

Technical Report:

Mapping Camel-milk Corridors in Wajir County



Prepared by:



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Disclaimer

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Executive Summary

This report is a presentation of the findings of a study on the “mapping of camel milk corridors in Wajir County”. The report also documents constraints at every level of the camel milk value chain and more importantly carries a raft of practical recommendations to improve efficiency of operations along the value chain in order to make investments more profitable. Enhanced profitability is expected to attract private investment which is seen as the sure way of guaranteeing sustainability. The study was found necessary as crucial information regarding the actual volume of milk consumed in Wajir town and where it comes was missing, yet this information was needed to guide investment in the milk chain. Workable recommendations on capacity building needs for players along the chain were also needed. The study was commissioned with two objectives, that is, 1) Mapping camel milk supply chain corridors to Wajir town and (2) Identifying areas for training and infrastructure interventions along the supply chain.

Quantitative and qualitative data was collected using methodologies including guided key informant interviews along the value chain from producers to consumers, interviews with relevant service providers like staff from Mercy Corps, VSF-Suisse, ADESO and director of livestock production. The physical and chemical attributes of camel milk at each node of the supply chain was also assessed. To test the economic viability of camel milk enterprise, three scenarios involving handling of 2000, 1000 and 500 litres of milk daily were analysed in terms of gross margins, benefits/cost ratio, cumulative net present value and internal rate of return. In all the three scenarios, capital inputs including a cooling facility, bulk pasteurizer, aluminium cans, sealer and packaging material were provided for. Labour cost relating to collection of milk from the field, actual cost of buying and transporting the milk, overhead costs covering electricity bills and salaries for employees were all taken into account. The study identified eight main camel milk supply corridors these were; ELDAS –Wajir Town, Arbajahan-Wajir Town, Lagbogol-Hadado-Wajir Town, Diff-Wajir Town, Macheza-Wajir Town, Khorof-Wajir Bor-Wajir Town, Tarbaj-Wajir Town and Bute-Buna-Wajir Town. A total of 10,000 litres of milk is delivered and consumed in Wajir town daily with Diff-Wajir town route supplying 3,450 L followed by Arbajahan- Wajir Town (2,590 L) and Lagbogol-Hadado-Wajir Town (1,400 L). The main milk collection points were Nurkilo in Arbajahan route (1,130 L), Hadado in Lagbogol route (1,100 L) and Adanawale in Arbajahan route (550 L). The furthest milk collection point was 150km away from Wajir town. At producers’ level, markets and limited knowledge on hygiene management were found to be limiting factors. Lack of cooling facilities and use of plastic containers were critical issues at the level of primary traders. Lack of dedicated vehicles, failure to consider milk as a main load and delays in delivery owing to long distances were transport related limitations. Lack of dedicated milk selling points and cooling facilities as well as limited value addition were found to be fundamental issues at the secondary traders’ level in Wajir town. Consumers had no platform to voice their concerns and were particularly perturbed by use of plastic material (containers and polythene papers) which they associated with increasing incidences of throat cancer. Consumers were also concerned that milk is sold in open and dusty environment. Poor social governance is a cross cutting challenge. Regarding the economic analysis, gross margins were positive and significant, benefit/cost ratio >1 meaning the enterprise is breaking even and making profit in all the 3 scenarios.

The cumulative net present value which shows the amount of money the investor would have at the end of 1st year after recovering the investment cost is much higher compared to the money the investor originally had (5,707,000 compared to 1,630,000 for scenario 1; 2,948,000 compared to 1,180,000 for scenario 2 and 2,811,000 compared to 980,000 for scenario 3). The internal rate of return which compares the opportunity cost of investing in the enterprise Vis a Vis investing the money in a fixed deposit account in the local commercial banks is much higher (22 – 36%) across the three scenarios than the commercial interest rate which currently ranges between 8 to 10.5%.

The key capacity building and infrastructure related investment recommendations are:

1. Training on hygienic milk handling practices at all levels, business skill development and sensitization on health issues related to consumption of raw milk and use of plastic containers.
2. Pilot strategic infrastructure investment in 2 of the 8 routes supplying most of the milk and in locations where high volume of milk is collected along the routes. At the primary trader level - metallic/steel cans modified with non-spill lids, bulking sheds with counters and water supply, solar powered chilling facilities, modified motor-bike milk transport carriers are recommended. At the secondary trader level (Wajir town) - strategically built milk selling sheds/kiosks with infrastructure incentives (water supply, counters, bulk pasteurizer, low-cost packaging and electrical sealant) is recommended.
3. Establish at county government level an all-inclusive camel milk supply chain platform (consumer inclusion is key) to facilitate exchange of information, dialogue and appreciation of the role and obligations of every player. This should be coordinated and convened on regular basis by the director of livestock production.
4. The established supply chain platform should be used to create strong functional horizontal (within a level/node) and vertical (between the levels/nodes) alliances/relationships with a clear set of rules, regulations and run by appointed chain managers.
5. Facilitate anchoring of the rules and regulations to govern the alliances in Wajir County agricultural policies in order to empower the value chain managers and to achieve the desired high standards of camel milk quality and safety in the county.
6. Facilitate expansion of market for camel milk and products and promote private investment in the camel milk value chain. This should be done through taste fairs for the products which should be preceded by preparation of camel milk value added products including clean fresh milk, pasteurized milk, yoghurt, ghee, cheese and candy. Invited participants should include local and non-local consumers representing the wealthy, medium income earners and low category members of the society. The taste fairs will be used to educate participants on the health benefits of camel milk and also take them through the camel milk business model analysed in this study. The participants should then be allowed to taste the various products and their feedback captured. This feedback will inform potential investors on the products preferred by consumers.

Adopting above recommendations will promote household resilience for Northern Kenya communities so as to allow them to better cope with drought extremes, improve market linkages and create new business opportunities to spur growth of the agricultural sector. The improved value chain will also engage more women in economically viable activities with an overall benefit of improving wealth and nutritional health of the people of Wajir County in line with the objectives of Mercy Corps.

1.0 Background

The Building Resilience and Adaptation against Climate Extremes and Disasters (BRACED) is a three year, DFID funded programme designed to build resilience of vulnerable people, especially women and girls in the face of climate shocks and stresses. BRACED programme is being implemented by a consortium of Non-Governmental Organisations (NGOs) in Southern Asia region and in the African Sahel and neighbouring countries. Mercy Corps has partnered with University of Nairobi's, African Drylands Institute for Sustainability (UoN-ADIS) to implement the BRACED programme in Wajir County, Kenya. Mercy Corps will leverage on UoN-ADIS dryland resource management technical expertise to prosper Wajir Communities and ensure their livelihoods are resilient to climate change through innovative technology transfer, training, research and policy dialogue. Since 2014, Mercy Corps has supported the development of the camel milk value chain through i) formation of women dairy trader groups in Wajir town and ii) an economic viability study that enhanced basic understanding of the camel milk distribution system. The study found that approximately 5000 liters of milk was sold daily in Wajir town, the milk was either sold as raw or boiled form with small volumes processed and sold as yoghurt. It is under this context that UoN-ADIS was tasked with the responsibility of building on Mercy Corps work through mapping of the camel milk corridors to Wajir town. The mapping exercise was carried out between 14th and 22nd July 2016 and addressed the following specific objectives (1) Mapping camel milk supply chain corridors to Wajir town and (2) Identifying areas for training and infrastructure interventions along the supply chain. The overall aim of the mapping exercise was to identify specific areas along the supply chain that can be targeted for investment so as to enable the camel milk supply chain to function efficiently and transform it into a vibrant and profitable value chain.

2.0 Data collection approach

The mapping activity used a value chain approach that targeted all levels of the camel milk supply and marketing chain. Both quantitative and qualitative data was collected (Figure 1). Qualitative information was gathered through Key Informant interviews (KIs) using a questionnaire guide with producers, primary and secondary traders, transporters and service providers that included staff from the department of livestock production, Mercy Corps Wajir officers, Wajir VSF-Suisse and ADESO officers. Additional qualitative and quantitative information was gathered from assessing the physical and chemical attributes of camel milk at each node of the supply chain where possible. Two types of tests were used that is, the physical organoleptic test (visual and smell) and chemical tests; California Mastitis Test (CMT) and alcohol test. During an inception meeting with Mercy Corps staff in Wajir, eight (8) camel milk corridors were identified. These were Eldas, Arbajahan, Lagbogol-Hadado, Diff, Macheza, Khorof-Wajir Bor, Tarbaj and Bute-Buna. Field travel to Lolukuta North, Hadado, Eyrib, Kursin and Lagbogol was carried out based on resources available and distances to be covered given the time frame for the mapping exercise.

