

Market Access and Extent of Commercialisation Among the Smallholder Dairy Farmers in Zimbabwe

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Abstract

This study assesses the extent to which market access determine commercialisation among the smallholder dairy farmers in Zimbabwe. A total of 225 smallholder dairy farming households, randomly selected from 11 milk-producing cooperatives in Zimbabwe were analysed using descriptive statistics and the Tobit, regression model. The empirical results indicated that the proportion of farmers' milk delivered to the market was significantly affected by the mode of transport used to carry the milk from the farmer's homes to the market. The results show that farmers using more efficient though costly transport mechanisms such as a car, tractor, or motorcycle were more likely to get their milk to the market not only on time but also in good condition. Farmers using primitive methods of carrying the milk to the market such as walking on foot, wheelbarrow or bicycle were often only able to deliver once per day though commercial dairy cows are regularly milked more than once per day. The study stresses the need to find locally relevant milk transport mechanisms such as the corporate hiring of vehicles motorcycles or tractors by farmers residing close to each other to promote efficiency and profitability among the smallholder dairy farmers.

Keywords: market access, commercialisation, Tobit regression model, smallholder dairy farming, Zimbabwe, market information

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1. Introduction

One of the most significant current discussions in the study of agricultural and rural development is the role of markets in the commercialisation of smallholder agriculture. Several studies have revealed that market participation by smallholder farmers is a pathway towards commercialisation and efficiency which ultimately leads to poverty reduction, livelihoods improvement, and economic development in the rural areas (Timmer, 1997; Hanyani-Mlambo, 2000; Ayele et al., 2003; Shepherd, 2007; Sibanda, 2008; Arias, Hallam, Krivinos & Morrison, 2013; Poole, 2017). Moreover, recent evidence also shows that smallholder agriculture in developing countries which presently is overall subsistence can shift into commercial farming thereby contributing more to improving rural livelihoods by utilising the power of markets (Moll et al., 2007; Wiggins & Keats, 2013; Mtimet & Pica-ciamarra, 2016). However, research shows that despite growing opportunities that have been brought forward by governments, the private sector and international development partners to promote smallholder farmers access to markets, the majority of smallholder farmers in developing countries continue to be detached from full participation in input and outputs markets (Barrett, 2008; Jayne et al., 2010). Inadequate linkages to efficient, competitive and inclusive markets are among the key reasons for low levels of commercialisation among smallholder farmers in the developing countries (Arias, Hallam, Krivinos & Morrison, 2013).

A considerable amount of literature has been published on the challenges of smallholder farmer market participation in developing countries. Majority of these for example (Pingali & Rosegrant, 1995; Leavy & Poulton, 2006; Hazell et al., 2007; Arias, Hallam, Krivinos, & Morrison, 2013; Mtimet & Pica-ciamarra, 2016) have identified high transaction costs, information deficiencies and weak support institutions as the significant constraints to enhanced market participation by smallholder farmers in developing countries. In their recent study on linking smallholder farmers in Africa to markets, Wiggins & Keats (2013) identified remoteness, low productivity, low prices, and lack of market information as the four main hindrances to smallholder participation in the markets. Having access to market information helps to guide farmers about the buyers, prices, as well as the required standards and grades for specific markets (Tadesse & Bahiigwa, 2015). Meanwhile, limited understanding of basic market dynamics such as seasonal price fluctuations, market negotiations, and collective marketing negatively affect smallholder farmers with limited market information (Shepherd, 2007; Olwande & Mathenge, 2011; Tadesse & Bahiigwa, 2015). Moreover, market information also helps farmers to make crucial farming decisions such as what to produce, where to sell and how much to expect in return for their investments (Tadesse & Bahiigwa, 2015).

Challenges of smallholder market participation are very evident in Zimbabwe where the majority of the farmers are family managed smallholder subsistence enterprises that produce mainly for family consumption and where applicable selling surplus products to the markets (Mudimu, 1989; Rusike & Sukume, 2006; Siziba, 2007). There is a consensus among several researchers that smallholder farmers' market participation in Zimbabwe should

be enhanced to improve rural incomes and reduce rural poverty and household food insecurity (Muir-Leresche & Muchopa, 2006; Rusike & Sukume, 2006; Shumba & Whingwiri, 2006; MAMID, 2012). The comprehensive agricultural policy framework (2012-2032) produced by the Ministry of Agriculture Mechanisation and Irrigation Development (MAMID) of the Government of Zimbabwe identified lack of market information, poor roads condition to transport products to the markets and unfavourable terms of trade as some of the critical challenges affecting smallholder farmers access to markets in Zimbabwe (MAMID, 2012). The rural areas of Zimbabwe where most of the smallholder farming takes place are remote with poor infrastructure which hinders the flow of information. Most of the agricultural information about prices, inputs and consumer preferences in Zimbabwe are channelled through the television, radio and the print media which does not reach most of these areas, therefore, depriving the local people of the information (Chokera et al., 2014). A related study by Njaya (2014) in two districts (Murewa and Mutoko) in Mashonaland East province, Zimbabwe revealed that smallholder farmers generally lack necessary information about the markets such as consumer demand, market dynamics, market facilities, marketing niches, and market intelligence. Moreover, a recent study by Musasa et al. (2015) in Rusitu Valley of Manicaland Province, Zimbabwe has revealed that the majority of farmers lack market information thereby limiting their capacity to manage seasonal gluts. In many cases, such farmers are forced to sell their produce to intermediaries and usually making losses (Musasa et al., 2015).

