Effects of Rwanda Dairy Development Project on the Livelihood of Dairy Farmers in the Western Province of Rwanda

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Abstract

The dairy sub-sector of the agricultural sector in Rwanda is crucial for rural development, poverty reduction, nutrition improvement and food security. Dairy farmers in Rwanda have faced many challenges which affect their livelihood. The government of Rwanda (GoR), in collaboration with the International Fund for Agricultural Development (IFAD), recently set up the Rwanda Dairy Development Project (RDDP) as one of the projects to promote the development of the dairy industry.

The study was carried out with the aim of assessing the effects of farm ownership, access to credit and the Rwanda Dairy Development Project (RDDP) on the livelihood of dairy farmers in the Western Province of Rwanda and identifying the best practices in climate adaptation strategies outlined by the dairy farmers.

The results show that dairy farmers who owned and operated their farms (self-owned) experienced an increase in

income during the RDDP and more farmers have moved from renting and joint ownership of farms to solely owning farms due to them receiving cows from the project. Also, dairy farmers now have easy access to credit facilities for dairy business. Several benefits received from the RDDP (Training, Vaccinations, Semen, Artificial Insemination and Forage seeds) have helped the farmers to adopt better farming practices which have improved their monthly income. Climate change affects the diary farming business, however, the farmers have recognized some adaptation strategies for climate change.

Recommendations were given among which are that more dairy farmers should be encouraged to join cooperatives for easier access to credit and loan; more effort should go into sensitising the farmers about the RDDP and the benefits available and more training on climate-smart agriculture should continue; also that more information on climate change and its effects should be easily accessed by dairy farmers. The Rwanda Dairy Development Project (RDDP) has been of benefit to the dairy farmers in Rwanda while improving their livelihood.

Keywords: Livelihood, Dairy sub-sector, Intervention, Dairy farmers, Rwanda Dairy Development Project

Introduction

Problem statement

The International Fund for Agricultural Development (IFAD) has recognized agriculture as one of the important sectors of a nation's economy that can drive poverty reduction faster. IFAD has invested in rural people, empowering them to increase their food security, improve family nutrition and increase incomes. IFAD began this in 1978 and since then has reached about 464 million people in sub-Saharan Africa, Asia and many other countries through different (intervention) projects. In Rwanda, IFAD started operations in 1981 and has financed projects in various aspects of rural development worth more than $200 million. Reports on the projects have shown that with access to finance, markets, technology and information,

rural people can lift themselves out of poverty. Intervention projects are part of the solutions that foster development. The Rwanda Dairy Development Project (RDDP) is one of IFAD's intervention projects in Rwanda. This study is an assessment of the first year of the implementation of RDDP on the livelihood of dairy farmers in Rwanda.

Dairy farmers have faced many challenges in Rwanda. Some of these challenges include limited access to market, low milk production, loss of milk due to inadequate preservation/storage facilities and knowledge, low access to credit, animal diseases, not enough forage, high cost of having a decent cowshed and damaging effects of climate change. These challenges have effects on the livelihood of dairy farmers in Rwanda. The study explores the effect of these challenges on the livelihood of dairy farmers in Rwanda and also proposes solutions. Livelihood here is defined basically by the income of dairy farmers in the study area.

In 2015, country leaders gathered at the United Nations Assembly to put thoughts together following the expiration of the Millennium Development Goals (MDGs). They arrived at a conclusion which was tagged Sustainable Development Goals (SDGs), a set of 17 goals which emphasize the development of all sectors in all countries, with the ultimate focus on improving the living conditions and the livelihood of every citizen in all countries without depleting national resources or jeopardizing the future of coming generations by preventing them from meeting their own needs of high and quality living conditions.

In line with the aim of the SDGs, the government of Rwanda has promoted the development of the dairy industry through a number of projects such as the African Development Bank (AfDB)-funded Development of Dairy Cattle and Livestock Infrastructure Projects and the Phases 1 and 2 of the USAID-funded Rwanda Dairy Competitiveness Programme (RDCP). In addition, SNV Rwanda, Heifer International, 'Send a Cow' and the recently completed Bill and Melinda Gates Foundation-funded East African Dairy Development Project have supported dairy development in Rwanda. The projects are being implemented in 17 districts selected for the RDCP II across the five milk-sheds in Rwanda. Since the National Dairy Strategy (NDS) was developed after wide consultation by the stakeholders, most of the projects supported by development partners fit under the NDS framework which emphasizes the importance of public-

private-producer partnerships. These intervention projects are targeted at fostering cordial relationships among rural farmers, increasing milk production and productivity in the country as well as increasing the income of the producers.

This study seeks to answer the following questions:

1. What is the effect of dairy farm ownership on the livelihood of dairy farmers in the Western Province of Rwanda?
2. What is the influence of access to credit on the livelihood of dairy farmers in the Western Province of Rwanda?
3. What is the effect of the contribution of the Rwanda Dairy Development Project on the livelihood of dairy farmers in the Western Province of Rwanda?
4. What are the best practices in climate adaptation strategies outlined by dairy farmers in the Western Province of Rwanda?

