Economic study of the milk value chain through the Kiganda-Bujumbura Mairie circuit in Burundi

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Abstract

The value chain (VC) analysis of commodity chains is a strategic tool made for measuring, developing and maintaining sustainable a commodity. This paper analyzes the economic dimension of the milk VC through the Kiganda-Bujumbura Mairie circuit in Burundi. Using primary data, a distribution of profit margins between actors was assessed. This survey involved a sample of 67 actors. The sampling technique used was the "snowball" method due to the lack of a sampling frame of actors. Secondary data were also collected in order to complete the primary data. The analysis was carried out using general and quantitative tools compatible with the subject matter. The results show that retailers benefit an average monthly profit margin of 201 Burundian franc (BIF) [US$0.097] per liter with an average monthly turnover of 1,818,733BIF [US$879.48]. Dairy farmers have a monthly profit margin of 187BIF [US$0.090] per liter. Their average monthly turnover is 134,894BIF [US$65.23]. The collectors have a profit margin of 78BIF [US$0.037] per liter with an average monthly turnover of 1,815,000BIF [US$877.67] and the wholesalers have a profit margin of 47BIF [US$0.022] per liter with an average monthly turnover of 7,257,480BIF [US$3,509.52]. Low margins are mainly due to the small quantities of milk produced and high production costs. Dairy farmers breed local breeds, with the constraints of balanced feed. The problem of suitable transport and processing equipment also affects the quality of the milk. Small dairy farm would benefit from forming associations and/or cooperatives. Being in associations and/or in cooperatives, they should be able to breed the improved breed, benefit from other advantages such as training, easy access to veterinary services, agricultural financing credits, etc. Public authorities must at all times monitor compliance with standards governing the dairy sector, and introduce regulatory measures if necessary.

Introduction

Due to the globalization of trade and the unprecedented development of the VC, the taste and nutritional value makes milk a most competitive and highly valued product in the international market and plays a very crucial social, territorial and economic role (Otte, 2010; Ferrari, 2017; Missohou, 2020). Empirical studies (Massow, 1990) prove that Asian, European and American countries remain the main milk producing, exporting and consuming countries and their surplus is sold at low prices and/or distributed as donations or aid in developing countries. Developing countries are lacking in animal proteins, which constitutes a very important external market for them. On the other hand, most African countries find difficulty meeting national demand because of poor milk production and productivity, hence the need to import milk, which has a negative impact on their economies. The demand for milk is constantly increasing due to urbanization, population growth and consumer demand based on the trend towards westernization (Dieye, 2003; Chatellier, 2020). The Strategic Guidance Document on Livestock (2010) of Burundi clearly states that livestock alone contributes 14% to the Gross Domestic Product (GDP), or 29% of the agricultural GDP. It is moreover one of the strategies developed by the agri-breeders in order to increase spectacularly their incomes, productions, to create employment, to constitute savings on foot, etc. On this, the breeding also participates in the qualitative and quantitative improvement of the food and nutrition. Thus, the relationship of complementarity between agriculture and livestock is to be strengthened because the livestock sector occupies a very prominent place in Burundian farming systems through its supply of manure, necessary to maintain and restore soil fertility. The objective of this article is to conduct an analysis of the milk VC from an economic perspective through the Kiganda-Bujumbura Mairie circuit and to map the distribution of added value among the various actors in the milk VC. The remainder of this article is structured as follows: a literature review on the VC is developed. Next, the study materials and methods are described. Results are presented and discussed. The paper ends with a conclusion.

Literature review

The concept of the VC dates back to work carried out in the 1960s and 1970s, when the challenge of identifying the development factors of mineral-exporting countries became important (Girvan quoted by Kaplinsky, 2020). The VC approach also has its origins in France, in the 1960s, in the "filière" approach used to study farmer contracts and vertical integration in French agriculture. At that time, the VC terminology was not widely used, and the "filière" approach was preferred in French agriculture (UNIDO, 2009). Since 1985, the VC concept was popularized and it was mentioned that a firm's competitive advantage cannot be assessed by considering the firm as a whole. A systematic examination of all a company's activities in their interaction is crucial to analyzing the real source of competitive advantage (Porter, 1985).

