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Factors and Components Affecting Dairy Smallholder Farmers and the Local Value Chain— Kvemo Kartli as an Example

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Abstract: Smallholder farmers are the cornerstone of the livestock sector and an essential element in building and developing the local dairy value chain, critical for developing its local economy. In Georgia, and despite the efforts made since independence from the Soviet Union until now, farmers still face many problems that prevent them from participating effectively in developing the dairy value chain, especially heavy metal pollution that afflicts the study region. This research study refers to smallholder farmers' viewpoints in the Kvemo Kartli region on the dairy production sector and the problems these farmers face. This study also investigates the effect of several factors (ethical factors, traditions, animal welfare, cultural factors, etc.) on the dairy value chain. The convergence model was used in the mixed-method approach's triangular design as a methodology for this research study. As part of the social data, 140 farmers who produce and sell milk and cheese in the Kvemo Kartli region were interviewed. The results showed the influence of the ethical, cultural, and traditional factors in developing the value chain. The results also showed the problems and difficulties small farmers face in rural areas, on the one hand, and the gap between these farmers and governmental and private organisations on the other hand. These results are compared to those of a previous study, where interviews with experts in Georgia's dairy production sector were performed.

Keywords: dairy products; value chain; smallholder farmers; food safety; heavy metals; Georgia

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1. Introduction

Studies indicate that about 75% of the farms in the world are family farms, as most of them are small family farms. Despite the different development and modernisation policies that each country adopts to advance the agriculture field in all its sectors, smallholder farmers face many challenges at the local and international levels [1].

Smallholders are the backbone of the economy in countries that depend heavily on agriculture. The dairy sector is one of the most important agricultural sectors for smallholder farmers, as it plays a fundamental role in their daily income and self-sufficiency as well as food security [2–6]. If farmers are forced to change their behaviour due to international hygiene standards without suitable governmental solutions to support them, social problems will arise, and economic issues will appear for society. Thus, this may lead to the farmers' abandoning their farms. The resulting consequences may be drastic, which may occur in fundamental changes in the landscape due to the lack of pastoralism and the inadequate supplies and nutritional status of former smallholders [2–7]. The change will also affect the range of goods; for example, instead of traditional Georgian cheese, it will be replaced by the international cheese ''type gouda."

In Georgia and most developing countries, milk production depends on smallholder farmers. It also contributes to securing family livelihoods, supporting food and nutrition sovereignty, and maintaining food safety [8–10]. Therefore, smallholder farmers in these countries are considered one of the most important actors in developing the agricultural

sector. Milk production is an integral part of the small farm economy in Asia and many other countries. It is what provides them with self-sufficiency in terms of food and some cash. For example, smallholder dairy producers in countries such as China and Thailand account for a large part of the economic policies adopted in developing the dairy sector. Many smallholder farmers in these countries have become able to compete and grow their produce [11–13].

On the other hand, there are several countries in which the dairy production sector at the local and international levels is still in the initial stages, and there are continuous attempts to develop and advance it to reach the level and efficiency of local and international standards. In countries such as Georgia, Pakistan, Bangladesh, Mongolia, and others, smallholder farmers mainly contribute to the provision of milk. However, the dairy value chain in these countries is still under development to meet the local requirements of dairy and cheese, and then to try to reach production efficiency with international standards that would help develop this chain [11–13].

However, dairy production growth in developing countries globally results from an increase in the number of animals kept rather than an increase in productivity per head [10,14]. The low quality of feed, animal care and disease prevention, the demand of access to markets, and the utilisation of all available services in turn lead to the non-development of the dairy value chain [10].

Dairy production is one of the oldest agricultural sectors in the Kvemo Kartli region in Georgia [15]. The dairy market in Georgia is one of the most important economic sectors in the country; Georgia annually produces approximately 500 million tons of milk [16]. The smallholder farmers are the main and the most important producers of milk. However, smallholder farmers sell milk through informal channels without any health or legal supervision, as most of them do not have the necessary experience to produce milk with safety specifications [15,16].

The collapse of the Soviet Union for Georgian farmers was a huge turning point in every aspect. In the Soviet era, there were collective farms that kept stock of breeds in the dairy sector, but in the post-Soviet period, these farms no longer existed. Small land areas were allocated to all smallholder farmers and provided access to common pastures [17–20].

Nevertheless, because of the civil war and all the economic and political problems and crises that the country suffered from, smallholder farmers mainly adopted diversified subsistence farming, with a few cows or small numbers of other farm animals (such as chickens, sheep, goats, pigs, etc.). They also cultivated some crops to feed livestock and others for personal consumption [19].

At that time, the economic conditions were deplorable, so small farmers relied on producing milk and selling it in the local market in their villages or sending it to Tbilisi with a third person, earning some money to barter this milk for other food products [19,21,22]. Non-cash exchange trading became very popular, for example, exchanging cheese for hay.

It also appeared that farmers sent their livestock daily with the village herds to the pastures; the shepherd supervised them. Thus, there was no supervision or control over the reproduction of this livestock or the bulls' quality. As local breeds of adapted and unimproved cows increased, there was limited potential to improve productivity in the dairy and meat sector [19,23].

At the time of the collapse of the Soviet Union, the available veterinary services collapsed, including all the other services that were provided for money despite their low quality and poor value. The relationship between farmers and veterinarians was damaged, as there was a lack of trust in all parties' services [19]. The changes that occurred during the collapse of the Soviet Union and afterwards in Georgia affected women in particular, as the responsibility for livestock farming, cleaning and feeding the animals, and milking the livestock was the women's share, including processing dairy products and making cheese [19,24].

Women had enough experience at that time to know if disease had afflicted any of the livestock, and they were also able to diagnose these symptoms and order the necessary

medicines. However, in the pre-and post-Soviet era, women were suffering from limited freedom in society due to social and cultural reasons. As men were doing all the work outside the home, women had limited access to any new information or development in agriculture and livestock [19,24,25].

In the past few years, and during the reforms being undertaken by the country, the Georgian economy was in an essential stage of transformation [26], and especially after 2004, intensive work was done on developing concepts and methods of working economic strategies and deepening the concept of economic liberalisation [21]. Despite this, small farmers who live in rural areas still depend on dairy products. They use the state's pastures for grazing and send their livestock to mountain grazing areas accompanied by the shepherd in the summer season, informally. They depend heavily on hay in the winter [22,27].

This study is considered part of several research pieces, some of which have been published [28,29], which delved into experts' opinion in developing the dairy value chain in Georgia and farmers' perception regarding water quality and risks in the Mashavera River Basin in the Kvemo Kartli area.

As several studies also dealt with water and soil analyses in the Kvemo Kartli region in Georgia, this region suffers significantly from heavy metal pollution. Therefore, this research aims to determine the problems that farmers suffer from on the ground and the extent to which food safety systems are applied and compare them with experts' opinion.

1.1. Socio-Cultural Factors

The citizens' concept of sustainability in the livestock sector illustrates the critical and fundamental role of values. For many, especially smallholder farmers, sustainability is a socio-cultural concept of livestock production systems [30]. In Ethiopia or the Netherlands, for example, the socio-cultural aspect plays a critical role. Production is not the only goal of the dairy sector, but several considerations must be taken into account, such as the connection of dairy and cheese production to the national or agricultural culture and the technology used for production, which may differ according to different cultures and traditions [30,31]. For Azerbaijan, Armenia, and Georgia, the socio-cultural concept was greatly important, especially in the transition period [32].

The dependence of smallholder farmers in Georgia on producing milk is substantial. The production and sale of milk and the manufacturing of many types of cheeses are still the cornerstones of Georgian society and Georgian culture [33]. However, producing high-quality milk requires technical skills and accurate knowledge for every dairy value chain step. Despite their extensive and ancient experience in milk production and its derivatives, farmers in Georgia face many problems represented in the lack of training and failure to keep pace with modern technology and the inability to control the market [33,34]. For example, the increase in the import of powdered milk, and the increase in the demand for it by large dairy producers, negatively affected small farmers. In 2016, the import of milk powder reached 8.34 tons, compared to 2017, when it increased to nearly 9862 tons [33,35].

Farmers, relying on their ancient culture and traditions, do not see that self-managed animal feed is necessary to feed their livestock. They depend entirely on pastures, as some practices still exist even after the Soviet Union's collapse, e.g., farmers grazing their livestock together [23]. Farmers send their cows with a shepherd to feed on the pastures, or the peasants take turns doing that daily, but if the farmer is unable to do so, he hires a shepherd to do this task [23].

As farmers who do not have the time or ability to take care of their livestock, they sometimes rent their cows to other farmers or milk production companies that pay them in cash or give them in return products such as cheese or butter [23]. The old norms of dealing between farmers and milk collectors still exist, as all that is agreed upon is verbally between the two parties, and the payment process for farmers is either weekly or every two weeks. However, some farmers prefer advance payments for other needs. The milk collectors sometimes depend on giving the farmers some of what they need (such as fodder,

for example) and thus deduct the feeding cost from the final amount to be paid to the farmer in exchange for milk [23]. These traditions, which depend on the ancient peasant culture, still dominate Georgian society in the countryside to a large extent and build a steady bridge of trust between farmers and milk collectors [36].

