WORLD BICYCLE RELIEF®

Mobility: Buffalo Bicycles Impact on Dairy Farmer's Productivity

Full Report
Palabana Dairy Cooperative Research Study
March 2016

Acknowledgements

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Executive Summary

In areas of the developing world, where people are challenged to make a livelihood because of distance, transport plays an essential role in market access and productivity.

For example, many dairy farmers in Palabana, Zambia, transport milk cans over long distances, which limits the number of deliveries they can make in a day and the volume of milk they can carry. Farmers traveling on foot or using unreliable bicycles are often late in making deliveries and the milk quality suffers as a result.

To help overcome these challenges, World Bicycle Relief (WBR) and the Palabana Dairy Cooperative (PDC) partnered to sell high-quality, rugged Buffalo Bicycles to dairy farmers in this rural community. From 2011 to 2014, dairy farmers bought 281 Buffalo Bicycles through the PDC's employee purchase program – a low-risk model that enables farmers to acquire a tool that increases their productivity and quality of life without any up-front capital.

Background

World Bicycle Relief mobilizes people through "The Power of Bicycles". Since its founding in 2005, WBR has worked to address the need for affordable, reliable transportation in rural areas of developing countries. World Bicycle Relief oversees large-scale philanthropic bicycle distribution programs and its subsidiary, Buffalo Bicycles, Ltd., produces the bicycles that enable individuals to achieve mobility and thrive.

In 2015, WBR conducted a research study on its multi-year relationship with the PDC to evaluate the influence of Buffalo Bicycles on the farmers, the cooperative and the community. The study was a quasi-experimental design employing quantitative and qualitative research methods for data collection. Both cross-sectional and cohort data are used for descriptive and multivariate regression analysis of farmers and outcomes.

PDC members purchased Buffalo Bicycles from 2009-2014, and by 2014 most farmers owned at least one Buffalo Bicycle. As farmer status changed from not having a Buffalo Bicycle to having a Buffalo Bicycle, their milk delivery and milk volume results were analyzed in relation to this change.

Findings

The study showed that farmers with Buffalo Bicycles made more deliveries, transported more milk each trip, reduced spoilage and increased income, compared to farmers who walked or used other bicycles and other transportation modes.

Because farmers can cover longer distances in shorter periods and because the bicycles are more reliable, farmers with Buffalo Bicycles made up to 25% more deliveries per month than farmers without the bicycles. Having a Buffalo Bicycle means the farmer can regularly make up to two deliveries of milk per day with less spoilage.

Farmers with Buffalo Bicycles delivered 23% more liters of milk than farmers without the bicycles. The Buffalo Bicycle's large-capacity rear rack and sturdy frame enable farmers to transport more milk than they could on foot or in a wheelbarrow.

Farmers with Buffalo Bicycles earned 23% more income per month than farmers without Buffalo Bicycles. Of the owners surveyed, 88% stated their incomes had increased due to the ability to transport higher volumes of milk. Farmers also reported saving money on bicycle repairs and maintenance.

Farmers with Buffalo Bicycles reduced their travel time to the cooperative by 45%. For example, a trip of 55 minutes by foot was reduced to an average of 30 minutes with a Buffalo Bicycle. Farmers using other bicycle brands had frequent breakdowns, which resulted in delayed or aborted deliveries and milk spoilage.

Additionally, 95% of farmers interviewed use the Buffalo Bicycle to better their lives. The bicycle gives family members access to education, healthcare and social networks such as friends, community centers and church.

100% of respondents perceived the Buffalo Bicycle as more reliable than other bicycles. Farmers felt the Buffalo Bicycle is dependable for carrying heavy loads and highly suitable for the rough terrain of the Palabana area — features which influenced the farmers to buy the Buffalo Bicycle for their transportation needs at the farm.

PDC members state the use of Buffalo Bicycles to deliver milk has resulted in a better quality product. Milk delivery is on time, with fewer bicycle breakdowns, resulting in less spoilage and increased volume for the cooperative. Ultimately, this means the PDC can sell more milk to its sole buyer, Parmalat, thereby increasing revenue. In addition, the cooperative is building a new cold store to triple its capacity. The PDC chair also shared that the Buffalo Bicycle employee purchase program has attracted new members to the cooperative.

Approximately nine of every 10 farmers interviewed expressed satisfaction with the system of purchasing bicycles under the employee purchase program, with only 11.6% (5) reporting they faced a challenge in meeting the payment terms. Payments for the bicycles are deducted from farmers' milk sales over a three-month period, and the PDC has maintained a 100% repayment rate to date. On average, cooperative members own two Buffalo Bicycles.

Conclusion

Based on the positive results of this study and others, World Bicycle Relief is moving forward with confidence in the Buffalo Bicycle's impact and the effectiveness of the employee purchase program model to bring the bicycle to more dairy cooperatives and farmer groups in Zambia and beyond.

1. Introduction

1.1. World Bicycle Relief

World Bicycle Relief (WBR) mobilizes people through "The Power of Bicycles." The nonprofit organization was founded by F.K. Day, Executive Vice President of SRAM, and his wife Leah Missbach Day, a professional photographer, in response to the Indian Ocean tsunami in December 2004. Through a partnership with many corporate, foundation and individual donors, WBR delivered 24,400 high-quality, locally sourced bicycles to carefully selected men, women and children left in greatest need in the wake of the tsunami.

Since then, WBR has worked to address the need for affordable, reliable transportation in rural areas of developing countries. World Bicycle Relief oversees large-scale philanthropic bicycle distribution programs and its wholly owned for-profit subsidiary, Buffalo Bicycles, Ltd., produces the bicycles that enable individuals to achieve mobility and thrive.

Buffalo Bicycles, Ltd. sells bicycles directly to non-governmental organizations, businesses, farmers and individuals in need of rugged, reliable transportation. This operation improves the efficiency and cost structure of WBR's philanthropic program areas of education, healthcare and economic development— working to build a sustainable bicycle infrastructure in developing countries.

By combining philanthropy with social enterprise sales, WBR's innovative model enables the organization to distribute more bicycles per donor dollar through greater efficiencies of scale, creating more impact wherever it works. WBR works closely with partners, supporters and end-users to design and implement sustainable programs that leverage best practices and local expertise. Continuously striving to improve, the organization is committed to measuring and evaluating the results of its work.

With the experience and expertise gained over the last 10 years designing and delivering more than 285,000 Buffalo Bicycles, WBR has developed an efficient, innovative and scalable model to

successfully address the great need for reliable, affordable transportation in rural areas of developing countries.

1.2. Palabana Region of Zambia

Palabana is a rural community located in the Chongwe District of Zambia about 32 km east of Lusaka, the capital. For the population of 7,431 (Central Statistical Office of Zambia, 2010), the primary economic activities are small-scale crop and livestock farming – characterized by traditional production techniques – and other small businesses. Major crops cultivated include maize, cotton, groundnuts and sunflowers. Cattle rearing, a prestigious trade, is also common in the area, not only for producing milk, but also for cultivating and fertilizing the land, and providing financial security. The community has experienced an increase in dairy farming since the establishment of the Palabana Dairy Cooperative (PDC) in 2000, which created a ready market for milk through its supply to Parmalat, a multi-national dairy and food corporation.

The first Buffalo Bicycles distributions in the Palabana area were through philanthropic programs, including the RAPIDS healthcare program in 2007 and WBR's Bicycles for Educational Empowerment Program (BEEP) in 2009. In keeping with WBR's innovative blended model, social enterprise sales followed, beginning with a micro loan program through Vision Fund Chongwe and an employee purchase program with the Palabana Dairy Cooperative in 2011.

