

SureChill.
Revolutionary Cooling



Transforming
Energy
Access

Shell Foundation | 

Dairy industry

Feasibility study report for a solar-powered refrigerator in Kenya



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Our conclusions, suggestions and recommendations, women involvement, farmers aspirations, insight on design & innovation



BACKGROUND OF THE STUDY

CURRENT ISSUES IN THE DAIRY VALUE CHAIN IN KENYA

- High milk losses (monetary) at the farm level due to;
 1. Spoilage/milk going bad due to poor storage
 2. There is weak demand in milk producing regions because dairy farming has now been widely adopted – this causes forced consumption of unsold milk at home and income loss as a result.
 3. Rejection because of quality issues due to poor handling/delayed delivery (higher during wet season when production is high and roads are bad)
- Significant losses occur with evening milk, when farmers need to preserve milk until morning, often using improper preservation techniques
- FAO (2011a) estimated the national milk loss at 7.3%; most of it (5.7%) at the farm level due to spoilage of evening milk, resulting in financial losses and wastage

Source; <https://www.kdb.go.ke/index.php/milk-producers-groups/>

Source; <https://farmersreviewafrica.com/kenya-launches-dairy-industry-sustainability-roadmap-2023-2033-aims-at-doubling-farmers-milk-output>

Kenya Dairy Industry Sustainability Roadmap 2023-2033 goals align with a perceived need for better preservation techniques:

- Double milk production to 10 billion liters/year
- Increase productivity from 10 to 20 liters per cow/day
- Raise formal milk marketing from 30% to 50%
- Increase small-scale farmer revenue from KES 12,000 to KES 56,000/month
- Ensure 80% of marketed milk goes through cold chain

Key interventions in the roadmap:

- Provide on-farm coolers for farms who produce over 50L milk/day and not walking distance from cooling facility
- Implement climate-smart approaches to market additional 2.5billion of quality milk/year to meet growing demand
- Government support to grow dairy farmers through dairy cooperative societies

Source; <https://www.kdb.go.ke/index.php/milk-producers-groups/>

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- Economic efficiency is when **all goods and factors of production in an economy are distributed or allocated to their most valuable uses and waste is eliminated or minimized.**
- Analysis of the three production systems using the Cobb-Douglas stochastic frontier cost function for zero grazing, semi-zero grazing and open grazing production systems revealed economic efficiency increases with production intensity:
 - Open grazing: 0.43
 - Semi-zero grazing: 0.51
 - Zero grazing: 0.69
- Factors influencing efficiency:
 - Positive: Education, social capital
 - Negative: Gender disparities, land size, market access
- Membership in social capital:
 - Dairy cooperative membership (39%)
 - Limited Sacco participation (32%)
 - Minimal informal saving groups involvement (5%)

SURECHILL COOLING SOLUTIONS & DAIRY SECTOR POTENTIAL

Current success

- Over 500 fridges home & small business fridges deployed in Coast & Western Kenya regions
- Cooling-as-a-service model tailored to small businesses

Key product features:

- 24/7 cooling for off-grid & weak-grid areas
- No batteries required
- Energy cost savings

Current market insights:

- Higher value for productive users vs. Domestic
- Immediate ROI for small businesses

Dairy sector opportunity:

- Address milk loss in value chain between small-holder farmers, milk cooperatives, dairy processing companies and the ultimate consumer of dairy products.
- Improve refrigerated dairy product distribution
- Explore storage for milk, yogurt, unpasteurized milk

Next steps

- Conduct dairy value chain analysis
- Identify needs and gaps for SC cooling solutions

THE RESEARCH OBJECTIVES

What knowledge gap(s)

- 1) Understand the current milk supply and value chain from “farm to fork”**
 - a) Who is involved (farmers, co-operatives, dairy processors, manufacturers, retailers, consumer & others).
 - b) What is the role of women in dairy farming, how are women involved, what are the timeframes involved?
 - c) What issues does each group face especially relating to the preservation of unpasteurized milk; where in the chain is there wastage
 - d) What measures are currently taken to address wastage (including refrigeration), how much of a problem does wastage represent and who bears the cost?
 - e) Are special milk storages/containers required or preferred for storage and transport and what is their composition and dimensions (material, shape, affordability, availability, price etc.)
- 2) Identify where in the supply/value chain SC could add value; how value would be added, for whom and what would that value be “worth” to them?**
 - a. Where in the value chain is refrigeration being used / where it is not where it might be required.
 - b. What Proxy/alternative refrigeration solutions are being used at the moment; what do they cost (to buy and run) and what are their pros and cons? (e.g. generators/cooler boxes/AC-DC conversions by use of inverters/batteries/solar).
- 3) Test the proposed product from SureChill to get reactions from target customers**
 - a) Insights from target customers about the proposed cooling solution
 - a. Appeal of the test product – suitability of the test product, get buy-in on the test product
 - b. Benefits of the test products to the target customers and features that are important to target customers, ideal size, etc
 - c. Likelihood to buy the test product (measure their sensitivity to price using the pay as you go model (using Van Westendorp's Price Sensitivity Meter)
- 4) Impact of the SC fridge on business**
 - a) Assess both social and business impact of the fridge
 - b) Assess milk preservation improvement,
 - c) Record product satisfaction and product utilization feedback

THE LEARNING OBJECTIVES & INFORMATION AREAS

- 1) Learning objectives
 - a) Who is involved (farmers, co-operatives, dairy processors, manufacturers, retailers, consumer & others).
 - b) What is the role of women?
 - c) How are they involved?
 - d) What are the timeframes involved?
 - e) What issues does each group face especially as relates to the preservation of unpasteurized milk; where in the value chain does milk wastage occur?
 - f) What measures are currently taken to address wastage (including refrigeration), how much of a problem does wastage represent and who bears the cost?
 - g) Are special milk storages/containers required or preferred for storage and transport and what is their composition and dimensions (material, shape, affordability, availability, price etc.
- 2) Information areas
 - a) What is the best place in the dairy value chain where SC cooling solution will be most effective/impactful
 - b) How SC Fridge can make a difference (wasted avoided, cost saving, revenue growth)
 - c) Appeal of the test concept to target customers
 - d) Sensitivity to price; Establish target customer's sensitivity to price through evaluating elasticity of demand at various price points using the proposed financial business model to advice on the optimum price for the proposed product

The outcome expected from this study and the business decisions to be made by SureChill include:

1. Identify the target group(s) which SureChill can solve refrigeration challenges/barriers, and whether challenges/barriers are season driven.
2. Develop a value proposition for each target group developed.
3. Identify potential route to market for the target group(s) and how SureChill would service that demand.
4. Identify if the current HSB fridge is likely to be appropriate for the identified target groups, and if not what modifications/new products will meet their needs.
5. How many products can fit in the 65L fridge bearing in mind bottles sizes/shapes and different arrangement to maximise space and the margins/profits of the different products and extra benefits of having SureChill fridge.
6. Refine the value proposition to ensure it is price competitive and develop a business model that will be profitable for both target group(s) and SureChill.
7. Identify upper limit for affordability of current/new products that SureChill will supply to meet the needs.
8. It will help SureChill identify competitors in the market and thereby develop an appropriate market entry strategy.

THE DATA COLLECTION METHODOLOGY & PROCESS

1. Stage 1: Pre-requisite

- Milk cold chain research, qualitative study
- Understand the distribution value chain, identify the key stakeholders/player,
- Get Kenyan market statistics on milk wastage, preservation, business models, etc.
- Objective and result aim: identify segments, areas, stakeholders with the high potential for our fridge

2. Stage 2: Market stimulation

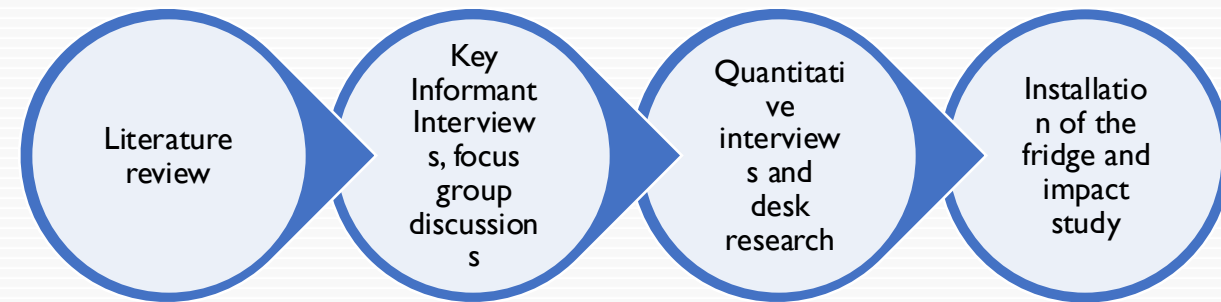
- Create offer and marketing materials to stimulate the selected groups/stakeholders/segments and study their behaviour and reaction
- Make observation on product acceptance, technology understanding and adoption, affordability, importance of this product for business, willingness to acquire
- Note all objections, insights, feedback on the product and offers
- Objective and expected results: Select 10 high potential customer with a real interest to the fridge for the focus group study part

3. Stage 3: Study the selected group without our fridge installed

- Study their business models and pattern and economics
- Milk preservation challenges and the current alternative in use, loss and negative impact on their business
- Understand seasonality, understand the business turnover (sales; revenue, profit)

4. Stage 4: Installation of the fridge and impact study

- Assess both social and business impact of the fridge
- Assess milk preservation improvement,
- Record product satisfaction and product utilization feedback



RESEARCH LOCATIONS

Nakuru and Bomet counties

- High milk production areas and, potentially, high consumption as well
- Major off-grid actor (MKOPA Solar and ENGIE, both using the PayGo business model) have operations in these counties, an indication of potential for off-grid products

