

Fodder production and conservation practices for smallholder dairy farmers in the Imbo plain of Burundi

Francine Ahimpera^{1,2,3,4*}, Napoleon Munyaneza², Albert Iribagiza², Godfrey Jabulani Manyawu³, Lionel Nyabongo³, Anthony Macharia King'ori⁴

¹Ministry of the Environment, Agriculture and Livestock, National Veterinary Laboratory of Burundi

²Research Center in Animal, Plant and Environmental Production Sciences, Burundi University, Animal Health, and Production Department

³International Livestock Research Institute (ILRI)

⁴Egerton University, Department of Animal Science.

*Corresponding Author

Francine Ahimpera

Egerton University, Department of Animal science, Kenya.

DOI: 10.5281/zenodo.13892308

Article History

Received: 15.08.2024

Accepted: 27.09.2024

Published: 04.10.2024

Abstract: The study was conducted on 384 smallholder dairy farms located in five Provinces of the Imbo Plain of Burundi. It assessed the status of livestock feeding and identified potential dry season feed interventions by smallholder dairy farmers. A survey using a structured questionnaire was used to collect information on fodder production, fodder conservation, feeding management, feed resources, and marketing. The Kobo collect tool was used to facilitate the activity. Data were analyzed using IBM SPSS Statistics 20 software. Quantitative data were analyzed using descriptive statistics while qualitative data were analyzed using the association of some variables by using cross-tabulations. Results from the study showed a high level of availability of natural fodder (96.9%) and established fodder (94.5%) during the wet season with scarcity during the dry season (87.2% and 85.7% respectively). It was observed that there was a low level of adoption of fodder conservation and marketing. The study concluded that the low adoption level of fodder production, conservation, and marketing practices may be a result of the low education level and consequently increased poverty among smallholder dairy farmers. To prevent dry season feed scarcity, smallholder dairy farmers, were encouraged to adopt new technologies of conservation of surplus fodder available in the wet Season. They were also inducted to new technologies of treating crop residues for use as animal feed during the dry season period.

Keywords: Livestock, feed scarcity, milk production, season, smallholder income, Burundi.

Abbreviated title: Fodder production and conservation practices.

Cite this article:

Ahimpera, F., Munyaneza, N., Iribagiza, A., Manyawu, G. J., Nyabongo, L., King'ori, A. M., (2024). Fodder production and conservation practices for smallholder dairy farmers in the Imbo plain of Burundi. *ISAR Journal of Agriculture and Biology*, 2(10), 9-14.

Introduction

Agriculture is the main economic activity of the smallholder farmers in the Imbo plain of Burundi. Here, farmers practice mixed crop-livestock farming and in recent years there was a strong drive to increase agricultural intensification on small-scale farms (Nabahungu et al., 2019) due to shortage of land. Livestock contributes directly to human nutrition by providing meat, milk, and eggs, which rich protein sources needed to maintain good health (Keringingo et al., 2022). Livestock contributes economically to crop farming by providing manure. Most crop farmers rely on manure because chemical fertilizers are not easily accessible. Manure is also needed for fodder production.

In addition to improving human nutrition and health, Government is also promoting dairy farming to mitigate unemployment, especially in youth. However, even though many Governments and donor project have been promoting dairy farming in recent years,

adoption of improved livestock feeding technologies (including production and conservation of fodder) have been generally low. This has caused a decrease in milk production, especially during the dry season when there is an increase in milk consumption, hence a deficit in supply. In many east African countries, new forage varieties was introduced to improve dairy animal nutrition and productivity in order to enhance rural livelihoods (Ashley et al., 2018).

The dairy sector in Burundi has been facing forage supply constraints which are related to population growth. Increased population led to shortage of arable and communal grazing land (Bacigale et al., 2019). It also caused many households to become landless and food insecure (Ludgate et al., 2015). As a result, the Government introduced a Zero-Grazing Policy in 2020.

Seasonal variations in feed supply and quality, especially during the dry season, has been affecting milk production (Balehgn et al., 2020) suggested that introduction of improved forage varieties,

enhancing the quality of existing low-quality roughages (crop residues), and improving production and utilization of concentrates, are important interventions that can improve the supply of high quality feed. Therefore, the following study was carried out to evaluate the status of fodder production and conservation practices on smallholder dairy farmers in the Imbo plains. Specific objectives of the study were to (i) identified challenges and opportunities in the adoption of improved forage technologies by smallholder dairy farmers; (ii) assessing existing annual fodder flows at smallholder farms and (iii) determining the feasibility of improving household income through the adoption of improved agronomic, conservation, and marketing practices of fodder.

