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Can Dairying Have an Impact on Livelihoods of Zimbabwe's Smallholder Farmers? Chikwaka Small-scale Dairy Case Study

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Abstract
Smallholder dairy projects were developed after independence to help smallholder farmers boost their economic base. Considering the number of years since the schemes were implemented, smallholder farmers should be advanced into dairying. Many members of the dairy smallholder cooperative struggle to make ends meet through dairying. Given the tiny percentage of people who are serious about dairying (22%), the study looked into the profitability of the Chikwaka smallholder dairy cooperative. A questionnaire was used to collect costs connected with normal management methods in the dairy industry. Aside from dairying, the farmers' sources of income and the frequency of their incomes per year were also noted. The data was analyzed using the Statistical Package for Social Scientists (SPSS) version 20.0 for Windows and Microsoft Excel. On the basis of gross revenue (values of milk sales) and corresponding variable expenses, gross margin (GM) calculations were conducted. Despite the fact that it is a dairy village, most homes do not profit from dairying. The average household gross margin contributed a maximum of 15% to the overall household gross margin. Other households' gross margins were negative. Dairy farming could be successful if farmers employ locally sourced feedstuffs as a way of cutting costs but providing appropriate nourishment to milking cows. Dairying could be profitable if treated as the primary income generating enterprise and given appropriate attention it requires.

Keywords: *Chikwaka, dairy community, gross margin, milking cows, profitability.*

1. Introduction

Smallholder dairy schemes in Zimbabwe were founded shortly after independence, in 1980, to aid with the improvement of the revenue base of smallholder farmers in the country. Agribusiness revenues generated by smallholder farmers' mixed farming activities are essential to their survival and well-being. Smallholder farmers do not have access to irrigation infrastructure to assure year-round field crop production, and as a result, their revenue is only received once a year from their crops. It is against this backdrop that the implementation of smallholder dairy schemes was spurred on by the possibility of improved income flow and rural livelihoods that these schemes offered.

In Zimbabwe, according to Gunjal and Pound (2010), 69 percent of the population lives in rural areas, with about 40 percent of the population living in poverty (Zvinorova et al., 2012). Agribusiness is the most important source of income for rural inhabitants in Zimbabwe. When it comes to household livelihoods in mixed crop-livestock farming systems in Zimbabwe and most African countries, the ruminant component is the most

important (McDermott et al., 2010). In crop-livestock systems, staple crops are combined with cattle or small ruminants to form a cohesive whole.

Smallholder dairy production encourages households to generate recurring monetary income (Mutiwanyuka, 2021), as opposed to the traditional method of receiving a lump sum of cash once a season after the solitary harvested crops. Milk is mostly derived from indigenous cattle, which will be used for draft power, resulting in low milk production levels (Zvinorova et al., 2012). There are a variety of services provided by these animals, including social security and ceremonial services, meat, milk, income generated through the sale of either live animals or meat or milk, and draught power (Mapekula et al., 2009). In the smallholder sector, there is less documentation of the resources that are utilized to produce milk (Zvinorova et al., 2012), and as a result, the contribution of these resources to the households is unclear. In the past, the national extension services in Zimbabwe were primarily focused on large commercial farms, and some of the recommendations given were not suitable to smallholder farmers. There is little information available on the profitability of smallholder dairy production in Zimbabwe. The study's main goal was to characterize dairying in the Chikwaka smallholder dairy cooperative as a first step in determining the profitability of Zimbabwean smallholder dairy production systems in the future.

2. Materials and methods

2.1 Study site

The research was carried out in Zimbabwe's Goromonzi and Murewa districts, with farmers registered with the Chikwaka milk collection center (MCC). Chikwaka communal area is located about 50 kilometres north of Harare in Natural Region IIa, which receives 800 to 1000 mm of rainfall each year (Kashangura, 2014). The rainy season lasts from late October to April, with the rest of the year being dry. The average daily temperature ranges from 5 degrees Celsius in June-July to 35 degrees Celsius in October, with ground frost occurring every year. The soils are mostly low-fertility granite sands (Hove, Franzel and Moyo, 2003). Chikwaka's principal farming system is mixed crop-livestock agriculture, with maize as the major crop (Mkuhlani et al., 2018). Groundnuts, roundnuts, millet, sunflower, sweet potato, and cowpeas are also grown, as are vegetables, primarily during the dry season. Cattle (both beef and dairy), goats, and poultry are examples of livestock kept. Beef cattle are typically grazed in communal grazing areas, but dairy cattle are typically grazed close to homesteads. In addition, crop leftovers, purchased concentrates, saved forages (hay and silage), and maize grain are fed to dairy animals.