Religious culture also has a significant role in Georgia, and it also affects the demand for dairy products. As the majority of Georgians are Orthodox Christians, the rates of demand for dairy products decrease during fasting periods; thus, prices are significantly affected by this, as farmers are affected automatically during this period. In the post-fasting period, the demand for these products increases dramatically, and consequently, the pressure on prices increases, which directly affects farmers [23].

1.2. Socio-Demographic and Socio-Economic Factors

Socio-demographic factors such as gender, family, and language, socio-economic statuses such as income, education, employment, and locality or living area are essential vital factors that directly affect farmers and the existing agricultural economic system [37–40].

According to the Eurostat report in 2019, the National Statistics Office of Georgia (Geostat) follows the international standards in labour market statistics. Still, there are some exceptions; in Georgia, farmers who produce goods for their consumption are classified as workers. The percentage of these people is considerable, which directly contradicts the International Labour Organization (ILO) concept, as the rate of employment in Georgia is overestimated. In return, there is a low rate of unemployment compared to other countries [41].

Figure 1 shows the difference in the population between urban and rural areas in Georgia. It shows that the proportion of the rural population has decreased since 1926, reaching 41.0 in 2020 compared to previous years [42,43].

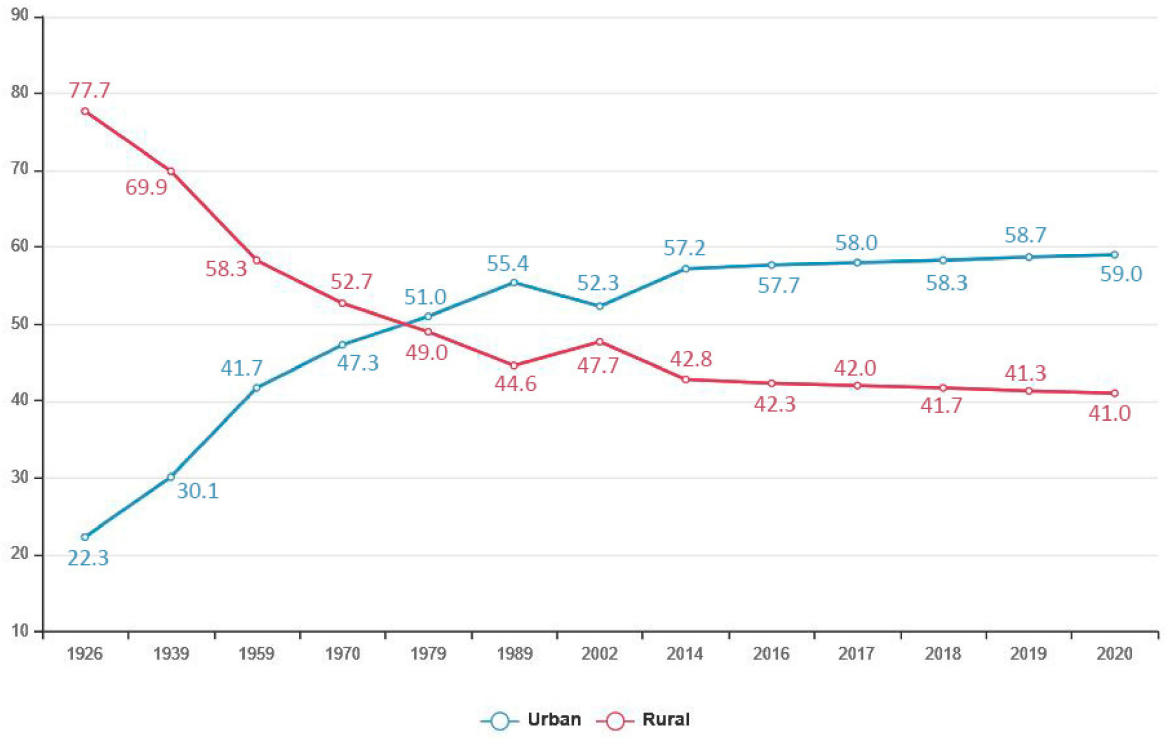

Figure 1. Distribution of the Georgian population (%) in urban and rural areas [29,30].

Based on the Geostat report 2016, the number of populations in the Kvemo Kartli region has decreased significantly compared to the 2002 census, dropping to 14.6% compared to the capital Tbilisi people, which increased by 2.5% [44].

As Georgia has undergone massive changes since the collapse of the Soviet Union and its conflicts, many constructive initiatives and programs have emerged that help develop the countryside and support smallholder farmers [17,18,45,46].

The government promoted women in rural areas, provided the necessary support for them in agricultural businesses and cooperatives, and supported their participation in industry and their inclusion in local decision-making bodies [47,48]. Based on the IFAD report in 2018, rural women's access to information, available services, and decision-making are much lower compared with men in Georgian agrarian society. Therefore, according to the United Nations Global Gender Gap Index, Georgia is ranked 90 out of 144 countries [47]. The average male income in Georgia's agricultural sector is 25 per cent higher than that of women, as women own only about 31 per cent of the farms, which is almost a quarter of the farms owned by men [47].

The access of farmers in rural areas to and control of the market is complicated, especially with respect to climate change. Smallholder farmers face new risks, but they do not have sufficient knowledge of adaptive measures and cannot afford them. This development represents a new threat that may threaten rural areas [47,49].

Based on the Geostat report in 2019 (Table 1), the farmers' share of the sale of agricultural products concerning the household's total income decreased in 2019 to 5.5% compared to 6.4% in 2016 [43].

Table 1. Farmers share of agricultural products from the total income of the household (%) [30].

Year	2016	2017	2018	2019
Share of income (%)	6.4	4.7	5.5	5.5

All these factors subject Georgia dairy production to significant challenges: the decline in the population in rural areas, the increase in poverty, and the loss of dynamism and entrepreneurship in those areas with a rise in the emigration of young people and a small number of retirees, who depend for their livelihoods on remittances, as well as social transfers and subsistence farming [35,47].

1.3. Ethical Factors

The Georgian society relies heavily on animal products and, in particular, on dairy products [22]. The demand for these products increased in the past years, and this massive increase in production raised a wide range of ethical issues. One of the most important of these issues is the concern for animal welfare [50].

Consumer awareness of food quality and safety has increased dramatically, as animal products' ethical factor has played a significant role in consumer behaviour [51,52]. On the other hand, dairy producers, retailers, and the food industry are demanding higher standards for animal welfare to obtain superb quality, which supports the economy on the one hand and maintains food safety and food security standards on the other hand [50]. All this prompted small farmers and large landholders to think about the safety and welfare of the animals.

Animal welfare is a complex subject that differs from one culture to another. It is a subject that has scientific, cultural, social, ethical, religious, and political dimensions. Providing safe food for people depends on the health and productivity of these animals [50]. For example, the state legislation that aims to support animal welfare in farmers' opinions is not entirely fair from a political perspective. The increase of such laws creates a feeling of insecurity among farmers and undermines confidence in the political decision [26,33,50].

Regarding traditions, studies have shown that rural farmers have a common understanding of the cultural, political, economic, and social context of what it means to be a good farmer. Therefore, modern financial plans and legislation aimed at developing the dairy sector and increasing interest in animal welfare are considered by many farmers as a threat because this contradicts their culture and deep-rooted traditions [26,33,50,53].

Besides, these farmers' experience is also a significant factor, especially in the ethical matter. Political decisions, which aim to increase farmers' awareness and knowledge, play a major role in creating a communication bridge between them and the responsible parties [33,50]. As a result of all the circumstances that Georgia went through, from the collapse of the Soviet Union to the internal problems that the country suffered from, small farmers were and still face many issues in the dairy production sector [26]. The lack of fodder and the limited pastures available for grazing cows are among the most critical problems facing farmers. The lack of adequate shelter for animals or places prepared for them in terms of health in rural areas increases the dangers that animals suffer [53]. The farmer's use of antibiotics in animal foods is due to the lack of health care caused by the lack of veterinarians [54,55]. The human consumption of these dairy products and milk may generate diseases and resistance that may be transmitted to farmers and threaten their safety and health [54,55].

In an attempt by small farmers to take care of the animals and in an effort to increase the quality of the dairy products, families owning many cows are trying to secure enough food from the grass in the summer and wheat, corn, and straw in the winter, despite the high prices of these materials, and to keep pace with animal welfare regulations [33,53]. In the Kvemo Kartli region, most farmers own a small number of cows with low productivity. Thus, securing the necessary fodder may be a problem for them compared to those with extensive holdings [53].

2. Methodology

2.1. Study Area

The research study was conducted in southeastern Georgia in the Kvemo Kartli region (see Appendix A, Figures A1 and A2). A survey on smallholder farmers' dairy production was completed in eight villages in Summer 2019 (Figure 2) in the Bolnisi and Dmanisi municipalities (Chapala, Vanati, Bolnisi, Mtskneti, Sabereti, Ratevani, Kazreti, and Kvemo Bolnisi).