Materials and methods

Study area

The area of study was the Eastern and North-Eastern parts of Burundi located between 2°48'30" and 4°20'43" latitude South, and 29°93' 63" longitude East. The average annual temperature was over 25°C with a maximum above 30°C (June-August) and a Minimum below 15°C. Precipitation was 800-1100mm of rain spread over 7-9 months (September-May). The relative humidity was about 70%(MEEATU, 2013).

In the northern part, along the Lake Tanganyika, the vegetation was made of a reed bed with *Phragmites mauritians* (reed grass) as well as other aquatic, semi-aquatic, and ruderal species. The coastal strip and the surroundings of mouths of the lake's tributaries contained remains of ancient vegetation that was still flooded, spontaneous fodder (*Cynodon dactylon*, *Macrotyloma axillare*, *Digitaria abyssinica*). All this flora constituted a purification system for lake water against alluvium and other materials washed away by erosion from the foothills.

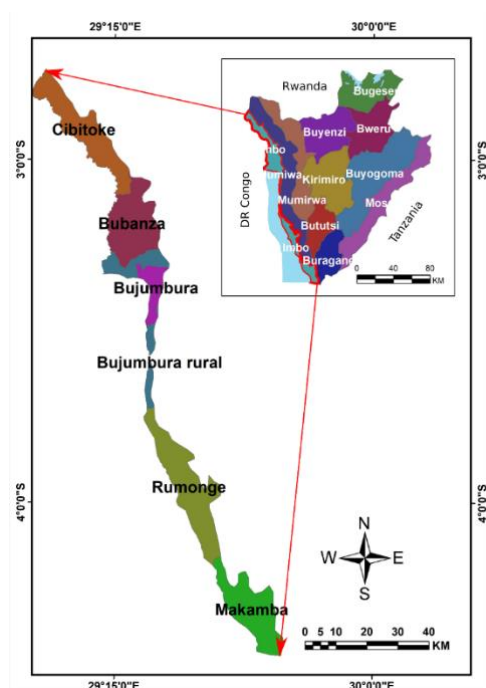


Figure 1: Map of the study area(Nkurunziza et al. 2024)

Study design

Smallholder dairy farmers interviewed were selected through a stratified structure in five Counties of the Imbo Plain of Burundi. Sub-county and Wards were those affiliated by the Regional Integrated Agriculture Development Project in the Great Lakes (PRDAIGL). A survey questionnaire was used to collect information on fodder production, fodder conservation, feeding management, feed resources, milk production, and marketing.

Survey distribution

The survey was carried out in the Imbo Plain region in five provinces i.e., Cibitoke, Bubanza, Bujumbura, Rumonge, and Makamba. In each province, two sub-counties were randomly selected depending on the number of sub-counties to provide a total of 10 Sub-counties. The interview was conducted in the Kirundi language and answers were translated to English by enumerators. Interviews were conducted face-to-face with a household representative to avoid influence from other household representatives in survey responses. To facilitate activities in the survey, smartphones containing questionnaires were used by the enumerators.

Sampling methods

A total of 384 participants were selected randomly from five provinces of the Imbo Plain from a list of smallholder dairy farmers affiliated with the Regional Integrated Agriculture Development Project in the Great Lakes. The number of farmers to be interviewed was determined using the formula:

$$n = \frac{z^2 pq}{e^2} \quad (\text{Hazra and Gogtay 2016}) \quad \text{where:}$$

n: sample size

z: confidential interval (value 1.96 at 95%)

p:0.5(the expected proportion of household benefiting of the PRDAIGL)

q:1-0.5

e:5% (the allowable margin of error)

For each site, the farmer's fodder production and conservation practices were assessed to determine the level of improvement of feed technology. Data was collected on household characteristics such as sex, age, family size, education level, and economic variables such as landholding, livestock population, and fodder production, conservation. Farmers' knowledge and practices in harvesting time, post-harvest management, and feeding, were recorded.

Data analysis

All survey responses were collected and entered in Microsoft Excel (2010). The Statistical Package for Social Sciences (SPSS) software (version 20) computer programs were used for data analysis. Both quantitative and qualitative data were analyzed. Qualitative data were analyzed using descriptive statistics, and quantitative data were analyzed using the association of some variables through cross-tabulations respectively.