The other hindrance to smallholder market participation in Zimbabwe is the poor infrastructure which affects proper storage and timely transportation of the products to the market (Muir-Leresche & Muchopa, 2006; Moyo, 2010; Chokera et al., 2014; Musasa et al., 2015). Most of the agricultural products produced in Zimbabwe including milk are perishables and therefore requires appropriate storage. Due to inadequate storage facilities, many farmers are forced to sell raw commodities which do not fetch attractive prices thus lowering the farmer's income (Chokera et al., 2014). The same findings were confirmed by Njaya (2014) who concurred that poor storage facilities often force farmers to sell to uneconomic markets thereby compromising their profitability. A study by Chokera et al. (2014), revealed that the majority of rural farmers in Zimbabwe rely on primitive methods of assembling and storage which do not have proper ventilation hence lowering quality and prices of the commodities. In the case of milk, it must be delivered to the market for safe storage and further processing within a specified period before it goes bad. Transportation of the agricultural products to the market is another challenge for the majority of the Zimbabwean smallholder farmers. The deplorable conditions of roads in Zimbabwe, geographical and institutional isolation from the markets and lack of suitable vehicles collectively drive the marketing costs high therefore discouraging farmers from commercialising their productions (World Bank, 2017). Many of the smallholder farmers in Zimbabwe rely on public transport to ferry their produce to the market. Unfortunately, public transportation does not cover all relevant locations at times that are convenient for the farmer (Njaya, 2014). The World Bank (2017) reports that access to efficient and reliable transport can potentially increase farmer income by 10 to 100 per cent.

The majority of smallholder dairy farmers in Zimbabwe sell raw milk to MCCs (Mupunga & Dube, 1993; Ngongoni et al., 2007; Kagoro & Chatiza, 2012). As a perishable commodity, raw milk has to be delivered to the markets before it deteriorates. Although most MCCs are located in the most central locations within the community, their accessibility by the participating farmers varies depending on the distance, the condition of the road and the transport system used. Most of the studies conducted about the viability and profitability of small-scale dairy farming in Zimbabwe (e.g. Mupunga & Dube, 1993; Mutukumira et al., 1996; Masama, 2005; Ngongoni et al., 2007; Hamudikuwanda, 2008; Zvinorova et al., 2013; Matondi et al., 2014) focussed on the productivity at the farmer level constraints and opportunities. Although production constraints at the farmer level are real, a study by Poole (2017) revealed that raising smallholder farmer productivity will have limited success if market linkages are not strengthened. All the small-scale dairy farmers in Zimbabwe are affiliated to central marketing locations known as Milk Collection Centres (MCCs). All MCCs are managed by qualified and experienced staff who usually have enough information about prices, quality and other market dynamics. The MCCs also have viable linkages with large processors and markets. Universal market access challenges such as lack of market information, unfavourable terms of trade and unfavourable pricing are usually not a significant concern for the smallholder milk farmers in Zimbabwe. However, distance to the market, the mode of transport and market liquidity are potential challenges. This study aims to investigate the effects of market access on the commercialisation of smallholder dairy farming in Zimbabwe with a focus not on the market but the factors surrounding the means to access the market. First, the study examined the relationship between HCI and the distance to the market. Secondly, the study evaluated the relationship between the HCI and the mode of transport used to carry the milk to the market. Finally, the study examined the link between HCI and market liquidity. Market liquidity in this study refers to the financial capacity of the market to absorb the farmer's output all the time.

2. Research methodology

2.1 Data

The data for this study includes the 225 smallholder dairy farming households randomly selected from the 11

small-scale dairy cooperatives in Zimbabwe. A two-level multistage sampling technique was applied to select the respondents for this study. First, 11 smallholder dairy cooperatives were selected using simple random sampling. Second, the probability proportional to size was used to decide the number of units to be reached in each cluster. Finally, simple random sampling was again used to select the survey respondents in each cluster. Table 1 below summarises the final sample for the locations and number of farmers interviewed in each area.

The study used a structured questionnaire to collect data using one-to-one interviews with the head of the households that owned small dairy farms. The questionnaire used had both closed-ended and open-ended questions. The questionnaire designed had clear objectives and was structured into sections to ensure that all relevant issues are addressed. The questionnaire collected data on the number of cows owned by each household, the number of cows milked by each household at a time and the volume of milk produced by each household per day. Also collected were the volume of milk marketed by each household per day, the market where each household sells the milk, the distance to the market, the transport used to carry the milk to the market and the ability of the market to absorb all that is delivered. The questionnaire content validity was reviewed by a panel of experts associated with dairy farming and agricultural economics, and their suggestions were used to modify the items of the instrument. This was to ensure that the instrument measured what it intended to measure; items were worded, and statements were not ambiguously stated. A pre-test was conducted with 20 smallholder dairy farmers, to establish the reliability of the instrument.

