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Dairy Value Chain and Household Development in Rwanda

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Abstract

The value chain in terms of dairy can lead to the development of business and households in general. Hence, the aim of the study was to examine the dairy value chain and household development in Rwamagana district in Rwanda. The study employed a descriptive research design to examine the dairy value chain and household development in Rwamagana district in Rwanda. The target population was 11,595 respondents. The sample size was 385 respondents got by using Slovin's formula. The study used purposive and simple random sampling techniques to determine the sample size. Questionnaire and interview guides were used to collect the data. The validity of the research instrument was maintained by distributing the research instruments to the expert respondents in the area of the study while reliability was maintained by conducting a pilot study that provided reliability of the research instrument. The findings revealed that technical services, dairy inputs availability and profitable market access contributed in household incomes. It was also revealed that animal husbandry techniques by reproduction and artificial insemination promoted cross-breeding, where 50% of respondents confirmed that their cows increased from 1 to 2, and other at 46.9% increased up to 5 cows. The study found that 98.2% of the respondents received trainings on animal health disease management and 97.9% of them practiced what acquired from training, and this improved the animal health and reduced the cows' death rate. Majority of dairy value chain actors at 88.5% of respondents cultivated fodder to feed their cows and 91.7% of them gained different conservation techniques such as hay making and silage useful in dry and drought seasons to avoid milk shortages and cow death. Besides, 73.2% of respondents of dairy chain actors had different milk equipment to support in keeping good quality and safety, storage and feeding such as milk cans, choppers, sprayers and other testing materials, and 87% of them accessed veterinary pharmacies nearby. Findings revealed that a large number of respondents at 90.9% consumed milk at home level which improved the households' members livelihood, and the surplus was sold to milk collection centers, milk kiosks, restaurants, hotels, schools. The study recommended that farmers should be mobilized for more house water harvesting strategies and increased measures of fodder conservation by hay making and silage techniques. Government and private sector in partnership with dairy chain actors should put in place a processing plant for products development, diversification, market penetration and market development strategies. There should be mobilizing of private investors or cooperatives in the dairy equipment shops.

Keywords: *Dairy, Value change, Household, Household development and dairy value chain, Rwanda*

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1.0 Introduction

Globally, a value chain can increase the efficiency of a business by adding the most value possible at the lowest cost. A value chain is a business model that describes the process or activities required by companies to add value to a product or services. It includes a range of activities required to bring a product to the customer starting from idea generation to distribution and anything in between. Value chain management brings various benefits, including improved flow of materials and products, reducing waste in the supply chain process, seamless flow of information, enhancing the overall customer experience (Kremer,2021). Lots of benefits can be gain in effective value chain such as better product planning, research and development by creating cross-platform teams, standardization of processes by measuring the metrics of the business, reduction in cost by optimizing the value chain components or activities, improved flow of materials and products through accurate forecasting of sales as well as demands, improvement in after-sales services and customer support through coordinated operations (edrawmax, 2021).

Regionally, the key players in the dairy value chain are the input suppliers, farmers of various sizes, milk collection centers, processors, retail outlets and consumers. Each of the players in the value chain carry out various value adding services, the input suppliers for instance provide various veterinary drugs, milking equipment, all services, feed among other services. The primary producer in the dairy value chain – the farmer carries various animal husbandry measures such as disease control measures, provision of feed to in-calf and lactating cows' requirements and traded through the formal marketing channels (Acharya, 2016). Billions of people around the world consume milk and dairy products every day. Not only are milk and dairy products a vital source of nutrition for these people, they also present livelihoods opportunities for farmers, processors shopkeepers and other stakeholders in the dairy value chain (Muehlhoffet al., 2013, as cited in Hill, 2017).