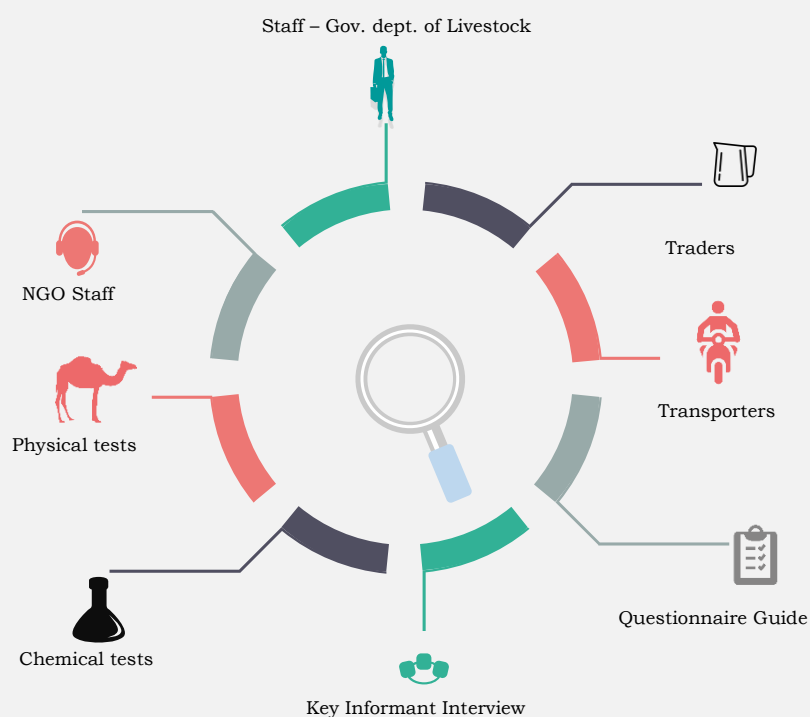


Figure 1: Data collection approach

3.0 Findings

The camel milk supply chain corridor to Wajir town is composed of several key actors as represented in the flow chart below. The arrows depict the information flow between the different supply chain nodes/levels.

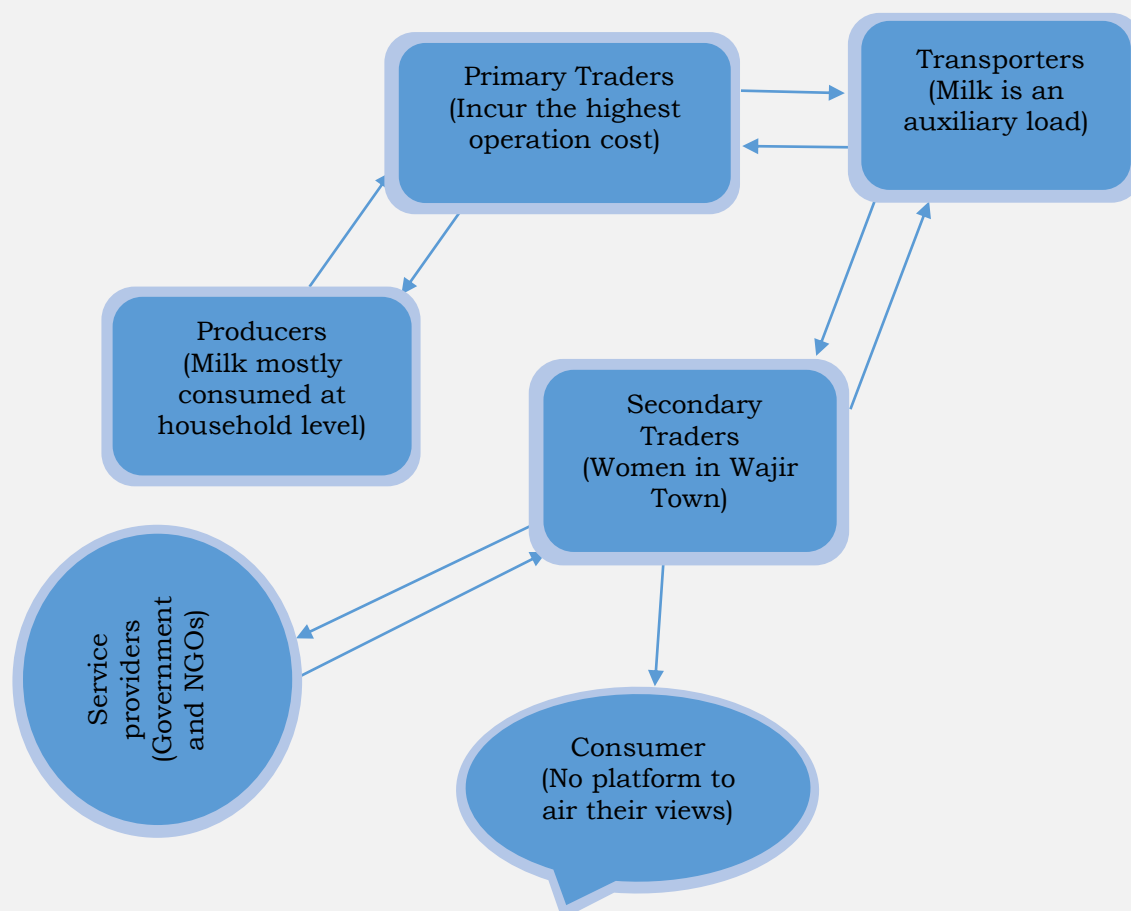


Figure 2: Flow Chart showing key actors in the Camel milk value chain in Wajir County



Figure 3: Right Fore Quarter milk paddle C that was positive for sub-clinical mastitis on CMT. Note the gel like formation of milk in paddle C when compared to the milk in paddle D.

3.1 Objective 1: Mapping camel milk value chain actors

3.1.1 Producers/Camel owners

Three producers were interviewed where one was from Lolukuta North and the other 2 were from Hadado area. The Lolukuta North producer was the only one selling camel milk on a consistent basis. He was milking 30 animals in a herd of approximately 400 camels. The milking was done once a day with each camel producing on average 2.5 litres. A total of 80 litres was produced daily and was sold at a rate of Kenya Shilling (Kshs.) 30 per litre to a motorbike trader who also provides the 20 litre plastic jerricans used to transport the milk. The 2 Hadado producers were currently milking 18 out of 100 animals and 10 out of 80 animals with each individual animal producing 3 and 2.5 litres of milk, respectively. On average the producer with the larger herd milked the animals twice a day and collected 106 litres of milk. Most of this milk was consumed at household level, he only sold 3 to 10 litres at Kshs. 50 when the need for household groceries (tea leaves and sugar) arose. The producer with the smaller herd size did not sell milk and preferred to have the camel calves nurse the dams. He milked his animals only once a day and received on average 25 litres of milk which was all consumed at household level. Only 1 camel in Lolukuta of the total 3 tested positive on CMT for one quarter indicating a case of sub-clinical mastitis (Figure 3) above.

Reasons given for not selling camel milk:

- › Lack of incentive to sell camel milk due to low purchase prices especially during the wet season.
- › Lack of market outlet during the dry season when the herds move far from the village market centre as they track pasture.
- › Most camel owner's production goal was geared towards calf and meat production.

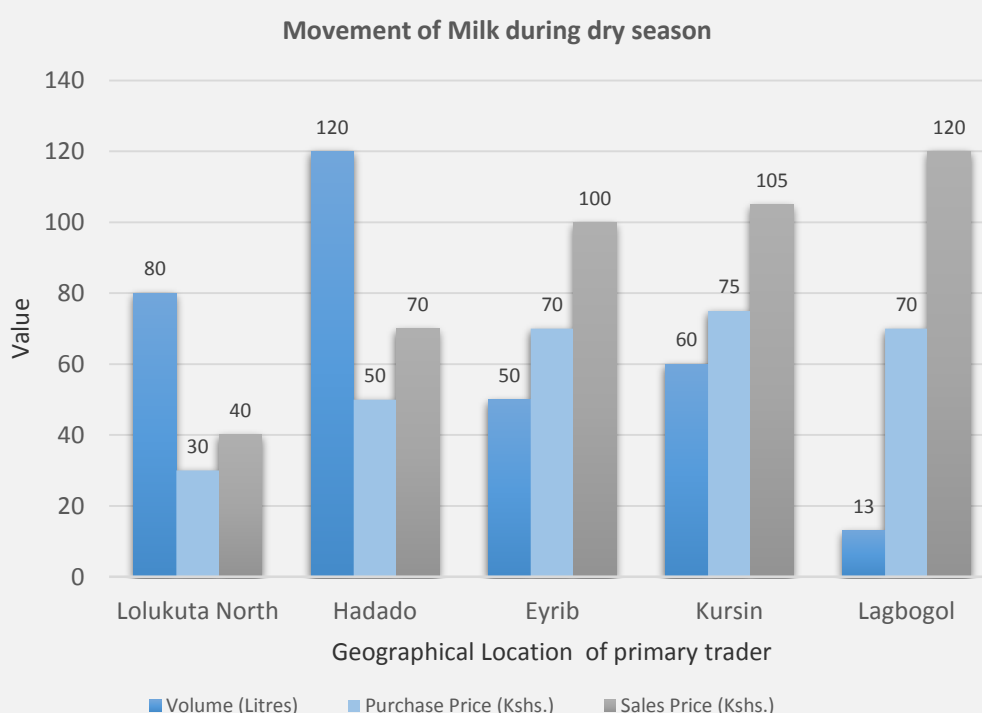
Knowledge on practices that cause milk spoilage

All the producers interviewed cited the following reasons as the main causes of milk spoilage

- › Milking animals showing signs of mastitis (swollen udder)
- › Lack of overall hygiene of the milkers (dirty hands and milking containers that are not properly cleaned or smoked (Figure 5).