Table 1: Summary distribution of respondents reached for this study.

Province	Dairy Project	District	Location of the dairy project	Respondents		
				Female	Male	Total
Mash East	Chikwaka	Goromonzi	Juru Growth Point	5	12	17
	Domboshava	Goromonzi	Damboshava	4	13	17
	Chitomborwizi	Chinhoyi	Crawford Farm	-	13	13
	Marirangwe	Beatrice	Marirangwe Business Centre	5	33	38
	Murehwa	Murewa	Murewa 44 Business Centre	8	4	12
Manicaland	Rusitu Dairy	Chipinge	Rusitu Valley	8	34	42
	Upperand	Chipinge	Rusitu Valley	3	12	15
Masvingo	Hamaruomba	Masvingo	Mushagashe Business Centre	7	20	27
Midlands	Gokwe	Gokwe	Gokwe Town	1	19	20
Mat South	Mzingwane	Umzingwane	Mawabeni Business Centre	6	12	18
	Claremont	Umzingwane	Bulawayo Peri Urban	2	4	6
Total	11	8	11	49	176	225

The study applied a causal modelling technique to examine the effect of market access on commercialisation among small-scale dairy farming in Zimbabwe. The statistical analysis for this research was carried out using R software. The graphs were generated using the ggplot2 library that provides many functions to generate bar graphs, histograms, scatter plots, and other charts. Further, the LM function (which is part of the stats library) was used to perform Tobit regression analysis. The data used for this study consisted of observations that were drawn randomly from the population.

2.2 Measuring smallholder dairy commercialisation

Despite several minor variations in how smallholder commercialisation is defined, there is an overall agreement among several authors that commercialized smallholder farming household's targets markets in their production decisions (Von Braun & Kennedy, 1994; Pingali & Rosegrant, 1995; Leavy & Poulton, 2006; Kirui & Njiraini, 2013; Hailua et al., 2015 and Boka & John, 2017). As presented by Leavy & Poulton (2006) and confirmed by Ele et al. (2013), this study considers commercialisation of smallholder dairy farming as the degree of participation in the dairy output markets. A smallholder dairy farmer who sells a higher proportion of their output to the market is considered more commercialised than a farmer who sells nothing or less. To measure the household level of commercialisation among the smallholder dairy farmers in this study, the household commercialisation index (HCI), which is a ratio of the gross value of all milk sales per household per year to the gross value of all milk production was used. This index which has also been used by Strasberg et al. (1999) measures the extent to which a household production is alienated toward the market. A value of zero would mean an entirely subsistence-oriented production and 100 mean a commercially oriented production. Unlike other methods which employ a crude distinction between the commercialised and "non-commercialised" households, the HCI treats commercialisation as a continuum (Kotchikpa & Wendkouni, 2016). Mathematically, it can be calculated as:

$$HCI = \frac{MilkSold * 100}{MilkProduced}$$

2.3 Model choice and specification

In addition to descriptive statistics and a pairwise correlation, the Tobit regression model, also known as the censored regression model was used to assess the statistical relationship between farmers' markets access and HCI. The Tobit Model is used to estimate linear relationships between variables in cases where there is either a left- or a right-censoring in the dependent variable (Lee, 1996; Scott, 1997 and Saulo & Le, 2018). In this study, the value of the HCI lied between 0 and 100 meaning that all the potential values of the HCI fall at or below the 0 thresholds are censored and likewise a value of the HCI at or above the 100 thresholds, all take on the value of that threshold. The Tobit regression model was estimated as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$$

Where $Y^* = HCI$; X_i is a vector of socio-economic explanatory variables relating to the market factors that include distance from market, market liquidity, and mode of transportation used. The details of the variables are presented in Table 2 below.

Table 2: Details about the variables used in the Tobit Model on markets access

Study Variable	Variable Description	Variable Type
Y*	Household Milk Commercialization index (HCI)	Dependent Variable
X1	Distance from Market (KM)	Independent Variable
X2	Market Liquidity – This variable represents the availability of funds in the market to enable the market to absorb the farmer's milk all the time	
X3	Mode of Transport – This variable represents the mode of transport used to carry the milk to the market.	

3. Results and discussions

3.1 Descriptive statistics

To assess the effects of access to markets on the commercialization of small-scale dairy farming activities in Zimbabwe, the study explored the effects of market liquidity, mode of milk transport, and distance from the market on the household commercialization index, first by using histograms, pairwise correlation and next by applying the Tobit Regression analysis. Table 3 below presents the descriptive statistics about the information on market access by smallholder farmers surveyed in this study. All the farmers reached in this study were drawn from milk producer groups (cooperatives) which are linked to Milk Collection Centres (MCCs). Although farmers can sell milk to any market of their choice, the results show that most of the farmers (over 90%) sell their milk to the MCCs while the remaining few sell either to private processors or markets within towns and villages. Selling to MCCs has several advantages compared to other markets. When farmers sell to the MCCs, they can access distant and bigger markets which they cannot practically reach individually. Also, when farmers sell to MCCs, they are paid once a month, thereby allowing them to plan their income and expenses accordingly.