2.2 Sampling procedure

The sixty-four smallholder dairy farmers registered in the Chikwaka small scale dairy scheme were the study's target group.

2.3 Data collection

Structured questionnaires that had been pre-tested were employed to collect data. Data collected included socio-demographic characteristics (age, gender, marital status, household size, employment, and educational background), land resource endowment

(arable, non-arable), crop and forage production (cropping patterns, input costs, crop and forage yields), and livestock activities (cattle breeds including dairy and dual purpose, draught power, milk sales and home consumption), reproductive performance of cows, and feeding systems during the lactation cycle. Farmers' other livestock species were also recorded. Dairy production's major obstacles were identified.

Costs related with routine management measures, such as animal treatments and vaccinations, were also obtained from farmers' records. These data were utilized to calculate the costs of dairying as well as the gross margin. Milk sales at the milk collecting center (MCC) were obtained from farmers and compared to MCC data. Farmers were categorized using collected information and for each farmer group, the number of cows that contributed to the milk sold was recorded.

Other sources of revenue for farmers, as well as the frequency of incomes each year, were documented. The produce sale price for various farm products, including cattle, as well as the related input expenses, were recorded for the purpose of calculating the associated enterprise gross margin. The annual household expenditures were calculated using financial requirements for education, health, clothing, lighting fuel (e.g., paraffin), fuel (e.g., diesel), and food products not grown on the farm.

2.4 Data analysis

The statistical program for the social scientists (SPSS) version 20.0 (SPSS, 2011) for Windows and Microsoft Excel were used to generate survey summaries. Frequencies and descriptive statistics were computed. Gross margin (GM) assessments were performed using computed gross revenue (milk sales values) and variable costs. The data was summarized, and the analysis was based on farmer typologies among scheme farmers. For each typology, profit measures such as net economic on-farm profit, home consumption value, and total household net income were calculated.

3. Results

Three farmer groups were identified among Chikwaka smallholder dairy scheme members. These were named as Resource constrained, Average and Wealthy households based on their resources safety. Various enterprises generate money for the household to differing degrees in smallholder setups. In general, higher-paying firms receive more attention than lower-paying enterprises. Table 1 depicts the overall picture of household income in the Chikwaka neighbourhood.

Table 1. Sources of income for Chikwaka households (US$)

Source	Household typology		
	Resource constrained	Average	Wealthy
	Mean	Mean	Mean
Dairy GM	-221	118.29	25
Beef GM	-20	-530	400
Goat GM	-30	-54	24
Poultry GM	266	-10	2315
Pigs GM	-5	65	-495
Crops GM	252	503	749
Garden/Horticulture produce GM	105	130	143
Total farm GM	**345**	**222**	**2313**
Home consumption value	717	1079	1618
Non-farm income	1682	1427	6444
Net economic on-farm profit	227	-3.99	2125
Net on-farm cash income	-325	-485	1248
Total household net income	1178	927	7565
Home consumption value –total value of home consumed animals, animal produce (including milk) and crops.			
GM –gross margin calculated as income less respective costs for the enterprise.			
Net economic on-farm profit/income –calculated as gross margin less overhead costs. This is full costing of the household as it covers imputed family labour costs.			
Net on-farm cash income –calculated as all farm income less associated costs. Family labour not taken into consideration.			
Total household net income –calculated as summation of net economic on-farm income and non-farm income.			

Table 2 displays survey results for key animal species and estimated livestock value for the three typologies.

Table 2. Livestock value for farmers actively involved in dairying (US$)

Animal type	Household typology					
	Resource constrained		Average		Wealthy	
	Mean	Value	Mean	Value	Mean	Value
Dairy	2	3000	3	4500	5	7500
Beef	4	1800	8	3600	9	4050
Goats	3	90	3	90	3	90
Poultry	41	205	25	125	84	420
Total livestock value		**5095**		**8315**		**12060**
Livestock numbers based on farmers' stock register and value calculation was based on average price for the respective animal species from among farmers who had traded animals in the area. The prices per each animal were: beef (US$ 450), dairy (US$ 1500), goats (US$ 30), and poultry (US$5).						