As cited by Hill (2017) that clearly, to determine the overall impact of dairying from the perspective of sustainable consumption and production is an extremely complex undertaking. It is also clear that the dairy sector impacts billions of people. To provide even further context, analysis undertaken by the International Farm Comparisons Network (IFCN) and published by the FAO has determined that 750–900 million people live on dairy farms (FAO, 2010a). Many of these are smallholder farmers living in developing nations where dairy is indispensable to their livelihoods. Latest estimates are that up to 1 billion people derive a significant proportion of their livelihoods from dairy if you include employment throughout the whole of the dairy chain (Steinfeld et al., 2010; IFCN, 2015; Dugdill et al., 2013, as cited in J.P. Hill,2017). According to Jaiswal, Chandravanshi, and Netam (2018), the promotion of dairy farming is often justified by the assumption that adopting household will consume more milk; generate employment and more cash income.

The country of Rwanda, is small and landlocked with a land area of 26,338 square kilometers at an altitude ranging from 1000-4500m above sea level. It has few natural resources and small industries sector. It is among mostly densely populated countries in Africa, as actually the Rwanda population estimate is 12,956,000 (Clay,2021). It has 4 provinces and the city of Kigali comprising a total of 30 districts, bounded to the north by Uganda, to east by Tanzania, to the south by Burundi,

and to the west by Democratic Republic of Congo. Regarding the settlement patterns, a high big number of the population is rural, scattered on hillsides or grouped into agglomerations/villages.

The country's economy is overwhelmingly increasing, with the majority of workforce engaged in agriculture sector. Diversified cultivation is practiced throughout the country. Dry beans, sorghum, bananas, maize, Irish potatoes, sweet potatoes, and cassava, are the primarily crops grown in Rwanda. Livestock husbandly is integral to the farming system (Clay, 2021). Agriculture is the main economic activity in Rwanda with 70% of the population engaged in the sector, and around 72% of the working population employed in agriculture. The agriculture sector accounts for 33% of the national GDP (FAO, 2021). In 2017 the livestock population consisted of an estimate of 1,194,895 cattle (Eugene, 2017).

Locally, the Rwandan dairy sub-sector has undergone dynamic progress after the Tutsi genocide of 1994 as during that period a highly cattle number was also affected and killed. After that period, the government of Rwanda, government and non-government organizations, individuals, imported pure dairy breeds from abroad, promoted cross-breeding technologies, intensified artificial insemination, as the issues of land and farm size had great influence on cattle production, zero grazing measures taken, farming locations determined, and in 2006 the one cow per poor family program been established. With these efforts made and programs set, the raw milk quantity increased.

In 2019 there were 799 000 crossbreed dairy cattle in Rwanda and projected that the number will increase to 1.17 million by 2022 representing an increase of 46% while milk production will grow from 747 million liters of milk produced in 2017 to 2.2 million liters by 2022, an18.2% boost(FAO, 2019). In Rwamagana district as generally in Rwanda, to have a structured dairy value chain from the milk production to consumption, different actors intervening in it were mobilized, organized, trained and coached on farming not only for luxury as traditionally done or home consumption but also farming as business. Although, the dairy industry has been grown rapidly, a number of processing units increased with dairy products diversification and marketing channels and strategies taken. Thus, this study will examine the development of dairy value chain resulting also to household development.

1.1 Problem Statement

Based on the Rwanda government policy, cattle production has been identified as an important and most appropriate way of improving household social-economic development amongst the larger Rwandan community. The President's cattle gifts program popularly known as "Girinka Munyarwanda" has contributed largely with obvious outstanding results towards massive increase in milk production over the past decade since its inception in 2006. The government plan is not of increasing a number of cows with low productivity but having few cows in small plots or zero grazing emphasize with high milk production (increase in metric tons). Towards this line, the government has scaled up artificial insemination for cattle improvement, which resulted in high figure of cross breed cows. The government has also imported pure breeds with high milk productivity.

In complement of genetic improvement, other technical services such as quality feeding and cattle treatment initiatives or disease control, have been emphasized. Variety of cattle quality grass have

been planted, fodder conservation measures done, feed plants established, watering systems (tap water, boreholes, powered pumping) initiated. Farmers and technicians have been trained on disease control, public and private veterinary services (pharmacies, cows' sprayers) increased. Increase in Milk production was obviously expected and in response, the government supported the establishment and operation of all value chain actors. Following such preparedness, large number of milk collection centers have been put in place, Milk transporters cooperatives have been created, farmers have been trained on different topics towards milk increase and quality control, Milk sellers have been organized, inputs suppliers mobilized to set branches near farmers and payments for sold milk have been done via financial institutions.