1.3. Palabana Dairy Cooperative (PDC)

PDC started in 2000 with approximately 20 members producing less than 200 liters of milk per day. Before organizing as a cooperative, the group was part of the Zambian government-sponsored Association of Dairy Farmers. The majority of PDC members, trained by the Dairy Institute, have been dairy farmers for three to four years and have received training over the years from outside organizations such as Land O'Lakes, Parmalat and Heifer International. The Ministry of Education is now turning the institute into a formal dairy training university. To join the cooperative, members make a one-time 100-kwacha payment ($19 USD[1]) followed by a five-kwacha annual payment.

As of 2015, the PDC had 100 members, 80 of whom are currently active. Of these, 30 are women and 50 are men. Sixty of the current members have been with the cooperative more than four years.

Transportation is a major challenge for dairy farmers living in a resource-poor setting with limited infrastructure, compounded by vast distances, rough terrain and washed-out roads in the rainy season. The combination of these factors greatly hampers the farmers' ability to deliver milk on time and in sufficient volumes to earn a livelihood. These dairy farmers – and other members of the Palabana community – needed a safe, reliable means of transportation that is cost effective, efficient and practical.

From 2011 to 2014, dairy farmers purchased 281 Buffalo Bicycles through the PDC. The first 10 farmers acquired the Buffalo Bicycles through Vision Fund, a microfinance partner of World Vision. Shortly thereafter, the PDC began working directly with WBR to sell Buffalo Bicycles through the cooperative's employee purchase program (EPP) – a low-risk model that enables farmers to acquire the Buffalo Bicycle without any up-front capital. Farmers pay off bicycles over a three-month period,

[1] Average exchange rate of 5.27 kwacha to the U.S. dollar between May 1, 2011 and May 1, 2014

with payments deducted from their milk sales. If farmers do not have enough revenue from milk sales to cover their loans (not just for Buffalo Bicycles), they must pay the difference in cash. The cooperative has had a few delayed payments, but to date 100% of farmers purchasing Buffalo Bicycles through the EPP program have paid in full.

In addition to benefiting farmers, the cooperative's Buffalo Bicycle sales have a wider community benefit. The PDC oversees a purchase program where other community members pay cash for Buffalo Bicycles on the same three-month credit terms as the dairy farmers. If the community member is a "known individual," they are approved automatically; otherwise, the individual must have a PDC member act as guarantor. If the individual does not pay, the amount is deducted from the guarantor's earnings.

2. Objectives of the Research Study

Early in 2015, World Bicycle Relief decided to undertake a study evaluating the impact of the Buffalo Bicycle on dairy farmers' milk deliveries, their household income and activities, and the growth of the cooperative.

This study was designed to answer the following primary research questions:

Has the use of the Buffalo Bicycle influenced the individual dairy farmers?

Has the introduction of the Buffalo Bicycle had any influence on the growth of the PDC?

What are best practices using the employee purchase program model?

3. Methodology

3.1. Study Design

Researchers conducting the Palabana Dairy Cooperative study used a **quasi-experimental design** employing qualitative and quantitative research methods for data collection and analysis. Both cross-sectional and cohort data were used for descriptive and multivariate regression analysis of outcomes among farmers. Research assistants were trained to extract data from paper records stored at the PDC and enter the data into electronic databases. They also conducted qualitative data collection with key informants and among a sampled group of farmers. The quantitative data collected were entered into ACCESS and analyzed using SPSS and STATA software. Qualitative data were collected, translated, transcribed and analyzed by theme.

3.2. Data Collection Methods, Tools and Procedures

Quantitative research methods were used to collect data on individual farmers through a cross-sectional household survey, as well as records of farmers' milk delivery, PDC sales to Parmalat, Buffalo Bicycle sales, and employee purchase program payments. **Qualitative methods of data collection** used in the study were a focus group discussion and an in-depth interview. The study only engaged respondents who, by informed consent, voluntarily accepted to participate.

Primary Data

Semi-Structured Interviews

A semi-structured household survey was administered to a targeted sample of **43 dairy farmers** representing approximately half of the active cooperative members. The randomly selected farmers had to be current PDC members who had purchased a Buffalo Bicycle. The selection also took into account the ease of access to the farmers, as well as their availability for the interview. The questionnaire included close- and open-ended questions asking farmers about their: experiences

as a dairy farmer; experiences with the Buffalo Bicycle; perceived impact of the bicycle on milk delivery and household activities; and perception of the employee purchase program. The farmer questionnaire can be found in the appendix of this report.

Focus Group Discussion

Researchers conducted one focus group discussion with **10 dairy farmers**, purposively selected based on their availability. Discussion questions focused on: the farmers' perceptions of the employee purchase program; experiences delivering milk prior to acquiring a Buffalo Bicycle; perceived changes on milk delivery and the household/community brought about by the Buffalo Bicycle; and perceptions of the Buffalo Bicycle compared to other bicycles.

In-depth Interviews

Two staff members from the cooperative – the chairman and the assistant manager – were purposively selected as key informants to respond to questions about: the PDC's strategy and challenges; perceived changes brought about by the Buffalo Bicycle on the cooperative, farmers and the Palabana community; and opportunities for improvement in the employee purchase program.

Secondary Data

Farmers' Milk Delivery

Monthly milk delivery records extracted from the PDC's paper registers show the quantity of milk (in liters and kilograms) delivered by each farmer to the cooperative each day of the month. The study includes data reviewed from milk delivery registers from January 2009 to December 2014. Research assistants input the data using a customized data entry screen in MS Access.

PDC Sales to Parmalat

Research assistants extracted records of the **monthly volume of milk sold** by the PDC to Parmalat from 2009 through 2014 from the cooperative's paper records and entered the data into an Excel template.

Buffalo Bicycle Sales

Paper records were maintained at the cooperative indicate when each farmer purchased a Buffalo Bicycle. The **bicycle sales records** merged with milk delivery records and household surveys provided a complete historical dataset including the farmer's milk delivery volume and timing of bicycle purchases.

Employee Purchase Program

The research team captured **employee purchase program payment data** through a template completed by PDC management, which included each farmer's name, date of Buffalo Bicycle purchase and payment dates. Researchers used the data to assess the program's repayment rate.

3.3. Data Management and Analysis

Primary Data

Semi-Structured Interviews

Closed-ended responses to the semi-structured questionnaires were coded and entered into SPSS version 17 and STATA 13 for analysis. Open-ended responses from the household questionnaire were coded using themes that emerged from the data; similar themes and content categories were given the same codes. In addition, supporting quotations were identified for inclusion in the report.

Descriptive statistics were used to summarize the data into frequencies and percentages, where appropriate. Inferential statistics, including fixed effects regression and t-test were run in SPSS and STATA for analysis of the key outcomes of interest for the study. Analysis tables were created in Excel for the generation of more customized tables and graphs.

Focus Group Discussion and Key Informant Interviews

Qualitative data obtained through a focus group discussion and a key informant interview were analyzed thematically and involved extracting significant statements from respondents' answers and categorizing similar responses into themes. Significant quotations are included in the report to illustrate themes being described.

Secondary Data

Farmers' Milk Delivery & Buffalo Bicycle Sales

Data extracted from farmers' milk delivery registers were merged with farmer records obtained from the cooperative, which include the date the farmer purchased his or her first Buffalo Bicycle, as well as the number of any additional bicycles purchased. From 2011 to 2014, an increasing number of farmers in the cooperative had purchased bicycles and by 2014 most farmers owned at least one Buffalo bicycle. As farmer status changed from not having a Buffalo Bicycle to having a Buffalo Bicycle, their milk delivery and milk volume results were analyzed in relation to this change. Merged milk and bicycle purchase records from the period 2009 – 2014 allowed generation of control and intervention groups, or before and after, which were coded farmers with Buffalo Bicycles and farmers without Buffalo Bicycles. The complete farmer records were exported to SPSS version 17 and STATA 13 for analysis.