Background of the Study

Description of the Rwanda Dairy Development Project(RDDP)

The overall goal of the RDDP is to contribute to pro-poor national economic growth and improve the livelihood of resource-poor rural households. This will be achieved by focusing on food security, nutrition and the empowerment of women and youth in a sustainable and climate-resilient dairy value chain development. Specifically, the project seeks to increase the competitiveness and profitability of the dairy sector for the provision of quality products from small-scale producers to domestic and regional consumers, thus improving their livelihood, food security and nutrition whilst building overall resilience.

Below are explanations of productive capitals that households can employ in combination with their labour allocation in livelihood strategies, in order to generate incomes and improve their well-being.

Physical Capital: This refers, at the household level, to the physical equipment and tools that are used in production. At the most basic level, these can include the house, farmland for planting forages, feeds, livestock, milking can(s) and so on. At the community level, it also includes access to

infrastructure such as road networks, markets, joint milk sheds, milk collection centre(s), clinics, schools and so on.

Natural Capital: Land used for the cultivation of food crops and the grass/forage bio-diverse ecosystems they support are seen as 'natural capital', in the sense that they are productive assets which provide a range of ecosystem services to households. Households may privatize areas through clearance for cultivation, and communities may also evolve customary institutions around common access and the use of 'natural capital' such as fisheries in order to ensure sustainable off-take levels. Gishwati, a paddock in Mukamira (a sector in Nyabihu district), which dairy farmers lease or own for the purpose of growing forage for their cows is guided by a law which governs the grazing and harvesting of forage.

Financial Capital: This includes household savings, credit (and debt, which is negative capital), insurance and so on. The Rwanda Dairy Development Project has made provision for grants for farmers who can present a well-structured business plan. Dairy framers can obtain credit to support their businesses through cooperatives.

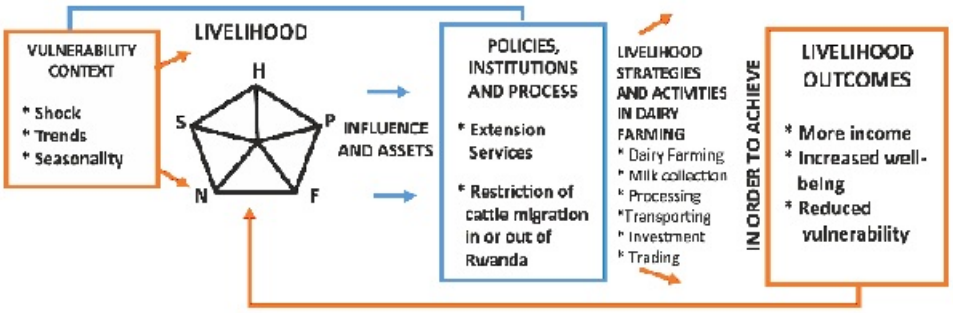
Social Capital: This refers to the kinship networks, associations, membership organizations and peer-group networks that people can use when in difficulty or turn to in order to gain advantage.

Important discussions by scholars took place on how assets could be combined, substituted and switched, with different portfolios emerging over time for different people in different places, and linking changes in natural capital (the environment) with social and economic dimensions; this was an important step forward. In particular, the focus on 'capitals' and the 'asset pentagon' kept the discussion firmly in the territory of economic analysis. A broader view of assets was also advocated. Scoones (2009) highlighted the opinions of Bebbington (1999: 22) about assets stating that he saw assets as 'vehicles for instrumental action (making a living), hermeneutic action (making living meaningful) and emancipatory action (challenging the structures under which one makes a living)'.

Vulnerability context, reflects the ever-present risk of seasonal fluctuations (e.g. shortage of water during the dry season, which affects milk production), and other shocks and underlying trends in livelihood conditions that are beyond the household's control. Shocks include disease

outbreaks among the cows, failure of produced milk to pass the alcohol test, lack of cold chain, fuel-price hikes (which impede the transportation of milk to the collection centres) and currency devaluation. At the household level, shock constitutes illness or the death of a family member (Allison and Springate-Baginski, 2009).

Livelihood is formed within social, economic and political contexts. Institutions, processes and policies, such as markets, social norms, and land ownership policies affect the ability to access and use assets for a favorable outcome. As these contexts change they create new livelihood obstacles or opportunities. Then, the Sustainable Livelihoods framework points to the households' livelihood outcomes, in terms of their state of *well-being*. A livelihood is sustainable if people are able to maintain or improve their standard of living related to well-being and income or other human development goals, reduce their vulnerability to external shocks and trends, and ensure their activities are compatible with maintaining the natural resource base.



The Sustainable Livelihoods Framework.

Notes: H: Human; P: Physical; F: Financial; N: Natural; S: Social

Source: Department for International Development (DFID).

Methodology

The study employed the survey method under which data were collected from different respondents at different locations through the survey interview guide.