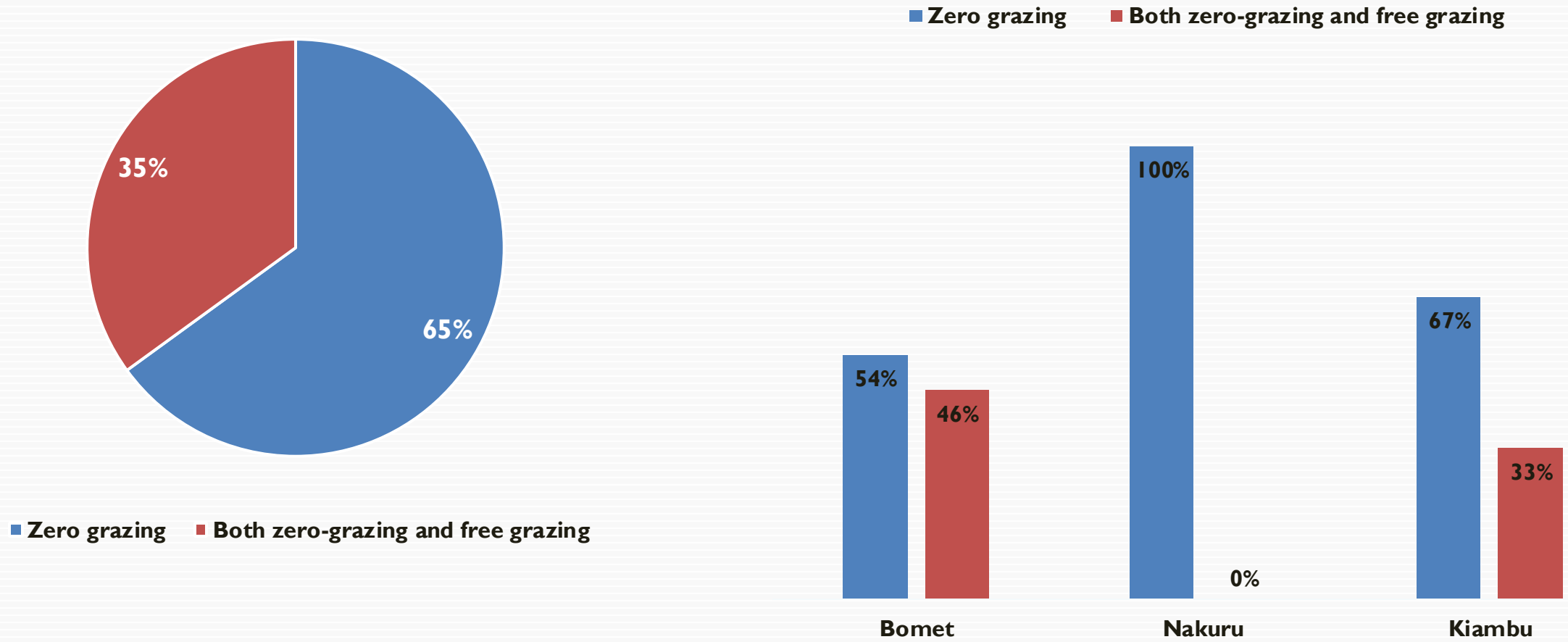
County	Focus group discussions	Location	Sample - qualitative	Sample - quant	Sample-ph. three
Nakuru	Small scale Farmers-milk who produce not more than 50L per day	Subukia - Mirironi	1	225	
	Small scale Farmers- who produce not more than 50L per day	Subukia - Ndungiri/Kabazi	1		1
	Small scale Farmers-milk who produce not more than 50L per day	Kuresoi south-Olenguruone	1		3
	Small scale Farmers-milk who produce not more than 50L per day	Kuresoi south- Tinet	1		
	Milk distributors (kiosk retail vendors, restaurants, institutions)	Subukia - Mirironi	1		
Bomet	Small scale Farmers-milk who produce not more than 50L per day	Sotik-Ndanai	1	225	
	Small scale Farmers-milk who produce not more than 50L per day	Sotik-Ndanai	1		1
	Small scale Farmers-milk who produce not more than 50L per day	Chepalungu-Siongiroi	1		12
	Small scale Farmers-milk who produce not more than 50L per day	Chepalungu-Siongiroi	1		
	Milk distributors, (to kiosks, restaurants, institutions)	Chepalungu-Siongiroi	1		
Kiambu	Small scale Farmers-milk who produce not more than 50L per day	Lari	-	-	3
County	Key Informant Interviews	Nairobi Metropolitan	Nakuru	Bomet	Kiambu
Nakuru, Bomet & Kiambu	Farmers; large producers - >200 litres	-	3	3	-
	Informal traders	-	3	3	-
	Dairy cooperative societies/producer groups	-	3	3	-
	Milk processors	6	2	2	-
	County governments	-	1	1	-
	Micro Enterprise Support Trust (MESPT)	1	-	-	-
	Non-government organization supporting dairy farmers	2	1	1	-
	Milk distributors (kiosks, restaurants, institutions)	-	5	5	-
Regulator - KDB	1	-	-	-	
	Total	10	18	18	20





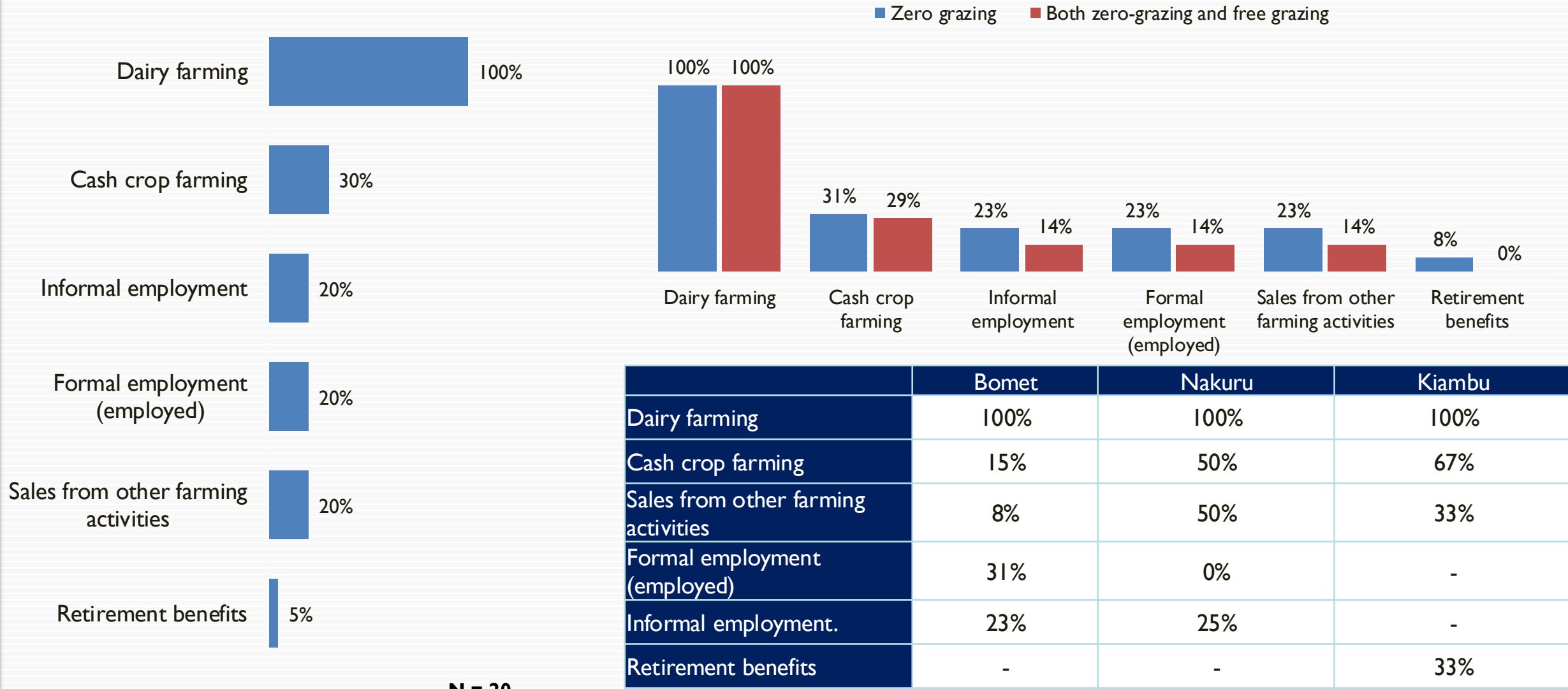
FINDINGS; PHASE TWO AND PHASE THREE (QUANTITATIVE)

FARMING CATEGORIES IN WHICH THE SAMPLED FARMERS PLAY



N = 20

SOURCES OF INCOME FOR THE DAIRY FARMER

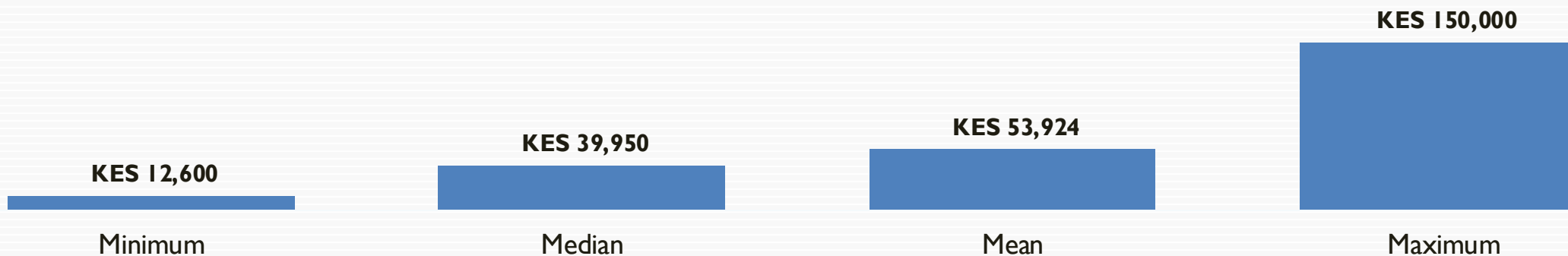


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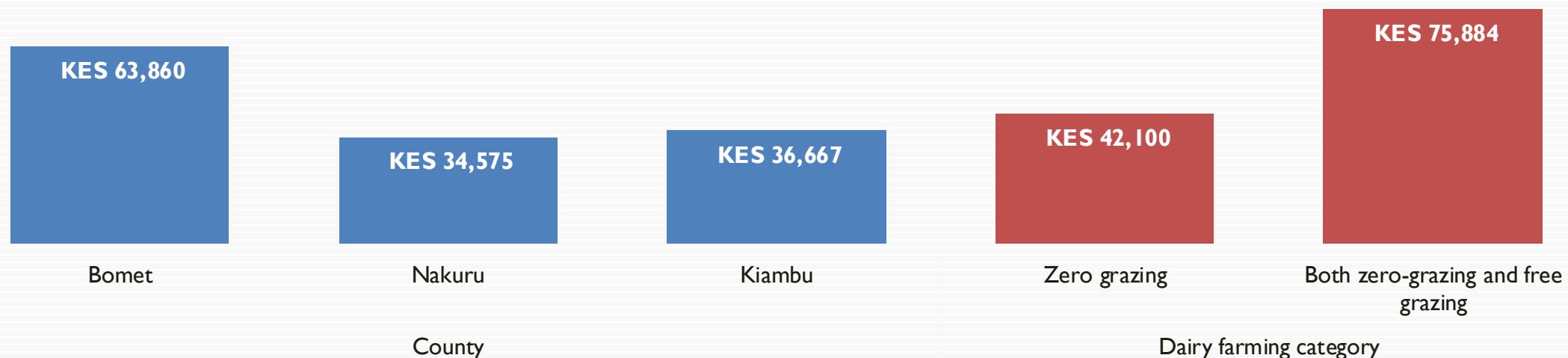
- Dairy farmer in Kiambu, Bomet and Nakuru have other sources of income.
- Cash crop farming and informal employment stand out as alternative sources of income