3.1.2 Primary traders

Five primary traders were interviewed and findings are summarised in figure 4 below. Primary traders in Lolukuta and Hadado used motorbike riders to collect milk from producers using their own plastic containers while those in Eyrib, Kursin and Lagbogol had milk delivered to them in small quantities by producers who delivered the milk on foot or with donkey carts. All primary traders did not keep milk transaction records and only 1 (Kursin) belonged to a group with 3 other women. The women bulk milk and sell to Wajir town together, the main benefit mentioned of being in the group was that she was assured a daily income even if she did not have sufficient milk quantities. The primary traders are grouped into two categories, the first are men who have invested in motorbikes and the second are women in the village market centres. The primary women traders who sent milk to Wajir town all have a kin ship relationship with the secondary women traders operating in Wajir town.



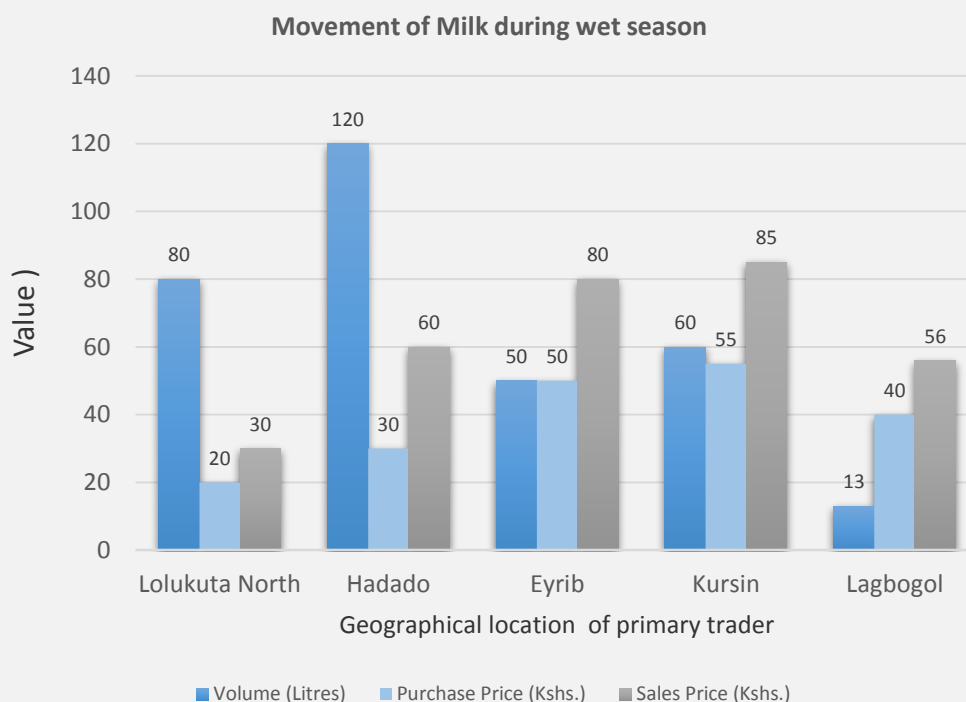


Figure 4: Graph showing seasonal quantities and prices of camel milk for each Primary Trader geographical location

Primary traders incur the cost of transporting milk to Wajir town and the cost varies with the size of container. On average the transporter will charge 10/- for 3L, 20/- for 5L and 50/- for 10L and 100/- for 20L. The primary trader also ensures that the plastic containers transporting the milk are clean, smoked and labelled well (Figure 3). Payment of milk transported to Wajir town is done the following day once the milk is sold. If the milk spoils on the way to Wajir town, the primary trader does not receive payment.



Figure 5: Different ways of labelling the containers by Primary traders

The CMT and alcohol (platform test¹) were used to test the quality of bulked milk at primary trader level. About 3 mls of camel milk was mixed in a small test tube with equal amounts of 68% of ethanol solution (Figure 4). The expected positive reaction includes coagulation, clotting or precipitation if the milk is fermenting due to increased levels of lactic acid. All milk tested at primary trader level was fresh and not boiled, there was no positive reaction for both tests indicating the milk was good and not fermenting. The women also sold goat and cow milk when available.

Strategies used to prevent milk spoilage

- › Containers used to collect milk from producers are clean and smoked, in most cases, the primary trader supplies the producer with plastic containers which are recycled cooking oil containers that have been cleaned well and fumigated with smoke from burned wood of the tree species *Olea africana*, *Acacia nilotica* and *Balanities aegyptica*.
- › Use of organoleptic test (sight and taste) to check for milk quality before accepting from producer/trader.
- › Ensure immediate dispatch to terminal market, milk collected in the early morning in most cases is not boiled. Milk that will be collected after 10 am or when transport delays occurs, is boiled and immediately put into the plastic containers before dispatch to terminal market.
- › Give advice to producers who bring fermented milk. However, most traders remarked that all camel milk is good, so most will purchase it at a lower price and sell it locally as fermented milk commonly known in the local dialect as 'Suusa'.

¹ Platform test- These are methods of assessing milk quality at the reception in the presence of the milk producers and which do not require elaborate laboratory facilities.



Figure 6: Camel milk quality testing using CMT reagent and paddle at primary trader level

A MAP OF CAMEL MILK COLLECTION POINTS IN WAJIR COUNTY

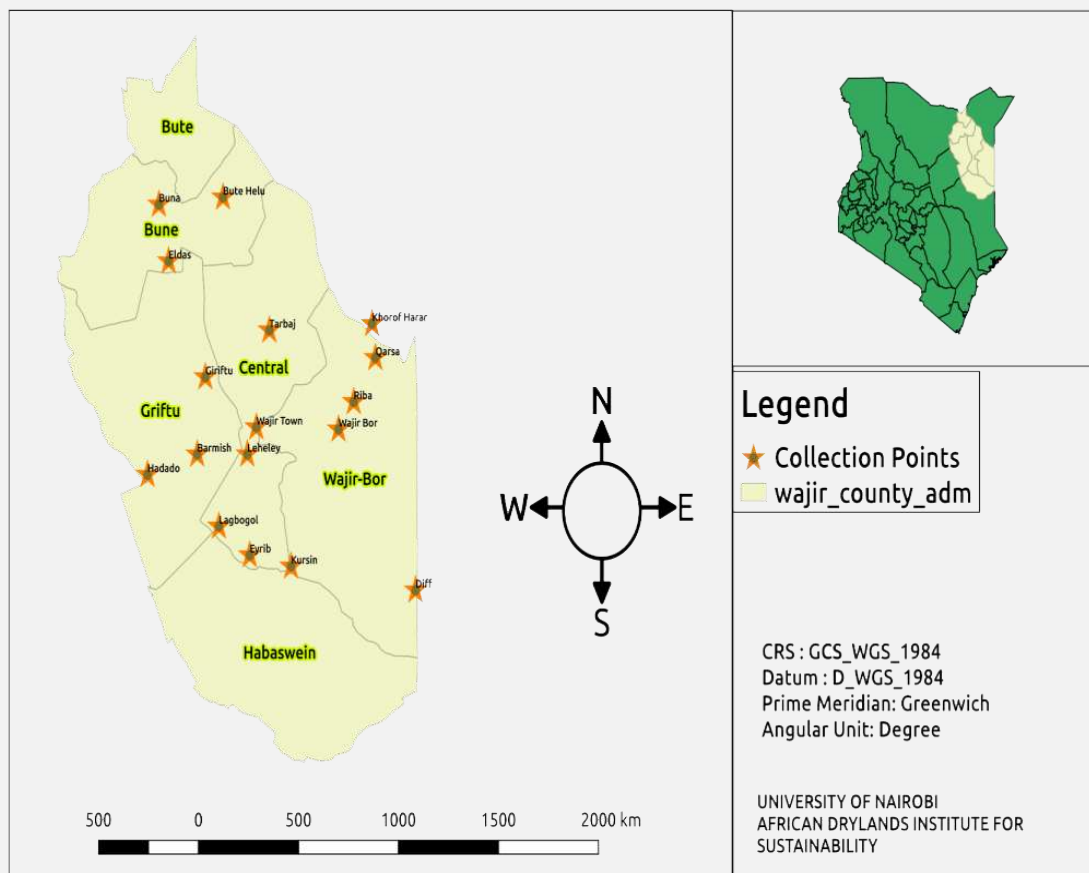


Figure 7: GIS map showing geographical location of camel milk collection points supplying Wajir town

3.1.3 Transporters

Their main role is to link the primary traders at village level to the secondary traders in Wajir town. The transporter collects milk at various points along their designated route (Figure 7). The distance covered based on Google map road distance calculation indicate that the furthest milk collection points are Diff, Buna and Khorof at approximately 150 kilometres from Wajir town. The transporters indicated that they also transport back to primary traders the empty plastic containers which in most cases also contains milk payments from the secondary traders. In some instances, the secondary traders may give the transporter the payment in cash to be delivered to the primary trader. There was no charge incurred to transport the empty containers back to the primary trader. All transporters interviewed indicated that the Diff route had the highest camel milk quantity (Figure 8).