Results

Farmer's characteristic

Table 1: Smallholder dairy farmers' characteristics

Provinces	Gender (%)		Education (%)				category of age (%)		
	Male	Female	None	Primary	Secondary	University	Young farmer (18-35yrs)	Adult farmer (36-60yrs)	Old farmer (>60yrs)
Bubanza	11.70	8.60	9.10	7.80	3.40	0.00	8.10	9.90	2.30
Bujumbura	12.20	8.90	9.90	7.60	3.60	0.00	5.70	13.30	2.10
Cibitoke	11.70	7.30	8.90	4.70	4.40	1.00	8.10	9.40	1.60
Makamba	9.90	9.60	8.10	7.30	4.20	0.00	3.40	12.80	3.40
Rumonge	11.20	8.90	6.50	7.30	6.30	0.00	3.40	13.00	3.60
TOTAL	56.70	43.30	42.50	34.70	21.90	1.00	28.70	58.40	13.00

Among the respondents, 43.2% were female, and 56.70% were male. A total of 42.4% had no formal education, 34.6% had primary level and only 1% (from Cibitoke Province) had university-level education. The mean age of dairy farmers in the Imbo plain was 43.7 years. Young farmers were fewer than adult farmers at 28.7 and 58.3% respectively.

Fodder availability

In Burundi, seasons affect the availability of fodder. In the results of the study, 96.4% of the respondents reported availability of natural fodder, 94.5% reported availability of established fodder and only 22.4 % reported the availability of crop residues in the wet season. About 68% of the respondents reported that there was low crop residues availability during the wet season.

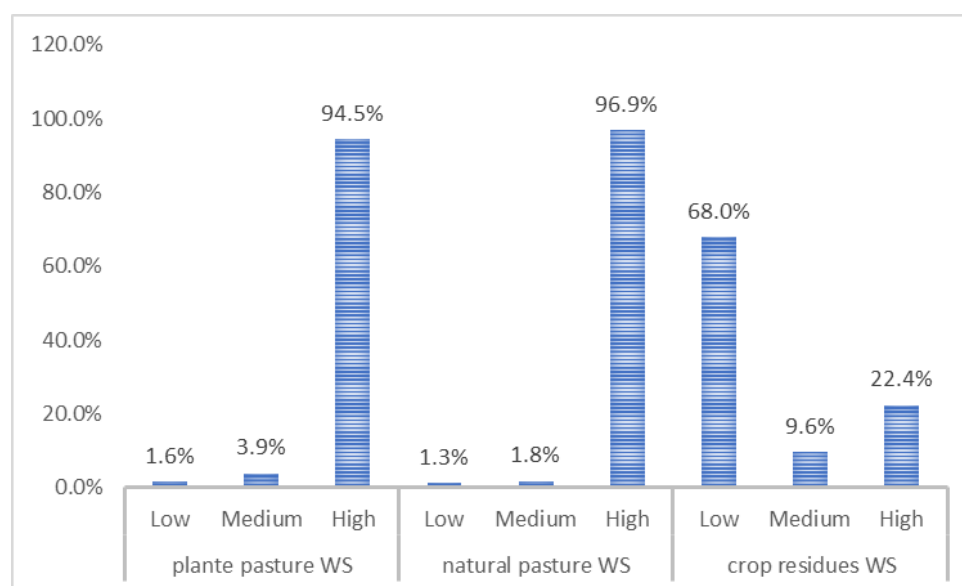


Figure 2: Wet season feed resource availability

More than 80% of smallholder dairy farmers reported dry season fodder scarcity as a major challenge in the Imbo plain of Burundi. Results from the survey showed a very low green fodder availability during the dry season: 87.2% reported poor availability of planted pasture, and 85.7% reported poor availability of natural pasture. On the other hand, high availability of crop residues during the dry season was reported by about 65.4% of the respondents.