1.2 Objective of the Paper

The objective of the paper was to examine the dairy value chain and household development in Rwamagana district in Rwanda.

2.0 Literature Review

Value chain is the range of activities required to deliver a final product (like milk or yoghurt) to the consumer. Often, the basic product (like milk) is processed, and made into a product that has more value. This happens for example when long life milk is made out of raw milk (Vernooiji, 2018). The key players in the value chain are the input suppliers, farmers of various sizes, milk collection centers, processors and retail outlets. Each of the players in the value chain carry out various value adding services, the input suppliers for instance provide various veterinary drugs, milking equipment, all services, feed among other services. The primary producer in the dairy value chain – the farmer carries various animal husbandry measures such as disease control measures, provision of feed to in-calf and lactating cows' requirements and traded through the formal marketing channels (Acharya, 2016).

2.1 Dairy technical services and household development

Table 1 presents an illustration of dairy technical services and household development.

Table 1: Dairy technical services and Household development

Dairy technical services in value chain development	**Household development key indicators**
Cattle treatment	Animal health and disease control
Artificial insemination and cross-breeding	Livestock increase; Milk production increase
Animal feeding techniques	Milk increase; Hay making and conservation
Access to technical opportunities from institutions/organizations, government, development partners, Donors, Private sector.	Earning different skills (Trainings and Coaching services); Good quality of raw milk and eradicating the unacceptability by buyers;

2.2 Access to dairy inputs and household development

Table 2 presents an illustration of dairy inputs and household development.

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Table 2: Dairy inputs and Household development

Dairy inputs in value chain development	Household development key indicators
Medicines/Vet Pharmacies	Cattle treatment improvement; Animal health improved (Increase of veterinary services and other inputs to support health of animals for increasing production);
Feeds/Fodder	Animal feeding for production increase; Establishment of quality feeds to match the potential productivity of the existing dairy cattle;
Dairy equipment	Milk equipment available; Safety of raw milk; Transport facilitation;
Water	Watering; Resolving the problems of water access, and drought season measures taken;

2.3 Access to dairy Markets and household development

Table 3 demonstrates an illustration of dairy markets and household development.

Table 3: Dairy markets and Household development

Dairy markets accessing strategies	Household development key indicators
Raw milk consumption	Farming as business; Efficient, hygienic and safe raw milk; Increase of raw milk produced and affordable to buyers; Generating on and off farm employment; Improving the livelihood of farming Household (Improved education and health of family members, etc);
MCCs	Milk aggregation; Accessing markets opportunities; Chilling facilities and infrastructures access;
Processed products	Sufficiency of dairy products; Milk products diversification; Creating employment;
Wholesaling Privates Distributors	Creating employment; Efficiency of storage facilities; Sales increase; Livelihood improvement; Education; Health of members
Retailing /Selling to Supermarkets Kiosks Milk zones Schools Hospitals Prisons	Enough dairy products at affordable price; Profit increase for retails; Reduction of marketing and distribution expenses; Creating employment; Livelihood improvement; Education and Health of family members improved; New opportunities in developing milk marketing: Feeder roads increase in different areas, easily access to milk markets to generate highly needed cash

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2.4 Household development

Dairying contributes positively and significantly to the income and employment of rural farming Household, especially the marginal and poor farmers, thereby providing them livelihoods and sustenance. Dairying helps in equitable distribution of income and employment among the rural farming Household, thereby reducing the disparity in holding of resources by the rural communities. Dairying helps to boost the nutritional level and hence the food security of the rural farming Household, especially the marginal and deprived sections of the rural society (Jaiswal et al., 2018). Boosting the nutritional level and increasing the food security of the rural farming household are helped by dairying, especially the marginal and deprived sections of the rural society. Adequate nutrition and a healthy productive population are increasingly recognized not only as resulting from but also as an important prerequisite for poverty reduction and economic and social development. Given evidence that children's nutrition affects their health, intelligence and educational performance and their economic status in adulthood, reducing childhood malnutrition also influences achievement of the MDGs related to universal primary education, gender equality and women's empowerment, improvements of maternal health and fighting human immunodeficiency virus (FAO, 2013).