The VC can be understood in either a narrow or a broad sense. Taken in a narrow sense, it comprises all the activities required to produce a product or service delivered to the end consumer, from the design phase through to the finished product, including the various intermediate transformation phases (transformation of raw materials and other components). In this context, the VC would involve the design of a product or service to be produced, the input acquisition process, production, marketing, distribution and after-sales service. All these activities form the "chain" linking the producer to the final consumer, and each activity adds value to the final product (Kaplinsky, 2000; Kaplinsky & Morris, 2002). In a company, added value or margin is the pivotal point of an economic analysis, based on the comparison of income from production factors (e.g. capital and labor). It is determined by means of the income statement, simply by comparing income and expenses. On the other hand, added value refers to quality, cost, delivery times, etc. These latter criteria are decided by end customers through their willingness to pay (Trienekens, 2011). The broad approach to the VC covers the complex activities carried out by various players (internal and external) within the company, from the raw materials in the chain to the sale of the final product. It starts from the raw materials production system and moves on to other companies involved in marketing,

assembly, processing, etc., up to the final product (Kaplinsky & Morris , 2002).

The VC gives an understanding of how the activities required in the production process are phased, and how the players involved in the chain interact through vertical and horizontal links. Vertical links are the synchronization of successive activities in the process of producing and marketing the finished product, while respecting quality, quantity, delivery times, etc. Horizontal links connect chain actors located on the same level of the VC (Stein & Barron, 2017). In the VC, two types of actors are distinguished. On the one hand, active actors (input suppliers, producers, distributors, consumers) in the chain, and on the other hand, actors (public authorities, local and international NGOs, etc.) who support the VC but are not directly active in the activities. These are support and development actors (UNIDO, 2009). Mapping is used to visualize relationships between actors, highlighting the interdependencies of players in production systems. It also pinpoints the constraints and bottlenecks faced by actors in the chain (Brossier, 1987). The VC analysis must encompass all questions of organization, coordination, strategies and power relations between the various actors. The VC is an analytical tool adapted to understanding the relationships existing between the actors in a chain, with a view to highlighting development potential. The ultimate goal of VC analysis is to be able to identify how to improve company's performance so that all actors are placed in a better situation that improves their standard of living (Lowitt *et al.,* 2015).

Materials and methods

Description and choice of zone
The commune of Kiganda is one of the five communes with three zones (Kiganda zone, Kanyami zone and Gatabo zone) in Muramvya Province. The commune of Kiganda is not among the areas of high milk production, but it has great potential to increase its production: the advantage of a humid tropical climate suitable for increasing the quality and quantity of milk production and productivity, the presence of milk collection cooperatives, and many other success factors that are likely to intensively and sustainably boost milk production and productivity to a high level. In addition, it is a very attractive area for development projects in the milk sector. The two milk collection cooperatives located in the commune were developed with the support of the government and its technical and financial partners, notably the Project of Development of the Sectors II (PRODEFI II). The commune is a strategic point for the marketing of commodities, particularly dairy products. The commune is located 73 kilometers from the city of Bujumbura, the economic capital with a population of 1,225,142 inhabitants. The city of Bujumbura is therefore a potential customer in terms of consumption of dairy products from our study area, given that the rural population consumes a small quantity of milk. The VC analysis of the commune's dairy products on the Kiganda-Bujumbura circuit provides an opportunity to identify the advantages and constraints in terms of investment for this highly attractive commune.

Data collection and methodological analysis
Data collection
The study was conducted through the Kiganda-Bujumbura Mairie circuit by means of field surveys. The data was collected using the Kobocollect software. The survey was conducted from December 29th, 2021 to February 18th, 2022. The sampling technique used, was the "snowball" method due to the lack of a sampling database of actors. This is a non-probability sampling technique that consists of identifying the first resource persons who will then be used to easily identify others in the same category until a representative sample size is reached. To this end, a sample of 67 actors was selected, including 24 dairy farmers, 2 collectors, 5 wholesalers and 36 retailers. Among these 24 dairy farmers, 8 dairy farmers were surveyed per zone, 4 of whom were members of milk collection cooperatives and 4 dairy farmers working individually. They were selected based on whether they were taming at least one lactating cow at the time of data collection and their willingness to respond to our survey questionnaire. Dairy farmers affiliated with cooperatives are obliged to sell their milk to them, but in some cases they chose to boycott the cooperatives and sold it to other local buyers. Unlike dairy farmers, there were only two milk collection cooperatives in the entire commune, and they were surveyed at most. Only nine retailers were identified in the entire Kiganda commune due to the problem of electrification in all areas. Of the nine retailers, five purchased regularly from dairy farmers and four from milk collection cooperatives. The remaining 27 retailers were those in Bujumbura

Mairie and were identified according to whether they regularly bought from wholesalers operating in the circuit studied. The five wholesalers surveyed were identified by the collectors based on their operation in the study area and their willingness to answer the survey questionnaire. The questionnaire was semi-structured. The methods used in field data collection were direct observation, interview and focus group. Interviews allowed respondents more freedom and creativity in answering questions (Cohen, Manion, & Morrison, 2017). Secondary data was also used to complement the primary data. They were collected in the various documentation and information centers at our disposal.