Sampling Design: The multi-stage sampling technique was adopted for this study, this involves the stages described below:

Stage 1: Selection of one district out of the 12 districts the RDDP covers: Nyagatare, Rwamagana, Kayonza, Gicumbi, Burera, Musanze, Nyabihu, Rubavu, Rutsiro, Nyanza, Huye and Ruhango, all across the 4 Provinces. Nyabihu district was purposively selected.

Stage 2: This involved calculating the sample size from the total population of dairy farmers in Nyabihu district.

Stage 3: Selection of sectors under the chosen district. Nyabihu district has 12 sectors, namely: Bigogwe, Jenda, Jomba, Kabatwa, Karago, Kintobo, Mukamira, Muringa, Rambura, Rugera, Rurembo and Shyira. Six sectors (Bigogwe, Jenda, Kabatwa, Karago, Mukamira and Rambura) were purposively selected from the 12 sectors.

Stage 4: Getting, training and deploying enumerators to the selected sectors for data collection with the use of a well-structured interview guide.

Stage 5: Respondents randomly selected from cooperatives, the milk collection centres (MCCs), as well as different households. Respondents comprised dairy farmers who had benefited from the project as well as farmers who were yet to benefit from the project.

Study population

Out of the 12 districts which the Rwanda Dairy Development Project (RDDP) covers, Nyabihu was purposively selected from the Western Province of Rwanda. Nyabihu district was one of the first districts to enjoy the early implementation of RDDP and this was as a result of the many challenges which dairy farmers had faced in times past. A total of 24,604 dairy farmers were recorded to exist in Nyabihu district as at the time the study was carried out. This number constituted both the beneficiaries and non-beneficiaries of the RDDP.

Sample size and data collection method

The total population of dairy farmers in Nyabihu was subjected to calculation using a sample size calculator online (Survey Systems, 2018) with a confidence level of 95%. The sample size obtained was 383, which number of people were selected randomly across six (6) of the twelve (12) sectors in Nyabihu district namely Bigogwe, Jenda, Kabatwa, Rambura, Mukamira and Karago.

Questionnaires (interview guide) were used to gather primary data from the respondents while secondary data were gathered from various publications about the RDDP, national statistics as well as publications from other scholars on dairy farming and livelihood. Examples are Poverty Analysis for Rwanda's Economic Development and Poverty Reduction Strategy Final Report, Rwanda Poverty Profile Report, Rwandan Integrated Household Living Conditions Survey, Detailed design report of the Rwanda Dairy Development Project (RDDP), to mention a few.

Validity and reliability of research instrument

To ensure validity of the research instrument used in this study, a face test was carried out while a pre-test was also done before the data collection exercise. The pre-test led to a rework of the questionnaire before the main study was conducted.

Data analysis

The data collected for the study were both primary and secondary involving quantitative and qualitative data. SPSS IBM 21 and MS Excel spreadsheet were used to analyse quantitative data.

Results and Discussion

Demographic characteristics of respondents

The demographic characteristics of the respondents are presented in table 1. The age distribution of dairy farmers in Nyabihu district indicates that a larger percentage (about 33 percent) of the population were between the ages of 31 and 40, which illustrates that the dairy sector in Rwanda is actively engaged by a population in their active productive years. It is also interesting to note that an older population (more than 2% made up of farmers over 70 years) were also involved in dairy farming. This may suggest that the dairy sector is sustainable in terms of labour force. The mean age of respondents was 45.38 years.

More than half (52.5%) of the respondents had primary school education while 24.3% had secondary school education. The net attendance rate (NAR) for primary schools in Nyabihu district was 89.2% in 2012 (NISR, 2012), which was higher than the National NAR given at 87.9% in 2013 (NISR, 2014 - EICV4, 2013). The net attendance rate for secondary schools in

Nyabihu was 23.5% in 2012 (NISR: 2012) while the national NAR was 23% in 2013. This means that more than half of Nyabihu children abandon schooling after their primary education to engage in economic activities. However, the national rise in secondary school net attendance from 17.8% in 2011 to 23% in 2014 is primarily driving the increase in secondary school attendance in the rural areas of Rwanda, and Nyabihu is not left out (NISR, 2014 - EICV4, 2013).

The majority (76.9%) of the respondents were married. This suggests that there is a possibility of having household help (human capital) in the dairy business.

As for gender distribution, results show that 71.9% of the respondents were male while 28.1 percent were female. Since men ordinarily dominate dairy farming, the RDDP seeks to increase women's participation and EICV4 (2013) revealed that more female-headed households than male-headed households have received an animal from other social protection schemes, hence women's involvement is on the rise and this might keep rising as the RDDP progresses.

It was found out that the majority (97%) of the respondents were Christians while 1.8% were Muslims and 1.2% did not state their religion. NISR (2012) attested that Christianity is the predominant religion in Nyabihu District with more than 95% of the population; Muslims represent 0.7%, and 3.7% are without religion.