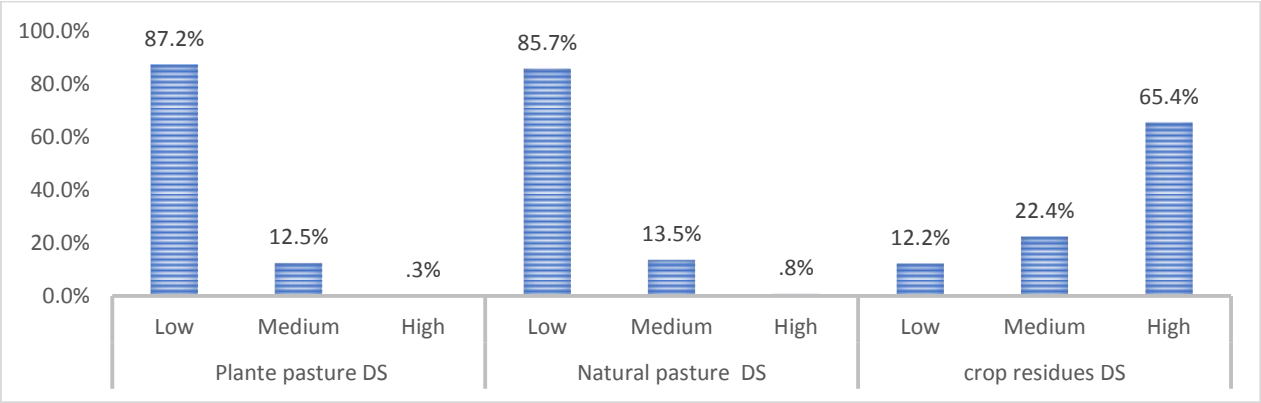


Figure 3: Dry season feed resource availability

Fodder production and conservation practices adoption

Table 2: Fodder production, conservation, and fodder sale practices (%)

Provinces	Fodder production (%)		Fodder conservation practice (%)		Silage making practice (%)		Fodder sale practice (%)	
	No	Yes	No	Yes	No	Yes	No	Yes
Bubanza	5.70	14.60	13.00	7.30	20.30	0.00	20.30	0.00
Bujumbura	3.10	18.00	15.10	6.00	20.80	0.30	20.60	0.50
Cibitoke	3.40	15.60	9.90	9.10	18.80	0.20	19.00	0.00
Makamba	3.60	15.90	11.20	8.30	19.00	0.50	19.50	0.00
Rumonge	1.30	18.80	12.80	7.30	20.10	0.00	20.10	0.00
Total	17.10	82.90	62.00	38.00	99.00	1.00	99.50	0.50

Results from the study showed a very low level of adoption of fodder conservation in the Imbo plain of Burundi. In the total number of 154 dairy farmers, 99% did not make silage. The main reason for not making silage was a lack of knowledge and scarcity of fodder due to the scarcity of arable land for forage and crop production.

Reason for poor fodder production levels and sales

Table 3: Reason for poor adoption of fodder production practices, and sales

Provinces	Reason for poor adoption (%)			Reason for poor fodder sales (%)	
	Lack of arable land	Lack of financial mean	lack of forage seeds	Low fodder production	Lack of fodder Sale market
Bubanza	4.70	0.30	0.30	19.90	0.30
Bujumbura	2.30	0.50	0.30	20.70	0.00
Cibitoke	2.60	0.50	0.30	18.90	0.30
Makamba	2.10	1.60	0.00	19.70	0.00
Rumonge	0.30	0.80	0.30	20.20	0.00
TOTAL	12.00	3.70	1.20	99.40	0.60

In five provinces of the Imbo Plain, the lack of arable land was the main challenge limiting smallholder dairy farmers the production of fodder. This resulted in feed scarcity, consequently reducing milk production. The lack of finances was also observed among smallholder dairy farmers. This issue could be solved by selling fodder, but the results indicated that 99.4% of respondents reported that low fodder production was the main reason that smallholder dairy farmers do not sell fodder.

The study assessed the farmers' access to credit where it was observed that 60.7% do not have access to credit. Only 39.3% were assumed to have access to credit. The table below shows the level of accessibility of smallholder dairy farmers to credit.

Table 4: Smallholder dairy farmers' accessibility to credit

Province	Access to credit	
	%No	%Yes
Bubanza	12.2	7.6
Bujumbura	13.8	7.3
Cibitoke	11.1	7.8
Makamba	10.9	8.6
Rumonge	12.0	8.1
Total	60.3	39.7

Fodder varieties and fodder sources

Different varieties of fodder were identified in the Imbo plain of Burundi. These included grass and leguminous fodder. The level of production depended on many factors such as land size, seed availability, and type of soil. For the smallholder dairy farmers interviewed, fodder production also depended on the palatability for livestock. The main fodders were:

(1) established fodder:

Table 5: Established fodder

Fodder type	Common name	Percentage
<i>Cenchrus purpureus</i>	Napier grass	65.9
<i>Calliandra calothyrsus</i>	Red Calliandra	12.5
<i>Desmodium intortum</i>	Green leaf desmodium	11.5
<i>Tripsacum laxum</i>	Guatemala grass	7.0
<i>Mucuna pruriens</i>	Velvet bean	2.5

(2) natural fodder: available during the wet season, characterized by a mixture of spontaneous fodder *Cynodon dactylon*, *Commelina benghalensis*, *Macrotyloma axillare*, *Digitaria abyssinica*

(3) crop residues were abundant in the dry season including cereal stovers such as millet, sorghum, maize, and haulms of leguminous crops such as beans and groundnut, and straw from rice.

It was observed that *Cenchrus purpureus* was the main grass established in the Imbo Plain of Burundi at the level of 65.9%. Leguminous fodder had a very low level of establishment. *Calliandra calothyrsus* was established at 12.5% while *Desmodium intortum* was established at 11.5%.

Discussion

The major factors that contributed to the low adoption of fodder technologies and practices among smallholder dairy farmers in the Imbo plain of Burundi included: i) farmers' limited knowledge of fodder production and conservation practices; ii) the lack of arable land for establishing fodder; iii) the limited access to investment capital; iv) lack of fodder/seeds producer groups (cooperative or association); v) lack of fodder sale market. Poor adoption of improved fodder production and conservation was also associated with low levels of education among the farmers. Results from the study showed that 77.2% had a low education level (non-formal/primary level). This may have negatively affected the adoption of fodder production and conservation technologies. It has observed that farmers with a high education level had better access to information and knowledge that was beneficial to farming operations (Balkaya et al., 2021). The study found that

only 21.90% had the secondary level of education, and they were exposed to rapid adoption technologies of fodder management. "Farmers with high education levels usually adopt new technologies more rapidly than with lower education levels"(Duguma et al., 2016). The mean age of smallholder dairy farmers was 43.7 years. While in Burundi the average retirement age is 60, Young smallholder dairy farmers were less (28.7%) compared to adult smallholder dairy farmers (58.4%). This affected negatively fodder production and conservation practice. As the age of the household increased the probability of adoption decreased because they become inactive to participate in the new technology dissemination process, most likely due to being influenced by the culture (Dehinenet et al., 2014). This may have affected the economy and increased poverty which was largely linked to low agricultural productivity. The availability of both natural and established fodder was observed only in the wet season. This resulted in excess supply which was not conserved. The lack of the tradition of conserving the excess forage in the wet season led shortage of feed in the dry season. About 22.4% of smallholder dairy farmers reported the availability of crop residue in the wet season. Those may be the rice producers located in some parts of the Imbo plain. In this region, rice straw was the most abundant feed. Its storage and treatment (urea/molasses treatment) could solve the feed scarcity issues. Indeed, crop residues were reported to be the main livestock feed during the dry season. Due to the scarcity of arable land, fodder production was not adopted. Most farmers tend to favor crop production (94.5%), to improve food security. The animals are fed insufficient crop residues obtained after harvesting. To prevent feed scarcity problems, it is possible to improve the current situation by conserving surplus

fodder during the wet season and treatment of crop residues during the dry season. It is also important to train farmers on feed management to prevent low income and poverty due to low milk production in the dry season.

Conclusion

The limited supply of feed and poor quality constituted the main constraints to the development of the dairy sector in the Imbo Plain of Burundi. Due to the low education level, smallholder dairy farmers were faced with problems of adopting new technologies that aimed to improve livestock feed availability. Livestock nutrition innovation could contribute to increasing income levels in households. To reach this, farmers could be inducted to change their behavior and collaborate with all partners involved in the development of the livestock sector (extension agents, public and private, and researchers). It is therefore important to train farmers on how to utilize locally available feed resources (fodder, animal products) to feed livestock all year round. In the perspective, it should be better to analyze chemical composition of existing grass-legumes and their impact on milk production, milk quality and body weight gain.

Acknowledgments

We wish to acknowledge Egerton University staff, especially all Animal nutrition lecturers for their scientific support. Our acknowledgment is to the International Livestock Research Institute for the financial support to carry out this study. Our thanks are also to the smallholder dairy farmers from the Imbo plain of Burundi for their active participation and for providing valuable information which is the core of this report. The facilitation of Mr. Jean Japhet NAKINTIJE is gratefully acknowledged. For those who assisted us, morally or materially, we express gratitude and thanks to them.