3.4. Data Quality Assurance and Limitations

The PDC maintains all records in hard cover notebooks and registers; to date, the cooperative has not introduced electronic management of records. Data collected for the study from 2009-2014 represent what was available and documented by management. In the process of cleaning and merging files, research assistants reconciled names, dates and any data gaps and inconsistencies to the extent possible. All data collected were cleaned and checked for consistency before analysis.

To ensure the highest data quality, research assistants with previous experience in data entry, data collection and survey interviewing were recruited. They were provided a short, intensive orientation program on the study's background and objectives, as well as a review on data collection tools, interviewing techniques, farmers' registers and the database.

4. Study Results

Study results include: **Five key findings** from the study (4.1); Socio-demographic information on farmers interviewed in the household survey (4.2); Information on Buffalo Bicycle ownership, farmers' perceptions of the Buffalo Bicycle, and condition of the Buffalo Bicycles (4.3); Information on the impact of the Buffalo Bicycle and the PDC (4.4); and Farmers' perception of the EPP (4.5).

4.1 Key Findings

4.1.1 Frequency of Milk Delivery

Farmers with Buffalo Bicycles made up to 25% more milk deliveries per month than farmers without the bicycles. In Palabana, after milk is produced, the farmer or farm workers transport it in cans to the cooperative by bicycle, foot or vehicle. Once a cow is milked, the milk must be delivered to the cold storage facility within one hour. Farmers typically deliver milk twice in a day – in the morning and in the afternoon. However, partly due to the challenge of transporting milk, sometimes farmers fail to make two deliveries in a day and are not consistent with the number of times they deliver milk either in the morning or in the afternoon in a month. Farmers interviewed in the household survey shared that late deliveries and milk spoilage were the top two issues faced in delivering milk to the cooperative.

Findings and analysis of data showed that in a month's period, farmers with Buffalo Bicycles were able to make 27 morning delivers as compared to 24 deliveries by farmers without a Buffalo Bicycle. This increase represents 2.90 more times (p< 0.000, CI:2.41-3.39) or 12.5% more deliveries. Regarding afternoon deliveries in a month, farmers with Buffalo Bicycles made 25 deliveries and those without made 20 deliveries. This increase represents 5.0 more times (p<0.000, CI: 4.40 – 5.64) or 25% more deliveries with a Buffalo Bicycle than without the bicycle.

For a subset of farmers (43) we ran a regression analysis controlling for the number of cows and the number of deliveries. This additional analysis has shown owning a bicycle did influence the number of deliveries.

Table 1 Farmer Milk Deliveries: Average number of days per month, 2011-2013

	With Buffalo Bicycle	Without Buffalo Bicycle	% Change	P-value	95% CI*	
					Lower	Upper
Average Number of Morning Deliveries	27	24	12.5%	<0.000	2.41	3.39
Average Number of Afternoon Deliveries	25	20	25%	<0.000	4.40	5.64

Table 2 Farmer Milk Deliveries: Average number of days per month, 2011-2013

		With Buffalo Bicycle	Without Buffalo Bicycle	% Change	P-value	95% CI*	
						Lower	Upper
2011	Average Morning Deliveries	28	23	22%	0.001	2.1	7.7
	Average Afternoon Deliveries	26	17	53%	<0.001	4.3	12.2
2012	Average Morning Deliveries	27	23	17%	<0.001	1.9	6.4
	Average Afternoon Deliveries	24	20	20%	<0.001	1.3	7.6
2013	Average Morning Deliveries	26	25	4%	0.172	0.6	3.4
	Average Afternoon Deliveries	25	21	19%	<0.001	1.7	5.9

*** CI** represents the upper and lower range of the difference between deliveries.

Table 2 shows a comparison of the number of days farmers delivered milk in a month with Buffalo Bicycles and without Buffalo Bicycles for the years 2011, 2012 and 2013. By 2014, most farmers owned a Buffalo Bicycle. Overall, from 2009 to 2014, the number of farmers making morning milk deliveries increased 26%, those making afternoon deliveries almost doubled, and the farmers making both morning and afternoon deliveries increased by 73%.

4.1.2 Volume of Milk Supplied to the Cooperative

Farmers with Buffalo Bicycles delivered 23% more liters of milk to the PDC than farmers without Buffalo Bicycles. While the quantity of milk produced depends primarily on the number of animals as well as animal welfare and health, farmers stated that the use of the Buffalo Bicycle has greatly enabled them to increase the volume of milk they transport to the cooperative. Before they purchased the bicycle, some farmers reported they transported milk on foot – delivering 60 liters per day using two farm workers carrying one 30-liter container each trip. With the Buffalo Bicycle, one farmworker can transport up to 80 liters (two 40-liter containers) per day using one Buffalo Bicycle. Farmers cited that the Buffalo Bicycle's greatest influence on the volume of milk delivered is the capacity to carry more milk per trip.

Analysis of the quantitative data shows a difference in the volume of milk transported to the cooperative each visit. With the Buffalo Bicycle, farmers delivered 1,780 liters per month; in comparison, farmers without the bicycle delivered 1,449 liters per month. The difference is 331 liters ($p<0.000$, CI: 208.7 – 453.1). Thus, farmers using the Buffalo Bicycle delivered an average of 71 liters of milk per day, while farmers without the Buffalo Bicycle delivered an average of 58 liters per day (assuming 25 delivery days a month).

When farmers were asked how the Buffalo Bicycle has influenced their daily milk supply to the cooperative, the primary response was their ability to carry a larger volume of milk, followed by more timely deliveries and fewer bicycle breakdowns with the Buffalo Bicycle. Farmers overwhelmingly reported the quantity of milk they are able to deliver daily to the cooperative has greatly improved – citing the bicycle as key to this improvement owing to its strength and carrying capacity. This is illustrated by statements from dairy farmers during the focus group discussion:

> **How has the Buffalo Bicycle influenced your daily milk supply to the cooperative?**
>
> *"Before we had the Buffalo Bicycle, we used to deliver 60 liters of milk every day by three workers by foot, but now, only one worker is able to deliver 80 liters of milk everyday using the bicycle."*
>
> *"With the Buffalo Bicycle, we have increased the amount of milk we are able to deliver to the cooperative; we are also able to deliver the milk on time which has enabled us to deliver milk of good quality."*

4.1.3 Increased Farmer Income

Farmers with Buffalo Bicycles earned 23% more income per month compared to farmers without Buffalo Bicycles. Farmers cited the primary reason for increased income was the higher volume of milk they were able to transport to the cooperative after purchasing a Buffalo Bicycle. At 3.14 kwacha per liter – the average price paid to farmers for milk from 2010-2014 – the additional 331 liters ($p<0.000$, CI: 208.7 – 453.1) transported using a Buffalo Bicycle translates to a 1039 kwacha increase in income. This translates into an average 197 USD increase in monthly income.[1] Thirty-eight (88.4%) of the farmers surveyed felt the Buffalo Bicycle increased their household income.

[1] Average exchange rate of 5.27 kwacha to the U.S. dollar between May 1, 2011 and May 1, 2014

Farmers related this increased income to the greater volume of milk they could transport to the cold store. During the focus group discussion, dairy farmers reported their level of earnings increased due to reduced transportation costs, as well as decreased costs for repairing and buying spare parts when compared to other bicycles that were used to transport milk before purchasing the Buffalo Bicycle.

How has the Buffalo Bicycle impacted the level of income for your household?