Table 3: Descriptive statistics about information on market access to dairy farms

Size	Details	Count	Percentage (N=225)
How Far is the Market	1 or Less Km	31	13.78
	1-2 Kms	41	18.22
	2-3 Kms	23	10.22
	3-5 Kms	34	15.11
	5-10 Kms	42	18.67
	10-15 Kms	40	17.78
	15 or More Kms	14	6.22
Where is the Milk Sold?	Milk Collection Centre	204	90.67
	Private Processors	15	6.67
	Others (Towns, Villages, other locations.)	6	2.67
Mode of Milk Transport	By Foot	60	26.67
	Wheelbarrow or Donkey	48	21.33
	Bicycle	52	23.11
	Motorcycle, Tractor or Car	65	28.89
The market can absorb all milk	No	75	33.33
	Sometimes	5	2.22
	Always	145	64.44

Source: Survey data, 2018

The study also examined the capacities of the markets where farmers sell their milk for absorbing everything the farmer must sell. The objective of this analysis was to explore if the liquidity of the market affects either positively or negatively the commercialisation of the farmers. Table 3 illustrates that one-third of the farmers (33.33%) reported that the markets they sell to do not have the capacity to absorb everything they sell. Unlike MCCs, local markets in towns and villages which are often not coordinated are tough to predict. As a result, the farmer can never ascertain with precision whether their milk will be bought or not. In cases where no market is available to absorb the farmers produce, farmers usually incur huge losses as milk often rots beyond certain storage limits. Although most MCCs usually absorb all that is delivered to them, there are some MCCs which are not connected to the larger processors which process their milk into several products which they, in turn, sell in the local markets. Some of such MCCs struggle to absorb the farmers' outputs, especially during the rainy seasons when most cows produce more than usual due to the availability of more feed and water. The study also collected data on the distance between the farmers' homes and the markets. The results in Table 3 shows that just over half of those surveyed resides in locations where walking on foot to the market is possible daily (up to 5km). On the other hand, about a quarter of the farmers (24%) resides in a location which is more than 10km from the market, where it is practically not feasible to walk to and fro the market daily. Even if such people are to walk on foot for distances above, 10 km they can only deliver once per day and chances of milk getting bad are high especially when the temperatures are high.

Figure 1 below shows the distribution of distance from market, and Household Commercialization Index using a pair-wise correlation diagram. It can be observed that the distribution of respondents based on distance from the market is skewed towards the left, indicating that most of the households stay close to the market. On the contrary, the distribution of the HCI is skewed towards right indicating that most of the households have high Household commercialisation index.