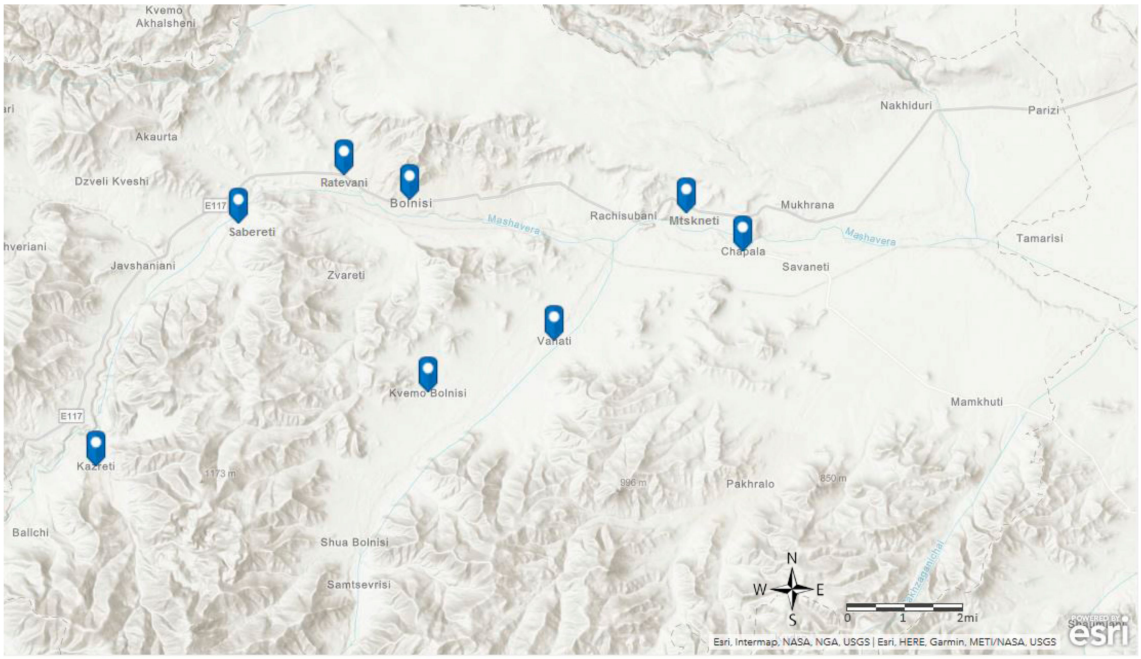

Figure 2. Map of the study area (Authors' illustration); ArcGIS Pro Data sources: Base map layer; ESRI satellite (ArcMap).

The Kvemo Kartli region of Georgia is considered the largest beef producer in the country and is close to the capital, Tbilisi. The primary source of income for families in this region depends on livestock, cattle, and sheep. According to Geostat statistics 2019 [56],

the Kvemo Kartli region has holdings oriented mainly on livestock production (18.4 per cent), which is the highest percentage compared to the rest of Georgia's regions. The total population of Kvemo Kartli is 434.2 people. In comparison, 244.5 inhabitants live in rural areas [43].

The total number of smallholder farmers in the Kvemo Kartli region is unknown. Many families do not depend on agriculture or raising cows or other husbandry animals in their living. However, they own a small number of cows and do officially sell their milk as raw milk or as homemade cheese. For this reason, it is difficult to know the actual number of farmers working in this field until now.

Smallholder farmers suffer from several problems, for example, the absence of modern agricultural machinery, the difficulty of accessing the local and international markets, the lack of knowledge of the current developments in the dairy markets and their production methods, and the problem of accessing veterinarians. Despite all these difficulties and challenges, producing good quality meat and dairy products is a growing market in Georgia.

2.2. Mixed Method Approach

This study relied on the convergence model in the tripartite design of the mixed-method approach. The use of a mixed-method design allows questionnaires or surveys and interviews to be conducted together [57].

As shown in Figure 3, we used the experimental design of qualitative and quantitative surveys and interviews as primary data. Data and information for the dairy sector in Georgia were approved as supporting data. The results of the interviews with dairy experts have been published [57]. This publication aims to present a quantitative survey with Georgian farmers and discuss the factors given expert opinions.

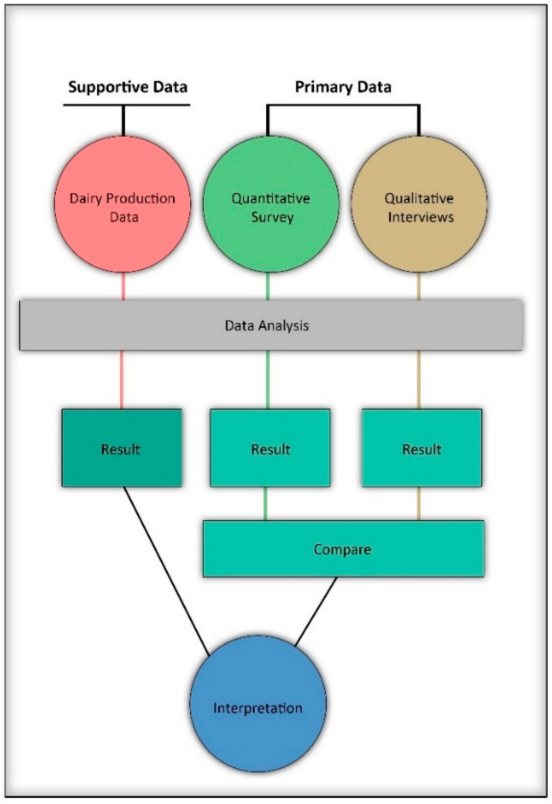

Figure 3. Study-method design (Adaption from Creswell and Clark (2006)).

2.3. Survey and Data Collection

All data used in this study were collected through a survey conducted in Georgia's Kvemo Kartli region. We collected these data from eight villages in June 2019. These villages were chosen based on our previous research, which showed heavy metal pollution in water, soil, and plants. We wanted to get in close contact with the smallholder farmers who live in this region and know the problems occurring in the area and their adherence to food safety standards in dairy production.

When we entered these villages, we did not establish any particular criteria to select the farmers whom we wanted to interview. Most farmers are not very welcoming to strangers, especially those who gather information, because they think they work for the government. Besides, these regions are known for having multiple nationalities. There are Georgians, Azerbaijan's, and a few Russians. Therefore, field trips were carried out to meet all the difficulties facing us.

The questionnaire was based on open and closed questions. All participants in this survey are smallholder farmers who depend for their livelihoods on raising livestock as a primary income or secondary income and on subsistence farming. The questions were arranged logically and interconnected with each other depending on the aim of this research. All interviews were face-to-face, and all these questionnaires were filled out during the interviews. Table 2 shows that the questionnaire was based on several factors (see Appendix A. Table A1), the most important of which are demographic and geographic factors, Georgian traditions, social and economic factors, and the ethical factor.

Table 2. The coded data and descriptive statistical analysis (N = 140).

Domains and Variables	Category (Coded)	%
Upstream (Input Supplies)		
Sociodemographic/Socio-Geographic		
Village	Chapala	20
	Vanati	7.1
	Bolnisi	15
	Mtskneti	13.6
	Sabereti	6.4
	Ratevani	13.6
	Kazreti	12.1
	Kvemo_Bolnisi	12.1
Gender	Male	75
	Female	25
Household socio-economic background		
Size of the household	Up to four members	46.4
	More than four members	53.6
Animal housing	Small barn with other animals	41.4
	Separate barn without other animals	17.1
	Outside small open barn with other animals	41.4
Dairy production or animal husbandry is the only financial income	Yes	12.9
	No	87.1

Table 2. *Cont.*

Domains and Variables	Category (Coded)	%
On-farm (production)		
General		
Started the dairy farm	More than 20 years ago	100
Basic knowledge of dairy farming	Yes	100
Reasons for starting dairy farming	Income	12.9
	Own consumption	32.1
	Both	55
Dairy farm structure, facilities, and management		
Other livestock on the farm	Hen	65
	Sheep	10
	Goat	5
	Calf	17.1
	Pigs	20
Number of cows	1–3 Cows	57.1
	4–7 Cows	22.1
	8–11 Cows	7.9
	12–15 Cows	7.9
	More than 15 Cows	5
Responsibility on the animals/farm	Wife, only	36.4
	Husband, only	2.9
	Wife and children	12.9
	Husband and wife	20
	More than two family members	27.9
Animal breed	Local breed	23.6
	Georgian mountain breed	2.1
	Both	7.1
	No idea	67.1
Cows for milk and meat purposes	Yes	100
Labour use in dairy farming		
Responsibility for feeding, cleaning, milking, and processing as well as marketing	One person	37.1
	Two people	33.6
	More than two people	29.3
Feeding		
Type of grazing for dairy animals	Free grazing (in the pasture) between March to August and no grazing between September to February	95
	Other	5
Feeding type	Grass	100
	Hay	70
	Corn	33.6

Table 2. *Cont.*

Domains and Variables	Category (Coded)	%
Sending the cows to the mountain in HS *	Yes	47.1
Enough fodder for dairy animals (for the entire year	Yes	3.6
Making conserved feed (e.g., hay)	Yes	3.6
Sources of water are available for animals	Khrami river	26.4
	Mashavera river	73.6
Satisfied with the water quality of the primary water sources	Yes	60
Water-amount enough for animals (yearly)	Yes	18.6
Output (Downstream)		
Milk selling point	Bazar	42.1
	Small Supermarket	30
	Collecting point (third person)	20
	On the road	17.1
Difficulties selling the milk	Yes	53.6
Cheese varieties	Sulguni	12.1
	Imeruli	39.3
	Sulguni + Imeruli	47.9
Cheese for marketing or self-consumption	Marketing	4.3
	Self-consumption	40.7
	Both	54.3
Milking techniques	With hand	100
Washing udder before and after the milking process	Yes	85.7

* HS: high season: from March to August.