DAIRY FARMER'S AVERAGE MONTHLY INCOME FROM THE SALES OF FRESH MILK

Income Distribution



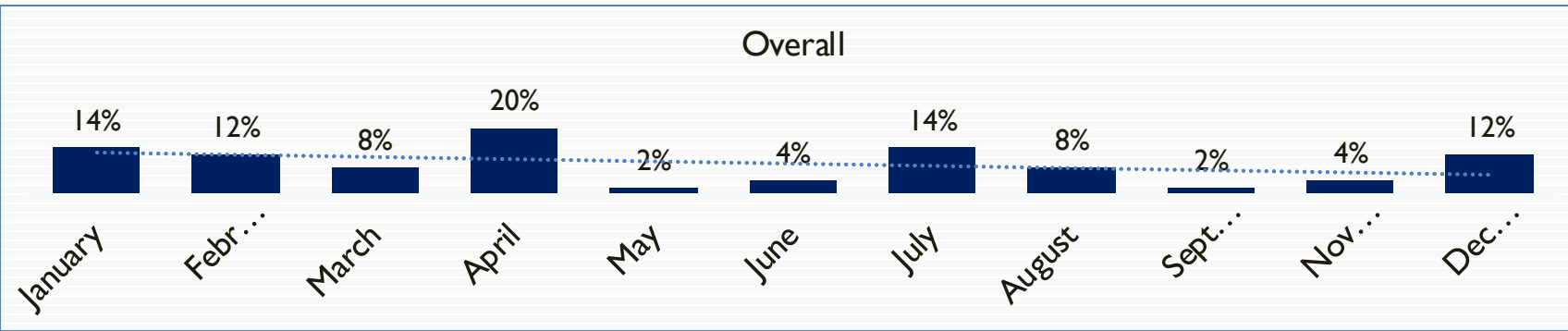
Mean Income from Milk



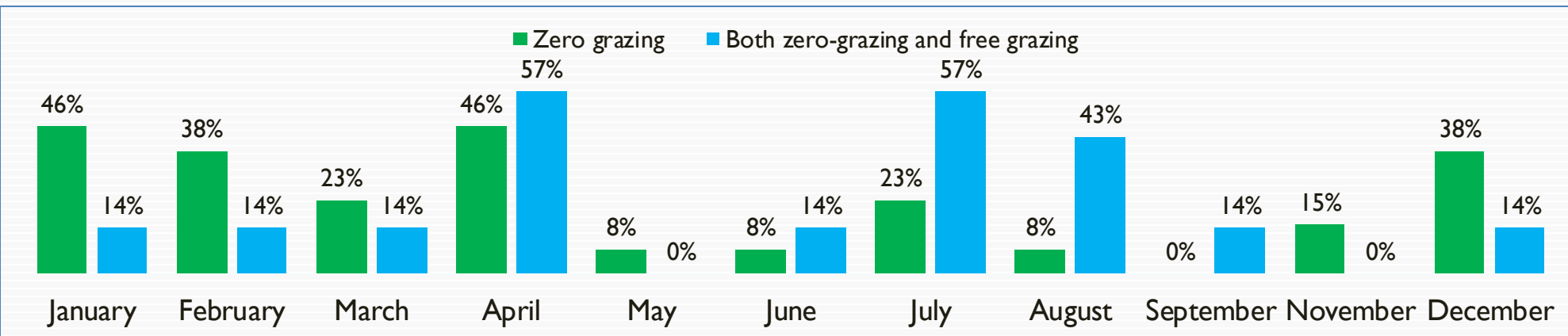
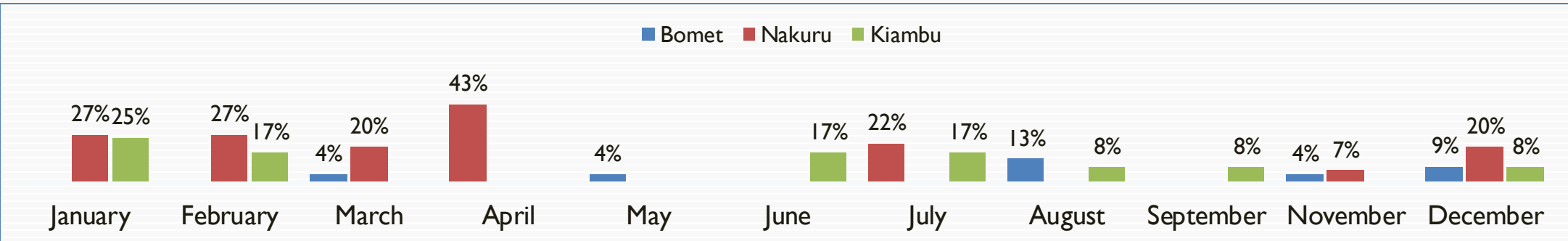
Income from dairy farming in Bomet is the highest, followed by Kiambu and then Nakuru. Farmers in Bomet tend to earn about double the figure that farmer in Nakuru earn

N = 20

HOW DOES THE DAIRY FARMER'S INCOME FROM MILK FLUCTUATE ACROSS THE YEAR?



- Dry season; September - December - March; low milk production, high production cost, less revenue and profit
- April & May - heavy rains - high milk production, low cost of production, low demand for fresh milk, low revenue and profits



- Fluctuations in income from dairy farming in Nakuru is the highest, followed by Kiambu
- Fluctuations in income is most pronounced in the month of January to April, and July to August

N = 20

FINDINGS FOR PHASE TWO - SUMMARY

- Only 39% of dairy farmers are cooperative members
- Low milk delivery rates to coops (Morning: 36%, Afternoon: 17%, Evening: 14%)
- Factors affecting cooperatives (Preservation facilities such as the proposed solar-powered fridge from SureChill can help to address some of these challenges.)
 - Distance to cooperative
 - Coop operating hours
 - Need for immediate cash
 - Governance issues/delayed payments
- 69% of the dairy farmers have less than 5 acres of land dedicated to dairy farming, squeezing farmers out of free-grazing in favour of mixed and zero grazing practices.
- Farmers are increasingly embracing dairy farming. Hence, we are seeing a shift in farmers selling their milk for cash as opposed to selling on credit. This behaviour explains partly the declining quantity of milk deliveries to the dairy cooperative societies.
- Dairy cooperative societies are adopting measures that help to increase their cash flows so they can pay on time and encourage farmers to increase supply of milk:
 - Signing MOUs instead of entering into contracts with milk processors
 - Opening up the disposal of fresh milk to all buyers as opposed to a preferred buyer.

FINDINGS FOR PHASE TWO – SUMMARY CONTINUED

1. Dairy farmers to a large extent operate as individuals. Use of social capital is mainly at the farm level as compared to membership in external informal organizations such as dairy cooperative societies, Sacco's and table banking.
2. About 4 in 10 small-scale dairy farmers are female. Besides providing labour they are involved in decision-making about dairy farming on their farms. Labour includes feeding the cows, milking and marketing the milk
3. About 4 in 10 of the dairy farmers are engaged in dairy farming full time
4. About 88% of these farmers have attained at least a secondary education (are literate)
5. 93% are aged 35 years and over (the sub sector isn't popular with the youth)
6. Those aged 35 years and over are optimistic about the dairy subsector (psychographics)
7. About 66% of these farmers are dependent on dairy farming for their livelihood (75% and above contribution to household income)
8. At least 95% of farmers keep the low-range dairy breeds, with an average of 10 cows per farm, and 69% of these farmers rearing the cows on less than 6 acre farm
9. Investment in dairy equipment is relatively low. Investment in chaff cutter and aluminium milk cans is the highest yet average (61% and 51% respectively)
10. Cost of milk production is high, eats into profit – see excel chart. This has a significant effect on efficiency in dairy production, hampers growth
11. Milk output per cow is rather low, averaging 10 litres per day
 - Key Challenges:
 - Low investment in dairy equipment
 - High production costs affecting profitability
 - Limited ability to influence price of milk/milk marketing power
 - Surplus milk management (15L rain season, 12L dry season)
 - Inefficient preservation methods for surplus & evening milk
 - Opportunities:
 - Improved cold storage could benefit farmers expecting better prices
 - Potential to address milk theft and quality preservation issues

PROFIT AND LOSS ACCOUNT FOR FREE GRAZING PRACTICE

FACTORS			Weighted Average Average	Rainy Season Average	Dry Season Average
Average Number of Cows in Herd	#		9		9
Milk Production per Cow Per Day	Litres		9.6	11.4	8.8
Total Milk Production Per Farm Per Day	Litres		90.1	107.2	83.0
Surplus Milk Per Farm per Day	%		14%	14%	14%
	Litres		12.6	15.0	11.6
Average Household Size	#		4	4	4
Average Per Capita Consumption per Day	Litres		0.3	0.3	0.3
Average Per Capita Consumption per Farm per Day	Litres		1.2	1.2	1.2
Milk Wastage per Farm per Day	Litres		11.4	13.8	10.4
Actual volume of milk sold per farm per day (excludes surplus and milk consumed by farmer HH)	Litres		78.7	93.4	72.6
Weighted Average Price Paid to Farmer per Litre of Milk	Ksh		45.1	38.7	47.8
	Ksh		42.40	37.79	44.30
Collected By Dairy Processor	Ksh		46.06	38.71	49.09
Delivered To Dairy Processor By Farmer	Ksh		45.55	38.71	48.36
Delivered To Dairy Cooperative Society By Farmer	Ksh		43.60	38.02	45.89
Delivered To Private Dairy Facility By Farmer	Ksh		45.01	38.19	47.82
Sold To Milk Retailers	Ksh		45.50	39.43	48.00
Given To Local School, If Any, Etc.	Ksh		47.80	39.78	51.11
Weighted Average Price of Surplus Milk(excludes Milk consumed by farmer HH)	Ksh		34.6	33.3	35.1
	Ksh		48.33	43.29	50.40
Price of Sour Milk	Ksh		30.00	30.00	30.00
Total Overhead Cost per Farm per Day	Ksh		3547.55	3629.39	3513.85
	Ksh		2475.37	2475.37	2475.37
Cost of Wage per Farm per Day	Ksh		246.86	246.86	246.86
Cost of Transport per Farm per Day	Ksh		236.29	318.13	202.59
Cost of Treatment per Farm per Day	Ksh		161.87	161.87	161.87
Cost of Operation per Farm per Day	Ksh		427.16	427.16	427.16
Actual Revenue Per Farm Per Day From The Sale Of Milk (Excluding Surplus Milk And Milk Consumed By Farm Household)	Ksh		3549.71	3609.23	3469.93
Actual Revenue From Surplus Milk(Excluded Milk Consumed By Household)	Ksh		394.53	459.91	365.87
Total Revenue inclusive of surplus Milk per Farm per Day (Excludes Milk Consumed by Household)	Ksh		3944.24	4069.14	3835.80
Farm Profit Per Day Derived From Milk Sold (Excludes Surplus Milk And Milk Consumed By The Farm Household)	Ksh		2.16	-20.16	-43.92
Farm profit inclusive of Revenue from surplus milk (excludes milk consumed by Household)	Ksh		396.69	439.75	321.94
Potential Profit that could be made if all milk plus surplus milk(except milk consumed by HH) was preserved in SC Fridge and sold at average price	Ksh		462.88	467.05	396.90
Potential Profit if all surplus milk(excludes milk consumed by HH) was preserved in SC Fridge and sold to neighbourhood instead as sour milk	Ksh		553.53	577.36	481.45
Fridge Cost to the Farmer per Day	Ksh		170	170	170
Farmer Balance after paying for SC Fridge	Ksh		226.69	269.75	151.94
Net Profit Margin	%		10.1%	10.8%	8.4%

Rain season is about 3.5 months while dry seasons lasts the longest – about 8 months

Notes

Surplus milk is estimated at 14% of Total milk produced

The Dry Season in Bomet is From Jan - March and June - October.