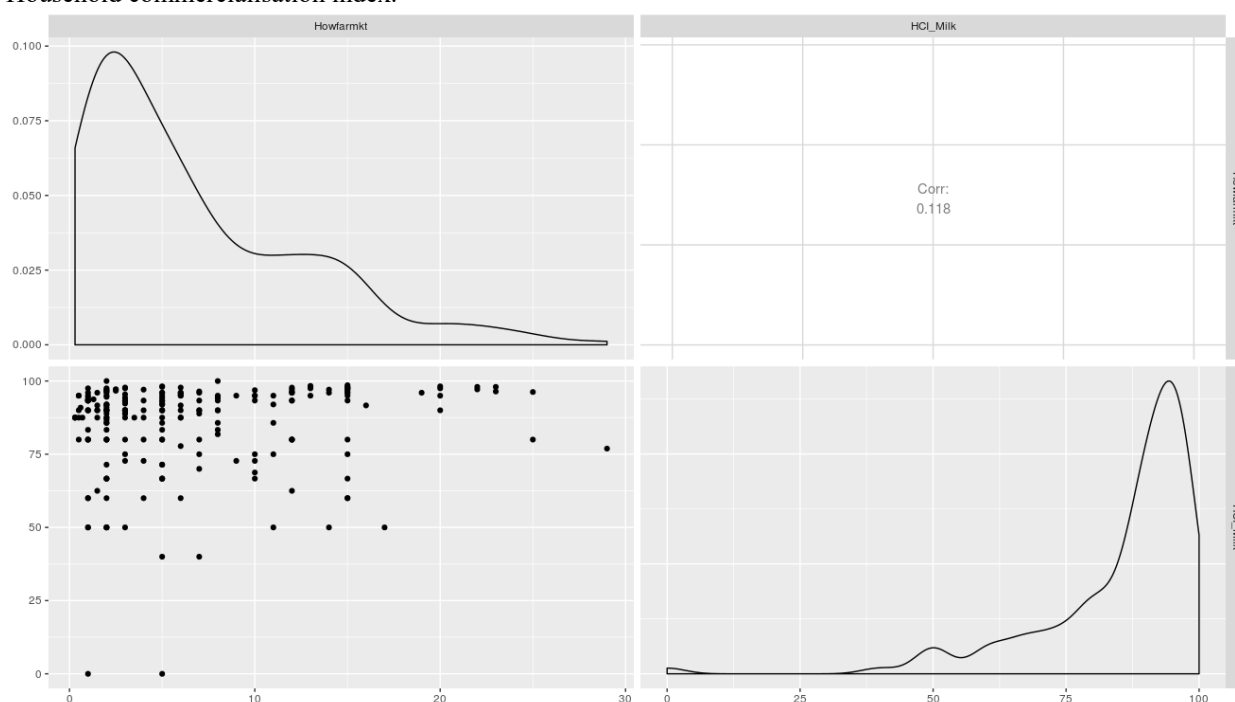


Figure 1: Pairwise correlation between HCI and distance from market

3.2 The effects of market access on smallholder dairy commercialisation.

The Tobit regression analysis was used to predict the relations between the HCI and distance from market, mode of transport used to carry the milk to the market and market liquidity. The Tobit Regression analysis results are summarized in Table 4 below. To get a sense of how accurate our model predicts the data and how much of the variance in the outcome is accounted for by the model, we calculate the correlation between the predicted HCI and actual HCI. The correlation between the predicted and observed values of Household (Milk) Commercialization Index is 0.8328. If we square this value, we get the multiple squared correlations, this indicates predicted values share 69.35% of their variance with Household (Milk) Commercialization Index.

Table 4: The effects of access to markets on the commercialization of small-scale dairy farming in Zimbabwe.

		Estimate	Std. Error	Z-value	P-value	95% CI (Lower)	95% CI (Upper)	90% CI (Lower)	90% CI (Upper)
(Intercept):1		81.614	2.71	30.111	0.000	76.302	86.927	77.156	86.073
(Intercept):2		2.67	0.055	48.236	0.000	2.562	2.779	2.579	2.761
Distance from Market		-0.471	0.249	-1.89	0.059*	-0.959	0.018	-0.88	-0.061
Mode of Transport Used	Bicycle	4.915	2.838	1.732	0.083*	-0.647	10.476	0.247	9.582
	Car/ Tractor/ Motorcycle	17.785	3.775	4.711	0.000***	10.386	25.184	11.576	23.995
	Donkey/ Wheelbarrow	7.448	2.861	2.603	0.009***	1.84	13.057	2.742	12.155
	Foot	.	.	.	.	.	.	.	.
Market Liquidity	Always	-1.83	2.249	-0.814	0.416	-6.239	2.578	-5.53	1.869
	Sometimes	9.335	7.146	1.306	0.191	-4.671	23.342	-2.419	21.09
	No	.	.	.	.	.	.	.	.

* p-val <0.10, ** p-val <0.05, *** p-val <0.01, r-square = 0.69, r (correlation coefficient) = 0.83, log-likelihood (df = 442) = -910.40, p-val <0.05

The data in Table 4 shows that there is a negative impact of distance from the market on the household commercialisation index. It is observed that for every unit increase in the distance from the market the household commercialisation index decreased by 0.471 units. As a highly perishable commodity, milk requires appropriate cold storage facilities, hygienic conditions and suitable transportation to take it to the markets before it loses value (Hahlani & Garwi, 2014). If the farmer is located close to the markets, they can practically and consistently deliver the milk to the market on time and at a cheaper cost. However, in the absence of competitive markets within the farmers reach, the middlemen often pay meagre prices to the farmers and then carry the products to lucrative and often distant urban markets where better prices are guaranteed (Kusina & Kusina, 2001). A study by Tadele et al. (2014) revealed that smallholder milk farmers in Ethiopia who are located closer to the markets tend to sell more of their milk in raw form while those located far away from markets tend to sell less. Similarly, a study on linking smallholder dairy farmers in Tanzania to urban markets revealed that farmers who are located far from the main urban milk markets often sell their milk through the informal channels where prices are usually low (Kailembo, 2013).

The results summarised in Table 4 also reveal a close relationship between the household commercialisation index and the mode of transport used to carry the milk to the market. For instance, the results show that households that reported using car/tractor/motorcycle have 12.871 unit higher household commercialisation index compared to the households that reported using a bicycle. On the contrary, there is no significant difference in the HCI of households that use donkey/wheelbarrow or transport milk by foot when compared to the households that transport milk using a bicycle. The results of this study indicate that having access to a more efficient mode of transport significantly increases the chances of taking the milk to the market on time. There are similarities between the findings presented in this study and those described by Tadele et al. (2014) and the World Bank (2017) which presents that in order to access excellent and reliable markets for perishable agricultural commodities, a good transport system is required. A good and reliable transportation system is required to reduce the time lag between harvesting, and the market, especially for perishable commodities. This is because in many SSA countries, transport is often not available in the rural farming areas and where available, the cost of transport can account for up to a third of the price of the agriculture inputs (World Bank, 2017).

The finding of this study agrees with Kailembo's (2013) findings which showed the mode of transport used to carry the milk to the market has a significant effect on the volume of milk that can be sold by the farmer. The same study revealed that farmers who carry the milk on their heads or use bicycles to transport milk to the markets could only carry limited amounts (Kailembo, 2013). Furthermore, recent research shows that, in most developing countries, about 40% of food losses are experienced at the post-harvest stage of the value chain, mainly due to the degradation and spillage from poor transport systems (World Bank, 2017). It is, therefore, crucial to transport raw milk from the farmers to the consumption points or for processing into less perishable forms because of its high perishable nature (Sinja et al., 2006). Moreover, there are several similarities between the findings of this study and those described by (Hahlani & Garwi, 2014). Among other challenges, they singled out the poor state of roads in the rural areas of Zimbabwe as real challenges to increased milk production and marketing by smallholder farmers. The availability of affordable and efficient transport system plays a crucial role in the marketing of agricultural commodities in Zimbabwe. A study on smallholder goat marketing by smallholder farmers in Zimbabwe conducted by Kusina & Kusina (2001) revealed that lack of transport to carry goats to more lucrative urban markets negatively affected the marketing of goats.