Table 1: Demographic characteristics of respondents

Characteristic	Frequency	Percent
Age Category		
31-40	102	32.2
41-50	73	23.0
51-60	59	18.6
61-70	39	12.3
71-80	6	1.9
81-90	1	0.3
Total	280	88.3

Characteristic	Frequency	Percent
Highest Educational Qualification		
No Formal Education	75	22.0
Primary Education	179	52.5
Junior High School	68	19.9
Higher School	15	4.4
University	4	1.2
Total	341	100.0
Marital Status		
Single	26	7.5
Married	266	76.9
Widow	53	15.3
Divorced	1	0.3
Total	346	100.0
Gender of Respondents		
Female	95	28.1
Male	243	71.9
Total	338	100.0
Religious Affiliation		
Christianity	321	97.0
Islam	6	1.8
Other	4	1.2
Total	331	100.0
Head of Household		
Female	65	19.5
Male	269	80.5
Total	334	100.0

Source: Field survey, 2018.

The results of previous surveys showed that raising cattle in Rwanda is far more common among male-headed households than female-headed ones (53% compared to 41%) (EICV: 2013). In Nyabihu, male-headed households were also in the majority (80.5%) compared to female-headed households (19.5%). The percentage of households raising cattle has risen nationally by three percentage points, from 47% to 50%, driven by an increase in Kigali City, Southern and Western Provinces (where Nyabihu is located).

Effect of Dairy Farm Ownership on Improving the Livelihood of Dairy Farmers

There was an increase of more than 4 percentage points in the self-owned pattern of ownership among the respondents (from 81.4% to 85.8%), showing that more people now own their dairy farming business compared to the period before the RDDP. This suggests that more people may have got cows from the RDDP. This indication was also supported by decreases in the percentage points of ownership patterns of both rent (from 2.9% to 2.1%) and joint ownership (from 3.3% to 2.1%). Earlier surveys (EICVs) indicated that the percentage of livestock-owning households rearing cattle increased over the years from 34.4% in 2006, to 47.3% in 2011 and 50.4% in 2014.

Table 2: Farm Ownership before and during RDDP

Farm Ownership	Before RDDP		During RDDP	
	Frequency	Percent	Frequency	Percent
Self-owned	250	81.4	291	85.8
Inheritance	33	10.7	30	8.8
Rent	9	2.9	7	2.1
Jointly Owned	10	3.3	7	2.1
Other	5	1.6	4	1.2

Source: Field survey, 2018.

Table 3 shows the average monthly income of the farmers according to forms of farm ownership. All forms of farm ownership witnessed increasing trends during the RDDP. This suggests that the RDDP improved the income levels of dairy farmers in Nyabihu district.

Table 3: Average monthly income of respondents and form of farm ownership before and during RDDP

Forms of Farm Ownership	Average Monthly Income before RDDP (RwF)	Average Monthly Income during RDDP (RwF)
Self-owned	41,054	63,244
Inheritance	124,500	243,200
Rent	94,333	169,114
Jointly-owned	28,920	133,714
Other	25,200	54,000

Source: Field survey, 2018.

Comparing the pattern of income of farmers, before and during the RDDP (see Tables 4 & 5), it is evident that dairy farmers who owned their farms made more income during the RDDP. However, only in the category of monthly income (0-20000RwF) was it seen that self-owned farmers made more income before RDDP compared to the same category during the RDDP. Subsequently, in higher categories of monthly income, self-owned farmers made more income than other forms of farm ownership. This may suggest that the project has been beneficial to self-owned farmers or sole proprietors in the dairy business in Rwanda.

Further analysis gives detailed information on the relationship between forms of farm ownership and monthly income before the implementation of RDDP. The self-owned form of farm ownership ranked highest at the 0-20000 RwF category of monthly income. Chi-square test was done at 5% probability, and a result of no significance was obtained (see Table 4).

Table 4: Relationship between monthly income and forms of farm ownership of the respondents before RDDP

	Form of Farm Ownership before RDDP					
	Self-owned	Inheritance	Rent	Jointly Owned	Other	Total
0-20000	119	19	4	6	3	151
20001-40000	43	5	2	0	1	51
40001-60000	30	2	0	2	1	35
60001-80000	14	1	1	1	0	17
80001-100000	17	4	1	0	0	22
100001-120000	13	0	0	1	0	14
120001-140000	4	0	0	0	0	4
140001-160000	3	1	0	0	0	4
160001-180000	2	0	0	0	0	2
180001-200000	2	0	0	0	0	2
>200001	2	1	1	0	0	4
Total	249	33	9	10	5	306

Chi-Square Tests: Value 23.765 at 0.981 significance

Source: Field survey, 2018.

Detailed examination of the relationship between the forms of farm ownership and monthly income during the implementation of RDDP was done. The results showed that self-owned form of farm ownership ranked highest at the 0-20000 RwF category of monthly income, although with a reduction in frequency (from 119 to 92), giving room for an increase in the frequency at other higher categories of monthly income, 20001-40000 (from 43 to 66) and 160001-180000 (from 2 to 11). Chi-square test was done at 5% probability, and a result of no significance was obtained (see Table 5).

