(0.257)	0.625
Productive assets value (logged)	0.204	(0.199)	0.306	-1.245	(1.044)	0.233
Membership to a Cooperative (1 = Yes, 0 = No)	0.036	(0.458)	0.937	1.233	(1.127)	0.274
Distance to Established Market	-0.026**	(0.013)	0.039	0.029*	(0.018)	0.095
Distance to livestock market	-0.018	(0.011)	0.103	-0.036	(0.035)	0.300
Distance to tarmacked road	0.002	(0.011)	0.883	0.058	(0.049)	0.240
Volume of milk produced (logged)	0.526***	(0.176)	0.003	1.398*	(0.756)	0.064
Access to Market Information (1 = Yes, 0 = No)	0.138	(0.619)	0.823	16.555***	(1.839)	0.000
Milk Price	0.087	(0.070)	0.218	-0.776	(0.477)	0.104
Constant	-4.706	(4.422)	0.287	-29.642	(14.385)	0.039

Log pseudolikelihood -84.474; Number of observations 172; Wald chi2(28) 525.510; Prob > chi2 0.000; Pseudo R2 0.214
Robust standard errors in parentheses

Source: Author's computations from RALs (2015).

et al. (2017) findings, which found that females were more likely to participate in traditional marketing channels due to their familiarity with local buyers or collectors. Female-headed farming households are expected to use the traditional markets, as they were more likely to sell milk at the local markets than their male counterparts.

The results further revealed that a 1-year increase in the number of years spent in school increased the likelihood of using the modern marketing channel by 0.6% (Table 3). On the contrary, an extra year in school decreased the likelihood of using one of the other marketing channels. Thus, smallholder farmers with higher levels of education are expected to have a better understanding of the market environment and therefore optimise their choice of a marketing channel accordingly. This result is in line with most research findings that show that education positively impacts participation in modern marketing channel (Moturi, Obare, and Kahi 2015; Ishaq et al. 2017; Neven et al. 2017).

Relative to the direct marketing channel, an increase in off-farm income decreased the likelihood of participating in the traditional marketing channel by 2.9%. Therefore, an increase in off-farm income by 1 Kwacha (USD 0.133) tends to increase the likelihood of switching from the traditional to the modern marketing channel. Similarly, Neven et al. (2017) and Mburu, Wakhungu, and Gitu (2007) found that off-farm income positively influences participation in the modern marketing channel. A possible reason is that higher incomes would help purchase high-value dairy equipment that would increase milk production, and consequently, the likelihood of using the modern marketing channel to absorb the resulting volumes. The findings, however, contradicts the findings by Kiwanuka and Machethe (2016), who suggested that having more income outside the dairy enterprise decreases the likelihood of using the modern marketing channel. According to Kiwanuka and Machethe (2016), having a higher off-farm income meant less specialisation in dairy production and decreased the likelihood of using the modern marketing channel.

Another key determinant in the choice of marketing channel was the distance to an established market with many buyers and sellers trading several goods and services. The distance to the market had a mixed effect on the marketing channel choice. Relative to the direct marketing channel, a 1-kilometre increase in distance to the market significantly increased the likelihood (0.1%) of using the modern marketing channel. However, it decreased the likelihood (0.4%) of using the traditional channel. These results suggest that users of the modern marketing channel may be well off and have better access to transport facilities, as represented by their productive assets endowment (Neven et al. 2006). These results are in contrast to findings by Ishaq et al. (2017). They found that an increase in distance to the market increased the likelihood of participating in the traditional market, with no effect on modern

Table 3. Marginal effects of the Multinomial logit regression model.

Independent variables	Traditional	Modern	Direct
Age	0.006	0.008	-0.014
Age squared	0.000	0.000	0.000
Gender of Household Head (1 = Female, 0 = Male)	0.250	-0.367	0.117
Education level of household head (years)	-0.004	0.006	-0.002
Household size	-0.004	0.001	0.003
Off-farm Income (logged)	-0.029	-0.002	0.031
Productive assets value (logged)	0.033	-0.034	0.001
Membership to a Cooperative (1 = Yes, 0 = No)	-0.002	0.032	-0.030
Distance to Established Market	-0.004	0.001	0.003
Distance to livestock market	-0.002	-0.001	0.003
Distance to tarmacked road	0.000	0.002	-0.001
Volume of milk produced (logged)	0.061	0.034	-0.095
Access to Market Information (1 = Yes, 0 = No)	-0.068	0.435	-0.367
Milk Price	0.015	-0.021	0.006
Constant			

Log pseudolikelihood -84.474; Number of observations 172; Wald chi2(28) 525.510; Prob > chi2 0.000; Pseudo R2 0.214

Robust standard errors in parentheses

Source: Author's computations from RALs (2015).

marketing channel participation. In addition, Tsourgiannis, Eddison, and Warren (2008) suggested that smallholder farmers' access to their own means of transport, such as motor vehicles, positively influenced the likelihood of accessing the modern marketing channel. As a result, they could access markets even farther away, compared to smallholder farmers without their own transport. Ultimately, the farther away the market is in terms of the traditional marketing channel, the less likely the farmers are to travel to these markets to access customers to sell their milk.