Data analysis

When carrying out a VC analysis, it is mandatory to use general, qualitative and quantitative tools. These tools do not all have to be used at the same time. Their use depends on the scope and purpose of the analysis. This is not a linear process. In addition, time, financial and other constraints can make the analysis less complete. The data analysis in this paper focused on the quantitative and qualitative data collected. The quantitative data related to the economic aspect of our study. Margins were calculated by comparing revenues and costs across the various actors identified in our VC. Margins were calculated for milk producers, collectors, retailers and wholesalers. The analysis was made easy by mapping actors, activities and milk volume flows. The results of the margin analysis enable to understand how added value is created and distributed along the entire dairy VC. Costs and margins were calculated using Microsoft Excel 2013 and statistical software. To complete our economic analyses, a content analysis of data was conducted from individual qualitative interviews and focus groups.

Results

Description of the milk value chain on the Kiganda-Bujumbura Mairie circuit

The milk VC studied was made up of actors who carry out their activities on a daily basis in the commune of Kiganda and in the province of Bujumbura-Mairie. The identification of these actors was a matter of itinerary: it was sufficient that the first actors were identified, others were indicated by them. The actors identified in the milk VC were - dairy farmers, collectors, wholesalers and retailers. One mini-dairy (Modern Dairy Burundi, "MDB") was not surveyed due to lack of data. All actors in this VC were identified from upstream to downstream, depending on the link at which they were positioned. Dairy farmers produced milk and sold it to local demand (collection cooperatives, government employees, hospitalized and non-hospitalized patients, local cafeterias, etc.). Some cooperative member dairy farmers instead preferred to sell their milk to other local buyers other than the collection cooperatives. Dairy farmers who were members of the cooperatives might sell their milk within the milk collection cooperatives and obtained livestock inputs from cooperative food and veterinary stores. They bought the package of livestock inputs proportional to the selling price of the volume of milk already sold to the cooperative. For this purpose, they distributed all the volume of milk produced between them and the different buyers (milk collection cooperatives and other buyers). The transport of the milk to the sales point could be provided by the dairy farmers or the buyer depending on the terms of the contract. All those who offered milk to cafeterias were involved in the transportation of milk on a daily basis. On the other hand, independent producers were free to sell their milk to any buyer who offered a higher price than other buyers. They sold the milk to retailers with cafeterias in the different localities of the commune, to local officials and to patients. As for the milk collection cooperatives, there were only two. One called "Abasangiragisabo" is located in the Kiganda zone and the other "Union des coopératives laitières" is located in the Gatabo zone. These cooperatives were developed under the financing of the State and the Project of Development of the Sectors II (PRODEFI II). They collected milk from the different zones in the commune of Kiganda. These cooperatives had milk collection agents, but in some cases the producer could decide to take the milk to the cooperative's headquarters himself, in which case the price of a liter of milk was increased by the cost of transport. The milk was collected by means of bicycles, plastic cans and aluminum jugs or by means of the head. The cooperatives had a headquarters, tanks to store the collected milk before it was sold to wholesalers, taps to keep the utensils clean, registers and notebooks to record the volume of milk collected and sold. They had also set up food and veterinary stores to facilitate farmers'

access to livestock inputs at a lower price than in other stores in the locality. After collection, these cooperatives sold the milk to wholesalers, local retailers and the mini-dairy (MDB). The retailers fell into two broad categories - five retailers (in the Gitabo, Kiganda and Renga areas) who bought milk directly from dairy farmers and four retailers (in the Kiganda and Gatabo areas) who bought from the milk collection cooperatives. One in Kiganda bought from "Abasangiragisabo" and the three retailers in Gatabo bought from the Gatabo Union of Milk Cooperatives. In Bujumbura Mairie, the twenty-seven retailers were indicated by the wholesalers who supplied them with milk on a daily basis and were located in the three communes of the Mairie. In some cases, milk from the commune of Kiganda did not fully meet the high urban demand. In such circumstances, retailers who did not have the required quantity of milk were forced to buy it outside the studied circuit, especially from wholesalers who sold milk from Gihanga, the most important production site. The additional quantity of milk, i.e., coming from a place other than the studied circuit, had not been evaluated in this paper. The wholesalers bought the bulk of the milk from the headquarters of the two collection cooperatives, of which they were also members, and transported it to Bujumbura Mairie, where the most important market was located.