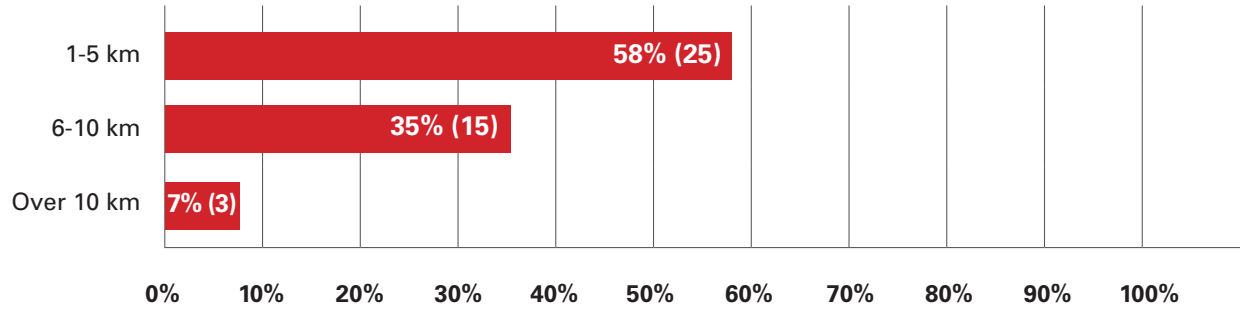
"We used to transport milk with a truck but because of high fuel costs we had to switch to using Buffalo Bicycles, which could take the same amount of milk per day and without any fuel costs. So it really reduced our transportation costs."

"The Buffalo Bicycle has helped us increase our income by spending less on spares and we are able to deliver about 80 liters of milk on time within 30 minutes."

4.1.4 Reduced Travel Time to the Cooperative

Farmers with Buffalo Bicycles reduced travel time to the cooperative by 45%. Farmers interviewed reported that a trip of 55 minutes without a Buffalo Bicycle was reduced to an average of 30 minutes with the bicycle. Before purchasing a Buffalo Bicycle, members faced an issue of transportation to the cooperative. Once cows have been milked, the milk has to be at the cold store within one hour. This study revealed that most farms are spread across long distances from the dairy cooperative. The farms visited during the study were located, on average, 5.5 km from the cooperative, with distances ranging from 2 km to 17 km, and more than 40% of the farmers living 6 km or more from the cold store. The majority of roads are rough and unpaved.

Figure 1 Farms: Distribution by distance to the cooperative



Farmers cited transportation of milk to the cooperative as a key challenge they face. They also shared that late delivery of milk is the number one issue they face when making milk deliveries. Although there is still a distance challenge to the cooperative for some farmers, this study demonstrated that farmers with Buffalo Bicycles have significantly reduced their travel time to the cooperative. Generally, focus group participants felt the Buffalo Bicycle had a positive impact on the quality of milk delivered to the cooperative resulting from reduced travel time and timeliness of milk deliveries.

How has the Buffalo Bicycle influenced your dairy supply to the cooperative?

"We are able to supply all the milk to the cooperative daily and on time, which maintains the quality of milk."

"We used to experience frequent breakdowns with other bicycles and we could spend more time fixing these bicycles which quite often led to late delivery of milk. But with Buffalo Bicycles, we don't have to waste time fixing the bicycles as they are very strong and can ride faster in this terrain. We are therefore able to deliver milk on time which preserves the quality of milk."

4.1.5 Use of Buffalo Bicycle for Household Activities

95% of farmers cited using the Buffalo Bicycle to better their lives. One-third (32%) reported their Buffalo Bicycles are also used by household members to go to school while over three-quarters (80%) said they rely on the Buffalo Bicycles to transport the sick to the health facility. On average, farmers live 4.8 km from the nearest school and 4.9 km from the nearest health facility.

What other income-generating or social activities have you used your Buffalo Bicycle for?

"This bicycle has really helped us. It is our means of transport at home—we use it for going to the field, taking maize to the hammer mill, carrying sick people to the clinic and also going to church."

In addition, 43% (18) of the farmers interviewed also relied on the Buffalo Bicycle for other income-generating activities at the household level, which they felt led to increased household income. These activities included taking farm produce such as vegetables and chickens to the market. Farmers also reported they relied on Buffalo Bicycles to transport farming inputs such as feed or fertilizer, and to take maize to the mill.

Further, the farmers and their families use the bicycle for social activities such as attending community meetings (95%, 41), visiting friends (81%, 35) and attending church meetings (79%, 34).

When asked how frequently Buffalo Bicycle are used to attend these social activities, 39.5% (17) of farmers reported "Very often", 14% (6) reported "Often" and 46.5% (20) reported "Occasionally". These findings confirm that farmers are primarily using the bicycle for economic activities.

Figure 2 Buffalo Bicycles: Additional use for social activities

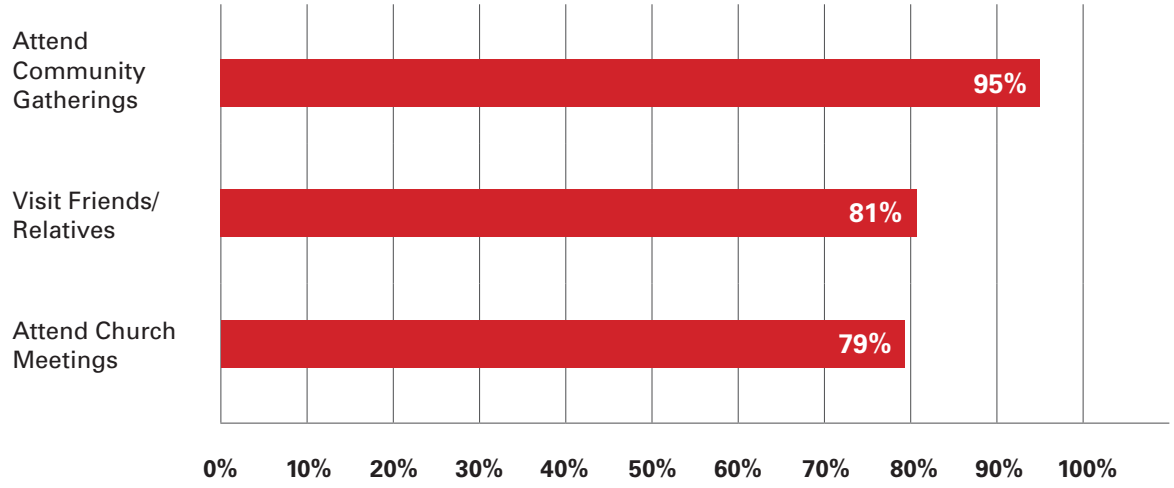
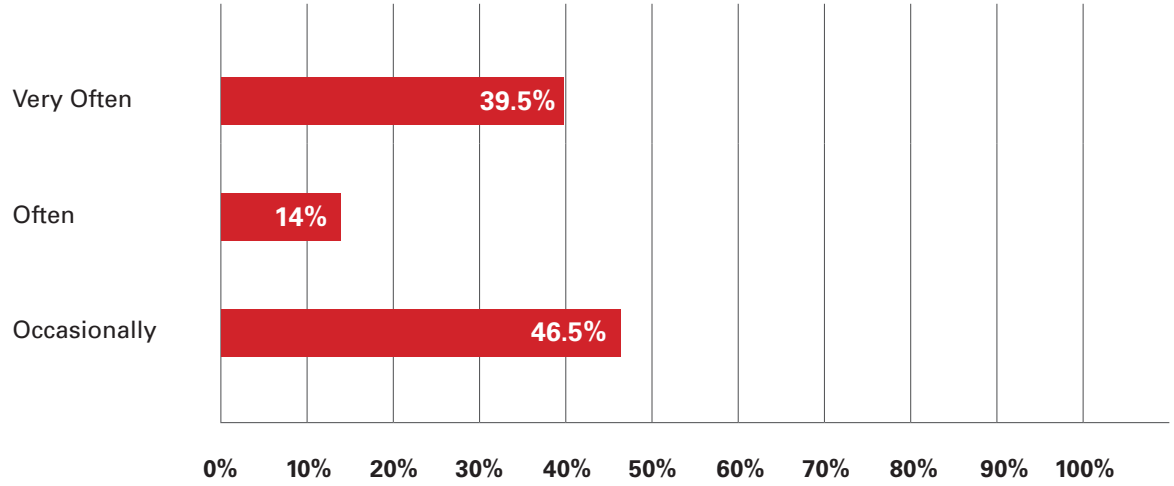