The survey included 140 smallholder farmers, of whom 105 were males, and 35 were females. These interviews were conducted on the farms in Georgian and Russian languages with the presence of a translator. All farmers were selected randomly. Later, all data were transferred and saved in English. Upon completing the survey, all data for the survey were transferred to an Excel datasheet.

The number of farmers interviewed was not high, but it is sufficient to know the opinions of small farmers in the Kvemo Kartli region of Georgia [58], so the size of these samples does not allow generalisation of the results to all small farmers in Georgia.

As for the following research study, an analysis of raw milk samples and homemade cheese will be performed. These samples were collected from those farmers being interviewed to see whether the milk is contaminated with heavy metals. Recent studies have proven their presence in soil, plants, and drinking water [29].

2.4. Data Analysis

As Table 2 shows, all the data were transferred to an excel sheet as coded data, to show the descriptive statistical results for each section of the variables. Age was not considered in this questionnaire because most farmers refused to mention their age, either because of their society's customs or because they did not know their exact birth date.

Because of the importance of animal welfare, animal husbandry places in the survey were divided into three sections (small barn with the other animals, separate barn without other animals, and outside the small open barn with other animals). The questionnaire also led to knowing the source of water used to feed the livestock. The majority of the results were distributed between the Khrami River and the Mashavera River. As previous

studies indicated, these rivers are polluted with heavy metals [59–63], and farmers are dependent on these river waters as a significant resource (water and grass) for their animals. The factor"type of feed and livestock feeding areas" indicates the validity of the fodder provided to livestock and its sources and whether the farmer depends only on grass or other feed. SPSS version 27.0 (IBM, USA) software was used for all the statistical analyses, where the overall comparison between the survey factors was calculated using Spearman correlations (r_s). A *t*-test for independent samples tested whether the means of two independent samples were different. ArcGIS Pro was used to map the study area.

3. Results and Discussion

3.1. The Factors and Components Affecting the Dairy Farmers and Value Chain Development

3.1.1. Socio-Demographic Factors

The results showed that the percentage of male farmers who participated in the survey was higher than the women's share (75% to 25%). The questionnaire's demographic characteristics show how Georgian society has been affected by ancient culture and traditions. Women in rural areas still do not have enough freedom or access to the market and follow up on all agriculture developments, especially the dairy production sector. As the questionnaire results show (see Figure 4), women are mainly responsible for the livestock on the farm or at home. They are the ones who milk the cows and prepare the milk for sale or for home use in making cheese or other products. Some of the women we interviewed reveal this situation as:

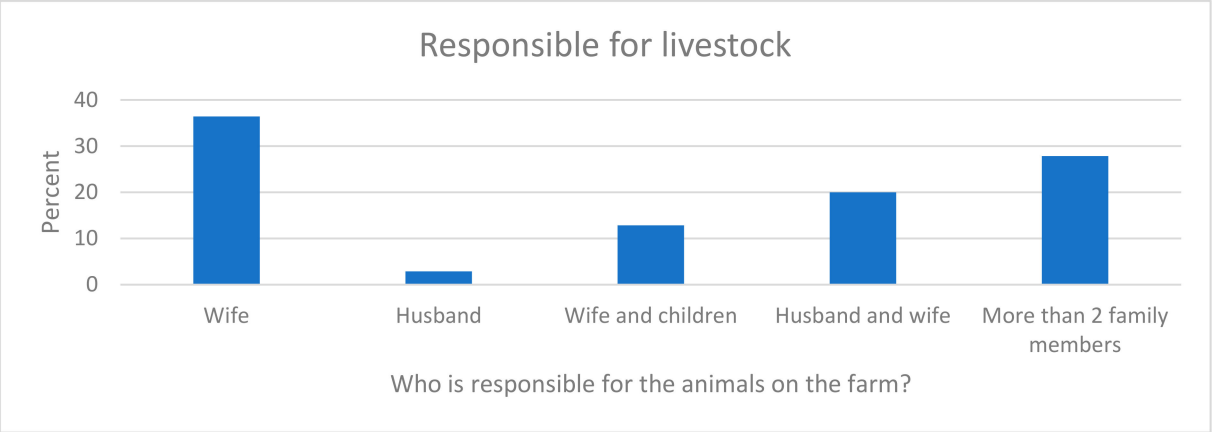

Figure 4. Persons responsible for livestock on smallholder farms in Georgia (N=140, Mean= 28, Std. Dev. = 18,207).

> I: *"We are the ones who do all the work at home. The men send the cows in the morning to the pastures only, and we are the ones who in the evening collecting the milk and preparing it for sale or to make cheese. This is the hard work and not selling the milk and cheese."* (9 June 2019, Chapala).

Other women stated that:

> I: *"My mom and grandmother did this work in the past; they milked cows and made cheese and prepared it for sale or home consumption. And here we are, doing the same work, nothing has changed."* (10 June 2019, Bolnisi).

3.1.2. Social and Cultural Factors

Furthermore, Georgian culture and traditions play an important role in rural society and directly influence livestock raising and marketing.

Figure 5 shows that 47.9% of the smallholder farmers interviewed use a large portion of the milk to make two types of cheese, Sulguni + Imeruli, as these two are among the most consumed types of cheese in Georgia.

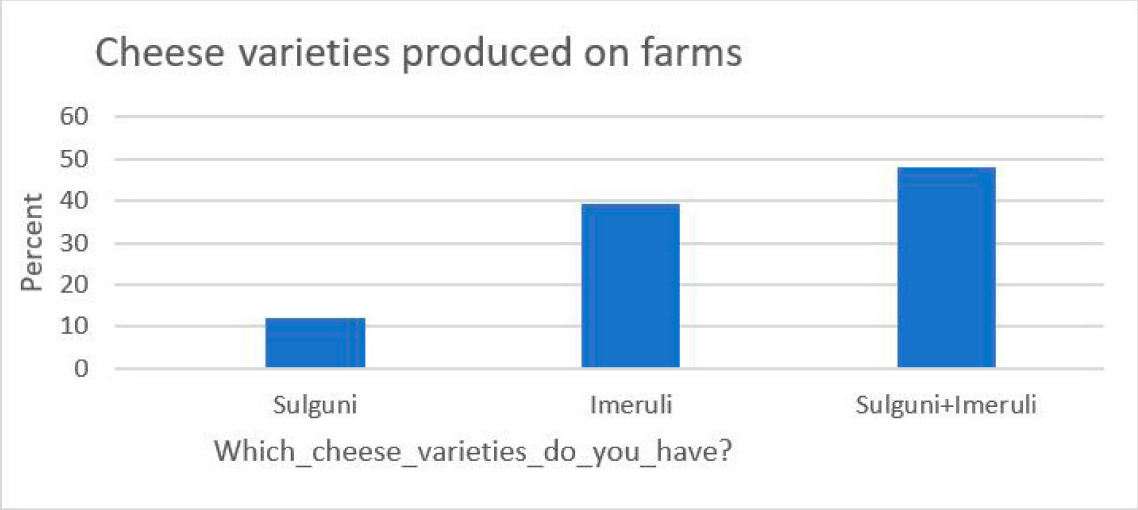

Figure 5. Cheese varieties made on interviewed farms (N = 140, Mean = 35, Std. Dev. = 31,112).

Smallholder farmers used to use pastures for grazing cows. It was not their previous habit to manufacture conserved fodder, as the questionnaire showed that 96.4% of them did not resort to making this fodder (see Table 2).

These results were compared with a previous study we conducted (interview with experts in dairy production in Georgia) [28]. The experts focused on Georgia's culture and traditions in developing the value chain of dairy products, especially in rural areas. It is crucial to take into account the cultural and social background of small farmers. With several reservations, women in rural areas are still the ones who make cheese at home and milk cows. Hygiene standards and food safety measures are rarely applied [28]. They sell the cheese or milk they produce on the streets, in small supermarkets, or the Bazar, and thus it is difficult to monitor them.

Based on all of this, smallholder farmers' social and cultural identity is an important and essential factor in developing the value chain for dairy production and supporting the rural community, which helps raise the local economy.

According to the United Nations' Women Oxfam report, the roles of men and women in agriculture and livestock are justified based on various factors, the most important of which are the differences in physical strength between them and gender stereotypes [64,65].