Mapping of milk volume flows
The results from the survey allowed us to map the milk volume flows from input supply to final consumption (*figure 1*). Wholesalers and retailers often suffered losses of an accidental nature, but these were very negligible. For wholesalers, this loss had been estimated at 0.5liter of milk per day per wholesaler. The loss could also be of a spoiled nature, but in this case, the milk was returned directly to the suppliers if this loss was manifested at the time of receipt of the milk and the latter endured it. These losses were due, for example, to an accident during transport, the time of heating, etc. For retailers, when the spoiled loss was found at the time of receipt, the milk was returned directly to the suppliers, but on the other hand, they endured it. All losses have been calculated and included in the figure 1. The remaining proportions were sold because in the absence of losses, the actor should sell the entire quantity purchased. But this rarely happened. The level of self-consumption of milk in Kiganda commune remained too low (13%), and the rest of the total volume produced (87%) was taken directly to Bujumbura Mairie to be resold and consumed because the demand was too high there. The low level of milk consumption was due to the fact that it was not part of the consumption habits of most households in Kiganda commune and their purchasing power remained very low. Thus, they preferred to sell it in order to acquire the financial means to meet their imminent needs instead of consuming it.

Economic analysis
The economic aspects as studied in this paper focused on the process of creation and distribution of added value between different actors of the milk VC.

Monthly profit margin for dairy farmers
Dairy farmers were involved on a daily basis in the supply of livestock inputs, production, milking and in some cases the transportation of milk from the place of production to the place of sale of the milk. The transport of milk for the producer depended on the terms of the contract. For this, they incurred costs related to these activities. The average total monthly cost of production of a liter of milk supported by each farmer surveyed was 497 (BIF) [US$0.24] per liter and the selling price of a liter of milk was between 600 [US$0.29] and 800BIF [US$0.387]. The added value was 65,824BIF [US$31.83] per dairy farmer per month. Their average turnover was 134,894 BIF [US$65.23]. The table 1 groups the dairy farmers according to the margin interval in which they were classified. According to this table, only 13% of dairy farmers had negative profit margins, i.e. their production costs exceeded the volume of milk produced. In other words, they were producing at a loss. On the other hand, 87% of dairy farmers had positive average monthly profit margins. Thus, 8% of producers had profit margins between 1 [US$1/2067.94] and 100 BIF [US$0.048] per liter, 25% had profit margins between 100 [US$0.387] and 200 BIF [US$0.0986] per liter, 42% received margins between 200 [US$0.0986] and 300 BIF [US$0.145] per liter, and 13% received margins between 300 [US$0.145] and 400 BIF [US$0.193] per liter.
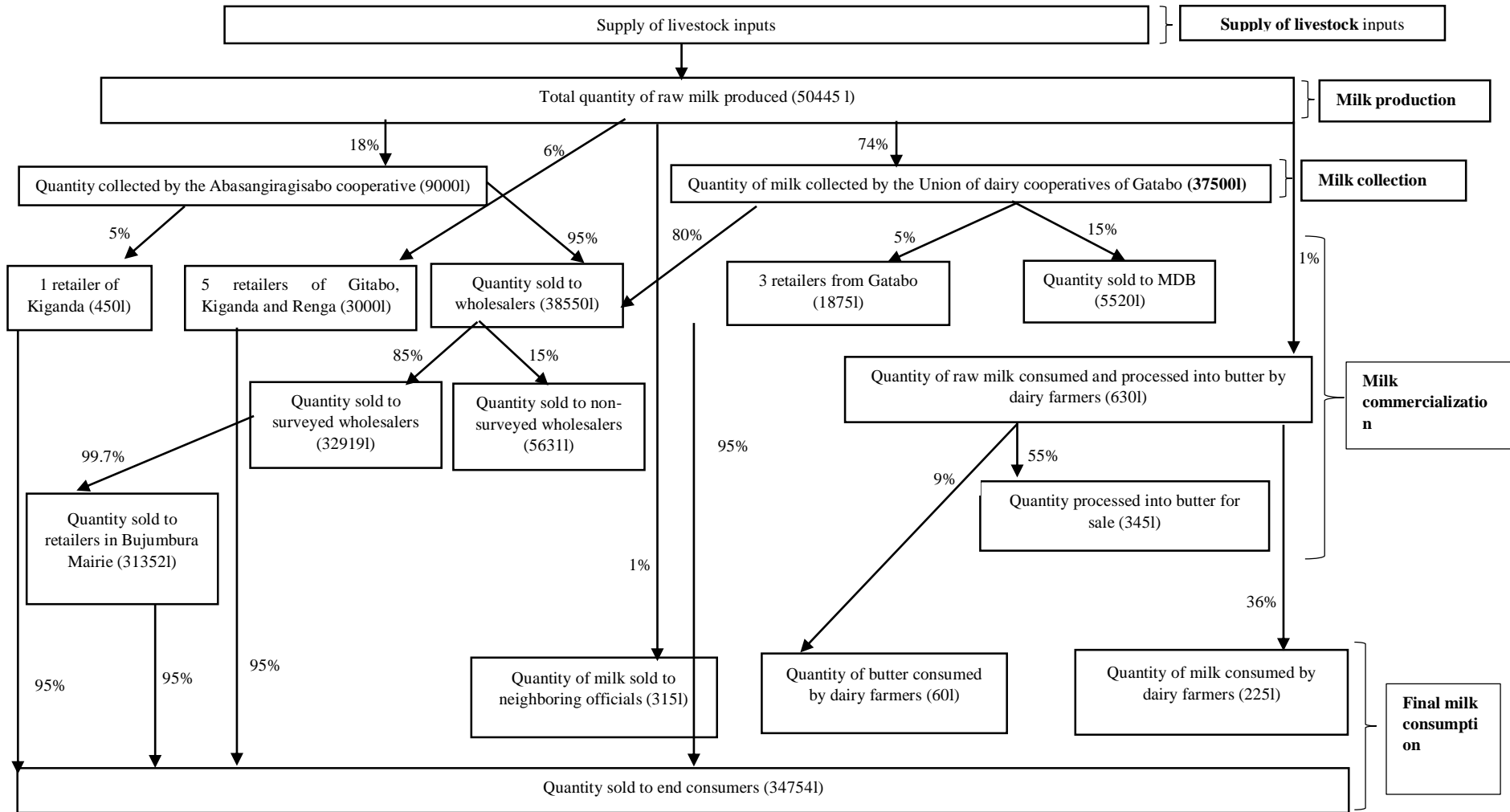
Figure 1