A MAP OF CAMEL MILK CORRIDORS IN WAJIR COUNTY

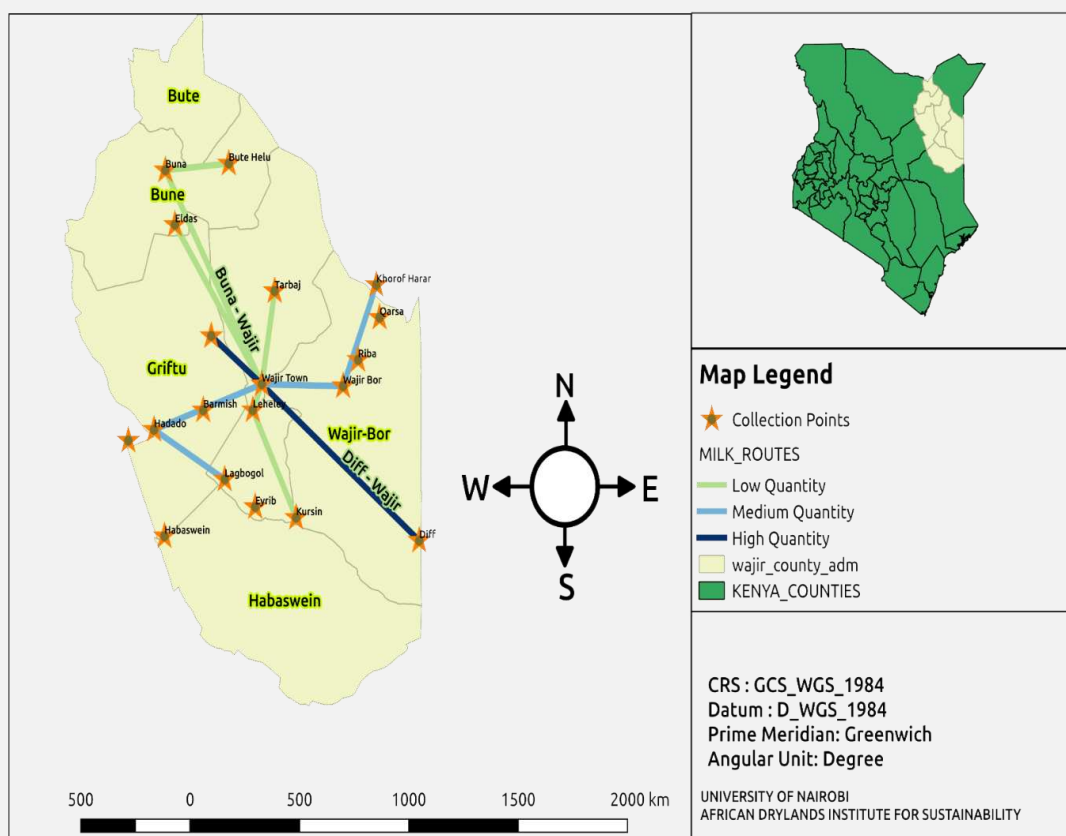


Figure 8: GIS map depicting the camel milk corridor routes supplying milk daily to Wajir town

The main vehicles used for transporting milk were buses, lorries (canters), vans and small vehicle. In addition, transporters indicated that milk was not the main load and sometimes delays in delivery could occur if the main load of the day is delayed (passengers, sheep, goats and goods). However, transporters were sensitive enough to ensure they collect milk early and deliver it to Wajir town before the ambient temperatures become too high. In addition, they ensured where possible, milk was the first load to be offloaded from their vehicles.

Milk in the 20L plastic containers was transported in the lorries or in the boot or carriers (van, bus and car). The 10, 5 and 3 litres were tied to the side of the vehicles particularly the canters so as to maximize the tonnage of load as well as to ensure safety of the containers (Figure 5).

Information gathered from the transporters proved crucial when quantifying (table 2) the amount of camel milk supplied daily to Wajir town. Approximately 10,000 litres of camel milk is supplied daily to Wajir town during the early dry season.

Knowledge on reasons for milk spoilage

- › Wet season is associated with milk glut and unsold milk will get spoilt,
- › Unhygienic milk handling practices, dirty milkers' hands, use of plastic containers that have not been cleaned well and not fumigated with smoke.
- › Milk that is not boiled and takes too long to reach its destination.

Table 1: Collection points and quantities of milk across 8 corridors in Wajir County

Name of Route, collection points and milk quantity	Total route milk quantity (Litres)
1. ELDAS – Wajir Town Dela, <i>Griftu (main collection point)</i> Tulatula	540
2. Arbajahan- Wajir Town Arbajahan- 250L, Adan Awale – 550L, Kubeysurur – 290L, <i>NurKilo (main collection point)-1,130L</i> , Griftu-180L, TulaTula -190L	2,590
3. Lagbogol-Hadado-Wajir Town Barmish- 300L <i>Hadado (main collection point)- 1,100L</i>	1,400
4. Diff – Wajir Town Aktalehel – 300L, <i>Burder -500L</i> , Welgaras- 200L, <i>Abaqdere-500L</i> , <i>Hubsoy 500L</i> , Noley-300L, Ohiya point 1 and 2-400L, Kulalely-400L, Eladow-350L	3,450
5. Macheza- Wajir Town Macheza-40L, <i>Kursi-80L</i> , Bakaja-20L, Qoqar-40L, Biliburbur -20L, Sukela-60L, Leheley-60L	320
6. Khorof-Wajir Bor- Wajir Town Qarsa- 200L, <i>Riba (main collection)-400L</i> , Wajir Bor-50L	650
7. Tarbaj – Wajir Town Jaijai-50L, Dabas-100L, <i>Tarbaj (main collection)-200L</i> Shebdaidai-100L	450
8. Bute-Buna-Wajir Town Ajawa- 200L, Buna – 200L, Malkagufu- 100L, Eldas -100L	600
Estimated total daily milk	10,000L

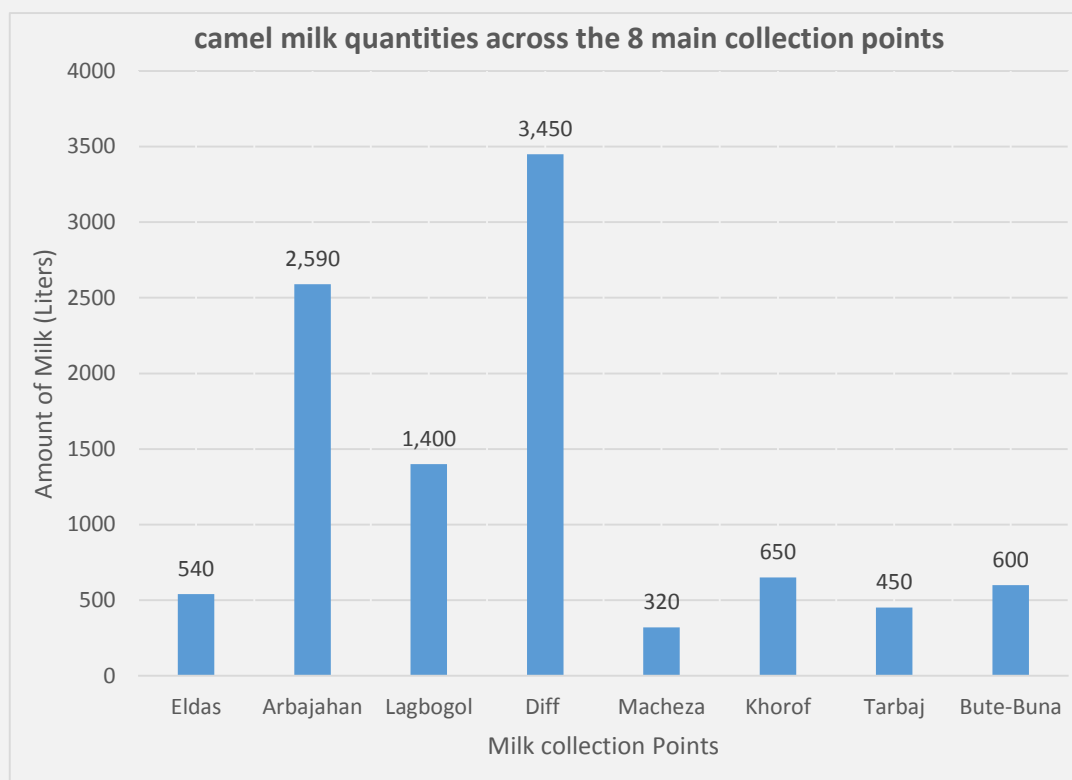


Figure 9: Graph depicting camel milk quantities across the 8 main collection points in Wajir County

3.1.4 Secondary Traders

The secondary traders were all women located in Wajir town, majority of whom sold the camel milk by the road side or in temporary make shift structures (Figure 10) in the main market areas (Soko Mjinga, Orahey) or at bus terminals (Griftu stage). Most of the women operate individually, however 3 groups, 2 previously supported by Mercy Corps and 1 by VSF-Suisse had premises and chilling facilities (chest freezers). Camel milk that arrived in the morning was sieved and placed in the freezer while milk that arrived in the afternoon was sieved, re-boiled (as it had been boiled by primary trader) before being put into the chest freezer (Figure 11).