Figure 3 Buffalo Bicycles: Frequency of use for social activities



4.2 Socio-Demographic information on Farmers

4.2.1 Background profile of respondents

This section provides background on the socio-demographic profile of a sample of 43 Palabana farmers who own Buffalo Bicycles. The dairy farmers, predominantly males (83.7%, 36), were successfully interviewed for the household survey. The mean age of the respondents was 46 years, with farmers ranging in age from 25 to 72 years. The average household size was five individuals. On average, the cooperative members had been engaged in dairy farming for seven years. Their primary sources of livelihood were dairy farming (88%, 37) and salaried employment (11.6%, 6). About 42% (18) have tertiary education, 39.5% (17) have secondary education, 14% (6) have primary education, and 4.7% (2) had not attained any level of education.

Table 3 Farmers Surveyed: Background profile of respondents

	Count (n = 43)	Percent
Gender		
Male	36	83.7
Female	7	16.3
Age		
20-29	4	9.3
30-39	10	23.3
40-49	13	30.2
50+	16	37.2
Household Size		
1-2	4	9.3
2-3	6	14
4-5	17	39.5
≥6	16	37.2
Education		
None	2	4.7
Primary	6	14
Secondary	17	39.5
Tertiary	18	41.9
Main source of livelihood		
Dairy farming	39	88.4
Paid employment	5	11.6
Total	43	100

4.2.2 Farm Size and Growth over Time

In 2014, the number of dairy animals owned by each farmer ranged from 2 to 112. On average, each farmer owned 21 animals. Generally, farmers employed few staff, with an average of three employees on each farm in 2014.

Figure 4 shows that over the years (2009 to 2014) there has been a steady increase in farm size as indicated by the average number of cows and average number of employees. Table 4 shows the average number of cows per farm increased from 8 in 2009 to 21 in 2014, while the average number of employees increased from one to three in the same period. Again, operating costs seem to be well controlled with few farmhands being employed despite the growth in farm size.

Figure 4 Cows and Employees: Trend in the average number, 2009-2014

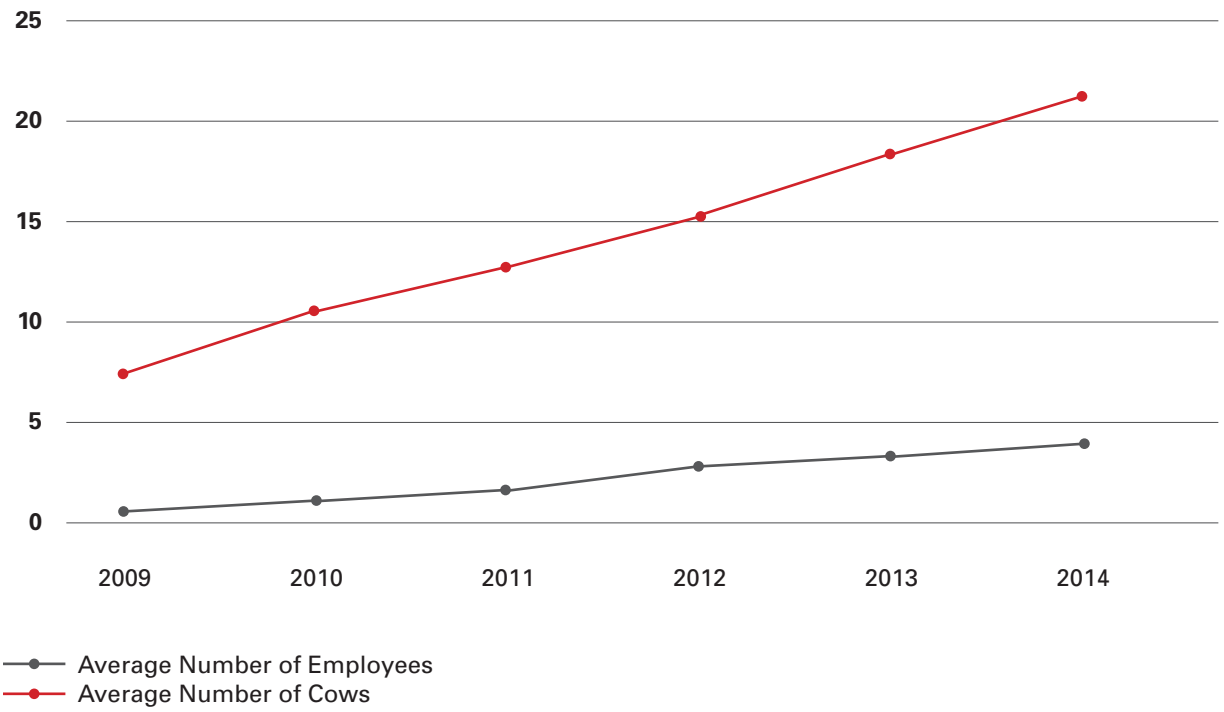


Table 4 Cows and Employees: Average number, 2009-2014

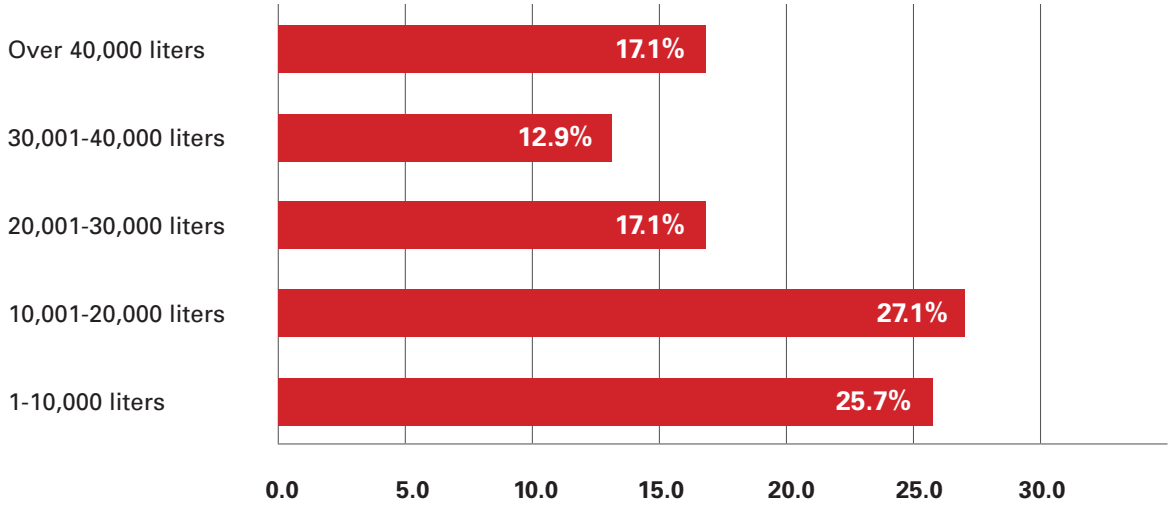
Year	Average Number of Cows	Average Number of Employees
2009	8.1	1.1
2010	10.4	1.3
2011	12.8	1.7
2012	15.3	2.4
2013	18.3	2.6
2014	21.2	3.2

Table 5 Farm Size: Number of cows per farmer, 2014

Farm Size	Percent	Number of Farmers
1-10 cows	20.9	9
11-20 cows	53.5	23
21-30 cows	11.6	5
Over 30 cows	14.0	6
Total	100	43

The majority of PDC members are smallholder farmers, with fewer than 15% having more than 30 dairy cows. In 2014 74% of members owned fewer than 20 cows and 70% of farmers sold 30,000 liters or less milk per year to the cooperative. Table 5 and Figure 6 show the 2014 distribution of the number of cows and liters of milk per year sold to the cooperative based on the sampled farmers and PDC sales records.