Milk volume flow map (source: authors)

Supply of livestock inputs	**Supply of livestock** inputs

Total quantity of raw milk produced (50445 l) — **Milk production**

18% 6% 74%

Quantity collected by the Abasangiragisabo cooperative (9000l)

Quantity of milk collected by the Union of dairy cooperatives of Gatabo (**37500l**) — **Milk collection**

5% 95% 80% 5% 15% 1%

1 retailer of Kiganda (450l)

5 retailers of Gitabo, Kiganda and Renga (3000l)

Quantity sold to wholesalers (38550l)

3 retailers from Gatabo (1875l)

Quantity sold to MDB (5520l)

85% 15%

Quantity sold to surveyed wholesalers (32919l)

Quantity sold to non-surveyed wholesalers (5631l)

Quantity of raw milk consumed and processed into butter by dairy farmers (630l) — **Milk commercialization**

99.7%

9% 55%

Quantity sold to retailers in Bujumbura Mairie (31352l)

Quantity processed into butter for sale (345l)

95%

1%

36%

95% 95% 95%

Quantity of milk sold to neighboring officials (315l)

Quantity of butter consumed by dairy farmers (60l)

Quantity of milk consumed by dairy farmers (225l) — **Final milk consumption**

Quantity sold to end consumers (34754l)

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Table 1

Margin distribution among dairy farmers

Margin class	Number	Relative frequency (%)
<1	3	13
[1-100[	2	8
[100-200[	6	25
[200-300[	10	42
[300-400[	3	13
Total	24	100

The average monthly profit margin of producers could be increased slightly considerably if income from manure, meat and many other related incomes were taken into account. For example, a basket of manure was sold on an average price of 1000 BIF [US$0.484]. Their average monthly profit margin was 187 BIF [US$0.09] per month per producer. Monthly profit margins ranged from 26 [US$0.012] to 309BIF [US$0.149] per liter of milk.