The Wet Season in Bomet is from April - May, and Nov - Dec

The Dry Season in Nakuru is from June - Feb

The Wet Season in Nakuru is from March - May

37.8% of the farmers grows feed on their own land, 26.1% purchase feed and 36.1 both grow and purchase their feed.

[<https://link.springer.com/article/10.1007/s11250-017-1274-z>]

All of the calcium and Licking salts are purchased and not produced by the farmers

75% of surplus milk is sold as sour milk while 25% of farmers sell it for a throws away price at end of day

PROFIT AND LOSS ACCOUNT FOR ZERO GRAZING FARMING PRACTICE

FACTORS		Weighted Average		Rainy Season		Dry Season	
		Average		Average		Average	
Average Number of Cows in Herd	#		9		9		9
Milk Production per Cow Per Day	Litres		11.7		13.9		10.9
Total Milk Production Per Farm Per Day	Litres		108.5		128.5		100.3
Surplus Milk Per Farm per Day	%		14%		14%		14%
	Litres		15.2		18.0		14.0
Average Household Size	#		4		4		4
Average Per Capita Consumption per Day	Litres		0.3		0.3		0.3
Average Per Capita Consumption per Farm per Day	Litres		1.2		1.2		1.2
Milk Wastage per Farm per Day	Litres		14.0		16.8		12.8
Actual volume of milk sold per farm per day (excludes surplus and milk consumed by farmer HH)	Litres		94.5		111.7		87.4
Weighted Average Price Paid to Farmer per Litre of Milk	Ksh		44.5		37.5		47.4
Collected By Milk Transporter	Ksh	43.94		37.21		46.72	
Collected By Dairy Processor	Ksh	46.42		38.61		49.64	
Delivered To Dairy Processor By Farmer	Ksh	45.58		37.79		48.79	
Delivered To Dairy Cooperative Society By Farmer	Ksh	43.42		37.33		45.92	
Delivered To Private Dairy Facility By Farmer	Ksh	44.25		36.85		47.30	
Sold To Milk Retailers	Ksh	43.15		36.63		45.84	
Given To Local School, If Any, Etc.	Ksh	44.67		38.08		47.39	
Weighted Average Price of Surplus Milk(excludes Milk consumed by farmer HH)	Ksh		33.9		32.4		34.5
Price of Surplus Milk if sold to neighbours at end of day	Ksh	45.50		39.42		48.00	
Price paid for spoiled milk (sour milk or mursik)	Ksh	30.00		30.00		30.00	
Total Overhead Cost per Farm per Day	Ksh		3805.94		3928.93		3755.29
Cost of Feed per Farm per Day	Ksh	2574.07		2574.07		2574.07	
Cost of Wage per Farm per Day	Ksh	369.9516		369.95		369.95	
Cost of Transport per Farm per Day	Ksh	297.8932		420.89		247.25	
Cost of Treatment per Farm per Day	Ksh	116.4241		116.42		116.42	
Cost of Equipment Operation per Farm per Day	Ksh	447.5965		447.60		447.60	
Actual Revenue Per Farm Per Day From The Sale Of Milk (Excluding Surplus Milk And Milk Consumed By Farm Household)	Ksh		4204.90		4189.78		4141.14
Actual Revenue From Surplus Milk(Excluded Milk Consumed By Household)	Ksh		473.91		543.38		442.83
Total Revenue inclusive of surplus Milk per Farm per Day (Excludes Milk Consumed by Household)	Ksh		4678.82		4733.16		4583.97
Farm Profit Per Day Derived From Milk Sold (Excludes Surplus Milk And Milk Consumed By The Farm Household)	Ksh		398.97		260.85		385.85
Farm profit inclusive of Revenue from surplus milk (excludes milk consumed by Household)	Ksh		872.88		804.23		828.68
Potential Profit that could be made if all milk plus surplus milk(except milk consumed by HH) was preserved in SC Fridge and sold at average price	Ksh		968.02		845.59		937.04
Potential Profit if all surplus milk(excludes milk consumed by HH) was preserved in SC Fridge and sold to neighbourhood instead as sour milk	Ksh		1035.47		922.94		1001.92
Fridge Cost to the Farmer per Day	Ksh		170.00		170.00		170.00
Farmer Balance after paying for SC Fridge	Ksh		702.88		634.23		658.68
Actual Net Profit Margin arising for the actual volume of milk sold per farm per day	%		18.7%		17.0%		18.1%

Rain season is about 3.5 months while dry seasons lasts the longest – about 8 months

Notes

Surplus milk is estimated at 14% of Total milk produced

The Dry Season in Bomet is From Jan - March and June - October.

The Wet Season in Bomet is from April - May, and Nov - Dec

The Dry Season in Nakuru is from June - Feb

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75% of surplus milk is sold as sour milk while 25% of farmers sell it for a throws away price at end of day

PROFIT AND LOSS ACCOUNT FOR ZERO GRAZING CONTINUED

FACTORS		Zero Grazing			Zero Grazing - Rainy Season			Zero Grazing - Dry Season		
		Current Weighted Average	SC Fridge Weighted Average	Difference	Current Weighted Average	SC Fridge Weighted Average	Difference	Current Weighted Average	SC Fridge Weighted Average	Difference
Average Number of Cows in Herd	#	9	9		9	9		9	0	
Milk Production per Cow Per Day	Litres	11.7	11.7		13.9	13.9		10.9	10.9	
Total Milk Production Per Farm Per Day	Litres	108.5	108.5		128.5	128.5		100.3	100.3	
Surplus Milk Produced Per Farm per Day	%	14%	14%		14%	14%		14%	14%	
	Litres	15.2	15.2		18.0	18.0		14.0	14.0	
Milk Consumed by the Farm HH per Day from the Surplus (therefore has zero value)	Litres	1.2	1.2		1.2	1.2		1.2	1.2	
Actual volume of milk sold per farm per day (excludes surplus and milk consumed by farmer HH)	Litres	93.3	93.3		110.5	110.5		86.2	86.2	
Actual Surplus Milk Per Farm per Day (excludes milk consumed by the Farm HH)		14.0	14.0		16.8	16.8		12.8	12.8	
75% Sold as sour milk		10.5	10.5		12.6	12.6		9.6	9.6	
25% Sold to neighbours		3.5	3.5		4.2	4.2		3.2	3.2	
Weighted Average Price Paid to Farmer per Litre of "Good" Milk	Ksh	44.5	44.5		37.5	37.5		47.4	47.4	
Weighted Average Price Received from Surplus Milk (excluding Milk consumed by farmer HH)	Ksh	33.9	44.5	10.6	32.4	37.5	5.1	34.5	47.4	12.9
Revenue arising from "Good" Milk sold per farm per day	Ksh	4,625	4,774		4,688	4,775		4,527	4,692	
Revenue from Milk sold per day	Ksh	4,152	4,152		4,145	4,145		4,084	4,084	
Revenue from Surplus Milk Sold per Day	Ksh	474	622	148.5	543	630	86.4	443	608	165.2
Total Overhead Cost per Farm per Day	Ksh	3,806	3,806		3,929	3,929		3,755	3,755	
Operating Profit per farm per day	Ksh	819	968	148.5	759	846	86.4	772	937	165.2

SUMMARY OF FINDINGS CONTINUED

1. Clarity of the concept was high
2. Concept appeal was high – 92%
3. Uniqueness of the concept; very unique – 87%
4. Attractiveness of the idea was high – 93%
5. Benefits of the concept; reduce milk wastage thru preservation – 40%, increase profitability – 19%, reduce costs of preserving milk – 12%
6. Usage – replace methods used currently to preserve milk – 69%
7. Preferred purchasing method is the Paygo, with an optimum daily price of KES 155
8. Suggestions for improvement – price – 29% and design of the fridge – 12%. Should not deviate significantly from the optimum price.

HYPOTHESIS FOR TESTING IN PHASE THREE (WHAT WE DON'T KNOW HENCE THE NEED TO TEST)

Hypothesis to test in phase three include

1. Adoption of the proposed fridge will eliminate wastage of milk by cutting down on unnecessary consumption of fresh milk that is left for speculation
2. Adoption of the proposed fridge will eliminate give away of surplus milk that is left at home for speculation by preserving the milk for a longer period of time, thus preventing the milk from going bad/sour and disposing the sour milk (mursik) at a throw away price.
3. Selling milk when still fresh after preservation will fetch a premium price from the best buyer/channel
4. Adoption and use of the proposed fridge will improve on efficiencies in the marketing of fresh milk. Farmer's ability to hold onto the milk for longer will increase their ability to bargain and get a good price for their milk hence increase their revenue and profit. This in the long term will encourage increased investment in dairy farming
5. Use of the proposed fridge will enable farmers to influence the price they receive for fresh milk since they won't be in a hurry to dispose the milk for fear of the milk going bad. The fridge will give them the assurance that the milk is well preserved for some extended period of time