Figure 10: Wajir town road side traders in temporary make shift structures



Figure 11: Camel milk stored in the chest

Table 2 below summarises the seasonal quantity and sales of camel milk by the three women dairy trader groups. Most milk was sold as fresh milk with few quantities processed by Wajir milk traders group into yoghurt. The dairy trader groups also sold cow and goat milk. Payment transaction between primary and secondary traders was on a credit arrangement. Secondary traders only paid primary traders after the milk in the container was sold. They then put the earnings in the containers and send them back with the transporter the following day.

Table 2 Table showing seasonal estimates of quantity of milk sold and price range for the 3 Wajir town milk traders

Name of group and membership number	Dry season milk Quantity (Litres)	Purchase price from primary traders Ksh/Litre	Consumer Sale price (Ksh/litre)	Wet season milk (Litre)	Purchase price from primary traders (Ksh/Litre)	Sale price to consumers (Ksh/litre)
Wajir milk traders (3 members)	50	150	210	50	90	180
Al-Rahim (12 members)	700	100	150	1000	90	120
Bakool (6 members)	200	135	210	400	110	150

Benefits of being in a group

- › Able to access NGO and government support for chest freezers and metallic milk cans for the Wajir milk traders.
- › Trained in milk hygienic practices, business skills, record keeping and value addition into yoghurt and sweets.
- › Pool financial resources to purchase assets such as chest freezer (Bakool group), pay rent for premises and construct another milk parlour (kiosk) which they don't pay rent for (Bakool group).
- › Social support-members can borrow loans for school fees and medical.

All traders indicated that camel milk spoilage incidences were rare, with most remarking that fermented camel milk also had a market so it was not a total loss for members. Power outages contributed to the highest milk spoilage incidences. The CMT and alcohol (platform test) were used to test the quality of bulked milk. About 3 mls of camel milk was mixed in a small test tube with equal amounts of 68% of ethanol solution. In the Bakool group, camel milk that had been left overnight had a CMT positive colour change reaction and precipitate formation after alcohol was added indicating it was undergoing fermentation. The milk in all groups delivered in the morning had no positive reaction for both tests indicating the milk was good and not fermenting.

Strategies used to prevent milk spoilage

- › Once milk arrives they use organoleptic test (sight, smell and taste) to ensure milk has not fermented.
- › During the dry season when camel milk is scarce the traders use a lactometer to check for milk density to ensure milk received has not been diluted with water (Wajir milk traders).
- › Immediate chilling of milk that arrives in the morning and re-boiling of milk received in the afternoon/evening before chilling
- › Advising primary traders who bring milk to ensure they test milk before accepting from producers and to ensure the plastic transport containers are cleaned and fumigated correctly.
- › Strongly warning the agent that they will be dropped if they bring spoilt milk

3.1.5 Consumers

Seven consumers (2 men and 5 women) were interviewed. The interviews targeted consumers buying fresh milk from the supermarket and consumers purchasing milk from the road side milk traders at Soko mjinga and Ohaley markets. The graph below summarises the consumer responses.

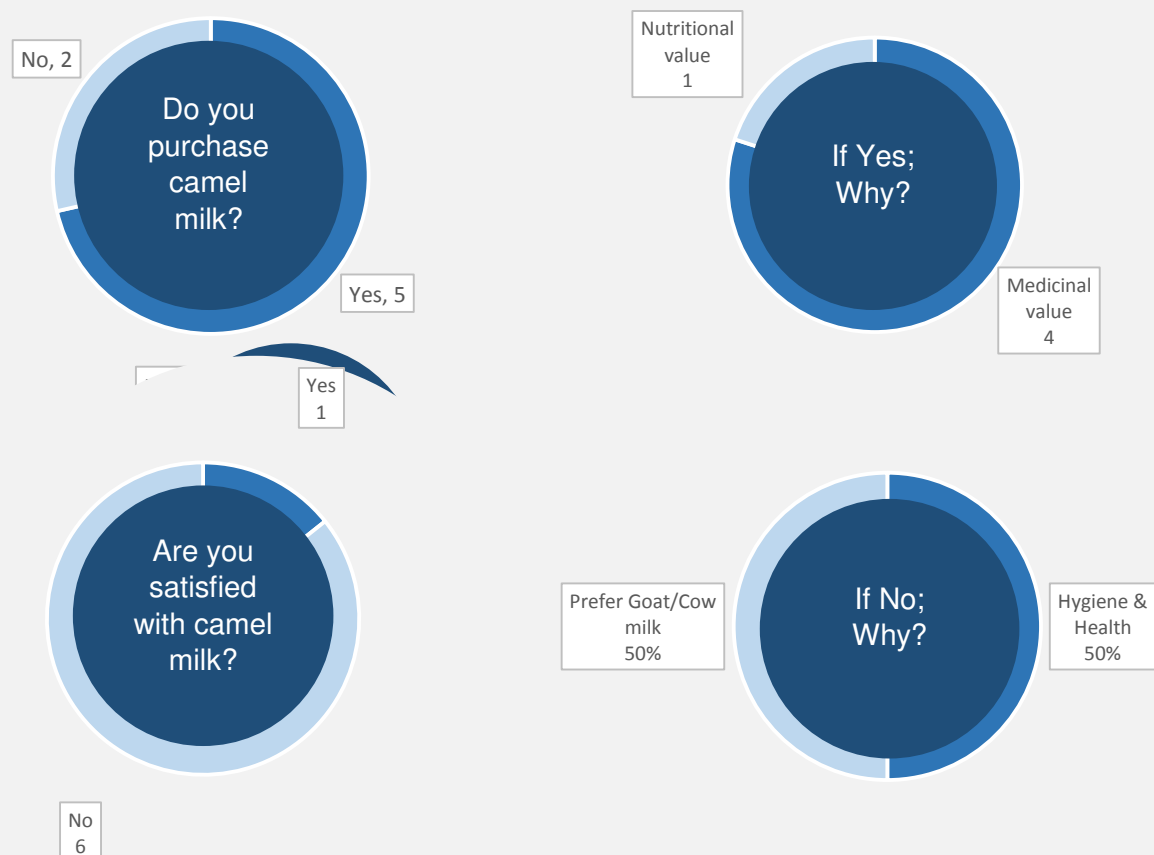


Figure 12: Pie chart depicting consumer responses on various issues concerning consumption of camel milk



Figure 13: Polythene material used to pack camel milk for consumers

Drinking fresh unboiled camel milk was the preferred consumer preference. In addition, consumers preferred milk that had not been stored in the fumigated containers as it tasted better. The concern that putting hot milk in polythene bags and plastic containers is detrimental to human health is real. The consumers interviewed were directly linking the use of plastic containers and polythene bags (Figure 10) to increased incidence of throat cancer and ulcers. This concern had also been captured across the supply chain from transporters to Wajir town trader level. Despite milk traders indicating that consumers were not experiencing milk spoilage, 3 of the 5 consumers indicated they had on several occasions experienced milk spoilage and adulteration (mixing of milk from different livestock species). Consumers were also concerned about drug residues (antibiotic or anthelmintics) in the milk.

It was also noted that consumers lacked knowledge on the existence of alternative more hygienic containers for milk transportation as well as existence of other camel milk value added products such as yoghurt.

3.1.6 Service providers

Service providers are government and non-governmental institutions that have invested in the development of the camel milk value chain in Wajir County. The KIs revealed that the camel milk supply chain is still individually based at all nodes and is not efficient. Previous attempts by service providers to transform the camel milk supply chain have been on small scale basis and have focused at the secondary trader level and to a smaller extent at the producer level. All service providers indicated that there have been several initiatives that had tried to create a platform for all service providers working in the camel milk value chain. These initiatives were convened by the Agricultural Sector Development Support Programme (ASDSP) that has a mandate of promotion of viable and equitable commercialization of the agricultural sector through value chain development. The ASDSP has a value chain stakeholder's platform but the meetings are not regular hence follow through of activities is not coordinated or monitored. The overall perception by the service providers was that the camel milk value chain lacked efficient coordinating body that can organize and create platforms to allow regular meeting of all players. They all suggested that the department of livestock should take up the lead role in coordinating stakeholders and calling for regular meetings. Outlined in table 3 are past activities supported by service providers as well as challenges and recommendations.