3.0 Research Methodology

This study employed a descriptive research design to examine the dairy value chain and household development in Rwamagana district in Rwanda. The target population was 11,595 respondents. The sample size was 385 respondents got by using Slovin's formula. The study used purposive and simple random sampling techniques to determine the sample size. Questionnaire and interview guides were used to collect the data. The validity of the research instrument was maintained by distributing the research instruments to the expert respondents in the area of the study while reliability was maintained by conducting a pilot study that provided reliability of the research instrument. The data was maintained by using SPSS software version 21.0.

4.0 Research Findings

The paper sought to examine the dairy value chain and household development in the Rwamagana district in Rwanda. The study results are outlined in sections. Normally, when dairy farmers and other chain actors are trained on animal health and disease management it proves the livestock increase and treatment, the good quality of raw milk, reducing milk adulteration and rejection by buyers.

Table 4: Training on animal health and diseases management

Respondents training on animal health and disease management		Frequency	Valid Percent
Valid	Farmers confirmed accessed animal health and diseases management training	377	98.2
	Farmers untrained on animal health and diseases management	7	1.8
	Total	384	100.0

The study results in Table 4 showed that 98.2% of 384 respondents were trained on animal health and disease management while 1.8% confirmed not trained. By conclusion, dairy value chain actors have been trained on animal health and disease management, which confirmed the sustainability of dairy chain and continuous of household development.

Table 5: Trainer on animal health and disease control

Trainer		Frequency	Valid Percent
	Sector Veterinary	13	3.4
	District Veterinary	2	.5
Valid	Project staff	43	11.2
	Sec vet + Dis vet +project +RAB	326	84.9
	Total	384	100.0

Source: Primary data (2022)

A shown in Table 5, it was revealed that 84.9% were trained by Sector veterinaries plus district staff, projects and Rwanda Agriculture Board staff. 11.2% were trained by projects, 3.4%trained by sector veterinaries while 0.5% were trained by district veterinaries. By conclusion, different institutions/organization participated in training dairy chain actors to get enough knowledge and skills.

Table 6: Farmers doing disease control

Disease control		Frequency	Valid Percent
	Yes	376	97.9
Valid	No	8	2.1
	Total	384	100.0

Source: Primary data (2022)

It was established that 97.9% of the respondents practiced what they had acquired from trainings of disease control in their cattle daily management as shown in Table 6. Bebe et al (2013) states as cited by Were (2017), that animal health should be observed regularly and to help in early detection and correctly diagnose the diseases.

Table 7: Recognition of a cow on heat before

Response		Frequency	Valid Percent
	Yes	188	49.0
Valid	No	196	51.0
	Total	384	100.0

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Based on the results in Table 7, most of dairy chain actors at 51% confirmed that before they were confused about the recognition of a cow on heat. Generally, there was need of training chain actors to avoid any shortage of milk or slow of cow increase that could occur.

Table 8: Training of dairy actors on cows' insemination

Response		Frequency	Valid Percent
Valid	Yes	375	97.7
	No	9	2.3
	Total	384	100.0

The Table 8 revealed that dairy chain actors confirmed being trained on cows' reproduction and importance of artificial insemination. This showed a number of respondents got trainings on recognition of a cow on heat and insemination. The 97.7% of respondents revealed a number of actors got training which was successful.

Table 9: Trainer on animal reproduction and artificial insemination

Trainer		Frequency	Valid Percent
Valid	Sector veterinary	27	7.0
	District veterinary	1	.3
	Project staff	9	2.3
	RAB staff	1	.3
	Sec vet+ dist vet+ project+ RAB	337	87.8
	None	9	2.3
	Total	384	100.0

Findings in the Table 9 confirmed that 87.8% of dairy actors got different trainings on cows' reproduction and artificial insemination from Sector and District veterinaries, Projects' staff and RAB staff.