Figure 5 Volume of milk delivered per year by farmers, 2014

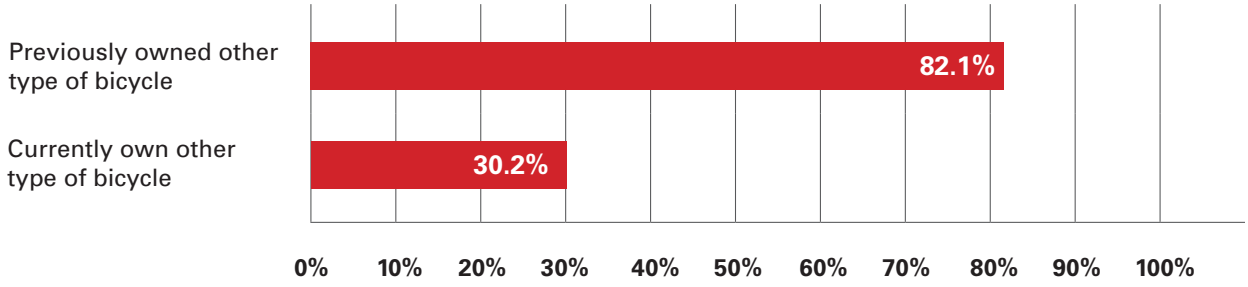


4.3 Buffalo Bicycle

4.3.1 Bicycle Ownership

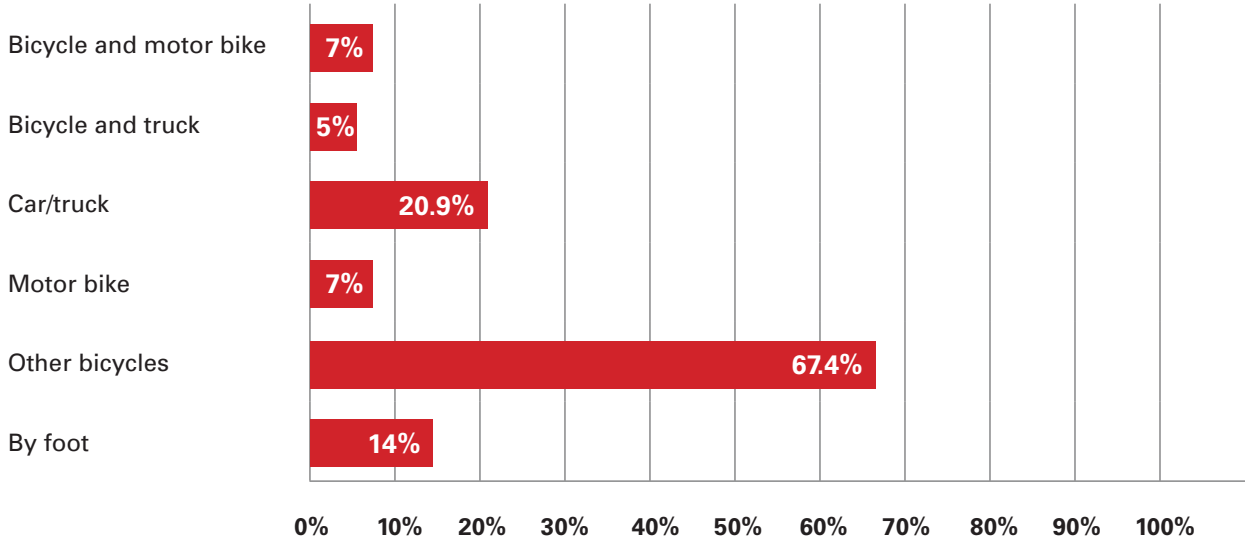
All the farmers interviewed reported having owned a Buffalo Bicycle. At the time of the study, 88% (38) of the farmers owned Buffalo Bicycle(s), while 12% (5) of the farmers reported having had their bicycle stolen at their farm. Farmers who reported owning a Buffalo Bicycle had, on average, two bicycles, and the highest number of bicycles owned by an individual farmer was five. 30% (13) farmers also owned other types of bicycles in addition to the Buffalo Bicycle; 82% (23) reported having owned another type of bicycle in the past.

Figure 6 Bicycles: Ownership by category



Before acquiring Buffalo Bicycles, the majority of farmers used other types of bicycles to transport their milk to the cooperative (67.4%, 29). Other farmers used a car/truck (20.9%, 9), motor bike (7%, 3) while the remainder of the farmers reportedly transported their milk by foot (14%, 6). About 7% (3) of the farmers used both motor bike and bicycle while 5% (2) used both truck and a bicycle.

Figure 7 Before Buffalo Bicycles: Transportation of milk by category



When respondents who used a truck or motor bike were asked to state the reasons why they switched to using the Buffalo bicycle, Box 1 shows the main themes that emerged from the responses.

Box 1 Reasons for switching to the Buffalo Bicycle

- Fuel was expensive and the volume of milk we used to take using a car was not equivalent to the costs incurred
- Milk used to go sour if we were to wait for the car to collect, the bicycle proved to be faster
- It was cheaper to use a bicycle than a motor bike
- The Buffalo Bicycle was able to deliver the volume of milk we produced

4.3.2 Farmers' Perception of the Buffalo Bicycle

100% of respondents perceived the Buffalo Bicycle as more reliable than other bicycles. Farmers felt the Buffalo Bicycle is reliable for carrying heavy loads and highly suitable for the rough terrain of the Palabana area — features which influenced the farmers to buy the Buffalo Bicycle for their transportation needs at the farm. This perception was also unanimous among farmers during the focus group discussion, as shown by the following statements.

How does the Buffalo Bicycle perform compared to other bicycles for carrying out farm and household activities?

"I think Buffalo Bicycle has a longer life span and you get to spend less on repairs, and it also looks nice."

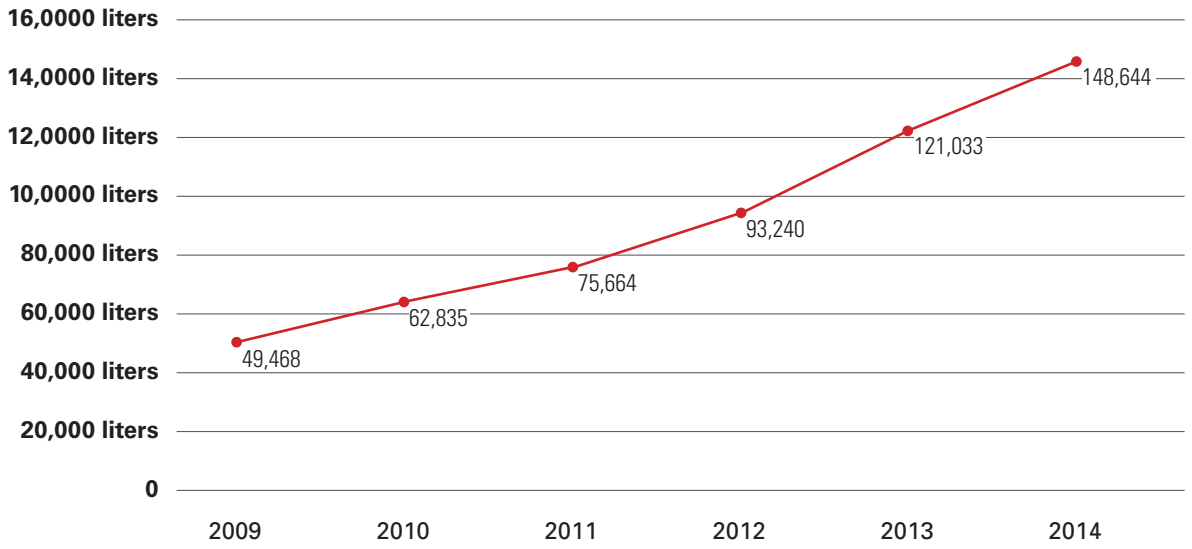
"The Buffalo Bicycle is very strong, suitable for this rough terrain we have here and besides it looks attractive when compared to other bicycles."