Women and men's roles are determined according to the available activities, as men believe that all work and activities that require physical strength are their responsibility. On the other hand, raising livestock and milking cows also requires a massive effort, especially in transporting milk and water intended for washing cows' udders, which is what women do in rural areas [64,65]. However, this patriarchal system is still prevalent in Georgia, especially in rural areas, as this society's traditions place women as responsible people [65–67]. According to the FAO report, many smallholder farmers consider gender equality in Georgia to jeopardise Georgian traditions, identity, and culture, pushing them to adhere to these traditions more strongly [68]. The Georgian government is striving to integrate women into the decision-making process and trying to help them reach the latest developments in the field of livestock breeding [64,68,69].

Thus, a proper understanding of women's role in the dairy chain helps develop and strengthen the dairy value chain. Rural women are the cornerstone for that, starting from the milking stage to preparing raw milk or making cheese for sale. Therefore, these laws and legislation should give more attention to rural women's roles and provide them with all the necessary support to include them in the stage of developing the local economy.

3.1.3. Ethical Factors

Furthermore, animal welfare and the microbiological quality of dairy products are essential factors in livestock breeding. They are closely related to the development of the dairy value chain on the one hand and the maintenance of food safety standards on the other hand.

In addition, microbiological quality is a significant component of the marketing and quality of dairy products, and therefore it is imperative to take this factor into account.

The results of the questionnaire (Figure 6) show that 41.4% of small farmers put cows in a small closed barn with other animals. This means the animal does not have freedom of movement at all. The area allocated to each animal is minimal, as cleaning, milking, and animal hygiene care is done in an unhealthy manner, and sanitation is almost non-existent. Sometimes the barn is not equipped with windows. The results also show that 41.4% of farmers keep their animals in a small open barn with other animals, as these animals suffer from the same conditions that the rest of the animals suffer in closed barns, but these barns have access to fresh air. As for 17.1%, they house cows separate from the other farm animals (Table 3), but it also does not fulfil the necessary animal welfare or food safety conditions.

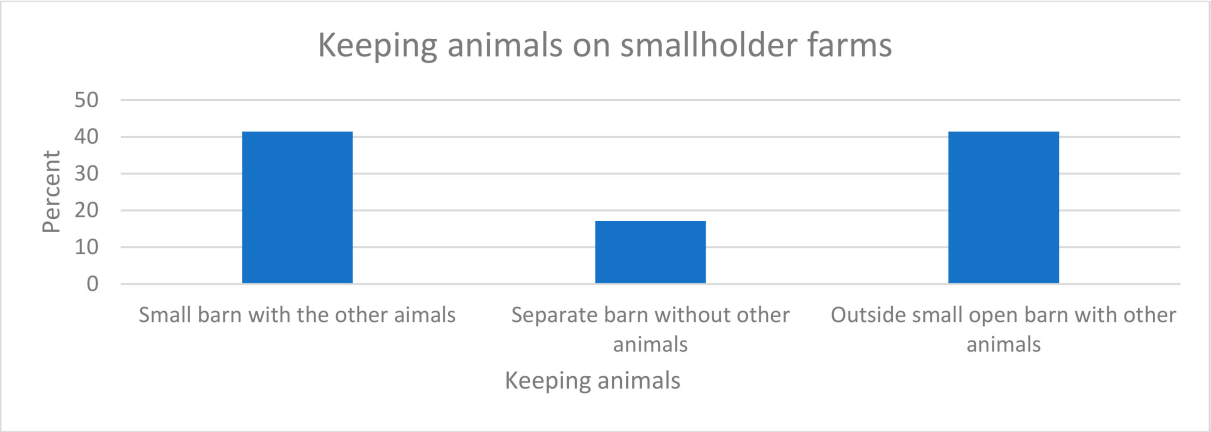

Figure 6. Percentage of farmers keeping cows together with other farm animals or in separate barns in Georgia (N = 140, Mean = 47, Std. Dev. = 19,629).

Table 3. The percentage of farmers interviewed who own other animals on the farm (%).

Other Farm Animals Owned by Farmers	Hen	Sheep	Goat	Calf	Pigs
N * = 100%	65	10	5	17.1	20

* N = 140 interviewees.

By comparing these results with other studies, Gieseke et al. [70] emphasised in a study conducted in Germany the importance of animal welfare in the development of the dairy sector as the cubicle's characteristics play a fundamental role in animal health.

Compared to another study conducted in Sweden, which focused on the importance of animal welfare and its positive effect on production quality, securing the necessary fodder for the cows, treating them well, and ensuring sufficient spaces in the barns help in developing the dairy value chain [71].

Another study in Canada showed that a lack of concern for animal welfare could lead to enormous consequences that harm cows' health and negatively affect the chain [72].

The results of the questionnaire also showed that all farmers interviewed depend only on the hand-milking process. As shown in Table 3, more than half of the farmers, 57.1%, have from one to three cows. Only 5 per cent of them have more than 15 cows. Therefore, a milking machine cannot be considered, as it costs money that the farmer cannot afford. It needs training to use it; also, the farmer does not receive any support from any party.

However, hand-milking in rural areas is also a big problem, as the questionnaire showed that 85.7% of farmers (Table 3) wash the cow's udder before milking. During the farmers' interview, we asked them to do the cows' milking in front of us if possible, and the results were shocking. Most farmers did not wash their hands before starting the milking process, and some of them had some wounds on their hands that were not covered during the milking process.

On the other hand, most of the places where cows were milked had deplorable sanitary conditions.

Each farmer had specific standards for cleaning the cow's udder. Therefore, fresh milk has not yet been analysed to ensure it is free from any type of bacteria or heavy metals. It is also susceptible to contamination from external factors that are not related to the cow's feed, the type of water supplied, or its health condition. As mentioned earlier, in a subsequent study, the milk taken from the cows of the farmers we interviewed will be analysed to support or reject our hypothesis regarding food safety and smallholder's dairy production.

One of the smallholder farmers stated:

> I: *"We milk the cows as our parents and grandparents used to do, and their health was durable, and here we are also healthy too, and this is evidence that these methods are feasible."* (10 June 2019, Vanati).

Another farmer said:

> I: *"When we were children, my grandmother would allow us to drink milk directly from the cow's udder without even washing it. That is why our generation is healthier than today's generation. My granddaughter sometimes does not drink milk if it is not boiled."* (11 June 2019, Ratevani).

The results show that depending on the Pearson factor in the correlation analysis, there is a strong relationship between the number of cows the farmer owns and between his/her consumption and the milk intended for sale.

A previous study with experts in dairy products [28] showed that it is challenging to monitor farmers fully, as the farmer who sells milk to a third party or dairy and cheese production companies is well observed. Still, the farmers who sell milk on the roads and in the Bazar or small supermarkets find it challenging to monitor them.

According to the FAO reports, small farmers who live in rural areas in Georgia do not have the knowledge and technical expertise to produce safe and high-quality milk. For them, there is no relationship between food safety and human health on the one hand and caring for animal health on the other hand [73,74].

The National Food Agency and the Ministry of Environmental Protection and Agriculture in Georgia are working hard in providing awareness campaigns and training courses in aspects related to livestock breeding. Still, the difficulty of trusting farmers in these departments and organisations is one of the most critical obstacles they face [33]. A smallholder farmer in rural areas trusts other experienced farmers more than they trust these organisations [33]. Likewise, most farmers in rural regions of Georgia are still milking cows by hand. They do not use any equipment for milking, as production on these farms is still rudimentary. Safety requirements and hygiene standards are still not met [33,73].

Despite all the National Food Agency (NFA) efforts and other organisations, farmers in rural areas still make cheese at home without supervision and sell it informally. Hence, food safety and hygiene standards are deficient [3,26,33,75].

At the beginning of 2020, a law was implemented that does not allow homemade cheese to be sold and can be consumed only at home. However, monitoring farmers, informal sales centres, storage, and transportation operations is challenging, negatively affecting dairy's value chain in Georgia and its development [3,33,75,76].

Thus, this research may clarify the importance of balancing the laws stipulated for livestock breeding and animal welfare and farmers' interests (applied or under implementation). For example, these new laws prohibit milk products' direct sale from farmers who did not follow the basic food safety measures. In that case, this may help the local economy

increase the production of high-efficiency milk from large stables or enterprises. Still, it will negatively affect small farmers because they depend on their daily income by selling raw milk. Therefore, the development plan must provide alternatives to help these farmers with their income or develop their methods used in producing milk.

3.1.4. Economic Factor

The questionnaire results also showed that most farmers, at a rate of 53.6% (Table 2), have significant problems selling the milk they produce, as farmers do not control the dairy market. Therefore, they always resort to selling their products through illegal channels. Previously, farmers relied on an intermediary person who collected milk from farmers and distributed it to dairy and cheese companies. Due to farmers' problems in rural areas and the lack of necessary resources and equipment, the produced milk became incompatible with milk producers' standards. Therefore, as Figure 7 shows, most of the farmers, 42.1%, sell their milk products in the bazaar, 30% of them depend on small supermarkets, and 17.1% try to sell what they produce on the roads. As for 20%, they still depend on a third party (collection point).