Table 10: Cow increase in number

Number		Frequency	Valid Percent
Valid	1-2	192	50.0
	2-5	180	46.9
	5-above	12	3.1
	Total	384	100.0

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Table 10 showed how the trainings impacted the household and cows in number increase where 50% of respondents confirmed that their cows increased from 1 cow to two and continued increasing. According to NIFA (2021), reproduction success in livestock is essential for the economic livelihood of producers.

Table 11: Dairy chain actors having forage plots at household

Plot size		Frequency	Valid Percent
Valid	0-1ha	340	88.5
	1-2ha	43	11.2
	2-10ha	1	.3
	Total	384	100.0

The Table 11 revealed that 88.5% of respondents had a plot size of forage cultivated ranging between 0-1ha

Table 12: Accessed trainings on forage conservation

Topics		Frequency	Valid Percent
Valid	On silage conservation	17	4.4
	On hay making	4	1.0
	Both	352	91.7
	None	11	2.9
	Total	384	100.0

Table12 revealed that 91.7% of dairy farmers received trainings on silage conservation and hay making.

Table 13: Practicing of fodder conservation at household

Technique of fodder conservation		Frequency	Valid Percent
Valid	Silage	15	3.9
	Hay making	252	65.6
	Both	106	27.6
	None	11	2.9
	Total	384	100.0

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In Table 13, 65.6% of respondents confirmed that they practiced hay making conservation at household level.

Table 14: Level of feeding concentrates to lactating cows

Agreement		Frequency	Valid Percent
	Dairy chain actors who fed with concentrates	140	36.5
Valid	Dairy chain actors who didn't feed with concentrates	244	63.5
	Total	384	100.0

The Table 14 showed the level of feeding lactating cows with concentrates. At 63.5 % of respondents confirmed not feeding lactating cows with concentrates while others did.The researcher found that milk producers would be technically supported to feed their cows with rich nutrient fodders and concentrates to increase the productivity with fair costs. According to Johnson (2013), feeding costs are a high proportion of the total production costs on dairy farms. According to capper and Bauman (2013) and cited by Were (2017), the livestock industry is charged with providing sufficient animal products to meet the market demand while it needs to improve the environment perspective of animal production. The primary producer in the dairy value chain – the farmer carries various animal husbandry measures such as disease control measures, provision of feed to in-calf and lactating cows' requirements and traded through the formal marketing channels (Acharya, 2016).

Table 15: Dairy equipment possessed by respondents

Dairy equipment		Frequency	Valid Percent
	Milking machine	2	.5
	Milk cans	9	2.3
	Sprayers	1	.3
Valid	Milk cans +sprayers	281	73.2
	Milk cans +choppers	24	6.3
	Milk cans +choppers +sprayer	67	17.4
	Total	384	100.0

Table 15 revealed that 73.2% of respondents had and utilized milk cans and sprayers, 17.4% had milk cans, choppers and sprayers, 6.3% had milk cans and choppers, 2.3% had milk cans, 0.5% had milking machines while 0.3% had sprayers only.

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Table 16: Use and source of animal drugs

Source of drugs		Frequency	Valid Percent
	Vet. Pharmacy	334	87.0
Valid	Private veterinaries	50	13.0
	Total	384	100.0

Most of respondents used animal drugs as highlighted in the table 16, where 87% sourced them from veterinary pharmacies.

Table 17: Water and source

Source of water		Frequency	Valid Percent
	Tap water	43	11.2
	Well	5	1.3
	Tap water +House harvesting +Lake	116	30.2
Valid	Tap water +House Harvesting +Well	181	47.1
	All	23	6.0
	Lake	16	4.2
	Total	384	100.0

Table 17 highlighted that all milk producers had water, where 47.1% used water from tap water, house and fetched from the wells. Other respondents fed water from different sources as revealed.