Table 3 shows milk quantities which were sold through the milk collection centre by Chikwaka dairy farmers.

Table 3. Average milk sold through milk collection centre, cows milked and the minimum and maximum yield/cow recorded under each farmer group

Parameter	Household typology		
	Resource constrained	Average	Wealthy
	Mean	Mean	Mean
Milk sold (litres)	446.5	1323.8	1648.4
Number of cows milked	1	2	3
Average yield (litres)/ lactation per cow	446.5	661.9	549.5

The associated running expenses for homes with dairy animals were veterinarian medications, feedstuffs, and human labour. The prices vary according to factors such as predicted milk yield and the farmer's knowledge of animal health issues. Table 4

shows the annual averages of various costs incurred by Chikwaka smallholder dairy producers in the day-to-day operation of their dairy industry.

Table 4. Average costs (US$) associated with dairying

Item	**Household typology**		
	Resource constrained	**Average**	**Wealthy**
	Mean	**Mean**	**Mean**
Veterinary costs	23	35	42
Feedstuff cost	462	339	453
Supplements cost	8	248	106
Herding cost	57	35	90
Mating cost	50	42	38
Transport cost	9	7	5
Other costs	19	30	280
Imputed family labour cost	374	372	383
Total variable costs	**1000**	**1108**	**1397**
No. of dairy animals	2	3	5
Cost per cow	**500**	**369.3**	**279.4**
The costs were computed using the inputs that were used by farmers per given time frame. ***Mating costs were charges associated with hiring bulls for breeding purposes.***			

Feed costs (feedstuff and supplements) contributed the most to the running costs of the dairy enterprise among all households. Feed costs provided 53 percent of total costs for average homes, while feed contributed 40 percent for rich households, which was less than for resource-constrained households (47 percent). Imputed family labour contributed 27.4 percent of total variable costs for the dairy enterprise of wealthy households, 33.6 percent for ordinary households, and 37.4 percent for resource-constrained households. Family labour was estimated to cost $3 each labour day (8 hours). The act of costing family labour is essential for households to understand the opportunity costs connected with their family labour. The opportunity cost of family labour is the value of services that could have been supplied to other jobs during the time those dairy activities were carried out. Using the enterprises that contributed positively to total farm gross margin in Table 1, the percent contribution of the various enterprises to total farm gross margin is shown in Table 5.

Table 5. Dairying percent contribution to household gross margin vs. other income generating enterprises

Source	Resource constrained	Average	Wealthy
Dairy	-	15	1
Beef	-	-	11
Poultry	43	-	63
Goats	-	-	1
Pigs	-	8	-
Field crops	40	62	20
Gardening/horticulture	17	16	4

The annual household expenditures were calculated using financial requirements for education, health, clothing, lighting fuel (e.g., paraffin), fuel (e.g., diesel), and food products not grown on the farm. The average annual household expenditures for resource-constrained households were US$ 1165.00, US$ 1341.00 for average households, and US$ 2013.00 for wealthy households. The sum of household expenditures and maintenance expenses per cow, shown in Table 4, for the representative household typology, provides the cash requirements for each home to make a living from dairy. Table 6 shows the number of milking cows required to meet family needs based on the dairy output performance for each home typology shown in Table 3.

Table 6. Number of milking cows to meet household cash requirements

Parameter	Household typology		
	Resource constrained	Average	Wealthy
	Mean	Mean	Mean
Average yield/cow/lactation (litres)	446.5	1323.8	1648.4
Milk yield/cow/day (litres)	1.5	4.4	5.5
Cash/lactation @ US$ 0.46/litre	205.39	608.95	758.26
Dairying operating expenses per cow (US$)	500.00	369.33	279.40
Disposable cash (US$) per lactation (cash/lactation less operating expenses)	*Nil* (-294.61)	239.62	478.86
Average annual household expenditure (US$)	1165.00	1341.00	2013.00
Total cash needs (dairy operating expense plus household expenditure) (US$)	1665.00	1710.33	2292.40
Milking cows to meet total cash needs	8	3	3
Note. Milking cows to meet total cash needs is obtained after dividing total cash needs by cash per lactation value.			

4. Discussion

The contribution made by diverse businesses demonstrates the importance of smaller stock to different social strata and their own economies. Smaller stock, such as indigenous chickens, will make a significant contribution to the well-being of households with limited resources, whereas in average and wealthy households, both small stock and large animals may make significant contributions to the well-being of households. The least valuable farm food was consumed at home by resource-constrained farmers (Table 1), whereas the most valuable farm produce was consumed at home by wealthy households, followed by average farmers.