Table 5: The relationship between monthly income and forms of farm ownership of the respondents during RDDP

Monthly Income	Form of Farm Ownership during RDDP					Total
	Self-owned	Inheritance	Rent	Jointly Owned	Other	
0-20000	92	10	2	1	0	105
20001-40000	66	3	3	2	1	75
40001-60000	35	4	0	0	2	41
60001-80000	13	1	1	0	0	15
80001-100000	19	3	0	0	1	23
100001-120000	12	0	0	0	0	12
120001-140000	13	3	0	1	0	17
140001-160000	9	1	0	0	0	10
160001-180000	11	2	0	0	0	13
180001-200000	4	1	0	0	0	5
>200001	17	2	1	3	0	23
Total	291	30	7	7	4	339

Chi-Square Tests: Value significance 40.421 at 0.452 significance

Source: Field survey, 2018.

Influence of Access to Credit on Improving the Livelihood of Dairy Farmers

Before the RDDP, the majority of the respondents (69.3%) had no access to financial assistance from savings and loans groups but during the RDDP, those who had access to financial assistance increased from 30.7 to 51.5 percent. This may be due to better organization of dairy farmers into cooperative groups. The RDDP also provides grants for dairy farmers, though only a few have benefited from the grants. Previous surveys stated that informal lenders remain the most common source of credit (NISR 2014; EICV4: 2013).

Table 6: Access to financial assistance from savings and loans groups before and during RDDP

	Before RDDP		During RDDP	
	Frequency	Percent	Frequency	Percent
Yes	99	30.7	168	51.5
No	223	69.3	158	48.5
Total	322	100.0	326	100.0

Source: Field survey, 2018.

The influence of access to financial assistance on the monthly income (RwF) of dairy farmers in Nyabihu district before and during RDDP, can be observed from the results of a cross-tabulation of access to financial assistance and monthly income of dairy farmers (see Tables 7 & 8). The results reveal that dairy farmers who had access to financial assistance made more income monthly than those who did not have access to financial assistance both before and during the RDDP. However, there was a tremendous increase across the categories of monthly income of farmers who had access to financial assistance during the RDDP, especially the category 160001-180000RwF (from 0-10).

Table 7: Relationship between access to financial assistance from savings and loan groups and monthly income of respondents before RDDP

Monthly Income (RwF)	Access to financial assistance from savings and loans group before RDDP?		Total
	Yes	No	
0-20000	30	140	170
20001-40000	15	32	47
40001-60000	17	18	35
60001-80000	9	8	17
80001-100000	9	13	22
100001-120000	10	4	14
120001-140000	3	1	4
140001-160000	2	2	4
160001-180000	0	2	2
180001-200000	1	1	2
>200001	3	1	4
Total	99	222	321

Chi-Square Tests: Value 44.048 at 0.000 significance

Source: Field survey, 2018.

Table 8: Relationship between access to financial assistance from savings and loans group and monthly income of respondents during RDDP

Monthly Income (RwF)	Access to financial assistance from savings and loans group during RDDP		Total
	Yes	No	
0-20000	31	69	100
20001-40000	33	38	71
40001-60000	15	25	40
60001-80000	10	4	14
80001-100000	18	5	23
100001-120000	7	4	11
120001-140000	14	2	16
140001-160000	7	3	10
160001-180000	10	3	13
180001-200000	4	1	5
>200001	19	4	23
Total	168	158	326

Chi-Square Tests: Value 53.725 at 0.000 significance

Source: Field survey, 2018.

For the relationship between access to financial assistance from savings and loan groups and the monthly income of respondents before RDDP, the Chi-square test result shows that there is a significant relationship. In comparison, income category >200001RwF moved from 3 before RDDP to 19 during RDDP, and despite not being able to access financial assistance, the same income category witnessed an increase from 1 to 4 during RDDP.

Some of the things the respondents indicated they used the financial assistance for ranged from purchase of improved breed of cows and feed, among many other things.

Effect of contribution of the Rwanda Dairy Development Project on livelihood of the dairy farmers

When asked if they had benefited from the RDDP, the majority (87.8%) responded in the affirmation that they had benefited or were currently benefiting from the project. Training and vaccines (70.4% and 69.8%) topped the list of benefits while cow/heifer was the least benefited.

Training and sensitization about the project were given high priority. However, 12.2% of the respondents said they have not benefited from RDDP, giving the reason that they had not heard about the project. This may be because the project was still in the early stage of implementation.

Before the RDDP, a large number of dairy farmers made between 0-20000 RwF monthly from milk production. During the RDDP, however, respondents who benefited from the project experienced increase in monthly income. This is evident in the categories of income, especially in the category of monthly income of above 200000 RwF (from 2 farmers before to 20 farmers during) as shown in Tables 7 & 8. One of the major benefits instrumental to the increased income (improved livelihood) of dairy farmers in the study area is the opportunity to sell milk readily at milk collection centres (MCC) at a regulated price per litre, which is higher than the prices per litre when sold to random retailers and consumers.

However, for dairy farmers who have not benefited from RDDP, a majority of them have their monthly income between 0-20000 and 20001-40000 RwF, as shown in Table 8.