Table 18: Raw milk produced per day before and after farming as business

Farming approach	Production range/day	Frequency	Valid Percent
Raw milk production before farming as business	0-5L	312	81.3
	5-10L	67	17.4
	10-20L	5	1.3
	Total	384	100.0
Raw milk production after farming as business	5-10L	2	.5
	10-20L	249	64.8
	20-50L	130	33.9
	Above 50L	3	.8
	Total	384	100.0

Table 18 showed that before farming as business by development of dairy value chain,the raw milk was produced at 81.3% in the range of 0-5 Liters per day. It was revealed that after the development

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of dairy value chain,the raw milk produced per day increased, where in the range of 10-20 Liters increased up to 65% as confirmed by respondents. By conclusion,this research confirmed the increase of the raw milk at household level which would contribute in increase of household incomes and development.

Table 19: Raw milk consumption and selling

Consumer	Consumption range	Frequency	Valid Percent
Quantity of raw milk consumed by calves	1-5L	306	79.7
	5-10L	62	16.1
	10-20L	16	4.2
	Total	384	100.0
Quantity of raw milk consumed at home per day	0-5L	349	90.9
	5-10L	34	8.9
	10-20L	1	.3
	Total	384	100.0
Quantity of raw milk sold per day	0-5L	67	17.4
	5-10L	140	36.5
	10-20L	141	36.7
	20-50L	35	9.1
	Above	1	.3
	Total	384	100.0

Based on results in Table 19, the raw milk produced at farmers' level was dispatched into three main outlets: Calves feeding; Home consumption, and Sales. For the quantity of raw milk consumed by calves per day, respondents at 79.7% confirmed that the consumption was between 0-5 Liters per day. The raw milk consumed at household level per day by family members, at 90.9% of respondents confirmed the consumption in the range of 0-5 Liters. From 36.5% to 36.7% of respondents confirmed that the raw milk produced per day was sold in the range of 5 - 20 Liters, while 9.1% confirmed between 20-50 Liters. Comparing calculations and statements, it was revealed that the quantity of milk sold was higher than the quantity consumed by calves and household members, which increased the household incomes.

Table 20: Buyers of raw milk produced and price

	Buyer and Price	Frequency	Valid Percent
Buyers of raw milk from producer	Kiosk	1	.3
	MCCs	228	59.4
	Processor	2	.5
	Middlemen	148	38.5
	Restaurant	5	1.3
	Total	384	100.0
Price of raw milk per liter	100-200Fr	160	41.7
	201-300Fr	224	58.3
	Total	384	100.0

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The results presented in Table 20 showed that 59.4% of milk produced by farmers was supplied to Milk Collection Centers (MCCs) plus the quantity collected by middlemen as confirmed by 38.5%, meaning that 97.9% of total sold milk was supplied to MCCs. The few remaining quantity was sold to locally to restaurants, kiosks, local processors. The total daily quantity collected by MCCs was also bought by Inyange Industries, Rwamagana Prison, Hotels, local Restaurants and retailers at affordable price. The researcher found that in Rwamagana district there were 5 milk collection Centres (MCCs) namely Kamirabose-Muhazi (1500Lt), Dufaco-Gishari (1000Lt), Dukundamatungo-Kigabiro (1800Lt), Cecora Zirakamwa-Rubona (2000Lt), CODAEGA-Gahengeli (1800Lt). It was also revealed that 58.3% of respondents sold their milk produce at a price ranging between 201- 300 Fr per liter. Milk producers were satisfied with the price. Referred to the research findings, the researcher confirmed that milk produced had a domestic market at a good price and dairy value chain was organized which motivated farmers to continue doing livestock as profitable business. Mostly sold fresh but sometimes also fermented—is sold by farmers to cooperatives, local restaurants, and neighbors (Kamanzi & Mapiye, 2012). According to FAO (2016), dairy chains link the actors and activities involved in delivering milk and milk products to final consumer, with each activity the product increases in value. Every actor of the chain should give the product the maximum added value at the minimum possible cost.

Table 21: Status of household income since farming and doing business

	Status	Frequency	Valid Percent
Position of respondents	Increase	160	41.7
	increase slowly	219	57.0
	no change	4	1.0
	Decrease	1	.3
	Total	384	100.0

The results in Table 21 showed that 57% of the respondents confirmed that their incomes increased slowly. On the other hand, this paper presents that 41.7% confirmed that there is an increase income among households while only 1% stated that there is no change in income based on doing business since they started farming.