Monthly profit margins for collectors
The collectors (milk collection cooperatives) were responsible for collecting the milk from the production site to the headquarters of each of these two cooperatives. The collection agents were in charge of this on a daily basis. The collectors included costs related to the collection of milk - the cost of transporting the milk, labor, electricity, etc. The cost of transporting a liter of milk varied between 50 [US$0.024] and 60 BIF [US$0.029] respectively for Abasangiragisabo and the Union of Dairy Cooperatives. The total average monthly cost of a liter of milk supported by each collector was estimated at 672 BIF [US$0.32]. The purchase price of a liter of milk was 600 BIF [US$0.29] for both cooperatives, while the selling price varied between 700 [US$0.33] and 800 BIF [US$0.386] per liter. The two collectors realized an average added value of 16,555,400 BIF [US$8,005.74] per month. Table 2 shows the distribution of collectors by margin class. The table shows that these two cooperatives all had positive monthly profit margins. The "Abasangiragisabo" cooperative had a profit margin of between 70 [US$0.033] and 80 BIF [US$0.0386] per liter, while the Union of Dairy Cooperatives of Gatabo had a margin of between 80 [US$0.0386] and 90 BIF [US$0.043] per liter. Overall, the average monthly profit margin for all two milk collection cooperatives was 78 BIF [US$0.0377] per liter. Their average turnover was 18,150,000 BIF [US$8,776.85].

Table 2

Distribution of collector profit margins

Margin class	Number	Relative frequency (%)
[70-80[	1	50
[80-90[	1	50
Total	2	100

Monthly profit margins for wholesalers
Wholesalers incurred costs related to milk transport, heating, electricity, rent, water, labor, etc. Overall, the average total monthly cost of a liter of milk was 1,053 BIF [US$0.5] per month per wholesaler. The purchase price was 700 BIF [US$0.33] and the selling price varied between 1,000 [US$0.483] and 1,400 BIF [US$0.677] for a

liter of milk. All the wholesalers surveyed were members of these two cooperatives at the same time. Their average monthly turnover was 7,257,480 BIF [US$3,509.5]. The value added was 6,084,692 BIF [US$2,942.39]. Table 3 shows the distribution of wholesalers according to their margin class. This table shows that all five wholesalers surveyed had positive average monthly profit margins. 40% of wholesalers had profit margins between 30 [US$0.0145] and 40 BIF [US$0.0193] per liter, 40% had profit margins between 40 [US$0.0193] and 50 BIF [US$0.024] per liter, and 20% had margins between 70 [US$0.0338] and 80 BIF [US$0.0386] per liter. The average monthly profit margin was estimated at 47 BIF [US$0.022] per liter per wholesaler. Although their average monthly profit margin per liter was very low compared to other actors, they bought and sold the greatest volume of milk per month (figure 1).

Table 3

Distribution for wholesalers' margins

Margin class	Number	Relative frequency (%)
[30-40[	2	40
[40-50[	2	40
[70-80[	1	20
Total	5	100

Monthly profit margins for retailers
Retailers incurred costs to fully accomplish their daily activities and these were related to heating milk, labor, electricity, payment of the communal tax and/or the Bujumbura town hall, rent, etc. The average total cost of a liter of milk was estimated at 1499 BIF [US$0.725] per month per retailer. The purchase price varied from 600 [US$0.29] to 1400 BIF [US$0.677] and the selling price varied between 1200 [US$0.58] and 2000 BIF [US$0.967] per liter depending on the economic environment where the milk trade took place. Their average monthly turnover was 1,818,733 BIF [US$879.49] per retailer per month. The average monthly value added was 15,633,767 BIF [US$7,560]. Table 4 shows the distribution of the retailers' margin. All 36 retailers surveyed had positive average monthly profit margins. This implies that their business was profitable. 61% of them had margins between 100 [US$0.08] and 200 BIF [US$0.0967] per liter, 33% had margins between 200 [US$0.0967] and 300 BIF [US$0.145] per liter, 3% had margins between 300 [US$0.145] and 400 BIF [US$0.193] per liter and 3% had margins between 400 [US$0.193] and 500 BIF [US$0.24] per liter. Their average monthly profit margin was 201 BIF [US$0.097] per liter for each retailer. The monthly profit margins varied from 122 [US$0.058] to 482 BIF [US$0.233] per liter of milk

Table 4

Distribution for retailers' margins

Margin class	Number	Relative frequency (%)
[100-200[	22	61
[200-300[	12	33
[300-400[	1	3
[400-500[	1	3
Total	36	100

Summary of monthly profit margins for actors

The table 5 shows the distribution of monthly profit margins per liter for the different actors surveyed. The difference between the monthly profit margins was largely justified by the total costs that each actor incurred in carrying out their daily activities. This implies that the more costs an actor incurred, the lower his monthly profit margin. Based on this table, it is clear that retailers benefited more from the milk VC than the other actors involved. They realized a monthly profit margin of 201 BIF [US$0.097] per liter. Dairy farmers received 187 BIF [US$0.09] per liter. Collectors (collection cooperatives) received 78 BIF [US$0.038] per liter and wholesalers received 47 BIF [US$0.022] per liter.