Table 3: An analysis of service providers' past activities, challenges and recommendations

Name of service provider	Type of support given and at what level	Challenges noted	Recommendations/ Gaps need to be addressed
Mercy Corps	Secondary traders <ul style="list-style-type: none"> - Formation of 2 women milk trader groups - Groups trained on hygienic milk handling practices and business skills - Established 2 milk selling points (ADC market and Griftu stage) - Provided each group with a chest freezer. 	Producers- <ul style="list-style-type: none"> - Poor hygiene of milkers hands, boma and containers. - Seasonal availability of feed which means milk production is also seasonal Primary trader- <ul style="list-style-type: none"> - Lack of hygienic bulking area with a chilling facility. - Challenge of transporting milk, milk is not a priority load. - Milk supply is seasonal as roads become impassable during rainy season. - lack of financial capacity to buy large volumes of milk Secondary trader- <ul style="list-style-type: none"> - Lack of hygienic milk selling points Consumers <ul style="list-style-type: none"> - No deliberate effort made to engage them, milk hygiene may be a concern. 	Producer- train on hygiene (milkers, boma, containers) and health of animals Primary trader- facilitate acquisition of hygienic containers (metallic or steel cans), provision of chilling equipment or a dedicated transporter who has a refrigerated truck for key collection routes. Secondary trader- provide hygienic milk selling sheds, containers, and machinery for value addition (yoghurt, pasteurization)

Name of service providers	Type of support given and at what level	Challenges noted	Recommendations/ Gaps need to be addressed
VSF-SUISSE supported by ADESO	<ul style="list-style-type: none"> - Trained 2,000 producers, 192 traders and 41 transporters on milk handling hygienic practices, business planning and management as well as group formation and dynamics. - Provided several steel/metal milk cans for transporting milk. – Notable success is the Wagalla primary trading group which has a dedicated public transporter to deliver milk to Wajir town. Daily milk delivery turnover is estimated to be 500-600 litres (dry season) and 1000-1500 litres (wet season). 	<p>Producers</p> <ul style="list-style-type: none"> - There is no change in practice due to traditional believes, attitudes and myths surrounding raw camel milk that is said to be medicinal. Smoking of milk has two roles; acts as a preservative and adds flavour to the milk which is a consumer preference - High microbial load at herd level <p>Primary and secondary Traders</p> <ul style="list-style-type: none"> - High incidence of antibiotic residues (15 to 20 out of 50 samples positive) at trader level raising the question of where the antibiotics were coming from? - There is no willingness to pay for added value (clean milk or yoghurt by consumers) which serves as a disincentive for traders. <p>Transporter metallic cans have a high spillage rate and are bulky</p> <p>What deters private investment</p> <ul style="list-style-type: none"> - Perception that only women engage in milk trading - Milk trade is a business for the poor members of the community. Well to do members of society buy processed cow milk from shops (powder or UHT). - Supply to Wajir town is clan based <p>Consumers</p> <p>No deliberate effort made to talk to consumers, but milk hygiene could be a problem.</p>	<ol style="list-style-type: none"> 1. Need to find ways to change mind-set. 2. Improve marketing especially the milk selling points in Wajir town 3. Encourage private investment in conducting transportation – innovative ways using motorbikes with specially designed carriers as well as investing in a processing plant.

3.2 Objective 2: Areas for training and infrastructure interventions

3.2.1 Identified training and infrastructure intervention areas

The table below summarises training areas and required infrastructure support as identified by stakeholders at each level of the camel milk value chain in Wajir County.

Table 4: Summary of training and infrastructure development needs at each node of the camel milk value chain for Wajir County

Camel Milk VC level	Training area	Infrastructure support
Producer	<ol style="list-style-type: none"> 1. Awareness on hidden wealth in camel milk trade 2. Hygienic milking practices 3. Disease recognition and management (sub-clinical mastitis) and importance of milk withdrawal after drug administration. 	<ol style="list-style-type: none"> 1. Grazing strategies (enclosures) or fodder production to cushion producers from low milk production during the dry season. This will ensure lactating animals remain close to water source hence maintain hygiene.
Primary Traders	<ol style="list-style-type: none"> 1. Hygienic milk bulking practices 2. Value addition of camel milk (cottage industry) 3. Benefits of being in trader groups and business skill development. 4. Awareness creation on hidden health issues (putting hot milk in plastic containers) 	<ol style="list-style-type: none"> 1. Chilling facility (Solar powered to target evening camel milk which is currently not coming to the market. 2. Shed dedicated to bulking milk 3. Investment in steel cans (cans should have non-spill covers). 4. Vehicle dedicated to milk transportation for each route.
Transporters	<ol style="list-style-type: none"> 1. Awareness creation on timing and handling of milk containers. 2. Sensitization on the steel container as a future introduction. 	<ol style="list-style-type: none"> 1. Financial support as incentives for transporters to invest in milk transportation.
Secondary traders	<ol style="list-style-type: none"> 1. Milk handling hygiene 2. In-depth training on camel milk value addition products such as yoghurt, ghee, cheese, powder milk, UHT and techniques of using preservatives to extend the shelf life of camel milk candy. 3. Encourage private investment in camel milk trade. 	<ol style="list-style-type: none"> 1. Steel/metallic containers 2. Construction of camel milk selling sheds/kiosks that have infrastructure incentives such as water supply, chilling facility, bulk pasteurizer, low-cost packaging material and sealant equipment.
Consumers	<ol style="list-style-type: none"> 1. Provide a platform where they can air their concerns to producers and traders. 2. Awareness creation on benefits and risks of consuming raw milk. 	<ol style="list-style-type: none"> 1. Better packaging and hygienic milk selling sheds.
Service providers	<ol style="list-style-type: none"> 1. Provide platform to share experiences and coordinate activities. <p>Suggestion put forward is to have the director of livestock production convene regular stakeholder meetings as this is would bring down the cost of convening such meetings by NGOs.</p>	<ol style="list-style-type: none"> 1. Development partners and government should pull resources to ensure meaningful infrastructure investments.

3.2.2 Economic Viability of Fresh Pasteurized Camel Milk Enterprise

The camel milk quantity information at each supply chain node together with purchase cost and sale value were adjusted and used to construct cost-benefit analysis (CBA) models. The models were designed to assess financial and economic outcomes of interventions, such as Benefits/Cost (B/C) ratio: PVC = present value of costs: PVB = Present value of benefits: NPV = Net present value and IRR = Internal rate of return. The analysis was done based on three scenarios that is, handling 2,000; 1,000 and 500 litres of milk daily. In all the three scenarios, the cost of buying basic capital inputs to facilitate the enterprise including a cooling facility, bulk pasteurizer, aluminium cans, low cost packaging and sealer were factored in. The cost of buying the capital inputs was arrived at through web browsing, consultation with UoN dairy processing plant manager and PROMACO Company which deals in milk handling equipment. The costs are therefore a realistic depiction of their current value. Depreciation of the capital inputs is calculated at a rate of 5% per annum. Costs of labour for collecting the milk from the field and overheads were estimated using standard business rates, that is, 15% of average buying price/litre for milk collection related labour and 10% for the overheads. Overhead costs considered include; electricity bill for running the cooling facility and bulk pasteurizer and labour cost for employees. The transport cost was calculated using data collected during the study. In computing the net outputs and the subsequent gross margins, average buying and selling prices which combined the seasonal prices were used, that is, Ksh. 72.8 and 110.7 for buying and selling, respectively. Common information for the three scenarios is presented in table 5 while cash flow statements are presented in the tables 6, 7 and 8 below. Figure 14 is a graphical presentation comparing key profitability indicators of the three scenarios.