4.4 Influence of Buffalo Bicycle and PDC Growth

4.4.1 Increased Milk Sales to Parmalat

The Palabana Dairy Cooperative has been selling milk to Parmalat since 2007. Review of milk supply records showed an increase over the years in the volume of milk supplied to Parmalat by PDC. The average monthly milk supply to Parmalat was 49,468 liters in 2009 compared to 148,644 liters in 2014. This represents a **200% increase** in the volume of milk supplied to Parmalat over the six-year period.

Figure 8 Milk Volume: Average number of liters supplied to Parmalat by year, 2009-2014



PDC members have shared that there is less spoilage and waste due to timely deliveries and fewer bicycle breakdowns, which caused delays in transporting milk to the cooperative. During the key information interview, the PDC chairman said:

"Buffalo Bicycle has increased productivity, efficiency among cooperative members, and good quality of milk and increased the volumes of milk being delivered to the Cooperative. This means we are able to supply more milk to Parmalat thereby increasing revenue to the cooperative and the farmers as well."

Both key informants felt the farmers' use of Buffalo Bicycles has brought efficiency in the delivery of milk to the cooperative, as they are now able to deliver milk on time. This has increased milk volumes being supplied to Parmalat, resulting in increased revenues for the cooperative in the

form of commissions. PDC is currently building a new cold store with capacity to hold 15,000 liters of milk, a threefold increase from its current 5,000-liter capacity. In the future, PDC management aspires to:

> *"…start providing loans to farmers, own animals as a cooperative, have a processing plant, have qualified personnel to run the business, process our own milk, start a chicken business, and have a meat factory."*

4.4.2 Farmers' Perceptions of Employee Purchase Program

The PDC chairman shared that the Buffalo Bicycle employee purchase program has attracted new members to the cooperative.

Approximately nine of every 10 farmers interviewed expressed satisfaction with the system of purchasing bicycles under the employee purchase program, with only 11.6% (5) reporting they faced a challenge in meeting the payment terms. The top three comments expressed about the program were: 1) the need for an extended payment period; 2) the poor availability of spare parts; and 3) the delay in bicycle deliveries.

Most focus group participants felt the need to increase the repayment period from three months to four months for farmers who are unable to pay within the current period. Farmers also reported that the limited availability of spare parts for Buffalo Bicycles remains a big challenge. They felt that opening an outlet for selling spare parts for Buffalo Bicycles within the Palabana community would greatly help in making spare parts available in the area. Some farmers expressed concern over delays in delivery of Buffalo Bicycles ordered through the cooperative.

> **Are there any recommendations or comments you have regarding the Employee Purchase Program and payment terms?**
>
> *"There is need to increase the number of months for paying so that everyone can afford to buy the bicycle including those that have the smallest income."*
>
> *"The employee purchase program is good but there is need to provide spare parts and also to have an agent at the cooperative who can be selling the spare parts and fixing the bicycles."*
>
> *"We don't know whether the problem is with our cooperative or with Buffalo Bicycles, but I think we should be able to get the bicycles when we need them. Otherwise people will be tempted to start buying other bicycles which are not as strong as Buffalo Bicycles."*

5. Conclusion

In this study we sought to understand the impact of the Buffalo Bicycle on dairy farmers' milk deliveries, their household income and activities, as well as on the growth of the Palabana Dairy Cooperative. **Our study showed that dairy farmers with Buffalo Bicycles made up to 25% more deliveries per month, delivered 23% more liters of milk, earned 23% more income per month, and reduced their travel time to the cooperative by 45%, compared to farmers who walked or used other bicycles and other transportation modes.** Furthermore, the study confirmed the Buffalo Bicycle provides family members access to education, healthcare and social networks such as friends, community centers and church.

In addition, PDC members stated the use of Buffalo Bicycles to deliver milk has resulted in a higher quality product because it is delivered on time. There is less spoilage due to bicycle breakdowns, which caused delays in transporting milk to the cooperative. Ultimately, this means the PDC is able to supply more milk to Parmalat, thereby increasing its revenue. In addition, the cooperative is building a new cold store to triple its capacity.

Finally, farmers shared their perceptions of the Buffalo Bicycle as a strong, reliable transportation tool for carrying heavy loads over rough terrain. Almost all the dairy farmers felt that having a Buffalo Bicycle significantly solved their transportation problems.

Based on this study and others, World Bicycle Relief is moving forward, confident of the Buffalo Bicycle's impact and the effectiveness of the employee purchase program model, to bring the bicycle to more dairy cooperatives and farmer groups in Zambia and beyond.

Appendix - Farmer Questionnaire

WORLD BICYCLE RELIEF®

ASSESSMENT OF THE INFLUENCE OF BUFFALO BICYCLES ON DAIRY FARMERS' MILK DELIVERIES

Questionnaire for Dairy Farmers

My name is..... I am a research assistant working with World Bicycle Relief. We are carrying out a study on the influence of the Buffalo Bicycle on dairy farmers' milk deliveries and also their experiences with the bicycle in their day to day farm as well as household activities. You have been selected to take part in this study.

Your participation in this study is highly valued and appreciated. The information you will provide will be very important in understanding how the Buffalo Bicycle and a similar purchase program would improve farmers' output and household income. As a respondent, your answers will be kept confidential. This questionnaire will take less than 45 minutes to complete. Your participation is voluntary and you have the right to end this interview at any time.

Can we proceed with the interview? *Yes* ☐ *No* ☐

Date of the Interview:...../..... /..... **Qre #.....**

Interviewer Name:..... **Start Time:.....**

Farmer Name:..... **Respondent Name (if different from Farmer) .....**

SECTION A: BACKGROUND INFORMATION			
1	Sex of the respondent	1. Male 2. Female	
2	Age at last birthday	Years ☐☐	
3	Are you the Head of Household?	1. Yes 2. No	
4	Could you give me the age and sex of usual members of the household excluding yourself?	No / Age / Sex 1 2 3 4 5 6 7 8 9 10	
5	Marital status	1. Single 2. Married 3. Divorced 4. Widowed 5. Separated	
6	Highest level of education attained	1. None 2. Primary 3. Secondary 4. Tertiary	

7	Main sources of livelihood ***(select all that apply)***	1. Crop farming 2. Dairy Farming 3. Fish farming 4. Paid employment 5. Other business (Specify).....	
SECTION B: DAIRY FARMING INFORMATION			
8	For how long have you been involved in dairy farming?	Years ☐☐	
9	At the time you started dairy farming, how many cows did you have?	Number of cows ☐☐	
10	From 2009 to 2014, how many cows and employees did you have at your farm?	Year | # of cows | # of employees 2009 2010 2011 2012 2013 2014	
11	For how long have you been a member of Palabana Dairy Cooperative?	Year joined ☐☐ Number of years ☐☐	
12	What motivated you to join the cooperative?	....	
13	Did you participate in the dairy farming training conducted through the Dairy Institute when the Palabana Dairy Cooperative was founded?	1. Yes 2. No	
14	Did you participate in any subsequent trainings? If so, please provide the year of each training that you attended and the name of the organization that conducted it.	1. Yes 2. No Year | Organization Name Training #1 Training #2 Training #3 Training #4 Training #5	
15	Other than training, what services, if any, have you accessed from the Palabana Dairy Cooperative? ***(select all that apply)***	1. No services 2. Purchase feed 3. Purchase vaccines 4. Purchase other agricultural inputs 5. Other services (Specify).....	
16	What challenges have you faced as a dairy farmer over the years?	1..... 2..... 3..... 4..... 5..... 6.....	

