Factors affecting traditional beer production in Rwanda: A case study of banana and sorghum brews

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Abstract :

The present study aimed to investigate factors influencing the production of traditional beers, such as Urwagwa and Ikigage, in Rwanda. It was conducted across four districts, namely Gicumbi, Gisagara, Kirehe, and Rusizi, each located in one of the four rural provinces of Rwanda. The study used the data collected for the diagnostic study conducted in 2023 on 132 producers and applied a logistic regression model. The results revealed the production of traditional beers is first and foremost influenced by economic and institutional factors rather than socio-demographic except for gender. Among the economic factors, availability of raw materials, access to financial services and land ownership are primary and most sensitive determinants to the production of the traditional beers in Rwanda while, institutionally, access to information and cooperative membership are also of the utmost of importance in the sector of the traditional beer brewing. The study on traditional beer brewing in Rwanda suggests also various policy implications to promote the production of traditional beers production, especially in rural areas. Key recommendations include supporting beer banana and sorghum cultivation to improve the availability of raw materials, reducing gender disparities, enhancing market information and financial services for producers, and establishing a regulatory framework to address quality standards and environmental concerns.

Keywords : traditional beers, production, Rwanda, banana beer, sorghum beer.

Introduction

In Africa, a variety of traditional alcoholic beverages are crafted from diverse agricultural sources, including sorghum, maize, barley, wheat, palm trees, bananas, and plantains . Generally, different names are attributed to the traditional beers depending on the country and locations. As of an example, in Southern parts of Africa, the most famous of traditional beers are *Chibuku* which

is a pan-African beer originated from Zambia and Zimbabwe; *Umqombothi* famously brewed and consumed in South Africa (Xolo et al., 2024)*; Dolo* commonly brewed in Burkina Faso and other many Western African countries such as Ivory Coast, Mali, Niger and Benin (S. Pale, 2011); *Pito* mostly brewed and consumed in Ghana and Nigeria (Zaukuu et al., 2016); *Tchoukoutou* in Togo (Osseyi et al., 2011); *Tonto, Omwenge, Kweete, Omulamba* in Ouganda (Mwesigye & Okurut, 1995); *Urwarwa , Insongo, Impeke and Kanyanga* in Burundi (Aloys & Angeline, 2009); *Gwagwa, Mbege, Kiambule* and *Komoni* (Kubo, 2014; Tüsekwa et al., 2000) in Tanzania; and *Buusa* and *Chang'aa* (Papas et al., 2010) in Kenya. Specifically, in Rwanda, indigenous beers, commonly known as traditional beers, are predominantly brewed from bananas and sorghum. "Urwagwa" is the term for banana beers, with banana as the primary raw material, while sorghum is utilized for brewing sorghum beer, locally referred to as "Ikigage" or "Amarwa.".

In Rwanda, bananas (*Musa spp.)* in highly regarded as a staple food crop, covering 23% of the land and cultivated by 90% of households (Nsabimana et al., 2010). Despite being a key dietary component for an extended period, the production of bananas is declining due to various direct challenges such as land constraints and banana bunchy top disease (BBTD) (Bagamba, 2007; Gabriel & Mupenzi, 2015) and banana Xanthomonas wilt (BXW) (Kilwenge et al., 2023). Other influencing factors on banana production include indirect elements like policies, fertilizer use and drought stress (Nansamba et al., 2022; Okech et al., 2005). Despite the significant role bananas play in Rwanda's diet and its contribution to food security (Kabirigi et al., 2024) and other environmental benefits such as soil conservation and protection (Lebailly P., Boureima F., Lare V., P. Ndimanya, 2018), agricultural reforms initiated since 2007 have led to the shift from beer banana to the cooking banana cultivation in different agro-ecological zones (Gaidashova et al., 2005). Consequently, the beer banana production declined with noticeable repercussions for the traditional banana beer production activities across the country.

Sorghum (*Sorghum bicolor (L.) Moench*), a cereal crop believed to have been domesticated from Ethiopia and Sudan, holds also significant importance as a staple food crop for millions in sub-Saharan Africa and South Asia (Khalifa & Eltahir, 2023). Predominantly cultivated in semi-arid and arid tropics, as well as tropical regions of African countries (Abreha et al., 2022; Kebbede, 2020), sorghum ranks as the fifth most crucial cereal globally, feeding over 500 million people after wheat, maize, rice, and barley (Mesfin & Girma, 2022).

Furthermore, Sorghum is cultivated to respond to different needs depending on regions and countries. In developed countries sorghum is viewed as a bioenergy and fodder crop for industrial use (Ronda et al., 2018; Stamenković et al., 2020) while low- and middle-income countries, where smallholder farmers play a significant role, cultivate sorghum primarily to meet growing food demand, contributing to food security (Hossain et al., 2022).