Table 5: Common Information for the Three Scenarios

Labour cost for milk collection & Rent (15% of average buying price/litre)	10.92
Overhead cost collection (10% of average buying price/litre)	7.28
Total	18.2
Transport cost (Kshs./litre)	6
Milk buying price across seasons	72.8
Milk selling price across seasons	110.7
Social discounting rate = IMF/World Bank lending rate	11.5
Depreciation of capital inputs	5% per annum
Current Kenya Commercial Banks Fixed Deposit Interest Rate	8 – 10.5%

Note: B/C = Benefits/cost ratio: PVC = present value of costs: PVB = Present value of benefits: NPV = Net present value: IRR = Internal rate of return

Table 6: Cash Flow Statement Scenario 1 Handling 2000 Litres Daily

INPUTS		1st Month	2nd Month	3rd Month	4th Month	5th Month	6th Month	7th Month	8th Month	9th Month	10th Month	11th Month	12th Month
Balance B/F('000)		(1,630)	(796)	38	872	1,706	2,540	3,374	4,208	5,042	5,876	6,710	7,544
Capital inputs													
Cooling facility (1800 L capacity)	550,000	0	0	0	0	0	0	0	0	0	0	0	0
Bulk Pasteurizer (500 L capacity)	630,000	0	0	0	0	0	0	0	0	0	0	0	0
Aluminum cans	400,000	0	0	0	0	0	0	0	0	0	0	0	0
low cost packaging and electric Sealer	50,000	0	0	0	0	0	0	0	0	0	0	0	0
Total-Capital inputs	1,630,000	-	-	-									
Variable inputs													
Cost of milk purchase of 2000L per day ('000)		4,368	4,368	4,368	4,368	4,368	4,368	4,368	4,368	4,368	4,368	4,368	4,368
Labor - collection ('000)		660	660	660	660	660	660	660	660	660	660	660	660
Labor – overhead ('000)		420	420	420	420	420	420	420	420	420	420	420	420
Transport Cost ('000)		360	360	360	360	360	360	360	360	360	360	360	360
Total - Variable inputs ('000)		5,808	5,808	5,808	5,808	5,808	5,808	5,808	5,808	5,808	5,808	5,808	5,808
Total Cost ('000)	1,630	5,808	5,808	5,808	5,808	5,808	5,808	5,808	5,808	5,808	5,808	5,808	5,808

OUTPUTS													
Sale of milk ('000)		6,642	6,642	6,642	6,642	6,642	6,642	6,642	6,642	6,642	6,642	6,642	6,642
Value of equipment @ depreciation of 5% per year ('000)													1,549
Total Sales ('000)		6,642	6,642	6,642	6,642	6,642	6,642	6,642	6,642	6,642	6,642	6,642	8,190
Net ('000)	(1,630)	(796)	38	872	1,706	2,540	3,374	4,208	5,042	5,876	6,710	7,544	9,926
Cost Benefit Analysis													
Gross Margin ('000)		834	834	834	834	834	834	834	834	834	834	834	2,383
B/C		1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.41
PVC (at a rate of 11.5%) – ('000)		5,209	4,672	4,190	3,758	3,370	3,023	2,711	2,431	2,180	1,956	1,754	1,573
PVB (at a rate of 11.5%) – ('000)		5,957	5,343	4,792	4,297	3,854	3,457	3,100	2,780	2,493	2,236	2,006	2,218
NPV ('000)		748	671	602	540	484	434	389	349	313	280	252	645
Cumulative NPV ('000)		5,707											
Calculation of Monthly (IRR) – ('000)	(1,630)	550	363	239	158	104	69	45	30	20	13	9	16
Monthly IRR		35 - 36%											

Table 7: Cash Flow Statement Scenario 2 Handling 1000 Litres Daily

INPUTS		1st Month	2nd Month	3rd Month	4th Month	5th Month	6th Month	7th Month	8th Month	9th Month	10th Month	11th Month	12th Month	
Balance B/F ('000)		(1,180)	(763)	(346)	71	488	905	1,322	1,739	2,156	2,573	2,990	3,407	
Capital inputs														
Cooling facility (1000 L capacity)	450,000	0	0	0	0	0	0	0	0	0	0	0	0	
Bulk Pasteurizer (300 L capacity)	480,000	0	0	0	0	0	0	0	0	0	0	0	0	
Aluminum cans	200,000	0	0	0	0	0	0	0	0	0	0	0	0	
low cost packaging and electric sealer	50,000	0	0	0	0	0	0	0	0	0	0	0	0	
Total-Capital inputs	1,180,000	-	-	-	-	-	-	-	-	-	-	-	-	
Variable inputs														
Cost of milk purchase of 1000L per day ('000)		2,184	2,184	2,184	2,184	2,184	2,184	2,184	2,184	2,184	2,184	2,184	2,184	
Labor – collection (‘000)		330	330	330	330	330	330	330	330	330	330	330	330	
Labor – overhead (‘000)		210	210	210	210	210	210	210	210	210	210	210	210	
Transport (‘000)		180	180	180	180	180	180	180	180	180	180	180	180	
Total - Variable inputs (‘000)		2,904	2,904	2,904	2,904	2,904	2,904	2,904	2,904	2,904	2,904	2,904	2,904	

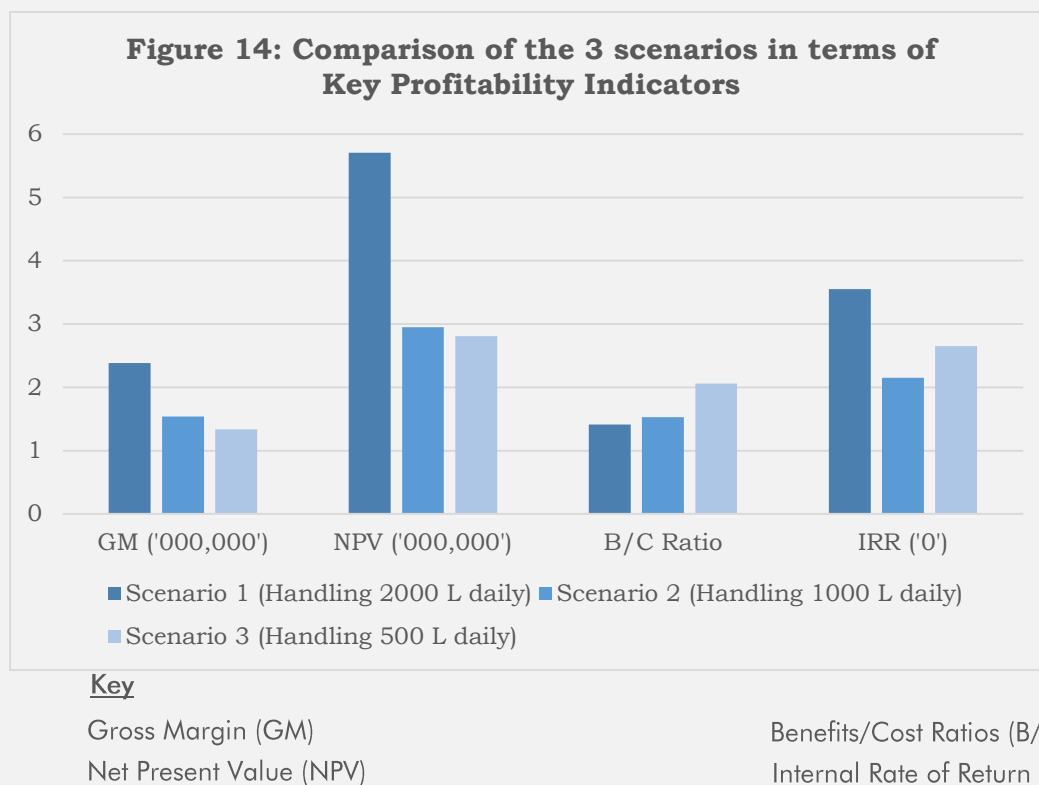
Total Cost ('000)	1,180	2,904	2,904	2,904	2,904	2,904	2,904	2,904	2,904	2,904	2,904	2,904	2,904	
OUTPUTS														
Sale of milk ('000)		3,321	3,321	3,321	3,321	3,321	3,321	3,321	3,321	3,321	3,321	3,321	3,321	
													1,121	
Total Sales ('000)		3,321	3,321	3,321	3,321	3,321	3,321	3,321	3,321	3,321	3,321	3,321	4,442	
Value of equipment @ depreciation of 5% per year ('000)													1,121	
Net ('000)	(1,180)	(763)	(346)	71	488	905	1,322	1,739	2,156	2,573	2,990	3,407	4,945	
Cost Benefit Analysis														
Gross Margin ('000)		417	417	417	417	417	417	417	417	417	417	417	1,538	
B/C		1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.53	
PVC (at a rate of 11.5%) –'000		2,604	2,336	2,095	1,879	1,685	1,511	1,355	1,216	1,090	978	877	786	
PVB (at a rate of 11.5%) – '000		2,978	2,671	2,396	2,149	1,927	1,728	1,550	1,390	1,247	1,118	1,003	1,203	
NPV ('000)		374	335	301	270	242	217	195	175	157	140	126	417	2,948
Cumulative NPV ('000)		2,948												
Monthly Internal Rate of Return (IRR) –'000	(1,180)	307	225	166	122	90	66	48	36	26	19	14	38	(24)
Monthly IRR		21 - 22%												