SECTION C: BICYCLE OWNERSHIP			
17	Do you own a Buffalo Bicycle at your farm?	1. Yes → Q20 2. No	
18	Have you ever owned a Buffalo Bicycle at your farm?	1. Yes 2. No → ***End the Interview***	
19	What happened to the Buffalo Bicycle that you owned?	1. Got broken (threw it away) 2. Gave it away 3. Got stolen 4. Other (Specify)……	
20	How many Buffalo Bicycles do/did you own?	# of Buffalo Bicycles ☐☐	
21	When did you purchase each of these Buffalo Bicycles?	Year / Month BB1 ☐ ☐ BB2 ☐ ☐ BB3 ☐ ☐ BB4 ☐ ☐	
22	***Ask only respondents who currently own a Buffalo Bicycle*** Are all your Buffalo Bicycles still working? If any are not working, which part is broken?	Working / Not working / Which part is broken? BB1 ☐ ☐ ☐ BB2 ☐ ☐ ☐ BB3 ☐ ☐ ☐ BB4 ☐ ☐ ☐	
23	Why did you decide to purchase the Buffalo Bicycle?	…… …… …… ……	
24	Do you currently own any oher type of bicycle in addition to the Buffalo Bicycle?	1. Yes → Q26 2. No	
25	Have you owned any other type of bicycle in addition to the Buffalo Bicycle?	1. Yes 2. No → Q29	
26	How long did you own the other type of bicycle?	Year purchased ☐☐ Number of years owned ☐☐	
27	How does the Buffalo Bicycle perform compared to other bicycles for carrying out farm and household activities?	1. No difference 2. Buffalo is more reliable 3. Buffalo is less reliable	
28	Explain your response to Q27	…… …… …… ……	
SECTION D: INFLUENCE OF THE BUFFALO BICYCLE ON MILK DELIVERY AND HOUSEHOLD INCOME			
29	How far is your farm from the cooperative?	Distance (kms) ☐☐	

30	What mode of transport do you currently use to take milk to the cooperative? ***(select all that apply)***	1. Vehicle (car / truck) 2. Motor bike 3. Buffalo Bicycle 4. Other bicycle 5. By foot	
31	How many minutes does it currently take you to deliver milk to the cooperative using the Buffalo Bicycle?	Time (minutes) ☐☐☐	
32	Before you purchased the Buffalo Bicycle, how did you transport milk to the cooperative? ***(select all that apply)***	1. Vehicle (car / truck) 2. Motor bike 3. Other bicycle 4. By foot	
33	***Ask respondents who used a car/truck or motor bike*** If you used a car/truck or motor bike to transport milk to the cooperative, why did you switch to using the Buffalo Bicycle?	…… …… …… ……	
34	Before you purchased the Buffalo Bicycle, approximately how many minutes did it take you to deliver milk to the cooperative?	Time (minutes) ☐☐☐	
35	How do you think having the Buffalo Bicycle has influenced your dairy supply to the cooperative?	…… …… …… …… …… ……	
36	Which of the following issues have you experienced with milk deliveries since joining the cooperative? ***(select all that apply)***	1. Milk spoilage 2. Late delivery (arriving after the milk delivery cut-off time) 3. Inability to deliver (not arriving to Palabana) 4. None of these	
37	Approximately many times per month did you experience each issue before you had a Buffalo Bicycle and after you had a Buffalo Bicycle?	Times per Month Without Buffalo / With Buffalo Milk spoilage ☐ ☐ Late delivery ☐ ☐ Inability to deliver ☐ ☐	
38	Please explain what has caused these issues.	…… …… …… …… ……	
39	Are your employees allowed to use the Buffalo Bicycle after work?	1. Yes 2. No → Q41	
40	In what ways do employees use the Buffalo Bicycle after work? ***(select all that apply)***	1. Go to school 2. Go to other jobs / earn money outside of dairy farming 3. Go to health clinics 4. Attend social activities 5. Other (Specify) …… ……	

SECTION E: INFLUENCE OF THE BUFFALO BICYCLE ON OTHER HOUSEHOLD ACTIVITIES			
41	How far is your house from the nearest school?	Distance (kms) ☐☐	
42	How many minutes does it take your child to walk to school?	Time (Minutes) ☐☐☐	
43	Has any member of the household used the Buffalo Bicycle to go to school?	1. Yes 2. No → Q47	
44	How many members of the household use the Buffalo Bicycle to go to school?	Number ☐☐	
45	How many minutes does it take them to get to school with a bicycle?	Time (Minutes) ☐☐☐	
46	How often do they use the Buffalo Bicycle to go to school?	1. Very often (once per week or more) 2. Often (once per month) 3. Occasionally (less than once per month)	
47	How far is your house from the nearest health facility?	Distance (kms) ☐☐	
48	How many minutes does it take you to walk to the nearest health facility?	Time (Minutes) ☐☐☐	
49	Have you ever used the bicycle to take a member of the household to the health facility?	1. Yes 2. No → Q52	
50	How many minutes does it take you to get to the nearest health facility using a bicycle?	Time (Minutes) ☐☐☐	
51	How often have you used the Buffalo Bicycle to take a member of the household to the health facility?	1. Very often (once per week or more) 2. Often (once per month) 3. Occasionally (less than once per month)	
52	Other than delivering milk to the cooperative, have you ever used the Buffalo Bicycle for any other activity aimed at bringing income to the household?	1. Yes 2. No → Q54	
53	If yes to Q52, what income-generating activities have you used the Buffalo Bicycle for?	1..... 2..... 3..... 4..... 5.....	
54	How do you think the Buffalo Bicycle has impacted the level of income for your household?	1. No change 2. Increase 3. Decrease 4. I don't know → Q56	

55	Explain your response to Q54	…… …… …… …… ……	
56	What social activities have you used the bicycle for? ***(select all that apply)***	1. Not used for social activities → Q58 2. Visit friends / relatives 3. Attend community meetings 4. Attend church / religious meetings 5. Other (Specify) ……	
57	How often has the bicycle been used for social activities?	1. Very often (once per week or more) 2. Often (once per month) 3. Occasionally (less than once per month)	
SECTION E: PERCEPTIONS ABOUT EMPLOYEE PURCHASE PROGRAM			
58	Are you satisfied with the system of buying the Buffalo Bicycle through the cooperative?	1. Yes 2. No	
59	Explain your response to Q58	…… …… …… …… …… ……	
60	Were you able to meet the payment terms?	1. Yes 2. No	
60	Did you face any challenge in meeting the payment terms?	1. Yes 2. No → Q62	
62	If yes to Q61, what challenges did you face?	…… …… …… …… …… ……	
63	Are there any recommendations or comments you have regarding the Employee Purchase Program and payment terms?	…… …… …… …… …… ……	

We have come to the end of our interview, thank you for your time.

Learn more and contribute to our impact at worldbicyclerelief.org

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