The study also assessed the effects of market liquidity on the commercialisation of smallholder dairy farming

in Zimbabwe. Contrary to expectation, the Tobit regression results presented in Table 4 show no significant relationship between the HCI and the market liquidity. Since all the farmers reached in this study were drawn from cooperatives which are linked to MCCs, the issue of market liquidity does not have a significant positive or negative impact on commercialisation. As long as production can be enhanced, marketing options are as of now available. Given the current national capacity gap created by the departure of many large-scale commercial farmers, the smallholder dairy farmers in Zimbabwe have the highest potential to excel as they cannot satisfy the market requirements (Hanyani-Mlambo, 2000). A study by Phiri (2014) shows that the milk processors in Zimbabwe are currently operating at less than half their full capacity because of challenges at the primary production levels.

4. Conclusions and policy implications

This study investigated the extent to which market access affects the commercialisation of smallholder dairy farming in Zimbabwe. The descriptive statistics indicated that over 90% of the farmers sell their milk to the MCCs while the remaining few sell either to private processors or markets within towns and villages. The pair-wise correlation analysis showed that the distribution of respondents according to the distance from the market was skewed towards the left, indicating that most of the households stay relatively close to the market. However, the distribution of the Household Commercialization Index (HCI) was found to be skewed towards right indicating that most of the households had high Household commercialisation index. The Tobit Regression results indicated that distance to the market and market liquidity had no significant impact on the household commercialisation index. The variable that had the most influence on the HCI was the mode of transport used to carry milk to the market.

The results of this study indicated that no matter the location of the farmer or the distance to the markets, farmers with access to a faster and more efficient mode of transport are more likely to commercialise than farmers with no access to modern transport systems. Unlike some large-scale dairy farmers who have refrigerated storage facilities which can store milk safely before delivering it to the market, smallholder dairy farmers do not have such secure storage facilities. Therefore, they have to sell the milk to the market on time before it deteriorates. Also given that commercial dairy milk is milked at least twice per day, farmers with access to transport can deliver all their daily production to the market, but those relying on primitive methods of transport such as wheelbarrows, bicycle and walking on foot can only deliver once in a day thereby incurring losses.

To ensure that smallholder dairy farmers have the most commercial impact on the lives of the participating households, governments and other supporting stakeholders should ensure that affordable and efficient transport systems are in place to carry all the farmers produce to the market in time. Since most individual farmers produce at the household level are often too low to justify moving a vehicle, it is crucial for farmers to form groups not only to facilitate production but also to combine their milk in a single hired vehicle. This will reduce the cost for the farmer while increasing the income of the transporter. Farmers are most likely to make efforts to produce more if they are confident of the availability of means to carry their product to the market. Transporters are more likely to avail their vehicles to carry the milk for a fee when the roads are good, and the farmers are organised. Thus, one policy improvement does not work in isolation therefore policy-makers aiming to promote commercialisation of smallholder dairy farming should address all the other logistical constraints in the rural areas.

References

- Arias, P., Hallam, D., Krivinos, E. & Morrison, J. 2013. *Smallholder integration in changing food markets*. Rome. <http://www.fao.org/docrep/018/i3292e/i3292e.pdf>.
- Ayele, S., Assegid, W., Jabbah, M., Ahmed, M., & Belachew, H. 2003. *Livestock marketing in Ethiopia: a review of structure, performance and development options: Socioeconomics and Policy Research Working Paper 52*.
- Barrett, C.B. 2008. Smallholder market participation: Concepts and evidence from eastern and southern Africa. *Food Policy*, (Food Policy 33): 299–317. www.sciencedirect.com.
- Boka, G.T. & John, C. 2017. Climate Change Challenges, Smallholder Commercialization and Progress out Poverty in Ethiopia. , (253).
- Von Braun, J. & Kennedy, E. eds. 1994. *Commercialization of Agriculture, Economic Development and Nutrition*. Baltimore, MD: John Hopkins Press.
- Chokera, F., Ngwenya, T. & Njovo, M. 2014. The Role of Agricultural Marketing on Empowering Rural Farmers In Masvingo Province, Zimbabwe. *European Journal of Business and Management*, 6(3): 153–163. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.859.5625&rep=rep1&type=pdf>.
- Ele, I.E., Omini, G.E. & Adinya, B.I. 2013. Assessing the Extent of Commercialization of Smallholding Farming \nHouseholds in Cross River State, Nigeria. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 4(2): 49–55. <http://www.iosrjournals.org/iosr-javs/papers/vol4-issue2/J0424955.pdf?id=4031>.
- Hahlani, C., & Garwi, J. 2014. Operational Challenges to Smallholder Dairy Farming : The Case of Mayfield