When compared to other households, farmers that were resource constrained had the lowest numbers of dairy and beef animals (Table 2). There were no differences in the percentage of goats owned by the three different family groups. The resource-constrained farmers raised more fowl than the average household, despite their limited resources. The cheap purchase price for these animal species was cited as a reason for the higher poultry numbers among resource-limited households and the lack of differences in goat ownership between household groups. The reproductive rate of smaller stock is also higher than that of large ruminants, resulting in greater numbers among all farmer groups. A higher number of animals per family was found in wealthier households, resulting in a higher livestock value than the other categories as shown in Table 2.

The milk collection center received a higher volume of milk sales from wealthy households (Table 3). This was due to the fact that they had a greater number of dairy animals, including the biggest

number of lactating cows, than the other households. Milk production, on the other hand, contributed barely one percent to the aggregate profit margin of the wealthy families. Because of the various character of revenue-producing industries among wealthy households, other enterprises such as poultry, cattle, field crops, and horticulture were generating significantly more income than dairying. Households with more financial resources reported utilizing more commercial feed (dairy meal) than other households. Higher off-farm income was shown to be associated with higher quantities of dairy meal, which raised the amount of cash available for spending on other livelihood financial requirements, such as the purchase of dairy meal. Average households, on the other hand, had the highest milk production per cow due to the fact that they were producing more milk from a smaller number of cows.

Agribusiness production cannot be evaluated in isolation from other sources of revenue and the possibility of obtaining inputs from a variety of different sources. This is demonstrated by the contribution of non-agricultural activities to household income, such as rentals and remittances, among other things. Households can employ cash earned from sources other than agriculture to increase agricultural production on the farm.

It is possible that the lower contribution of dairying to overall gross margin for wealthy households and the absence of any contribution for resource-constrained households is attributable to the multipurpose usage of dairy animals. In addition, producers may have other non-milk values for keeping dairy animals, which may be difficult to account for in the financial statements. Apart from milk, additional direct benefits derived from dairy animals include progeny, which may be gained by farmers, so expanding the number of their herd, and waste, which can be used to fertilize their fields as alluded to by Mutiwanyuka, 2021. The other incentive came in the form of ownership of dairy animals, since farmers were granted dairy cows as loans, which they were required to repay in instalments from the milk sales they generated. The payment method that was implemented was advantageous to the farmers because it allowed them to pay using cash that they could have acquired from some of their cash-generating ventures in the past. This payment method enabled resource-constrained households to buy dairy cows by paying for them in instalments over a longer period of time.

The fact that beef animals provide a negative contribution to overall farm gross margin for resource-constrained and average households may be explained in part by the complex ownership structure and the responsibilities that livestock perform in communal areas. Beef animals are used by households for a variety of functions, including traction and farm waste (organic fertiliser). However, there will be costs connected with the up-keep of the animals, and their value will be locked-up in them, and can only be realised once the animal has been sold or when a monetary value is attached to the services that the animals provide. It is also possible that the animals are owned by people who live in cities, and that they will have the last word when it comes to selling of the animals. Cattle sales may be necessary as a last resort in emergency situations, such as when these households are unable to pay school fees for their children or when they are unable to pay for family members' medical expenditures. All of this contributes to lower or negative results for the contribution of beef cattle to the total gross margin of the industry.

When examining net economic on-farm profit (full costing), wealthy households are on the "right track," followed by resource-constrained households, as indicated by positive numbers in the net economic on-farm profit row (Table 1). According to net on-farm cash income, the wealthiest

households (70 percent) earned the most, followed by resource-constrained households (43 percent), and the average households (25 percent) earned the least (26 percent). According to Table 1, based on an average household size of 5 and total net income, household income per capita was greater for wealthy families (US$ 1513.00), followed by resource-constrained households (US$ 235.60), and average farmers (US$ 185.34). As of December 31, 2020, the national average per capita income was US$ 1200.00. (Trading Economics, 2021). Due to the fact that the wealthy group constitutes a minority of the population, the majority of the households leave way below the national average income per capita.