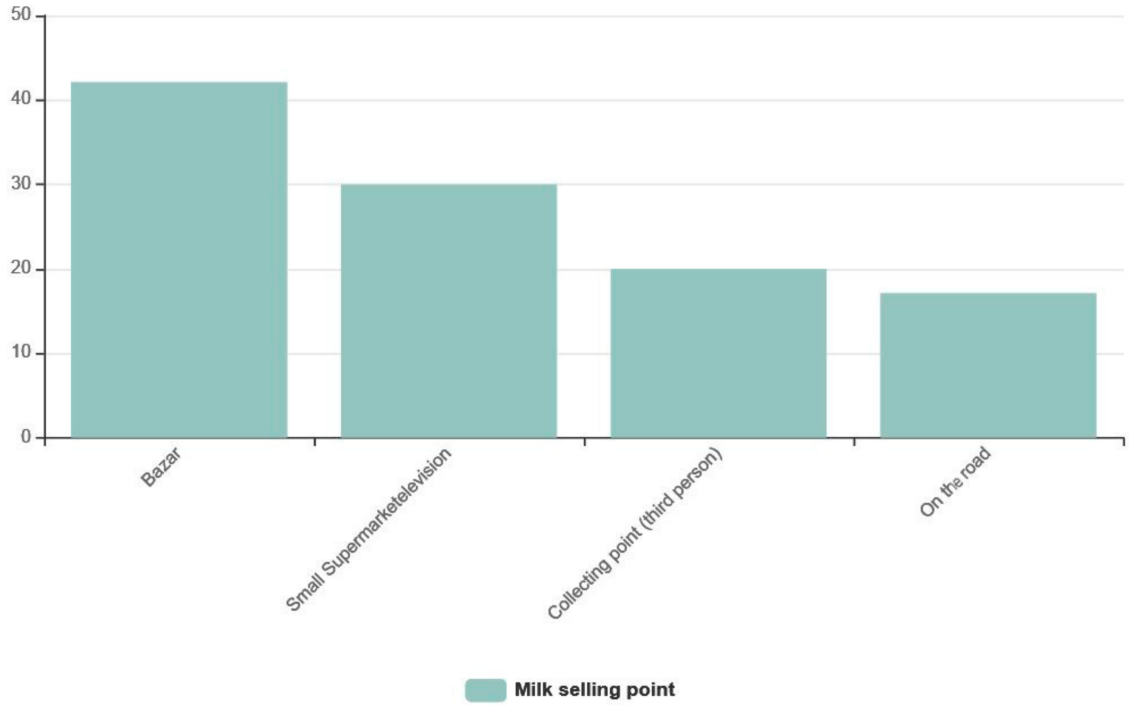

Figure 7. Milk selling points of smallholder farmers in the Kvemo Kartli region (N = 140, Mean = 38, Std. Dev. = 15,840).

Farmers cannot produce high-quality milk as they do not have adequate and appropriate resources to reach these standards. Dairy SME and large cheese factories refuse to buy raw milk as it does not follow food safety laws.

To verify the significant issues in terms of selling milk, a T-test was used to compare farmers who suffer from difficulties in selling their milk products and others who do not face this problem (see Table 4). The T-test showed that there is a difference between farmers who suffer from selling the milk compared to others who do not face this problem concerning the amount of fodder in the high season (HS), ($\text{Mean}_{\text{with difficulties}} = 1.243$, $\text{Mean}_{\text{without difficulties}} = 1.415$, $t = -2.051$, $p < 0.05$). The lack of necessary fodder and pastures negatively affects the quality and quantity of milk, making it difficult to sell, whereas Cohen's $d = -0.349$ suggests a medium effect size of the relevant test.

Table 4. Independent Samples *t*-Test of the difficulties in selling milk.

Independent Samples *t*-Test							
				95% CI for Mean Difference			
	t	df	*p*	Mean Difference	Lower	Upper	Cohen's d
Keeping animals	1.114	138	0.267	0.172	−0.134	0.478	0.189
reason for starting dairy farming	3.576	138	<0.001	0.413	0.185	0.642	0.606
Feeding in HS*	−2.051	137	0.042	−0.172	−0.338	−0.006	−0.349
Feeding in LS**	−0.831	138	0.408	−0.037	−0.125	0.051	−0.141
Purchase HS*	−1.729	138	0.086	−0.242	−0.519	0.035	−0.293
Purchase LS**	−1.797	138	0.075	−0.155	−0.325	0.016	−0.304
Sources of water are available for animals	−2.004	138	0.047	−0.149	−0.295	−0.002	−0.340
Average of the milk in HS * L/day	0.105	138	0.917	0.013	−0.238	0.265	0.018
Average of the milk in LS ** L/day	0.542	138	0.589	0.042	−0.111	0.195	0.092
Cheese varieties	0.067	138	0.946	0.008	−0.233	0.249	0.011

Note. Student's *t*-test, * HS: high season: from March to August, ** LS: low season: from September to February.

This difference also appears regarding the animals' water sources (Mean $_{\text{with difficulties}}$ = 1.667, Mean $_{\text{without difficulties}}$=1.815, t = −2,004, $p < 0.05$). As in the scarce seasons, it is challenging to sell milk, but also, with the lack of water, selling becomes more difficult for these farmers. Cohen's d = −0.340 suggests a medium effect size of the relevant test. Therefore, farmers are still suffering from a large problem in selling their milk products, and the gap between them and the small and large milk producers have become very complicated.

Spearman correlation analysis was applied to analyse the data. Table 5 shows that the correlation between the purchase in the low season and the average of the milk in the low season is $r_s = 0.304$ ($p < 0.001$); thus, the correlation is statistically significant. The positive sign of the correlation coefficient shows that this is a relationship between the two variables in the same way; this means that higher purchase values in the low season are associated with higher milk values in the low season. Likewise, Table 4 shows that the correlation between the purchase in the high season and the average of the milk in the high season is $r_s = 0.395$ ($p < 0.001$); thus, the correlation is statistically significant. The positive sign of the correlation coefficient shows that this is a relationship between the two variables, which means that higher purchase values in the high season are associated with higher milk values in the high season.

Table 5. Correlation matrix of milk production and animal feeding (Spearman correlations-rs).

Spearman's Correlations											
Variable		Feeding in HS.		Purchase HS.		Purchase LS.		Feeding Grass in the Mountain in HS.		Average of the Milk in H.S. L/Day	Average of the Milk in L.S. L/Day
Feeding in HS.	Spearman's rho	—									
Purchase HS.	Spearman's rho	0.257	**	—							
Purchase LS.	Spearman's rho	0.208	*	0.794	***	—					
Feeding Grass in the mountain in HS.	Spearman's rho	0.149		−0.135		0.006		—			
Average of the milk in H.S. L/day	Spearman's rho	0.386	***	0.395	***	0.333	***	−0.127	—		
Average of the milk in L.S. L/day	Spearman's rho	0.301	***	0.372	***	0.304	***	−0.048	0.589	***	—

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, H.S.: high season, LS: low season.

Comparing these results with the previous ones of expert interviews [28] showed that government agencies specialising in the field of dairy and cheese production and small and large factories require farmers to obtain milk of high standards, which includes all the conditions and specifications of food safety. Smallholder farmers, in turn, do not

have sufficient and necessary resources to fulfil these conditions, so a large gap has arisen between these parties.

Experts have confirmed that smallholder farmers play an essential role in the new laws and legislation in dairy production. Compared to this questionnaire's results, farmers suffer from many problems, and government support for them is insufficient, as the relationship is poor between them. One of the farmers interviewed stated when we asked him if he suffers from a lack of feed or water:

> I: *"Veterinarians are the only ones who communicate with us, but also not always. In specific periods of the season, we may suffer from a shortage of feed or even water, and we do not always have the price of preserved fodder. At that time, the cows may suffer from some diseases, and their production will be deficient, so then we find only these veterinarians to help us."* (9 June 2019, Bolnisi).

Another farmer stated:

> I: *"When we see one of the government agencies in our village, we know immediately that problems are coming, so it is better to avoid talking to them."* (12 June 2019, Mtskneti).

Moreover, this study shows that smallholder farmers face different problems in the Georgian dairy value chain than those faced by experts and government agencies. The experts focused on food safety and international food safety standards and their importance in developing the value chain for dairy production. In contrast, the farmer sees this problem differently; for example, water availability and quality are some of the most critical factors for small farmers. As Table 2 shows, 81.4% of farmers do not have enough water for their livestock, and all of them depend on the existing rivers.

As indicated by the survey, in the Kvemo Kartli region, farmers depend mainly on the Khrami River and the Mashavera river. Table 6 shows the value of the Chi-Square test ($X^2 = 3.961$, df = 1, $p < 0.05$), as it explains that the farmers who are dependent on these two rivers have problems selling their milk. These results suggest that the respondents in the Khrami River area face more problems by selling their milk than in the area of the Mashavera River.

Table 6. Chi-Square Test of the difficulties selling milk.