Best practices in climate adaptation strategies outlined by dairy farmers

Households in Rwanda identified climate change most frequently as the main environmental issue affecting their plots. The main sources of information were meetings and training and radio or TV. Environmental destruction for dwellings was more common in the Western, Northern, and Southern provinces, but affected a lower percentage of dwellings in the Eastern Province and Kigali City (EICV4: 2013).

Adaptation practices for reduction in water availability

Respondents in Nyabihu district highlighted some of their climate change adaptation practices. When asked how they coped whenever there was reduction in water availability for their cows, close to half of the respondents (49.2%) said water harvesting was their adaptation practice while 34.9% said they got water from boreholes (Table 9).

Table 9: Climate adaptation practices for reduction in water availability

Adaptation Practice	Frequency	Percent
Water harvesting	124	49.2
Borehole	88	34.9
Waste water treatment	35	13.9
Other	5	2.0
Total	252	100.0

Source: Field survey, 2018.

Adaptation practices for water reduction by gender

For the relationship between the climate adaptation practices by the rural farmers in Rwanda and gender, results (Table 10) reveal that more females compared to males got water from water harvesting (73 to 49) and boreholes (65 to 21) whenever there was reduction in water availability for their dairy business needs. The chi-square test done at 5% gave a significant result at 0.053 .

Table 10: Climate adaptation practices for reduction in water availability and gender

Adaptation Practices	Gender of Respondent	
	Male	Female
Water harvesting	49	73
Borehole	21	65
Waste water treatment	8	27
Other	1	4
Total	79	169

Chi-square test: Value 7.700 at 0.053 significance

Source: Field survey, 2018.

Adaptation practices for water reduction by educational qualification

For the relationship between climate adaptation practices by the rural farmers in Rwanda and academic qualification, the results reveal that more farmers who had primary education got water from water harvesting (72) and boreholes (49) whenever there was reduction in water availability

for their dairy business needs. The chi-square test done at 5% gave a significant result at 0.006.

Table 11: Climate adaptation practices for reduction in water availability and highest educational qualification

Adaptation Practices for Reduction in Water Availability	Highest Educational Qualification				
	No Formal Education	Primary Education	Junior High School	Higher School	University
Water harvesting	28	72	16	4	0
Borehole	16	49	21	1	0
Waste water treatment	8	16	7	3	1
Other	1	0	4	0	0
Total	53	137	48	8	1

Chi-square tests: Value 27.645 at 0.006 significance

Source: Field survey, 2018.

Assessment of the relationship between climate adaptation practices by rural farmers in Rwanda and marital status revealed that more farmers who were married got water from water harvesting (97) and boreholes (69) whenever there was a reduction in water availability for their dairy business needs. The chi-square test done at 5% gave a significant result at 0.000.

Table 12: Climate adaptation practices for reduction in water availability and marital status

Adaptation Practices for Reduction in Water Availability	Marital Status		
	Single	Married	Widowed
Water harvesting	3	97	24
Borehole	7	69	12
Waste water treatment	2	26	7
Other	3	1	1
Total	15	193	44

Chi-square tests: Value 31.070 at 0.000 significance

Source: Field survey, 2018.

Table 13 shows the adaptation practices of respondents when there was reduction in grazing land. A higher percentage (44%) of the respondents stored forage for the dry season feeding while some (29.2%) fed their cows with agro-forestry leaves by planting the trees earlier. Others

(25.1%) preferred to feed their cows with concentrates, while only a few (1.6%) engaged in the use of hydroponics technology to plant forage.

Table 13: Climate adaptation practices for reduction in grazing land

Adaptation Practice	Frequency	Percent
Storage of forages for dry season feeding	107	44.0
Feeding of concentrates	61	25.1
Use of hydroponics technology	4	1.6
Planting of agroforestry trees	71	29.2
Total	243	100.0

Source: Field survey, 2018.

An examination of the relationship between climate adaptation practices by the rural farmers in Rwanda and gender revealed that more females compared to their male counterparts adopted storage of forage for dry season feeding (71 to 36), planting of agroforestry trees (57 to 14) and feeding of concentrates (39 to 20) to their cows whenever there was a reduction in grazing land for their dairy business needs. The chi-square test done at 5% gave a no significant result at 0.113.

Table 14: Climate adaptation practices for reduction in grazing land and gender

Adaptation Practices for Reduction in Grazing Land	Gender of Respondent	
	Male	Female
Storage of forages for dry season feeding	36	71
Feeding of Concentrates	20	39
Use of Hydroponics technology	0	3
Planting of agroforestry trees	14	57
Total	70	170

Chi-square tests: Value 5.981 at 0.113 significance

Source: Field survey, 2018.

The results of the relationship between the climate adaptation practices by the rural farmers in Rwanda and educational qualification, revealed that farmers who had primary education ranked highest in the adoption of storage of forage for dry season feeding (63), planting of agro-forestry trees (32) and feeding of concentrates (27) to cows whenever there

was reduction in grazing land for their dairy business needs. The chi-square test done at 5% gave no significant result at 0.087.