Table 22: Source of household incomes

Source of income		Response	Frequency	Valid Percent
Valid	Sales of cows	Yes	341	88.8
		No	43	11.2
		Total	384	100.0
	Sales of raw milk	Yes	377	98.2
		No	7	1.8
		Total	384	100.0
	Sales of manure	Yes	314	81.8
		No	70	18.2
		Total	384	100.0
	Sales of animal feeds	Yes	1	.3
		No	383	99.7
		Total	384	100.0

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The respondents confirmed receiving incomes from different cows' sources as highlighted in the table 22, where 88.8% of respondents confirmed having incomes from cows sales, 98.2% received money from selling raw milk on daily basis during cows' lactating period, 81.8% confirmed receiving money from manure sales, while 0.3% of respondents received money from animal feeds selling. A household can get income from milk sales, animal sales, manure sales, and use of manure as fertilizer (Liveness et al., 2021). According to Otto Garcia et al (2017), dairy farm income refers to incomes coming from profit and loss account for the dairy enterprise of the farms only. According to Chand et al (2015), as cited by Liveness et al (2021), dairying generates income and contributes to food and nutrition security. According to Kashish (2017), dairying is not only source of employment and income for smallholders, but also a storehouse of wealth, an asset that often helps tide over unforeseen demands for liquid cash. Dairy farmers use the income from milk to purchase other food items such as rice, meat, maize, fish, vegetables, cooking oil, beans, sugar, and salt (Kalumikiza, 2012, as cited in Liveness et al.,2021),nonfood items as well as pay for hospital bills, school fees, and other services (Liveness et al.,2021).Nongovernmental organizations(NGOs) and other development partners consider smallholder dairying as a tool to enhance livelihood of rural poor households and as a tool in climate change adaptation and resilience (Chagunda et al.,2016, as cited in Liveness et al., 2021).

5.0 Summary of findings

The objective of the paper was to examine the dairy value chain and household development in Rwamagana district in Rwanda. It was found that technical services, dairy inputs availability and profitable market access contributed in household incomes. It was also revealed that animal husbandry techniques by reproduction and artificial insemination promoted cross-breeding, where 50% of respondents confirmed that their cows increased from 1 to 2, and other at 46.9% increased up to 5 cows. Respondents at 98.2% received trainings on animal health disease management, and 97.9% of them practiced what acquired from training, and this improved the animal health and reduced the cows' death rate. Majority of dairy value chain actors at 88.5% of respondents cultivated fodder to feed their cows and 91.7% of them gained different conservation techniques such as hay making and silage useful in dry and drought seasons to avoid milk shortages and cow death. Further, 73.2% of respondents of dairy chain actors had different milk equipment to support in keeping good quality and safety, storage and feeding such as milk cans, choppers, sprayers and other testing materials, and 87% of them accessed veterinary pharmacies nearby. Findings revealed that a large number of respondents at 90.9% consumed milk at home level which improved the households' members livelihood, and the surplus was sold to milk collection centers, milk kiosks, restaurants, hotels, schools.

6.0 Conclusion

Based on the findings, the study concluded that most of the research participants were happy and confident of their business which made easier and helpful in primary data collection. This was because they made progressive in cattle rearing, they got enough trainings and acquired dairy equipment, cattle were well treated and fed, chain actors were away of milk quality and safety, milk production increased, accessed markets affordable prices, payment modalities were

respected, government institutions and projects continued assisting up to a sustainable dairy development. The dairy chain actors got progressive households' solutions.

7.0 Recommendations

Based on the study's findings, the following recommendations were made;

i. Farmers should be mobilized for more house water harvesting strategies and increased measures of fodder conservation by hay making and silage techniques.
ii. Government and private sector in partnership with dairy chain actors should put in place a processing plant for products development, diversification, market penetration and market development strategies.
iii. There should be mobilizing of private investors or cooperatives in the dairy equipment shops.

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