Contingency Tables				
Sources of Water Are Available for Animals	**Difficulties Selling Milk**			
	Yes	**No**	**Total**	
Khrami River	25	12	37	
Mashavera River	50	53	103	
Total	75	65	140	
Chi-Squared Tests				
	Value	**df**	***p***	
X^2	3.961	1	0.047	
Likelihood ratio	4.039	1	0.044	
N	140			
Log Odds Ratio				
	95% Confidence Intervals			
	Log Odds Ratio	**Lower**	**Upper**	***p***
Odds ratio	0.792	0.003	1.582	
Fisher's exact test	0.787	0.063	∞	0.035

Note. For all tests, the alternative hypothesis specifies that group *Khrami River* is more significant than *Mashavera River*.

A farmer declared the following when asked whether the current water source suffices his needs for the whole year:

> I: *"The river is not close to my house, and therefore we have to walk a long distance every day to bring water for the livestock, as drinking water is limited, and we cannot always give our livestock from it. Unfortunately, no one offers us an alternative or solution to this problem."* (9 June 2019, Chapala).

And another stated:

> I: *"How can the milk production of my cows be high when we do not have enough water or sufficient amount of feed?"* (13 June 2019, Kvemo Bolnisi).

A T-test was used to compare farmers' difficulties, depending on the two rivers that pass through these villages (see Table 7), because the hypothesis states that people in this region of Khrami River have different answers from farmers in the region of Mashavera river.

Table 7. Independent Samples *t*-Test of the available water sources.

Independent Samples *t*-Test							
					95% CI for Mean Difference		
	t	**df**	***p***	**Mean Difference**	**Lower**	**Upper**	**Cohen's d**
Keeping animals	−1.262	138	0.209	−0.220	−0.566	0.125	−0.242
reason for starting dairy farming	2.590	138	0.011	0.346	0.082	0.609	0.496
Feeding in H.S *	0.520	137	0.604	0.050	−0.141	0.242	0.101
Feeding in L.S **	−0.083	138	0.934	−0.004	−0.104	0.095	−0.016
Purchase H.S *	1.300	138	0.196	0.207	−0.108	0.521	0.249
Purchase L.S **	1.652	138	0.101	0.161	−0.032	0.354	0.317
Average of the milk in H.S * L/day	0.546	138	0.586	0.078	−0.206	0.363	0.105
Average of the milk in L.S ** L/day	2.273	138	0.025	0.196	0.025	0.367	0.436
Difficulties selling milk	−2.004	138	0.047	−0.190	−0.378	−0.003	−0.384
Cheese varieties	−0.716	138	0.475	−0.099	−0.371	0.174	−0.137

* HS: high season, ** LS: low season.

The test showed a fundamental difference in milk production between farmers who use the Khrami River compared with farmers from other villages who depend on the Mashavera River in LS.

The milk production of farmers in the Khrami River region is, on average, higher than the milk production of the farmers in the Mashavera River region (Mean $_{\text{Khrami}}$ = 1.351, Mean $_{\text{Mashavera}}$= 1.155, t = 2.273, $p < 0.05$). Simultaneously, the farmers in the Mashavera River region suffer from many problems, including the difficulty of accessing river water or permanent water pollution. Cohen's d value (Cohen's d = −0.340) suggests a medium effect size of the relevant test.

Nevertheless, as shown in Table 2, 96.4% of the farmers do not have sufficient fodder for cows for the whole year, and they cannot make preserved fodder (such as hay; see Figure 4). Therefore, the cows suffer from a significant shortage of feed, which is negatively reflected in the amount of milk production.

A T-test was used to compare farmers who have enough fodder for their animals (for the entire year) and others who do not (see Table 8). It is essential to know if the farmers depend only on local pastures or different types of local or imported feed. The T-test showed that there is a difference between farmers who have enough fodder compared to others who do not have the required amount of fodder in the low season (LS), (Mean $_{\text{have enough fodder}}$ =1.400, Mean $_{\text{don't have enough fodder}}$ = 1.044, t = −3.069, $p < 0.05$).

Table 8. Independent Samples *t*-Test of Enough Fodder for dairy animals (for the entire year).

Independent Samples *t*-Test			
	t	**df**	***p***
Size of the household	0.706	138	0.481
Number of cows	−0.160	138	0.873
Milking the cows (per day)	2.304	138	0.023
Milk for cheese production	0.562	138	0.575
Feeding in L.S **	3.069	138	0.003
Purchase H.S *	0.312	138	0.756
Purchase LS **	NaN		
Feeding in H.S *	2.201	137	0.029
Starting dairy farm	NaN		
Processing cheese	−0.896	138	0.372
Responsibility for feeding, cleaning, milking, and processing as well as marketing	0.219	138	0.827
Average of the milk in HS * L/day	1.198	138	0.233
Average of the milk in LS ** L/day	−0.035	138	0.972
Milk consumption at home	−0.669	138	0.505
Milk sold	−0.335	138	0.738

Note. Student's *t*-test, * HS: high season, ** LS: low season

Studies have shown that the Georgian agencies in the development of the dairy sector in Georgia are working to legislate and apply strict laws and regulations, which raise the efficiency and quality of the final product [27].

However, after the Georgian government adopted a unique system concerned with food safety in the country in 2010 [77], several new laws and legislation entered into force in 2020. These laws prevented all dairy companies from purchasing and collecting milk from farmers whose cows were not registered in the official government system [26]. Moreover, in 2014, after the signing of the joint agreement ''EU-Georgia Association Agreement" between Georgia and the European Union, Georgia is working hard to implement all food safety standards applied in the European countries [78,79].

However, all of these laws serve the consumer, and for the producer's interest so as to produce sufficient quantities of high-quality milk, adequate amounts of good quality feed must be available. Therefore, farmers try to save some money to buy preserved or concentrated fodder, especially for winter (wheat, corn, and straw). Thus, it becomes difficult for them to secure cleaning and sanitation services for their barns [53].

The Georgian government provides veterinary services for free. However, farmers sometimes need to pay specific amounts to obtain certain medicines for their cows because these services do not always include giving medicines free of charge. Therefore, they treat their cows with antibiotics, which pose a significant danger to human health and the quality and safety of the milk produced [79].

Compared to other studies, Belay et al. [80] showed the importance and influence of the socio-economic characteristics of dairy farmers on the management and development of the dairy sector, which demonstrated the strong correlation between the education level and years of experience with dairy management practices. Tina et al. [2] also confirmed that taking into account the social and economic factors in the dairy sector significantly affects its sustainability and the development of the dairy value chain, especially if the other factors that affect the chain are taken into consideration. In addition, as Mlelwa emphasised in his research, the dairy sector is significantly influenced by several socio-economic factors, such as the number of cows, the farmer's experience, knowledge, and workforce in each household, which all play an essential role in the development of this chain [81].

The Georgian government has come a long way in developing a sustainable food safety system in the country. The National Food Agency (NFA) built significant relationships with smallholder farmers, especially in rural areas. Where the NFA is the leading player in the Georgian agricultural sector, it is directly responsible for consumer protection, applying

food safety standards in the country, examining all dairy products' components, and comparing them to the final product [76,82]. Besides, Georgia now has a database to register animals electronically to monitor all dairy and cheese production activities and directly intervene if necessary [26].

Thus, based on all of the information mentioned in this section, the results of this research may help identify points of difference between decision-makers in governmental institutions and dairy experts on the one hand and smallholder farmers on the other hand. The comparison that was made between these parties and clarifying the problems these people face may offer future solutions based on the main factors mentioned in this research, which may be in the interest of all parties.

4. Conclusions

Smallholder farmers were and still are the cornerstone of the agricultural and dairy sector in Georgia. This study presents interviews with smallholder farmers in the leading region for milk and cheese production in Georgia. The results show their point of view, fear, wishes, and challenges and may help reach a common solution on how the dairy value chain should be developed. It may help government agencies to implement their plans for developing the dairy sector in Georgia and, at the same time, reach high food safety standards. The analyses of milk and cheese samples being purchased from the interviewed farmers will be analysed and may show critical points in the dairy value chain.

This study showed the impact of smallholder farmers' ethical and cultural identity on the Georgian dairy value chain. Farmers still adhere to the ancient traditions they inherited from their parents and grandparents, and rural women are still under the influence of those traditions. Although in this pastoral society, women are considered the primary and active element in the process of dairy production and cheese making, women do not have access to modern technology and studies related to dairy production. As a previous study with some experts in dairy production in Georgia showed, women are not concerned with much interest in development and modernisation programs for the dairy production sector in Georgia. This proves that smallholder farmers' ethical and cultural identity is a fundamental factor in developing the value chain of Georgian domestic dairy products.

The questionnaire results indicated that farmers are afraid of increasing the number of large dairy producers in Georgia, as smallholder farmers' production capacity is limited. Smallholder farmers cannot meet the substantial market requirements, and it is difficult to adhere to the stipulated food safety conditions. Thus, this confirms that farmers fear that their presence in the dairy market will be threatened by specialised farms that produce large quantities of raw milk.

However, smallholder farmers' microbiological quality of their dairy products is no longer acceptable in the market. As a result, farmers suffer from the constant fear of not selling their raw milk and homemade cheese products.

The study also showed that the problems that farmers suffer from are entirely different from those problems that the experts stressed in a previous study that farmers suffer from.