In the average group of homes, a higher milk yield per cow (661.9 kg/lactation) was achieved than in the other groups. In terms of yield, this translates to an average daily yield of 2.2 litres, which will be sufficient to meet the monetary requirements of the household if the cows are milked for the whole 300-day lactation cycle. However, the majority of farmers only achieved a peak milk yield of about 8 litres per day, with some reaching as high as 15 litres per day. The average milk producer price utilized was US$ 0.46 per litre of milk.

Dairy farming, if properly managed, has the potential to be a profitable venture for the Chikwaka community. However, depending on the direction of the shift, an increase or a drop in the price of milk will have either beneficial or negative repercussions for consumers. There is space for improvement in the dairying business in the Chikwaka scheme, as seen by the variations in dairy operating expenses (Table 4), the average milk production that may be achieved, and the net economic on-farm profit among Chikwaka dairy producers. Farmers should strive to produce more clean milk while keeping operational costs as low as possible, a process known as intensification of dairying.

When the number of cows required to satisfy the household cash needs is analysed (as shown in Table 6), it is discovered that as milk yield/cow grows, the number of cows required to fulfil the household cash needs decreases. Two cows will be required to cover the income demands of the average households as the milk yield/day per cow increases from the current production rate of 4.4 litres per day per cow to 7 litres/day per cow, which represents a 50% increase. Dairying, on the other hand, appears to be impractical for households with limited financial resources. This is due to the fact that the quantity of eight cows (Table 6) required to meet their cash requirements is beyond their means. At the current output level, they were only able to keep two milking cows and were therefore unable to break even.

For the resource-constrained group, the contribution of imputed family labour as a percentage of overall operating expenses was 37 percent, whereas it was 34 percent for the average group and 27 percent for the wealthy group of farmers. These findings were consistent with those of Moran et al. (2000), who observed proportions ranging from 17 to 30 percent as we progressed from the most lucrative farms to the least profitable farms. The variations in imputed family labour were partly related to variations in variable costs for each farmer group, as was the variation in imputed family labour. Chikwaka farmers, on the other hand, have the ability to cut their contribution to operating expenses from family labour costs. This can be accomplished by the efficient use of other dairying inputs, such as feed, to increase production. According to Moran et al., (2000) the development of management skills for the right timing of activities is another less easily quantifiable profit driver on dairy farms that can be measured.

Depending on the dairying operation, feed expenses might account for up to 80% of overall expenditures (Zamani, 2012). Chikwaka research discovered that the average family group received a maximum feed cost contribution of 53 percent of the total value of the study, which was a 27 percent deficiency from Zamani's findings. Although the low cost can be attributed to the use of other low-cost locally available feedstuffs, it is possible that this is a contributing factor to the milking animals producing less milk in this case.

Livestock play a significant role in ensuring global food security. This is accomplished through the provision of highly nourishing animal source foods, the provision of scarce cash income from the sale of livestock and livestock products, which is used to purchase food, and the use of their manure and traction to increase household cereal supplies, among other things (Herrero et al., 2013). Farming crops increased the livelihoods of smallholder farmers in mixed crop-livestock systems, while crops lagged behind the poultry enterprise for both resource-constrained and rich households in Chikwaka mixed crop-livestock systems (Table 5). Gardening is another form of income that was found to be more profitable than dairying in all households. The income from dairying is received monthly through the milk collection center, but the income from field crops is received once a year following harvest. It appears, however, that smallholder dairy producers in the Chikwaka region are not taking use of the benefits of dairying. Dairy farming contributes to the nutritional balance of rural populations as well as the expansion of the revenue base of smallholder farmers.

5. Conclusion

Despite the fact that dairying has the potential to be the primary source of income for Chikwaka smallholder dairy producers, its contribution to their lives is modest. Despite the fact that it is a dairy community, most farms were losing money from dairying. Dairying contributes 15% of total household gross margin, indicating that average households make a little profit margin. The wealthy households were focused on other businesses, as indicated by dairying's 1% contribution to total household gross margin. Dairy farming among resource-constrained households is unprofitable due to a negative gross margin. When compared to the findings of other researchers, the highest contribution of feedstuffs to dairying expenses in the range of 53 percent appears low. Dairying could be profitable in terms of nutrition provided farmers have access to home-grown feedstuffs capable of providing appropriate protein to milking cows. Improved nutrition quality and quantity may result in greater milk yield and returns from the farmers' few dairy cows. Dairying could be profitable if treated as the primary income generating enterprise and given appropriate attention it requires.

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