FINDINGS ; PHASE THREE – KEY FINDINGS

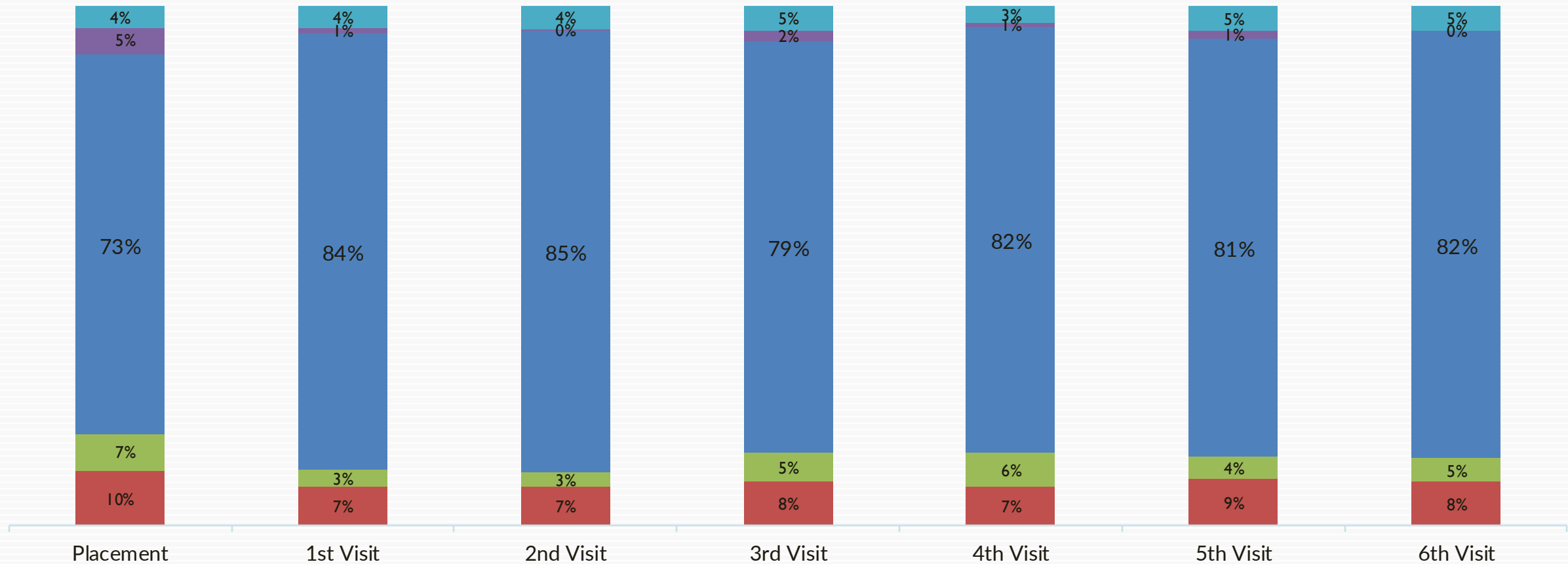
OVERVIEW OF THE FINDINGS – ALL IMPACTS WERE POSITIVE

1. The study revealed that the average number of milking cows per farmer remained steady at 5. Milk production fluctuated, averaging over 40 liters per day, with Bomet County recording the highest production levels.
2. **Key findings for target dairy farmers**
 - Home consumption of fresh milk dropped from 14% to 9% of total production.
 - Fresh milk given away decreased from 10% to 5%.
 - Fresh milk sales improved from 70% to 81% of total production.
 - Spoiled milk reduced from 6.4% to 0.2%.
 - The average selling price increased from KES 34 to KES 41 for cooperative sales, with prices in other markets (HORECAs, private buyers) fluctuating between KES 25 and KES 60
 - Production efficiency increased from 76% to 100%.
 - Sales efficiency rose from 58% to 81%.
 - Utilization efficiency improved from 44% to 81%.
 - Average operating profit increased from KES 560 to KES 1,254.
3. **Fridge Performance**
 - Overall fridge ratings improved from 84% to 87%.
 - Effectiveness of the fridge increased from 92% to 97%, though some farmers experienced technical issues requiring enhanced customer support.
 - The Net Promoter Score (NPS) reached 45%.
 - Interest in the fridge remained steady at 86%, with 76% of farmers expressing interest in purchasing one.
 - Bomet County farmers scored highest on most indicators, making it a priority region for the sales rollout.

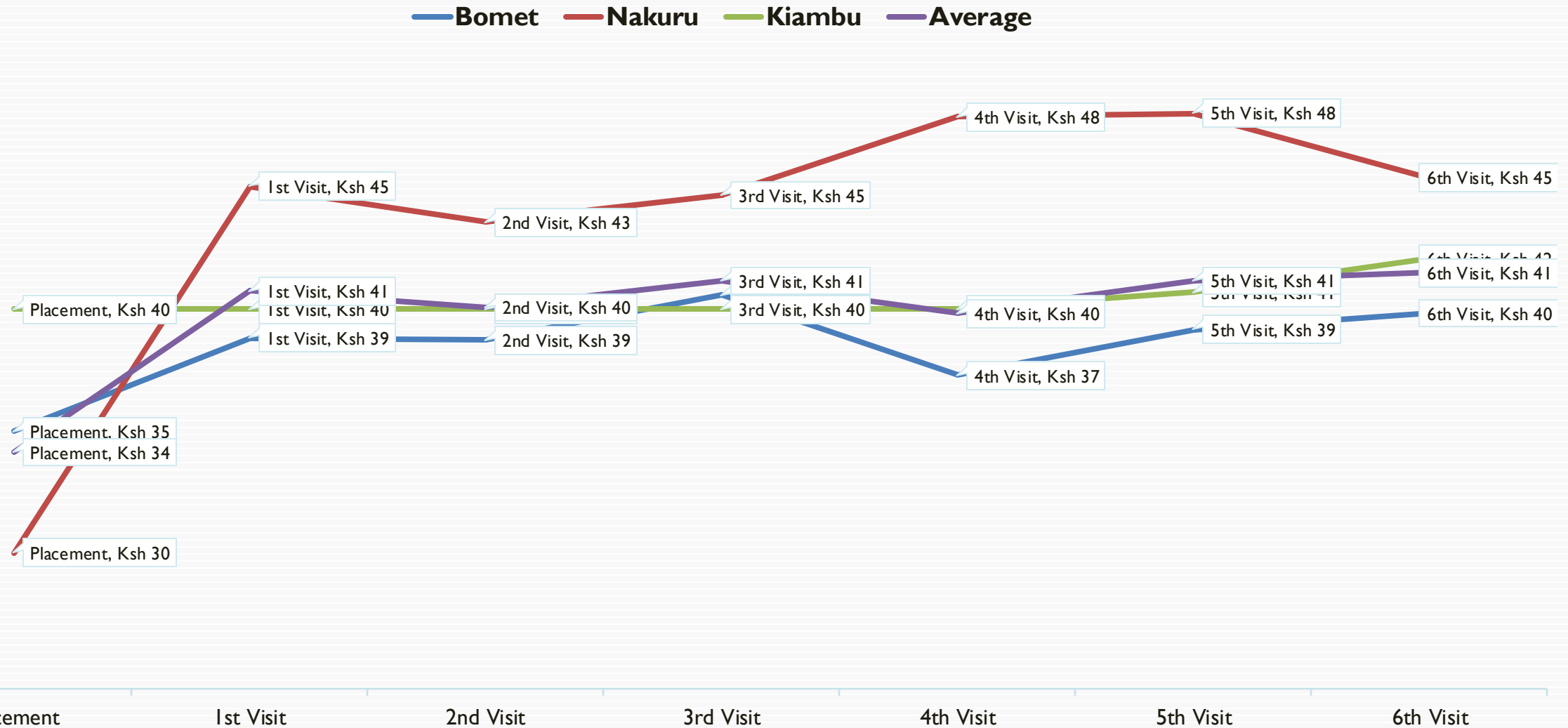
These findings suggest strong potential for dairy farmers to adopt and purchase the fridge.

DISTRIBUTION OF MILK PRODUCED

- Average quantity of fresh milk consumed at the household
- Average quantity of fresh milk sold per day
- Average quantity of fresh milk that is intentionally turned sour for domestic consumption
- Average quantity of milk that is given to neighbours (wasted)
- Average quantity of fresh milk that was intended for sale but got spoilt (wasted)