Table 5

Distribution of the average monthly margins for actors

Actor	Monthly profit margin (in BIF/l)
Retailers	201
Dairy farmers	187
Collectors	78
Wholesallers	47

Discussion

The dairy sector is crucial to the economic development of rural areas and ensures food security, especially in the fight against child malnutrition. It provides an important source for high-quality protein and micronutrients (Bennett *et al.*, 2006; Navarro, 2014). This paper aimed to conduct an analysis of the milk VC from an economic perspective in order to make its improvement. The study of milk VC on the Kiganda-Bujumbura circuit showed an uneven distribution of low margins among the actors involved in the VC. Upstream, dairy producers were small-scale dairy farmers with a low margin with some dairy producers (13%) achieving a negative margin. The production (output) and productivity (efficiency in combining production factors) were relatively low in terms of milk per cow and per day and in terms of the proportion of cows in lactation. Dairy producers raised the local breed of one or two cows. This local breed produces small quantities of milk, resulting in high production costs by comparing feed costs and milk production. Some small farmers raised cows to obtain organic manure preferred to chemical fertilizers, which contribute to soil and environmental degradation. This situation is similar to that in Rwanda. Small dairy farmers have low milk production, ranging from 0.7 to 3.2 liters per cow per day. The main reasons for Rwanda's low yield are the prevalence of local breeds, which by nuture do not supply high yields, and inadequate nutrition through either grazing or feed. By comparison, Kenya's average annual yield per cow is between 290 and 990 liters. Developed countries can achieve up to 8-9,000 liters per cow annually (East Africa Dairy Development , 2008). Before the law on permanent stabling, pastures were community meadows. Feeding was only a significant problem during the summer months. Inputs - crop residues, couch grass, *Commelina benghalensis*, etc. - were exchanged free of charge between farmers, but are now exchanged for money. Nowadays, with the law in application, livestock inputs are expensive. Dairy farms rely on naturally growing or cultivated grass as the sole source of nutrition. The policy of permanent stabling should be accompanied by increasing the cultivation of fodder crops for livestock feed. However, the high population density is a serious challenge for the cultivation of fodder crops. Farmers do not have enough arable land to grow feed for their livestock. The average arable land per farmer in Burundi is 0.5 hectares. Farmers prefer to grow crops for household consumption rather than fodder crops. Breeding improved breeds has high production and productivity. This type of breeding is restrictive for small-scale farmers with insufficient financial resources to purchase feed and veterinary services. In

addition, the improved breed is highly vulnerable to disease compared to the local breed. As a result, some farmers are risk-averse to this type of breeding. The most common method of genetic improvement used is the crossbreeding. Another factor driving up production costs is the collection and transport of milk to the cooperatives. Scattered farmers incurred high costs due to the low quantities produced and the collection and transport carried out called into question the quality of the milk collected, especially as this commodity is perishable, explaining partly the return of milk considered to be of poor quality. Improving dairy production from the supply side implies that substantial investments need to be made for increasing the productivity of dairy farming - through better feeding, improved breeds, and cattle management (Markovic & Dries , 2013; Ruben, Bekele, & Lenjiso, 2017).

A change of mentality in the production process is decisive in terms of organization to improve the performance of the dairy sector in the area studied. Co-operatives emerged worldwide in the dairy sector as an instrument to alleviate the vulnerability of dairy farmers and bundle resources. By pooling their supply and operating collectively owned dairy processing plants, dairy farmers were able to minimize their market risk. Though changes in technologies and transport have changed these patterns in many countries, the dairy sector remains largely co-operatively organised with dairy co-operatives ranging from very small scale to globally acting businesses, and varying levels of co-operative-private capital mixes (Oechslin, 2020; Knips, 2005). Studies (Holloway, 2000; Francesconi, Heerink, & D'Haese, 2010) on Ethiopia dairy development suggest that farmers' participation in dairy cooperatives resulted in a significant increase in the volume of milk production and market supply due to improved productivity. Impact measurements by comparing dairy cooperatives with individual dairy farmers suggests that cooperative organization has indeed a positive effect on commercial milk production and cow productivity. Dairy producers in the study area would benefit from being grouped into associations or cooperatives. They should benefit from economies of scale in production and marketing. They can also benefit from aid