- Dairy Settlement Scheme in Chipinge District of Zimbabwe. *Humanities And Social Sciences*, 19(1): 87–94. <http://iosrjournals.org/iosr-jhss/papers/Vol19-issue1/Version-4/P019148794.pdf?id=8729>.
- Hailua, G., Manjureb, K. & Aymutic, K. 2015. Crop commercialization and smallholder farmers' livelihood in Tigray region, Ethiopia. *Journal of Development and Agricultural Economics*, 7(9): 314–322.
- Hamudikuwanda, H. 2008. *Dairy production and Development Programme to increase Milk production in the Large Scale Commercial Dairy Sector*. Bulawayo, Zimbabwe.
- Hanyani-Mlambo, B. 2000. *Smallholder Dairy Production and Marketing in Zimbabwe: A socio-economic study of the Gokwe, Rusitu and Marirangwe dairy development projects*. Harare. <https://opendocs.ids.ac.uk/opendocs/handle/123456789/7208>.
- Hazell, P., Poulton, C., Wiggins, S. & Dorward, A. 2007. *The future of small farms for poverty reduction and growth*. Washington DC. <http://rstb.royalsocietypublishing.org/cgi/doi/10.1098/rstb.2010.0140>.
- Jayne, T.S., Mather, D. & Mghenyi, E. 2010. Principal Challenges Confronting Smallholder Agriculture in Sub-Saharan Africa. *World Development*, 38(10): 1384–1398.
- Kagoro, J.M. & Chatiza, K. 2012. *Zimbabwe's Dairy Subsector Study*. Harare. http://www.snv.org/public/cms/sites/default/files/explore/download/rarp_2016-dairy-subsector-study.pdf.
- Kailembo, L.S. 2013. *Linking rural smallholder milk producers to urban markets: A case study of selected wards in Kibaha District, Tanzania*. Van Hall Larenstein University of Applied Sciences. <https://edepot.wur.nl/279007>.
- Kirui, O.K. & Njiraini, G.W. 2013. Determinants of agricultural commercialization among the rural poor. In *4th Conference of AAEA. Hammamet, Tunisia*. Hammamet, Tunisia: African Association of Agricultural Economists: 1–12. [https://ageconsearch.umn.edu/bitstream/161618/2/Oliver K. Kirui et al.pdf](https://ageconsearch.umn.edu/bitstream/161618/2/Oliver%20K.%20Kirui%20et%20al.pdf).
- Kotchikpa, G.L. & Wendkouni, J.-B.Z. 2016. Factors influencing smallholder crop commercialisation: Evidence from Cote d'Ivoire. *African Journal of Agricultural Research*, 11(41): 4128–4140. <http://academicjournals.org/journal/AJAR/article-abstract/AEFDBFF61136>.
- Kusina, N. & Kusina, J. 2001. Goat marketing model for enhanced revenue generation by smallholder farmers in Zimbabwe. , 28: 1–7.
- Leavy, J. & Poulton, C. 2006. Commercialisations In Agriculture. *Ethiopian Journal of Economics*, 15(1): 1–40.
- Lee, M.J. 1996. *Methods of Moments and Semiparametric Econometrics for Limited Dependent Variable Models*. New York, USA: Springer.
- Matondi, G.H.M., Nyamushamba, G.B., Motsi, T.T. & Masama, E. 2014. Evaluation of smallholder dairy calf rearing systems in Zimbabwe. *Livestock Research for Rural Development*, 26(3).
- Ministry of Agriculture Mechanisation and Irrigation Development of the Government of Zimbabwe (MAMID). 2012. Comprehensive Agriculture Policy Framework (2012-2032). , (April): 42. <http://extwprlegs1.fao.org/docs/pdf/zim149663.pdf>.
- Moll, H.A.J., Staal, S.J. & Ibrahim, M.N.M. 2007. Smallholder dairy production and markets: A comparison of production systems in Zambia, Kenya and Sri Lanka. *Agricultural Systems*, 94(2): 593–603.
- Mtimet, N. & Pica-ciamarra, U. 2016. Dairy farmers' access to market in Uganda: Observing the unobservable: Invited paper presented at the 5th International Conference of the African Association of Agricultural Economists, September 23 - 26, 2016, Addis Ababa, Ethiopia. In *5th International Conference of AAEA*. Addis Ababa: African Association of Agricultural Economists: 1–13. <https://ageconsearch.umn.edu/bitstream/249282/2/342>. Dairy farmers market access in Uganda.pdf.
- Mudimu, G. 1989. *Zimbabwe Food Security Issues Paper*.
- Muir-Leresche, K. & Muchopa, C. 2006. Agricultural marketing. In M. Rukuni, P. Tawonezwi, C. Eicher, M. Munyuki-Hungwe, & P. Matondi, eds. *Zimbabwe's agricultural revolution revisited*. Harare: 299–320.
- Mupunga, E.G. & Dube, D.M.J. 1993. Smallholder dairy development programme in resettled and communal areas in Zimbabwe. *Future of livestock industries in east and southern Africa: Proceedings of the Workshop held at Kadoma Ranch Hotel, Zimbabwe, 20-23 July 1992.*: 165–172. <http://search.ebscohost.com/login.aspx?direct=true&db=lah&AN=19930463061&site=ehost-live>.
- Musasa, S.T., Musundire, R., Mashingaidze, A.B. & Makuza, S.M. 2015. A preliminary study of the orange (*Citrus sinensis*) fruit value-chain in Chimanimani Rural District, Zimbabwe. *African Journal of Agricultural Research*, 10(35): 3507–3516. www.academicjournals.org/AJAR.
- Mutukumira, A.N., Dube, D.M.J., Mupunga, E.G. & Feresu, S.B. 1996. Smallholder milk production, milk handling and utilization: A case study from the Nharira/Lancashire farming area, Zimbabwe. *Livestock Research for Rural Development*, 8(1): 93–107.
- Ngongoni, N.T., Mapiye, C., Mwale, M. & Mupeta, B. 2007. Effect of supplementing a high-protein ram press sunflower cake concentrate on smallholder milk production in Zimbabwe. *Tropical Animal Health and Production*, 39(4): 297–307.
- Njaya, T. 2014. The Economics of Fruit and Vegetable Marketing by Smallholder Farmers in Murehwa and Mutoko Districts in Zimbabwe. *International Journal of Research in Humanities and Social Sciences*, 1(1):