Following *a priori* expectations, the volume of milk produced impacted the choice of marketing channel the farmers used. An increase in milk production by 1 L increased the likelihood of using the traditional or the modern marketing channels by 6.1% and 3.4%, respectively. These findings agree with those of Moturi, Obare, and Kahi (2015) and Ishaq et al. (2017). They used herd size as a proxy for milk yield and found that higher milk production increased the likelihood of participating in modern marketing channels. Thus, all things being equal, higher milk volumes lead smallholder farmers to be more likely to switch from the traditional to the modern marketing channel that encapsulates higher volumes.

According to Ishaq et al. (2017), price increased the likelihood of a dairy farmer using traditional marketing channels in Pakistan. However, in this study, the price was not found to influence the smallholder farmers' choice of marketing channel significantly. A probable explanation for this is that price was not significantly different across the marketing channels², which would leave the farmers indifferent about the marketing channel based on price, *ceteris paribus*. In support of this argument, North (1990) and Mbogoh (1992) argued that price might not independently influence the decision. However, when coupled with transaction costs, such as information access, transport costs, quality inspections, and burdensome contractual arrangements, it is likely to influence how the farmer selects the milk marketing channel.

The results also showed that access to market information increased the likelihood of using the modern marketing channel. Those with access to commodity market and price information were more likely to use the modern marketing channel. According to expectations, users of the modern marketing channel had better education levels and had enough cognitive abilities to gather and utilise market information in the dairy sector. These findings resonate with Geoffrey et al. (2015) and Kiwanuka and Machethe (2016). The latter suggested that access to market information made smallholder farmers aware of the available opportunities and the associated risks in the various marketing channels. As a result, they were more likely to use the modern marketing channel compared to other channels. Another possible explanation is that modern marketing channels have avenues for providing market information to their users, thereby encouraging the use of the channel. On the contrary, the traditional and direct marketing channels may have limited market information dissemination tools available. Lack of effective information avenues signifies that price discovery in the traditional and direct channels is mainly established when one physically visits the market. This increases the transaction costs associated with accessing the traditional market due to lack of before-hand information as basic as price.

5. Conclusion

This study aimed to identify factors influencing the decisions of smallholder milk farmers in choosing a milk marketing channel in Zambia. This study posits that comprehension of these factors would enable tailored policies to enhance the transition from the informal to the formal sector and the formalisation of existing structures in the informal sector. The results indicate that several factors, including; gender of the household head, education level, off-farm income, volume of milk produced, access to market information, and distance to established markets, significantly impacted the smallholder farmers' selection of a milk marketing channel.

In the traditional marketing channel, the gender of the household head and volume of milk produced positively influenced the choice to participate. On the contrary, distance to the nearest established market and off-farm income negatively influenced the traditional market selection. Thus, the

amount of milk produced and gender was significant, at a 1% significance level, while the distance to established markets and off-farm income was significant, at a 5% and 10% level.

The gender of the household head, education level, distance to an established market, volume of milk produced, and access to market information influenced smallholder farmers' participation in the modern marketing channel. These factors positively influenced the likelihood of using the modern marketing channel, except for gender, where being female reduced the likelihood of utilising the modern marketing channel. The impacts of the covariates gender and access to market information were significant, at 1%, with the rest being significant at a 10% level.

These findings are relevant for evidence-based policy targeting since the dairy sector is a priority sub-sector of agriculture in Zambia. Generally, the findings show a poor utilisation of the modern marketing channel. Therefore, these findings will guide what policy actions need to be targeted to feed into achieving the objectives of the National Agriculture Policy (NAP) and the National Agriculture Investment Plan (NAIP). Possible remedies include reducing the distances to established markets or reduce the costs associated with access to these markets through infrastructure developments. These developments include providing a good road network and formalisation of markets in the local context by increasing the numbers of milk collection centres closer to the farmers to increase milk flow to the formal sector to stimulate sector and economic growth further. These measures would reduce smallholder farmers' transport costs in accessing the modern marketing channel and increase gross margins on milk sales. Also, increasing access to market information, support services and transparency in the milk value-chain are expected to encourage smallholder farmers' participation in the modern marketing channel.

The study makes a significant contribution in filling the shortage in the literature on the Zambian dairy sector. It joins the likes of Kiwanuka and Machethe 2016; Mumba, Pandey, and van der Jagt 2013; Namonje-Kapembwa and Hichaambwa, 2016; Neven et al. 2017 and others to provide a more comprehensive understanding of the dairy value chain in Zambia. To further solidify the understanding of factors influencing smallholder milk farmers decision in selecting a milk marketing channel, a choice experiment is recommended for further research to highlight farmers' preferences in making marketing decisions. Choice experiments aid in understanding consumers' revealed preferences among alternatives.

Notes

1. Household size represents the available family labour that can be used for the household's competing labour needs, including farming activities as smallholder farmers rarely use hired labour.
2. Average milk prices per litre per channel were as follows: Traditional channel ZMW 4.62 (USD 0.61), modern channel ZMW 2.74 (USD 0.55), and direct channel ZMW 4.17 (USD 0.36) (Table 1).

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