(donations, subsidies in terms of cow or material) from public authorities and other non-governmental organizations. They will also have easy access to mentoring services, training in techniques related to balanced livestock feeding, milk collection and storage. They would also have access to veterinary services, which are costly for individual and isolated dairy farmers. Low milk production may be due not only to the breed, but also to inadequate feed in quality and quantity such as low energy diets based on crop residues and by products, supplemented with leguminous fodder and a small quantity of feed concentrate. Breeding the improved breed, which is costly for individual dairy farmers, becomes easy and productive if small farmers form associations or cooperatives. Working capital requirements, mainly for fodder and veterinary services, would be financed by agricultural credits that are difficult to access individually due to lack of collateral and mortgages. Isolated dairy farmers in rural areas face information asymmetries in terms of prices for raw milk and/or pharmaceutical products. Grouping into associations or cooperatives facilitates the acquisition of reliable information in real time. Associations/cooperatives also increase negotiating power in terms of sales prices with other actors in the supply chain. Individual dairy farmers in the area are ruled by verbal (or even tacit) contracts to market their raw milk to the collecting cooperatives. The contracts of producers in associations would therefore be in writing, with clear and protective clauses for the parties involved in the contractualization. An efficient milk collection and distribution system to bring milk from the farmer to the end consumer is a critical factor in dairy development. Producers, collectors and distributors must be provided with specific equipment for milk collection, pasteurization, cooling, storage and distribution. In the case of dairy chain in Zambia, farmers involved in modern channels greatly benefited from improved breeds, tools, and operational management techniques to increase their milk output (Neven *et al.*, 2006). The appropriate equipment will enable to add value to the product but also benefit to consumers. Consumer preferences and shopping habits are rapidly changing. Urban or/and rural consumers face a wider choice of outlets and supermarkets are

taking a growing market share. Quality of products and reputation of its origin are vital in shaping the choice of consumers for particular shops and markets (Tschirley, Haggblade, & Reardon, 2014). Public advisory services and formal training should be valued highly by the public services or development projects. Few extension agents are trained in livestock production and do not have sufficient practical experience in dairy to effectively serve farmers. The training will also cover the management of manure from livestock, which causes serious environmental problems through its emission of greenhouse gases.

In many developed countries, the dairy market is one of the most heavily regulated agricultural markets. Government interventions in the domestic dairy market are most commonly aimed at controlling quantities of production, establishing minimum prices and guaranteeing farmers' incomes (Oechslin, 2020; Knips, 2005). In Burundi, the public authorities are the guarantors of the agropastoral sector, they must ensure that dairy sector standards are observed and put in place regulatory measures for any discrepancies observed. They must ensure fairness in the distribution of the profit margin between the various actors directly involved in the sector, by setting fair prices and guaranteeing the quality standards of the milk consumed in rural and urban areas. The improvement of infrastructures and the establishment of a reliable electrification system are the responsibility of the public authorities.

Conclusion

Analyzing the dairy sector using the VC tool makes it easier to improve the sector's performance and development by acting on the constraints, strengths and weaknesses identified.

Dairy industry development is achieved by implementing concrete and practical actions at all levels of the industry's actors. The economic study of the milk VC on the Kiganda circuit has shown that the players in the chain achieve low margins due to high production costs. For small-scale dairy farmers, this cost is explained by the fact that they breed a limited number of local cows, which by nature produce little milk. In addition, the lack of quality and quantity of feed means that this local breed does not produce at optimum levels. Milk production and productivity would be improved by breeding the improved breed. However, this type of breeding is highly restrictive for isolated smallholder dairy farmers with insufficient financial and material resources. Farmers are also incurring high transport costs. Organizational structure change is a key driver in improving margins for farmers. Small dairy farms would benefit from being grouped into associations/cooperatives. These structures offer intrinsic advantages, notably in terms of economies of scale, access to sources of financing, donations, supervision, veterinary services, etc. To maintain the quality of the dairy product, the actors in the sector need to be equipped with the appropriate equipment, given that milk is perishable product. Public authorities must ensure that dairy sector standards are observed, and introduce regulatory measures in the event of any discrepancies in terms of prices and/or the achievement of fair margins between the various actors. The improvement of infrastructures and the maintenance of a secure electrification system must be a permanent concern for public authorities.

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