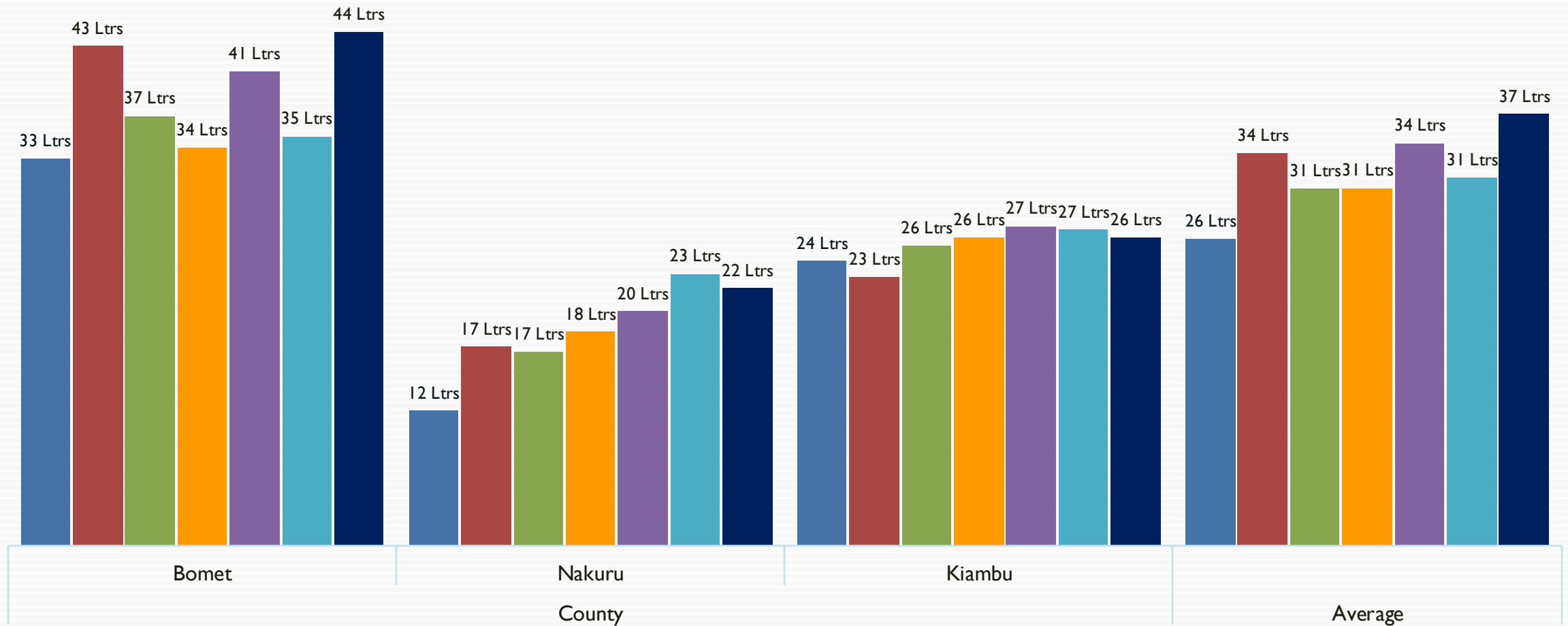


AVERAGE SELLING PRICE OF FRESH MILK PER LITRE : BY COUNTY

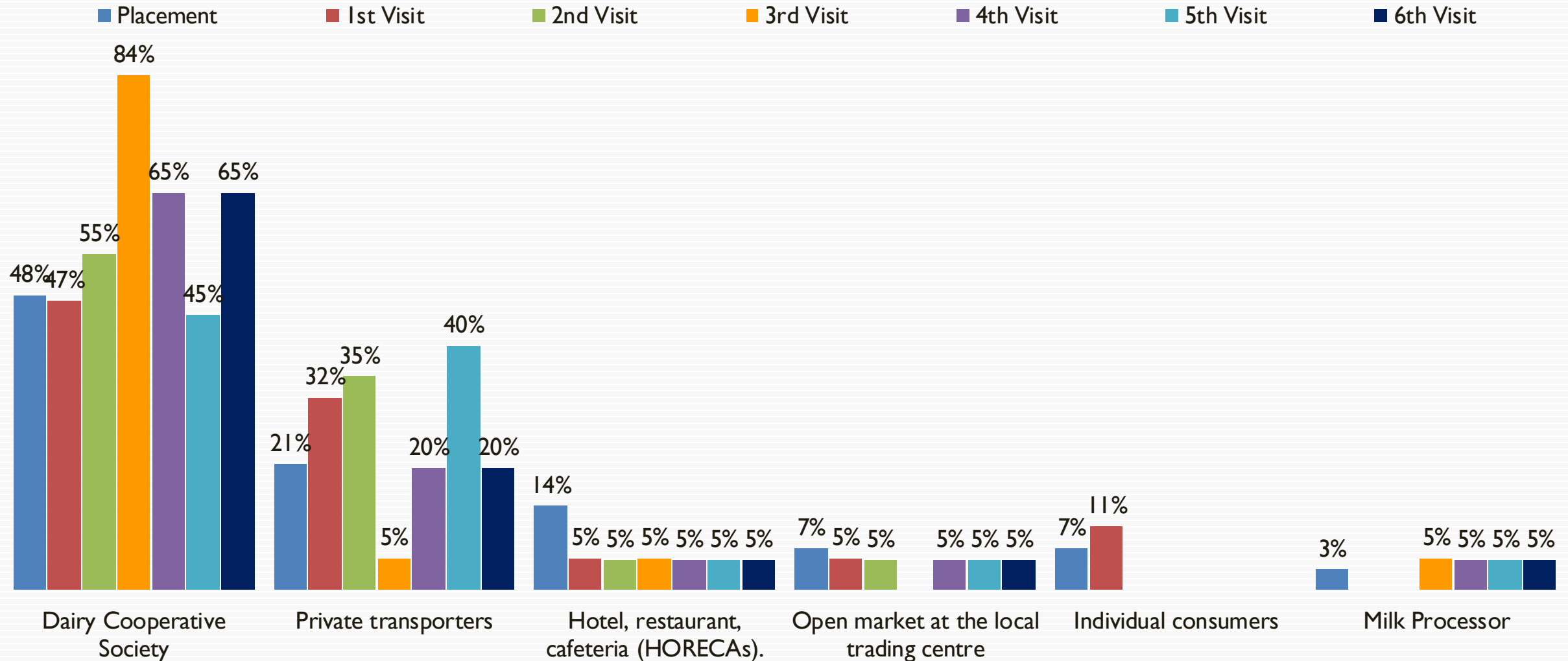


AVERAGE DAILY QUANTITY OF FRESH MILK THAT FARMERS SOLD : BY COUNTY

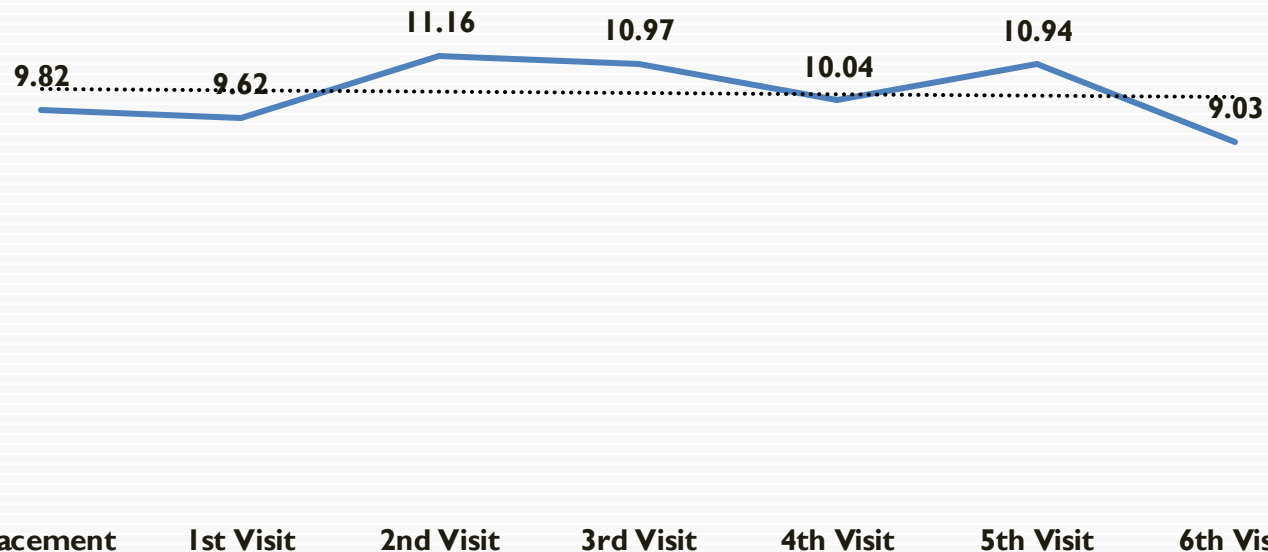
■ Placement ■ 1st Visit ■ 2nd Visit ■ 3rd Visit ■ 4th Visit ■ 5th Visit ■ 6th Visit



DISTRIBUTION CHANNELS THAT FARMERS PREFERRED TO SELL THEIR FRESH MILK

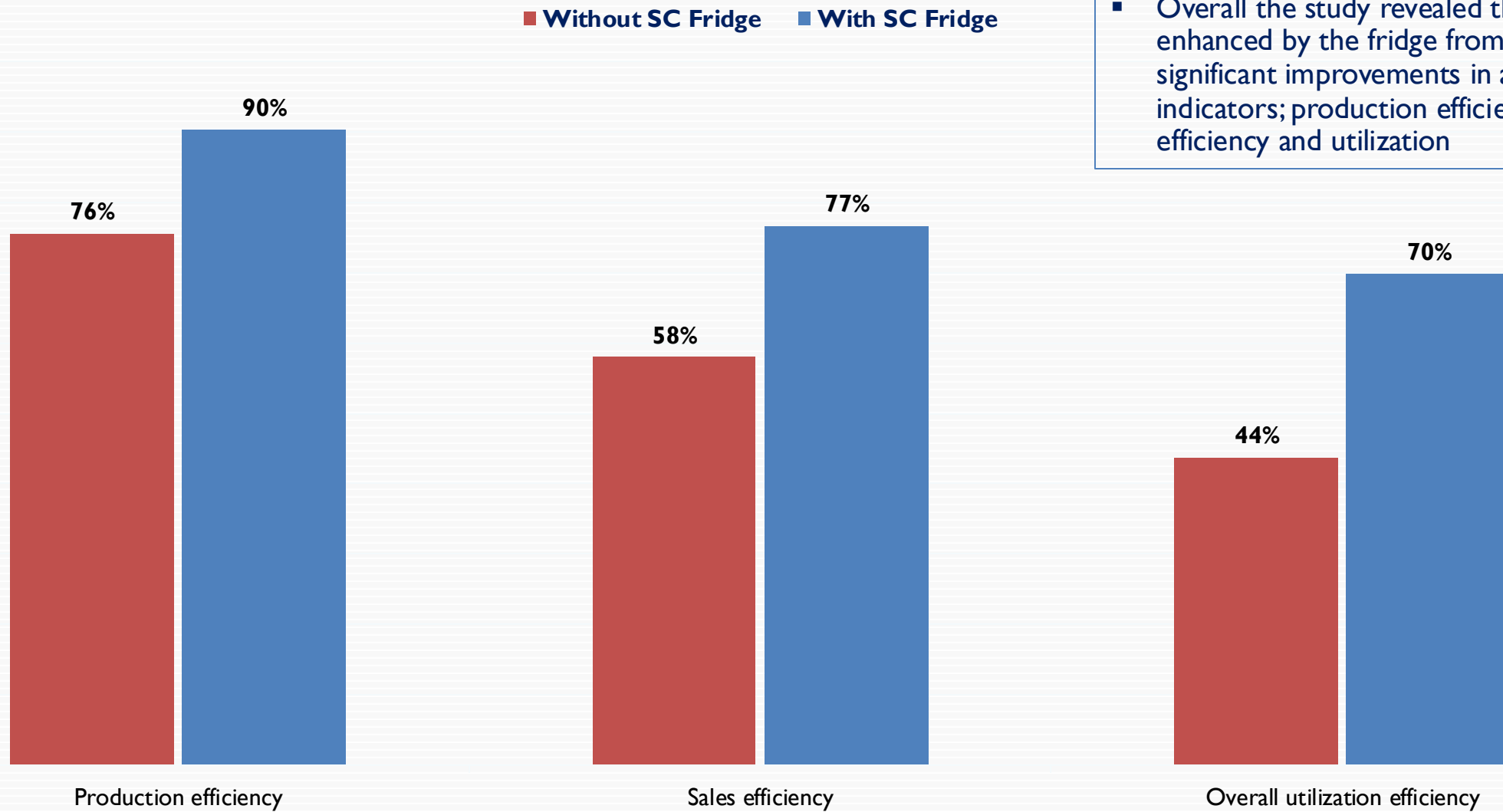


Cost Efficiency Ratio (Ksh/Litre)



1. **Cost Efficiency Ratio:** This ratio shows how well the farm manages its overhead costs relative to the amount of milk produced (i.e. Ratio of Total Overhead Costs to Total Milk Produced).
2. Despite the increase in operating profit, the farmers operating costs per litre of milk produced remained relatively stable over the period.
3. This suggest that the increased profitability of the farmers cannot be attributed to a reduction in the overhead and operating costs

A COMPARISON OF EFFICIENCY METRICS; WITH AND WITHOUT THE SURECHILL FRIDGE

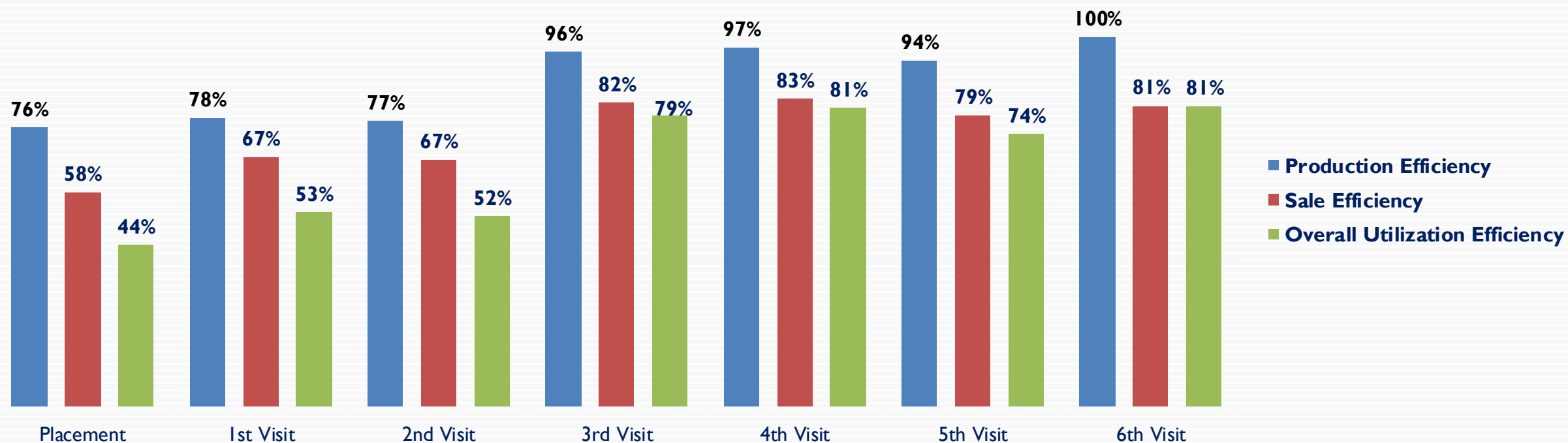


Overall the study revealed that efficiency was enhanced by the fridge from SureChill, with significant improvements in all the three indicators; production efficiency, sales efficiency and utilization