- 35–43. www.ijrhss.org.
- Olwande, J. & Mathenge, M. 2011. *Policy and development market participation among poor rural households in Kenya*. Nairobi.
- Phiri, E. 2014. *An Assessment of Zimbabwe's Dairy Sector*. Harare. https://www.academia.edu/9668624/An_Assessment_of_Zimbabwes_Dairy_Sector.
- Pingali, P.L. & Rosegrant, M.W. 1995. Agricultural commercialization and diversification: processes and policies. *Food Policy*, 20(3): 171–185.
- Poole, N. 2017. *Smallholder Agriculture and Market Participation*. Rugby: Food and Agriculture Organization of the United Nations and Practical Action Publishing. <http://www.developmentbookshelf.com/doi/book/10.3362/9781780449401>.
- Rusike, J. & Sukume, C. 2006. Agricultural input supply. In M. Rukuni, P. Tawonezvi, C. Eicher, M. Munyuki-hungwe, & P. Matondi, eds. *Zimbabwe's agricultural revolution revisited*. Harare: 279–297.
- Saulo, H. & Le, J. 2018. A class of asymmetric regression models for left-censored data. *stat. ME*, (1958): 1–18.
- Scott, J. 1997. *Regression Models of Categorical and Limited Dependent Variables*. California, US: Sage.
- Shepherd, A.W. 2007. *Approaches to Linking Producers to Markets*. Rome. <http://www.fao.org/docrep/pdf/010/a1123e/a1123e00.pdf>.
- Shumba, E. & Whingwiri, E. 2006. Commercialization of smallholder agriculture. In R. Mandivamba, E. Carl, T. Patrick, M. Munyuki-Hungwe, & P. Matondi, eds. *Zimbabwe's Agricultural Revolution Revisited*. Harare: University of Zimbabwe Publications: 631–718.
- Sibanda, R. 2008. *Market access policy options for PMD – Challenged Zimbabwe: a rethink trans boundary animal disease and market access; future options for the beef industry in Southern Africa*. Brighton.
- Sinja, J., Njoroge, L., Mbaya, H., Magara, H., Mwangi, E., Baltenweck, I., Romney, D. & Omore, A. 2006. Milk market access for smallholders : A case of informal milk trader groups in Kenya. *Research Workshop on Collective Action and Market Access for Smallholders*, (October): 2–6.
- Strasberg, P.J., Jayne, T.S., Yamano, T., Nyoro, J., Karanja, D. & Strauss, J. 1999. Effects of agricultural commercialization on food crop input use and productivity in Kenya. *MSU International Development Working Papers*, (71): vii + 28 pp.
- Tadele, M., Tewodros, T. & Noreen, B. 2014. Factors influencing urban and peri-urban dairy producers participation in milk value addition and volume of milk value added in Welmera Woreda, West Shewa Zone of Oromia Regional State, Ethiopia. *International Journal of Livestock Production*, 5(9): 165–172. <http://academicjournals.org/journal/IJLP/article-abstract/606A68847475>.
- Tadesse, G. & Bahiigwa, G. 2015. Mobile Phones and Farmers' Marketing Decisions in Ethiopia. *World Development*, 68: 296–307.
- Timmer, C.P. 1997. Farmers and Markets: The Political Economy of New Paradigms. *American Journal of Agricultural Economics*, 79(2): 621. <https://academic.oup.com/ajae/article-lookup/doi/10.2307/1244161>.
- Wiggins, S. & Keats, S. 2013. *Leaping and Learning: Linking smallholders to markets in Africa*. London. <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8401.pdf>.
- World Bank. 2017. *Enabling the Business of Agriculture in 2017*. Washington DC. <http://eba.worldbank.org/~media/WBG/AgriBusiness/Documents/Reports/2017/EBA2017-Report17.pdf>.