Table 15: Climate adaptation practices for reduction in grazing land and highest educational qualification

Adaptation Practice	Highest Educational Qualification				
	No Formal Education	Primary Education	Junior High School	Higher School	University
Storage of forages for dry season feeding	19	63	22	2	0
Feeding of concentrates	21	27	8	2	1
Use of hydroponics technology	0	4	0	0	0
Planting of agroforestry trees	14	32	19	5	1
Total	54	126	49	9	2

Chi-square tests: Value 19.081 at 0.087 significance

Source: Field survey, 2018.

Results on the relationship between the climate adaptation practices by rural farmers in Rwanda and marital status revealed that married farmers ranked highest in the adoption of storage of forage for dry season feeding (79), planting of agroforestry trees (58) and feeding of concentrates (45) to cows whenever there was a reduction in grazing land for their dairy business needs. The chi-square test done at 5% gave a no significant result at 0.222.

Table 16: Climate adaptation practices for reduction in grazing land and marital status

Adaptation Practice for Reduction in grazing land	Marital Status			
	Single	Married	Widowed	Divorced
Storage of forage for dry season feeding	7	79	20	1
Feeding of Concentrates	2	45	14	0
Use of Hydroponics technology	0	4	0	0
Planting of agroforestry trees	8	58	5	0
Total	17	186	39	1

Chi-square tests: Value 11.843 at 0.222 significance

Source: Field survey, 2018.

On adaptation practices for increases in temperature (Table 17), a large percentage (57.4%) of the farmers preferred to plant agro-forestry trees for the dual purpose of creating shade for their cows during hot periods and for feeding. Other farmers engaged in the use of vaccination (22.6%) and construction of sheds (19.4%).

Table 17: Climate adaptation practices for increase in temperature

Adaptation practice	Frequency	Percent
Taking vaccination	35	22.6
Construction of sheds	30	19.4
Planting of agroforestry trees	89	57.4
Other	1	0.6
Total	155	100.0

Source: Field survey, 2018.

The results on the relationship between the climate adaptation practices by rural farmers in Rwanda and gender revealed that more females than males adopted taking vaccinations (26 to 9), constructing sheds (25 to 4) and planting of agro-forestry trees (62 to 26) as mitigation against increase in temperature. The chi-square test done at 5% gave a no significant result at 0.130.

Table 18: Climate adaptation practices for increase in temperature and gender

Adaptation Practice for Increase in Temperature	Gender of Respondent	
	Male	Female
Taking Vaccination	9	26
Construction of Sheds	4	25
Planting of agro-forestry trees	26	62
Other	1	0
Total	40	113

Chi-square tests: Value 5.647 at 0.130 significance

Source: Field survey, 2018.

Examination of the relationship between the climate adaptation practices by rural farmers in Rwanda and educational qualification revealed that farmers who had primary education adopted taking vaccination (22), construction of sheds (14) and planting of agro-forestry trees (43) as

mitigation against increase in temperature. The chi-square test done at 5% gave a no significant result at 0.719.

Table 19: Climate adaptation practices for increase in temperature and highest educational qualification

Climate Adaptation Practices for Increase in Temperature	Highest Educational Qualification				
	No Formal Education	Primary Education	Junior High School	Higher School	University
Taking vaccination	8	22	3	1	0
Construction of sheds	6	14	7	1	0
Planting of agroforestry trees	18	43	24	4	0
Other	0	1	0	0	0
Total	32	80	34	6	0

Chi-square tests: Value 6.205 at 0.719 significance

Source: Field survey, 2018.

Results for the relationship between the climate adaptation practices by the rural farmers in Rwanda and marital status revealed that more farmers who are married adopt taking vaccination (28), construction of sheds (28) and planting of agro-forestry trees (65) as mitigation against increase in temperature. Chi-square test done at 5% gave a significant result at 0.023.

Table 20: Climate adaptation practices for increase in temperature and marital status

Climate Adaptation Practice for Increase in Temperature	Marital Status			
	Single	Married	Widow	Divorced
Taking vaccination	0	28	7	0
Construction of sheds	1	28	1	0
Planting of agroforestry trees	9	65	15	0
Other	0	0	1	0
Total	10	121	24	0

Chi-square tests: Value 14.648 at 0.023 significance

Source: Field survey, 2018.

On adaptation practices for floods (Table 21), a majority, (58.1%) of the farmers said they would rather take their cows away from the flooded areas while some others (42.7%) said they would put integrated watershed

management measures such as terraces, agro-forestry trees, and water ways in place against the floods.

Table 21: Climate adaptation practices for floods

Adaptation Practice	Frequency	Percent
Take Cows away from the flooded area	86	58.1
Putting in place integrated watershed management measures such as terraces, agroforestry trees, water ways	61	41.2
Other	1	0.7
Total	148	100.0

Source: Field survey, 2018.