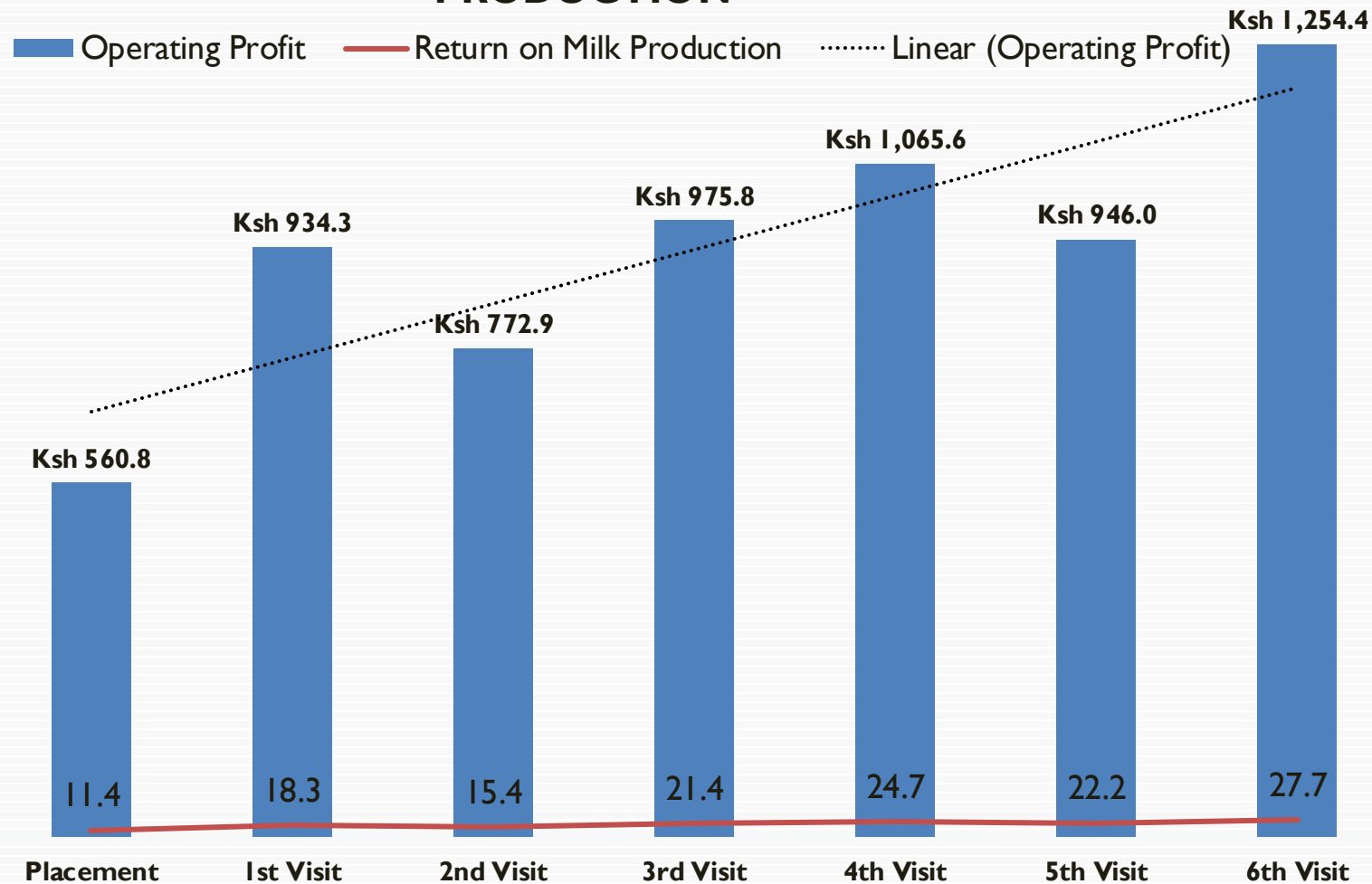
N = 20

A COMPARISON OF THE EFFICIENCY METRICS DURING THE PRODUCT TEST PERIOD

- High Production Efficiency indicates that most of the produced milk is used effectively, either sold, consumed, or given away. Low efficiency in this area can lead to increased costs and waste.
- High Sale Efficiency is crucial as it indicates that a large proportion of produced milk is successfully sold, thereby reducing waste and contributing to a more sustainable dairy industry.
- Overall Utilization Efficiency, a comprehensive metric that combines High Production Efficiency and High Sale Efficiency, provides a thorough evaluation of how well the entire production and sales process is functioning, offering reassurance about the thoroughness of your operations.



DAILY OPERATING PROFIT vs RETURN ON MILK PRODUCTION



1. Operating Profit: The operating profit per farm per day shows an upward trend, increasing from Ksh 560.76 during the Placement phase to Ksh 1254.43 by the 6th visit.
2. This indicates improved profitability over time which can be attributed to increased revenue from the sales of fresh milk, increase in volume of milk produced, increase in milk prices as well as a reduction in the operating costs
3. The Return on Milk Production (Ksh/Litre) which is the ratio of Operating Profit to Total Volume of Milk Produced also showed consistent increase over time.
4. This suggests that the profit per litre of milk produced has also been increasing. This implies that the increase in profitability **cannot** be attributed to an increase in the amount of milk produced.

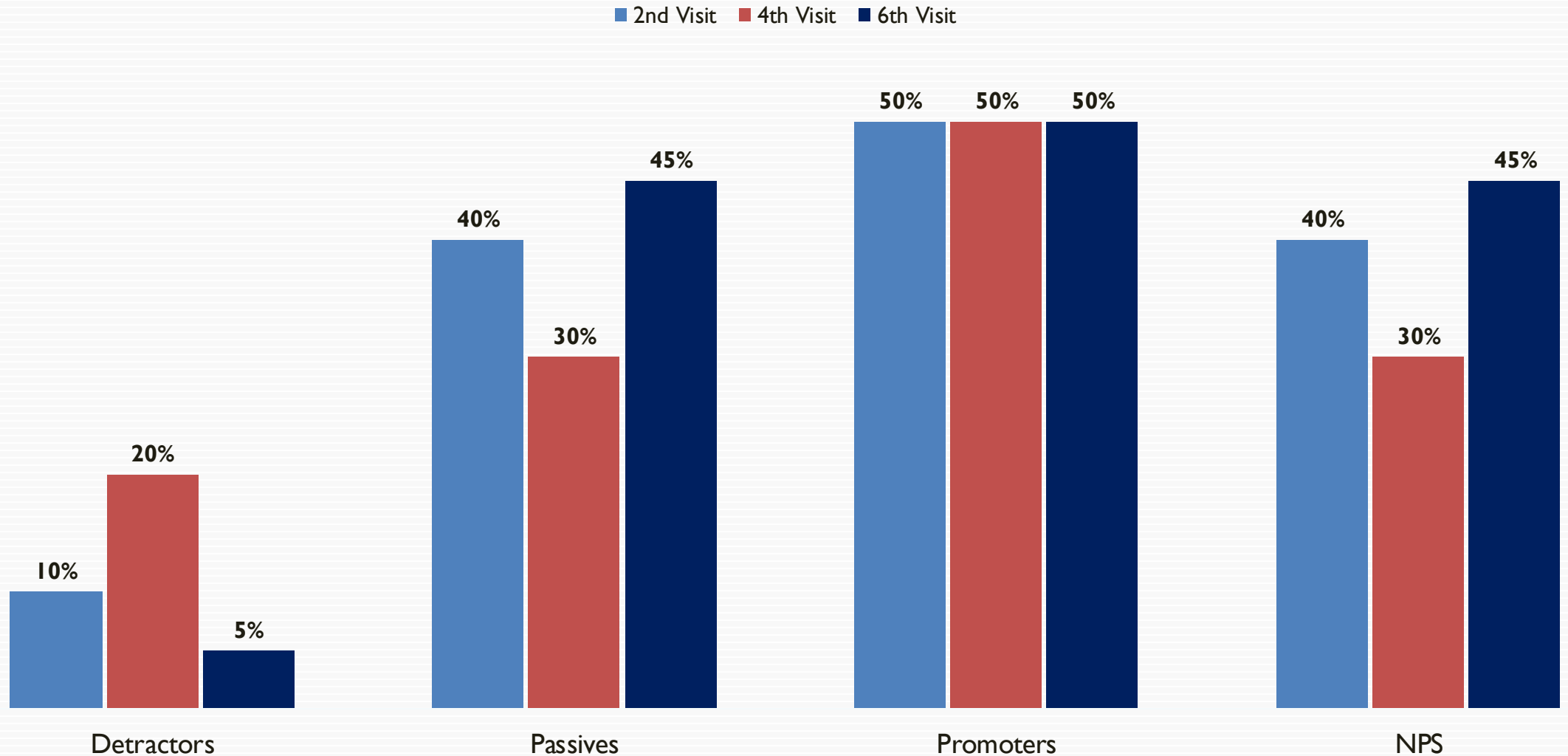
OVERALL PROFIT & LOSS ACCOUNT

FACTORS		Placement	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit	6th Visit
Average Number of Cows in Herd	#	7	6	5	5	4	5	5
Milk Production per Cow Per Day	Litres	6.7	9.2	9.4	10.0	9.7	8.9	8.8
Total Milk Production Per Farm Per Day	Litres	49	51	50	46	43	43	45
Surplus Milk Produced Per Farm per Day		10.9	5.8	7.6	13.1	7.7	8.3	8.6
Milk consumed by the household	Litres	5.0	3.7	3.7	3.8	3.2	3.8	4.0
Milk that was given away to neighbours	Litres	3.6	1.7	1.5	2.5	2.8	1.9	2.3
Milk that turned sour (mursik)	Litres	1.2	0.3	2.2	4.3	1.4	2.1	2.2
Milk that got spoilt	Litres	1.2	0.1	0.2	2	0.3	0.6	0.1
Actual volume of milk sold per farm per day (excludes surplus and milk consumed by farmer HH)	Litres	26.2	33.6	30.5	31.0	34.5	31.5	36.9
Actual Surplus Milk Per Farm per Day (excludes milk consumed by the Farm HH)		4.8	2.0	3.7	6.9	4.2	4.0	4.5
Sold as sour milk	Litres	1.2	0.3	2.2	4.3	1.4	2.1	2.2
Sold to neighbours	Litres	3.6	1.7	1.5	2.5	2.8	1.9	2.3
Weighted Average Price Paid to Farmer per Litre of "Good" Milk	Ksh	34	41	40	41	40	41	41
Weighted Average Price Received from Surplus Milk (excluding Milk consumed by farmer HH)	Ksh	30	30	30	30	30	30	30
Revenue arising from "Good" Milk sold per farm per day		1044	1427	1333	1477	1498	1412	1664
Revenue from Milk sold per day	Ksh	901	1367	1224	1271	1372	1293	1529
Revenue from Surplus Milk Sold per Day	Ksh	143	60	110	206	126	119	135
Total Overhead Cost per Farm per Day	Ksh	483	492	560	501	433	466	409
Operating Profit per farm per day	Ksh	561	934	773	976	1066	946	1254
Gross Profit Margin	%	53.7%	65.5%	58.0%	66.1%	71.1%	67.0%	75.4%
Returns on milk production	Ksh/Litre	11.40	18.26	15.40	21.36	24.72	22.21	27.66
Cost Efficiency Ratio	Ksh/Litre	9.82	9.62	11.16	10.97	10.04	10.94	9.03
Overhead Coverage Ratio		2.16	2.90	2.38	2.95	3.46	3.03	4.06
Production Efficiency	%	76%	78%	77%	96%	97%	94%	100%
Sales Efficiency	%	58%	67%	67%	82%	83%	79%	81%
Overall Utilization Efficiency	%	44%	53%	52%	79%	81%	74%	81%