Table 8: Cash Flow Statement Scenario 3 Handling 500 Litres Daily

INPUTS		1st Month	2nd Month	3rd Month	4th Month	5th Month	6th Month	7th Month	8th Month	9th Month	10th Month	11th Month	12th Month	
Balance B/F ('000)		(980)	(577)	(173)	231	634	1,038	1,441	1,845	2,248	2,652	3,055	3,459	
Capital inputs														
Cooling facility (1000 L capacity)	350,000	0	0	0	0	0	0	0	0	0	0	0	0	
Bulk Pasteurizer (300 L capacity)	480,000	0	0	0	0	0	0	0	0	0	0	0	0	
Aluminum cans	100,000	0	0	0	0	0	0	0	0	0	0	0	0	
low cost packaging and electric sealer	50,000	0	0	0	0	0	0	0	0	0	0	0	0	
Total-Capital inputs	980,000	-	-	-	-	-	-	-	-	-	-	-	-	
Variable inputs														
Cost of milk purchase of 500L per day –('000)		1,092	1,092	1,092	1,092	1,092	1,092	1,092	1,092	1,092	1,092	1,092	1,092	
Labor - collection ('000)		165	165	165	165	165	165	165	165	165	165	165	165	

Labor - overhead ('000)		105	105	105	105	105	105	105	105	105	105	105	105	
Transport – ('000)		90	90	90	90	90	90	90	90	90	90	90	90	
Total - Variable inputs ('000)	-	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	
Total Cost ('000)	980	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	1,257	
OUTPUTS														
Sale of milk ('000)		1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	
Value of equipment @ depreciation of 5% per year ('000)													931	
Total Sales ('000)		1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	2,592	
Net ('000)	(980)	(577)	(173)	231	634	1,038	1,441	1,845	2,248	2,652	3,055	3,459	4,793	
Cost Benefit Analysis														
Gross Margin ('000)		404	404	404	404	404	404	404	404	404	404	404	1,335	
B/C		1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	2.06	

PVC (at a rate of 11.5%) – '000		1,127	1,011	907	813	729	654	587	526	472	423	380	340	
PVB (at a rate of 11.5%) – '000		1,489	1,336	1,198	1,074	964	864	775	696	623	559	501	702	
NPV – ('000)		362	325	291	261	234	210	188	169	151	136	122	361	2,811
Cumulative NPV – ('000)		2,811												
Monthly Internal Rate of Return (IRR) – '000	(980)	285	201	142	100	71	50	35	25	18	12	9	21.5	(11)
Monthly IRR		26-27%												



3.2.3 Strong business case for private and public investment

The net outputs were accumulated over the months. For the different scenarios, computation of variable costs and outputs start after the purchase of capital input with the daily collection, escalated to monthly and then yearly. In discounting the costs, the monthly cost is divided by $(1 + 0.115)$ to the power of the specific month for example, 1 for 1st month, 2 for second month. The figure 0.115 (11.5%) is the social discounting rate equivalent to the International Monetary Fund and World Bank lending rate. Benefits are also discounted using the same formula. Internal rate of return (IRR) for specific months is estimated with the target of bringing it close to zero. In all the 3 scenarios, gross margins are positive and significant, benefit/cost ratio is > 1 meaning the enterprise is breaking even ($B/C = 1$ is the breakeven point) and making profit. The cumulative NPV which shows the amount of money the investor would have at the end of 1st year after recovering the investment cost is much higher compared to the money the investor originally had (5,707,000 compared to 1,630,000 for scenario 1; 2,948,000 compared to 1,180,000 for scenario 2 and 2,811,000 compared to 980,000 for scenario 3). The internal rate of return (IRR) which compares the opportunity cost of investing in the enterprise Vis a Vis investing the money in a fixed deposit account in the local commercial banks is much higher than the commercial interest rate which currently ranges between 8 to 10.5%.

The IRR was highest for the first scenario (35-36%), followed by the 3rd (26-27%) and then the second one (21-22%). The low IRR for scenario 2 means the capital inputs are not being optimally utilized suggesting the need to increase volume of milk being handled. An important observation here is that the higher the volume of milk, the higher the potential profitability as suggested by high IRR. However, in all the scenarios, the enterprise is profitable as high returns would be realized.

4.0 Conclusion and Recommendations

The economic viability of camels in arid lands is assured by their comparative advantages in their ability to adapt and remain productive under harsh climatic conditions (Schwartz, 1992). The unique characteristics of the camel makes it the livestock species of choice in climate adaptation and resilience (Field 2005). Research has proved that camel milk production makes a considerable contribution to local and national economies as well as to individual household livelihoods (Musinga et al., 2008; Yazan et al., 2015). The total population of camels in Kenya is estimated to be three million, with Wajir County hosting the largest camel herds estimated to be close to 533,651 animals (KNBS 2009). Camel milk production in Kenya is projected to be close to 553 Million litres annually (7% of the National total) and worth 16 billion Kenya Shillings (Behnke and Muthami 2011). The mapping of camel milk corridor activity used a value chain approach (VCA) that ensured data was collected across the camel milk value chain from production to the market levels. A VCA is recommended for economic valuation of livestock production systems that are not adequately represented in the Country's Gross Domestic Product (GDP). This is because a VCA is able to disaggregate data from different systems (pastoralism verses ranching) and capture primary and intermediary products and markets at each node/level. This means that non-market/peripheral transactions can be traced and fringe/indirect benefits can be captured (Musinga et al., 2008; Behnke and Muthama 2011).

An analysis and interpretation of information obtained from the mapping activity indicates that the constraints hindering the development of a vibrant and sustainable camel milk value chain in Wajir County are cross-cutting and cannot be effectively addressed through short-term based interventions which do not take a holistic view of the interconnected nature of actors in the value chain. At producer level the challenge of lack of commercial orientation to produce for markets, low milk volumes and hygiene concerns are tied to issues of lack of market access, poor organization of primary traders and poor development of infrastructure support such as chilling facility, dedicated transport vehicles and poor road network. This in turn results in small volumes of milk going through the value chain which adversely affects profitability among all other players in the chain and discourages public and private investment. Based on above findings the following seven main recommendations can be made. However, we need to highlight that in all cases, development of an all-inclusive and consultative governance structure at all levels of the camel milk supply chain is paramount.

The specific recommendations are;

- i. Training on hygienic milk handling practices at all levels, business skill development and benefits of forming groups at primary and secondary trader levels. Sensitization on health issues related to consumption of raw milk and use of plastic containers.
- ii. Strategic infrastructure investment - should first be piloted in 2 of the 8 routes supplying most of the milk and in locations where high volume of milk is collected along the routes. The recommended investments at various levels of the value chain are as follows: Primary trader level - metallic/steel cans modified with non-spill lids, bulking sheds with counters and water supply, solar powered chilling facilities, modified motor-bike milk

transport carriers. The motorbike technology would work very well with a dedicated vehicle to collect milk at bulking centres (see figures below).



Figure 15: A spill free metal can



Figure 16: A modified motorbike dedicated to transporting milk to collection centre.



Figure 17: Special motorbike carrier used to transport camel milk from interior locations to collection centres

- iii. Secondary trader level - strategically built milk selling sheds/kiosks with infrastructure incentives (water supply, counters, bulk pasteurizer, low-cost packaging and sealant).
- iv. Establish at county government level an all-inclusive camel milk supply chain platform (consumer inclusion is key) to facilitate exchange of information, dialogue and appreciation of the role and obligations of every player. This should be coordinated and convened on regular basis by the director of livestock production. This is expected to reduce cases of exploitation of one group of players by the others, amongst other advantages.
- v. The platform referred to under iii should be used to create strong functional horizontal (within a level/node) and vertical (between the levels/nodes) alliances/relationships. Once alliances are established they should be facilitated to;
 - Formulate rules and regulations to guide their operations and set standards to ensure milk quality and safety.
 - Nominate overall value chain manager as well as managers at every level and clearly define their roles and responsibilities. These managers should then be trained on good governance.

- Set up a monitoring and evaluation (M&E) mechanism where the managers should be able to visit the various groups of players as a team, may be on quarterly basis for conversation and capturing of feedback. The feedback should be shared during the supply chain platforms and action taken to address the issues raised.
- vi. Recognition and integration of the rules and regulations set up by the alliances into the Wajir county agricultural policies in order to achieve the desired high standards of camel milk quality and safety in the county. One fundamental responsibility of the value chain managers will be to ensure adherence to the set rules and regulations and they should therefore be empowered to take action against those flouting the rules. The initial support for the governance activities can come from Mercy Corps, County government and other interested NGOs. This support should be in form of an 'operations fund' to ensure self-sustenance.
- vii. The market for camel milk and products be expanded and private investment in the camel milk value chain promoted. This should be done through taste fairs for the products (two per year would be sufficient). The taste fair should be preceded by processing of camel milk into products including fresh milk, pasteurized milk, yoghurt, ghee, cheese and candy. Mixed local and non-local consumers and traders (wealthy, moderate and low category) should then be invited to the open taste fair. Before the tasting begins, the participants should be educated on the health benefits of camel milk and also taken through the camel milk business model as illustrated in scenarios 1, 2 and 3. The participants should then be allowed to taste the various products and their feedback captured. The fair is expected to attract new consumers, private investment in camel milk and also guide potential investors on preferred products.

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