Assessment of the relationship between climate adaptation practices by rural farmers in Rwanda and gender revealed that more females compared to males resolved to taking their cows away from the flooded areas (57 to 26) and putting in place integrated watershed management measures such as terraces, agro-forestry trees, water ways, construction of sheds (45 to 16) as mitigation against floods. The chi-square test done at 5% gave a no significant result at 0.243.

Table 22: Climate adaptation Practices for Floods and Gender

	Gender of Respondent	
Climate Adaptation Practice for Floods	Male	Female
Take cows away from the flooded area	26	57
Putting in place the integrated watershed management measures such as terraces, agroforestry trees, water ways	16	45
Other	1	0
Total	43	102

Chi-square tests: Value 2.826 at 0.243 significance

Source: Field survey, 2018.

Results for the relationship between the climate adaptation practices by the rural farmers in Rwanda and educational qualification revealed that more farmers who attained primary education resolved to taking cows away from the flooded area (53) and putting in place integrated watershed management measures such as terraces, agro-forestry trees, water ways,

construction of sheds (28) as mitigation against floods. The chi-square test done at 5% gave a no significant result at 0.538.

Table 23: Climate adaptation practices for floods and highest educational qualification

Climate Adaptation Practice for Floods	Highest Educational Qualification				
	No Formal Education	Primary Education	Junior High School	Higher School	University
Take cows away from the flooded area	10	53	18	3	0
Putting in place the integrated watershed management measures such as terraces, agroforestry trees, water ways	12	28	15	5	1
Other	0	1	0	0	0
Total	22	82	33	8	1

Chi-square tests: Value 6.983 at 0.538 significance

Source: Field survey, 2018.

Results for relationship between the climate adaptation practices by the rural farmers in Rwanda and marital status revealed that more married farmers resolve to taking their cows away from the flooded area (68) and putting in place integrated watershed management measures such as terraces, agro-forestry trees, water ways, construction of sheds (45) as mitigation against floods. The chi-square test done at 5% gave a no significant result at 0.192.

Table 24: Climate adaptation practices for floods and marital status

Climate Adaptation Practices for Floods	Marital Status			
	Single	Married	Widow	Divorced
Take cows away from the flooded area	6	68	12	0
Putting in place the integrated watershed management measures such as terraces, agro-forestry trees, waterways	6	45	10	0
Other	0	0	1	0
Total	12	113	23	0

Chi-square tests: Value 6.100 at 0.192 significance

Source: Field survey, 2018.

Summary, Conclusion and Recommendations

Summary

The study was carried out in Nyabihu district of the Western Province of Rwanda with the aim of assessing the Rwanda Dairy Development Project as it affects the livelihood of the dairy farmers in Rwanda. Out of the population of dairy farmers in Nyabihu district, about 350 were randomly selected across 6 sectors through their cooperatives, milk collection centres and households. It was discovered that the RDDP has contributed positively to the livelihood of the dairy farmers in Nyabihu district.

For farm ownership, dairy farmers who owned and operated their farms themselves (self-owned) experienced an increase in their income during the RDDP and more farmers have moved from renting and joint owning of farms to owning the farms by themselves consequent upon receiving cows from the project.

Dairy farmers now have easy access to credit for their dairy businesses. This has helped the farmers to purchase improved breeds of cows and sufficient feed when there is scarcity of forage. The improved breeds of cows produce more milk than the local breeds. This has further increased the production and sale of milk, thereby increasing the farmers' monthly income.

Several benefits received from the RDDP (training, vaccinations, semen, artificial insemination and forage seeds) have helped the farmers to have better farming practices which has improved their monthly income. These benefits are given to farmers free.

The farmers attested to the fact that climate change affects their farming business, however they recognized some adaptation strategies for climate change. A major climate change adaptation practice is the cultivation of forage when there is reduced grazing lands for cows. The RDDP provided forage seeds to dairy farmers. Also, some farmers buy concentrates for their cows and a few store forage till the dry season to use in feeding their cows. A lot of farmers opt for water harvesting when there is reduced water while some fetch water from community boreholes.

Conclusion

The Rwanda Dairy Development Project (RDDP) has been of benefit to the dairy farmers in Rwanda while improving their livelihood. This has been achieved through training on best dairy farming practices and access to markets. If this much could be achieved in just one year of its implementation, then much more would be achieved in the coming years of the implementation of the RDDP.

Recommendations

A lot of the dairy farmers now have access to credit. Some of the dairy farmers are yet to join a cooperative group. More dairy farmers should be encouraged to join cooperatives. The cooperative groups have made it easier for diary farmers to access credits and loans. Also, many of the farmers do not know about the grant available from the RDDP, more farmers should be made aware of the grant from RDDP, and be taught how to access the grant.

Despite the large percentage of dairy farmers who have benefited from the RDDP, about 12.2 percent of the respondents said they have not benefited from the RDDP because they have not heard of the project. The researcher suggests that more effort should go into sensitizing the farmers about the RDDP and the benefits available.

Dairy farmers in Rwanda have adopted climate adaptation strategies; it is therefore suggested that more training on climate-smart agriculture should be done. Also more information on climate change, its effects and ways of combating the effects of these changes should be easily accessible to dairy farmers.

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