NORMALIZED PROFIT AND LOSS ACCOUNT: WITH AND WITHOUT FRIDGE FOR THE TEST PERIOD - OVERALL

FACTORS			Without Fridge		Overall		Difference
				Weighted Average	With SC Fridge	Weighted Average	
Average Number of Cows in Herd			#	7		7	
Milk Production per Cow Per Day			Litres	6.6		6.6	
Total Milk Production Per Farm Per Day			Litres	46.5		46.5	
Distribution of Milk Produced		Without Fridge	With SC Fridge				
Milk Sold to Various Channels		73%	84%	Litres	34.0	38.9	
Household Consumption		10%	8%	Litres	4.8	3.7	1.2
Given To Neighbours		7%	4%	Litres	3.1	1.8	1.3
Mursik		5%	1%	Litres	2.2	0.4	1.8
Spoilt Milk		5%	3%	Litres	2.2	1.6	0.6
Actual Volume of Milk Sold					36.3	40.6	
Milk Sold to Various Channels				Litres	34.0	38.9	4.9
Mursik				Litres	2.2	1.6	
Weighted Average Price Paid to Farmer per Litre of Fresh Milk			Ksh	40.69		40.69	
Weighted Average Price of Mursik			Ksh	30.0		30.00	
Revenue arising from "Good" Milk sold per farm per day			Ksh	1,453		1,633	180
Revenue from Fresh Milk sold per day			Ksh	1,386		1,585	199
Revenue from Mursik sold per day			Ksh	67		48	-19.0
Total Overhead Cost per Farm per Day			Ksh	478		478	
Operating Profit per farm per day			Ksh	975		1,155	180
Daily Cost of SC Fridge			Ksh	156		156	156
Net Profit After Paying for SC Fridge			Ksh	819		999	24
Return on Milk production			Ksh/Litre	20.97		24.85	3.88

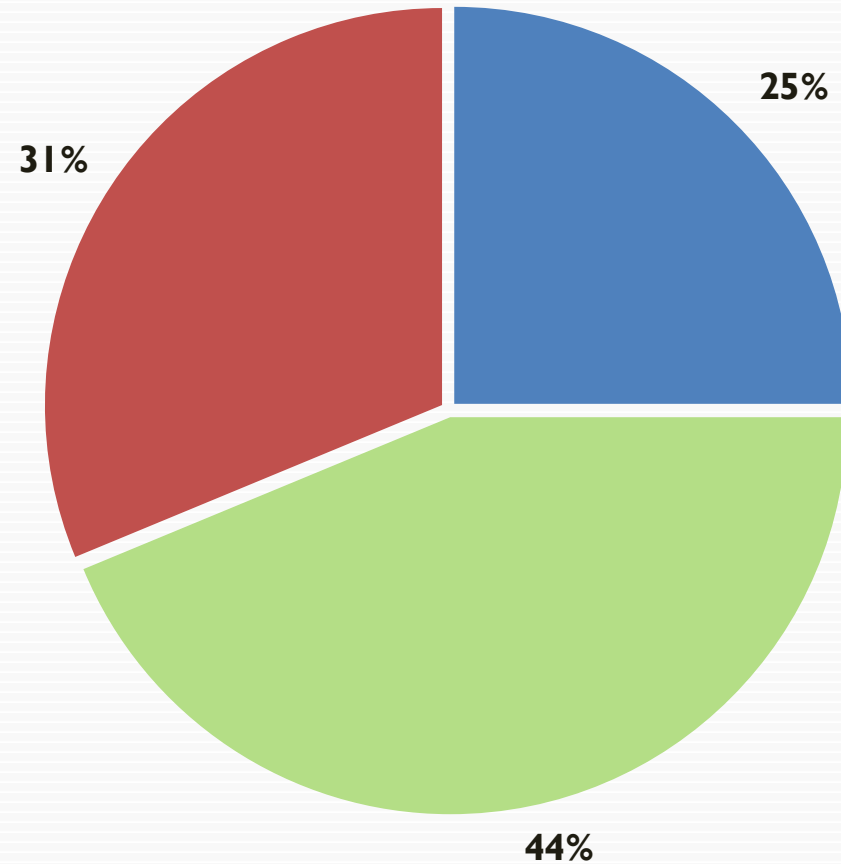
NET PROMOTER SCORE (LOYALTY) FOR THE TEST FRIDGE



N = 20

PREFERRED PURCHASE METHOD : OVERALL

■ Buy it by paying the full amount at once ■ Buy the fridge by paying instalments ■ None



N = 16

SUGGESTIONS AND RECOMMENDATIONS

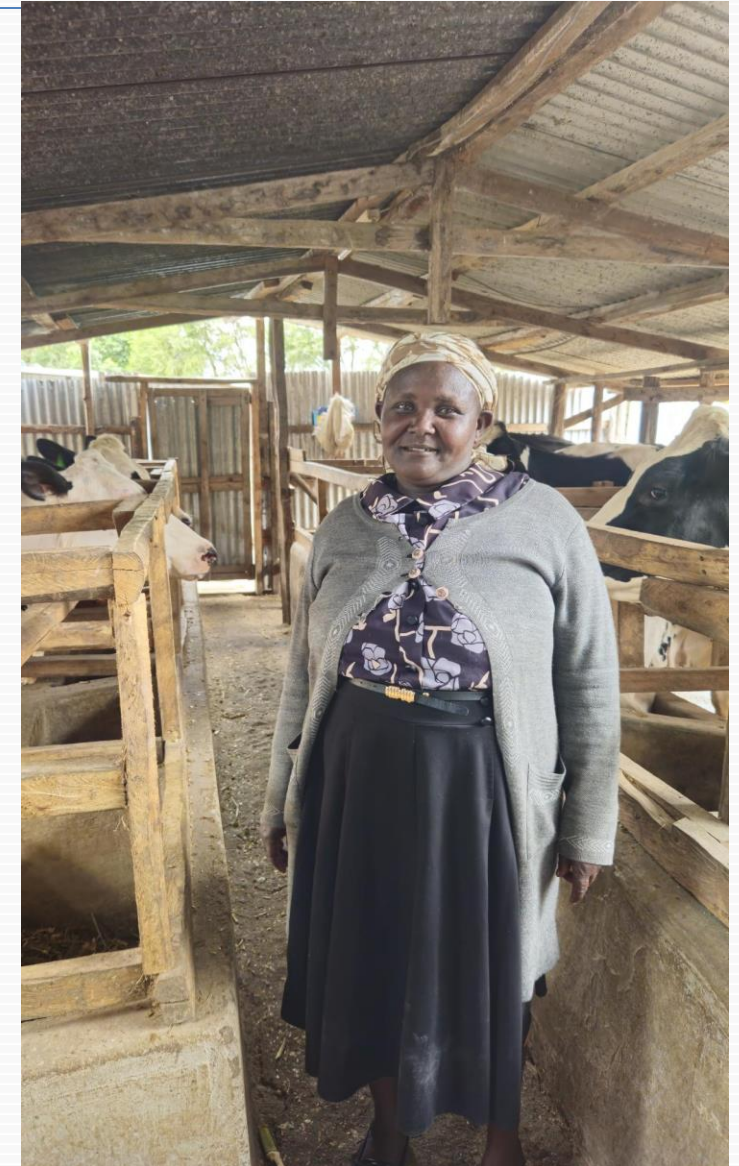
1. Dairy farmers are very sensitive to price; milk producer prices are volatile, demand for fresh milk is elastic. This translates into their investment decisions in the dairy farming practice.
2. The concept was well understood, resonated well with target market
3. Appeal of the test product was very high
4. Impact of the test product was significant during the test period
 - a) Reduced milk wastage
 - b) Increased quantity of fresh milk that was sold
 - c) Enhanced efficiency in milk production, sales and returns
5. Rolling out the idea;
 - a) The solar fridge is still an emerging product, and SureChill needs to invest in increasing awareness and communicating its value proposition. This can be achieved by actively participating in dairy sector events, branded marketing materials with cooperatives/processors/transporters, market activations and launching targeted social media campaigns
 - b) Develop a business model tailored for dairy cooperative societies and farmers, in collaboration with SACCOs as secondary partners and manufacturers who distribute processed products that require refrigeration.
 - c) Use above-the-line marketing to address both the practical and emotional needs of dairy farmers

WOMEN'S INVOLVEMENT IN DAIRY FARMING

Women play a vital, yet often under-recognized, role in dairy farming operations, contributing significantly to daily farm management and milk production.

Key Responsibilities

- **Farm labour**
 - **Feeding:**
Prepare and distribute feed to cattle, ensuring proper nutrition for optimal milk production.
 - **Milking:**
Perform regular milking tasks, often twice daily.
- **Milk handling**
 - **Storage:**
Properly store milk at appropriate temperatures to maintain quality.
 - **Delivery:**
Coordinate with transporters for milk pickup and ensure timely delivery to preserve freshness.
- **Selling**
 - **Direct Sales:**
Sell milk directly to local consumers, contributing to household income.
- **Supervision**
 - **Casual Worker Management:**
In some farms, women take on supervisory roles, overseeing and directing casual laborers in various farm tasks.



FARMERS ASPIRATIONS

1. Prosperity – to succeed in dairy farming
2. Increase income from dairy farming
 - a) control milk wastage so that all fresh milk that is intended for sale is sold and generates revenue
 - b) increase yield per cow, increase dairy herds to increase production
3. Financial security
 - a) invest income from dairy in other income-generating activities e.g., business
 - b) Invest in real estate for increased income
4. Improve quality of life of all household members
 - a) Use income from dairy farming to enroll their children in schools and colleges that provide quality education for a better future
 - b) Build a stone/modern house to enable enhance quality of life, away from mud-walled house
 - c) Access to power – solar-based solutions to power and enable them to access basic services such as lighting, television, radio
 - d) Automate farming chores – invest in equipment and machines that enhances production – save time so that they can use this to rest or engage in other activities – both economic and social e.g. community meetings, attending church, visiting school, market, etc.
 - e) Enable have enough time to rest – sleep on time, rest in-between chores at the farm during the day

INSIGHTS ON DESIGN AND INNOVATION

30% of the farmers highly recommended a bigger fridge and redesigning future fridge into a top-loader model that can hold at least 100 liters of milk due to the following reasons:

- Easier loading of stainless steel cans especially the 20 litres
- Maximizing space and simplifying arrangement
- Additionally, 25% expressed interest to start selling fresh milk at local markets. A top-loader design would allow them to easily fetch smaller quantities without needing to remove the entire can from the fridge, unlike the current design.
- A larger fridge with the capacity would enable 25% of farmers expand their dairy business by adding more cows, which in turn would require greater storage capacity.



PHOTOS FROM THE STUDY



Photos from the study







Thank you



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