References

- Ashley, K.; Wilson, S.; Young, J.; Chan, H.; Vitou, S.; Suon, S.; Windsor, P.; Bush, R. (2018). Drivers, challenges and opportunities of forage technology adoption by smallholder cattle households in Cambodia. *Tropical Animal Health and Production*, 50(1), 63–73. <https://doi.org/10.1007/s11250-017-1400-y>
- Bacigale, S. B.; Nabahunu N.; L., Okafor, C.; Manyawu, G. J.; Duncan, A. (2019). Assessment of livestock feed resources and potential feed options in the farming systems of Eastern DR Congo and Burundi. 1, 32. <https://www.researchgate.net/publication/332415053>
- Balehegn, M.; Duncan, A.; Tolera, A.; Ayantunde, A. A.; Issa, S.; Karimou, M.; Zampaligré, N.; André, K.; Gnanda, I.; Varijakshapanicker, P.; Kebreab, E.; Dubeux, J.; Boote, K.; Minta, M.; Feyissa, F.; Adesogan, A. T. (2020). Improving adoption of technologies and interventions for increasing supply of quality livestock feed in low- and middle-income countries. *Global Food Security*, 26(October 2019), 100372. <https://doi.org/10.1016/j.gfs.2020.100372>
- Balkaya, S.; Akkucuk, U. (2021). Adoption and use of learning management systems in education: The role of playfulness and self-management. *Sustainability* (Switzerland), 13(3), 1–27. <https://doi.org/10.3390/su13031127>
- Dehinenet, G.; Mekonnen, H.; Kidoido, M.; Ashenafi, M.; Bleich, E. G. (2014). The impact of dairy technology adoption on small holder dairy farmers livelihoods in selected zones of Amhara and Oromiya National Regional States, Ethiopia. *Global Journal of Agricultural Economics and Econometrics*, 2(5), 126–135. <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=742aec655b8cd0a3bf8d2e9df0808ab2df1a9a5>
- Duguma, B.; Janssens, G. P. J. (2016). Assessment of feed resources, feeding practices and coping strategies to feed scarcity by smallholder urban dairy producers in Jimma town, Ethiopia. SpringerPlus, 5(1). <https://doi.org/10.1186/s40064-016-2417-9>
- Hazra, A.; Gogtay, N. (2016). Biostatistics series module 5: Determining sample size. *Indian Journal of Dermatology*, 61(5), 496–504. https://www.scienceopen.com/document_file/fe61a295-177c-4cae-a0bc-7fd25219795d/PubMedCentral/fe61a295-177c-4cae-a0bc-7fd25219795d.pdf
- Keringingo, T.; Gunlu, A.; Mat, B. (2022). Importance of livestock and dairy cattle production in Burundi ' s economy : Importance of livestock and dairy cattle production in Burundi's economy : Review. July. https://scholar.google.com/scholar?hl=fr&as_sdt=0%2C5&q=Importance+of+livestock+and+dairy+cattle+production+in+Burundi+%E2%80%99+s+economy%E2%80%AF%3A+Importance+of+livestock+and+dairy+cattle+production+in+Burundi+%E2%80%99+s+economy%E2%80%AF%3A+Review.+July.+&btnG=
- Ludgate, N.; Tata, S. J. (2015). Burundi Landscape Analysis. September, 29. https://pdf.usaid.gov/pdf_docs/PA00M4Q6.pdf
- MEEATU (2013) L ' aménagement du territoire et de l ' urbanisme Plan r égional de mise en œuvre de la Stratégie Nationale et Plan d ' Action sur la Biodiversité aux Plateaux Centraux. 29. <https://www.cbd.int/doc/nbsap/sbsap/bi-sbsap-imbo-fr.pdf>
- Nabahungu, N. L.; Duncan, A. J. (2019). Assessment of livestock feed resources and potential feed options in the farming systems of Eastern DR Congo and Burundi Legume CHOICE Project View project Nile Basin Development Challeng (NBDC) programme View project Samy Bacigale International Institut. April. <https://www.researchgate.net/publication/332415053>
- Nkurunziza, S.; Nishemezwe, G.; Bosco, J.; Pascal, N.; Lionel, N. (2024). Prevalence and associated risk factors assessment of bovine fasciolosis in the Imbo Region , Burundi. *Parasitology Research*, 1–10. <https://doi.org/10.1007/s00436-023-08040-w>