As the questionnaire results showed, the lack of fodder and water scarcity and its low quality are fundamental problems that farmers face. The government is working to secure enough pastures for farmers in the summer, but that is not enough, as farmers do not have enough fodder or money to buy what is necessary for the winter season. The problems of river cleanliness in villages and river pollution with heavy metals do not receive much attention from the government agencies concerned. Therefore, directly and indirectly, all of this affects the quality of milk and cheese made in rural areas.

From the point of view of dairy experts, the problems of hygiene and animal welfare on the one hand, and the marketing of raw milk and dairy products, on the other hand, are the significant challenges facing these farmers. Thus, this proves a gap between dairy farmers and governmental and private organisations prioritising smallholder farmers' problems. On the other hand, these farmers do not give the quality of milk and animal welfare great importance due to the economic conditions and the problems they suffer from.

Hence, this study's results may help develop the dairy value chain in Georgia, where all the factors and components of this chain must be taken into account. The work of all actors and the continuous coordination between them will ensure the sustainability of this value chain.

On the other hand, the question remains open. Assuming that this stipulated legislation and laws have worked in smallholder farmers' interest and considered the factors critical to them, will this only have a positive impact? For years, these traditions used by smallholder farmers have been an essential part of the dairy sector's development stage in Georgia. Besides, will these farmers have the ability to control the local market or even develop production to suit food safety requirements if they can export their products to other countries?

The inability of smallholder farmers to cope with the changes taking place in the dairy sector may lead to the abandonment of farms, which in turn leads to a change in the range of products, a change in the cultural landscape (although there are under industrial animal husbandry, but more cows are kept in the barn), and food security changes. Therefore, the government should support the preservation of smallholder farmers through training and subsidies to create healthy and social living conditions.

Food safety laws have not curbed the pollution of rivers, soils, and plants with heavy metals from another perspective. The safety of farmers and the preservation of local production of high-quality milk and cheese should take priority.

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Appendix A

Table A1. Questionnaire Data.

Domains and Variables	Questions
Upstream (Input Supplies)	
Socio-Demographic/Socio-Geographic	
Village	
Gender	
Household socio-economic background	
Size of the household	
Keeping animals	
Dairy production or animal husbandry is the only financial income	Is dairy production or animal husbandry the only financial income?

Table A1. *Cont.*

Domains and Variables	Questions
On-farm (production)	
General	
Starting dairy farm	When did you start dairy farming?
Basic knowledge of dairy farming	Did you have basic knowledge of dairy farming?
Reasons for starting dairy farming	For which reason did you start dairy farming?
Dairy farm structure, facilities and management	
Other livestock on the farm	Do you have any other livestock on your farm?
Number of cows	How many dairy cattle do you have on your farm?
Responsibility on the animals/farm	Who is responsible for the animals on the farm?
Animal breed	Which animal breed you have?
Cows for milk and meat purposes	Are your cows for milk or meat purposes?
Labour use in dairy farming	
Responsibility for feeding, cleaning, milking, and processing as well as marketing	How many persons are responsible for feeding cleaning milking and processing as well as marketing?
Feeding	
Type of grazing for dairy animals	Can you tell me which type of grazing do you practise for your dairy animals and how many months a year?
Feeding type	
Type of fertiliser on your grazing land	Are you using any type of fertiliser on your grazing land?
Sending the cows to the mountain in HS.	
Feeding in the high season (HS.)	
Feeding in the low season (LS.)	
Purchase in the high season (HS.)	
Purchase in the low season (LS.)	
Enough fodder for dairy animals (for the entire year)	Do you have enough fodder for your dairy animals for the entire year?
Making conserved feed (e.g., hay)	Are you used to making conserved feed, e.g., hay?
Sources of water are available for animals	Which sources of water are available for your animals?
Satisfied with the water quality of the primary water sources	Are you satisfied with the water quality of the primary water sources?
Water-amount enough for animals (yearly)	Do you have enough water to feed animals yearly?
Output (Downstream)	
How many times do you milk your cows (per day)?	
What is the average of the milk in HS (L/day)?	
What is the average of the milk in LS (L/day)?	
Would you like to increase your milk production?	
Please can you tell me your milk consumption at home (%)	
Milk selling point	Are there any specific selling points where you are marketing your milk?
Difficulties selling milk	Do you ever face any difficulties selling your milk?

Table A1. *Cont.*

Domains and Variables	Questions
Cheese varieties	Which cheese varieties do you have?
Cheese for marketing or self-consumption	Is your cheese for marketing or self-consumption?
Milking techniques	How do you milk your cows?
Washing udder before and after the milking process	Do you wash udders before and after the milking process?

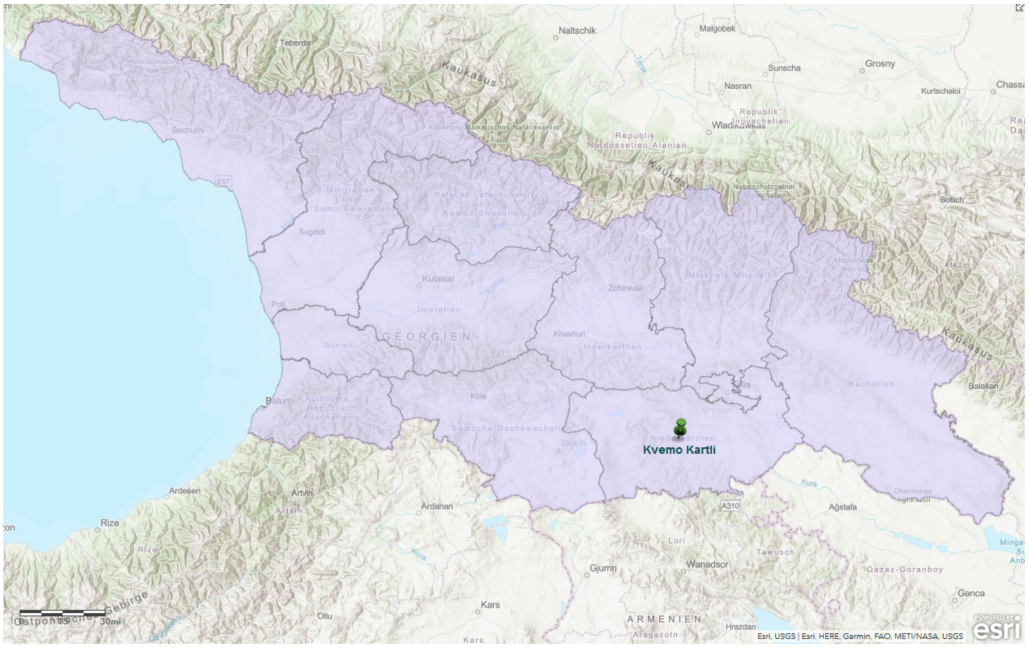

Figure A1. Georgia Map; ArcGIS Pro Data sources: Base map layer; ESRI satellite (ArcMap).

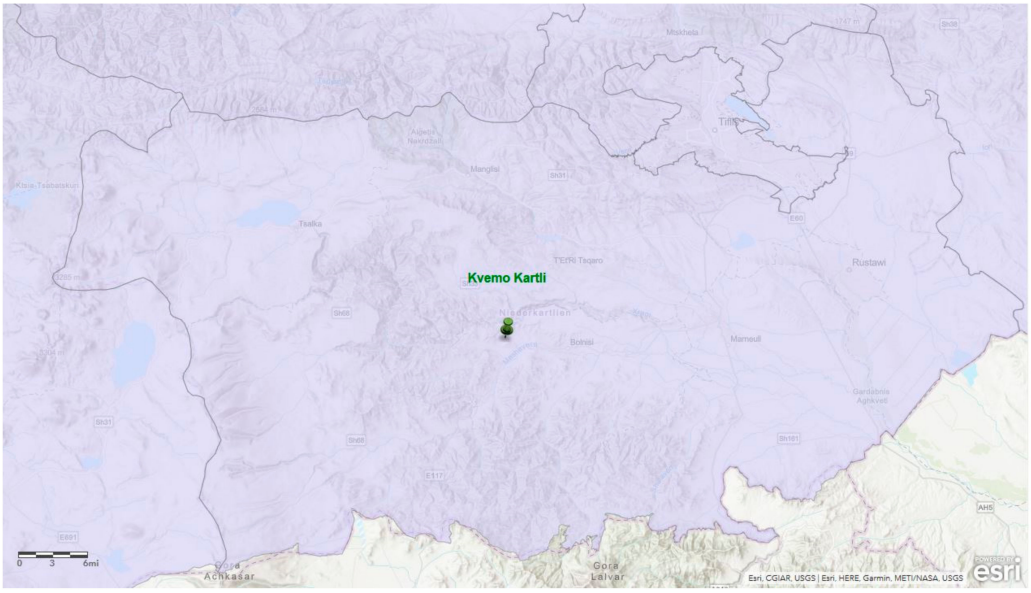

Figure A2. Kvemo Kartli region (Authors' illustration); ArcGIS Pro, Data sources: Base map layer; ESRI satellite (ArcMap).

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