In addition to its general global importance, sorghum plays a crucial role in Rwandan culture, as it is consumed locally as porridge, a popular breakfast choice, and brewed into both traditional and modern alcoholic and non-alcoholic local beers (Kazungu et al., 2023). However, at the farm level, sorghum yield remains low due to factors such as Striga species weeds, lack of high-yielding varieties, low soil fertility, pests and diseases and climate change which has led to the loss of 20 sorghum varieties (Niyibigira et al., 2024). Beyond these biotic and abiotic constraints, the sorghum cultivation is also affected by the implementation of Land Use Consolidation (LUC), as one component of the Crop Intensification Program initiated by the government of Rwanda since 2007, which excludes sorghum from both selected and prioritized crops (Muyombano & Espling, 2020).

These challenges are further compounded by limited farmer knowledge of appropriate cultural sorghum practices not forgetting the small size of available land, which, generally, hinders the adoption of new production technologies in agriculture (Fadeyi et al., 2022; Ruzzante et al., 2021); and specifically in sorghum production activities with direct impact on brewing of traditional beers.

Although the brewing methods of the African traditional beers differ from country to country and then region to region, depending on different materials used in the process such as millet, bananas, sorghum, maize meal, among others (Mawonike et al., 2018); the autochthonous beers share the common characteristics such as a refreshing sour taste with pH values of approximatively 3.5-4.5 and low alcohol contents ranging between 2-6% (Lee et al., 2015). Furthermore, beside their common characteristics, these traditional beers play important socio-cultural and economic roles, generally in African society, and, particularly, in many lives of many people in Rwanda specifically in all four districts (Gicumbi, Gisagara, Kirehe and Rusizi) of the study area.

Traditional beers play different economic, nutritional roles and societal innovation shaping the livelihoods of the rural communities (Cabras et al., 2023). Economically, traditional beers have been considered as one of the sources of income and consequently, diversify their livelihoods activities especially in rural areas (Kayodé et al., 2007; Tétédé Rodrigue Konfo et al., 2015). Socially, traditional beers are considered tools for maintaining friendship and relationship ties and inclusiveness among Rwandans. In this sense, they are mostly served as main drinks in a myriad of different ceremonies and festivals (marriage, gifts of cows, funerals, etc.) especially in rural areas (Lyumugabe & Songa, 2019). Notwithstanding the pivotal role played by traditional beers in Rwandan society, the traditional brewing industry exhibits limitations. There is a lack of socio-economic studies that comprehensively assess factors influencing production of traditional beers in Rwanda. In this context, the objective of this study is double. First, it profiles the characteristics of the producers and second, it attempts to shed light on the factors influencing the producers of the traditional beers who are living in different socio-economic and institutional conditions.

Material and methods

Data frame and sampling

The primary data utilized in this paper was collected in 2023 as part of a diagnostic study on producers of traditional beers in Rwanda specifically in four administrative districts namely: Gisagara, Gicumbi, Kirehe and Rusizi. The districts referred to are rural areas scattered across four provinces of the country where agriculture remains the primary activity of the population. In addition to the location, districts have been chosen based on their historical background in line with cultivation and utilization of sorghum and beer banana in brewing traditional beers. During the data collection, interviews were organized and administered to a purposively determined sample of 132 producers selected randomly. The table 1 presents further details on the distribution of sample size throughout the study area.

Table 1: Distribution of the sample size across the study area.

Province	District	Geographic coordinates	Numbers of respondents
North	Gicumbi	1° 34' 45" S; 30° 4' 4"E	26
South	Gisagara	1° 43' 58" S; 29° 41' 50" E	37
East	Kirehe	2° 15' 24" S; 30° 43' 34" E	49
West	Rusizi	2° 34' 12'' S; 29° 4' 31'' E	20
Total			132

In each district within the study area, data on socio-demographic factors were collected and processed to align with the objectives of the current research paper. Furthermore, the gathered information also encompassed various economic factors, such as access to financial services, availability of raw materials and land ownership and tenure, as well as institutional factors including access to information and cooperative membership.

Methods of data analysis

During the study, using R studio software, Chi-square test was used to assess the homogeneity of different variables. Furthermore, to mitigate the risk of Type I error, which could erroneously lead to the acceptance of a false null hypothesis (H_0) (Bolboacă et al., 2011) and usefulness of taking into consideration the small sample size (Zhou et al., 2023) and skewed distributions, the Fisher test was implemented, incorporating a two-sided alternative hypothesis test. Furthermore, in order to assess the effects, the logistic regression, which consists of assessing the relationship between the outcome variable and a given set of predictor variables was used (Peng et al., 2002; Zaidi & Al Luhayb, 2023). The model was selected due to its simplest algorithms used for modeling binary problems and its capability, not only, to provide log odds and their corresponding odds ratios for the likelihood but also modelling interaction effects (Jurafsky & Martin, 2012). The logistic regression model's form is:

$$ln\left[\frac{p(Y)}{1-p(Y)}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$$

where :

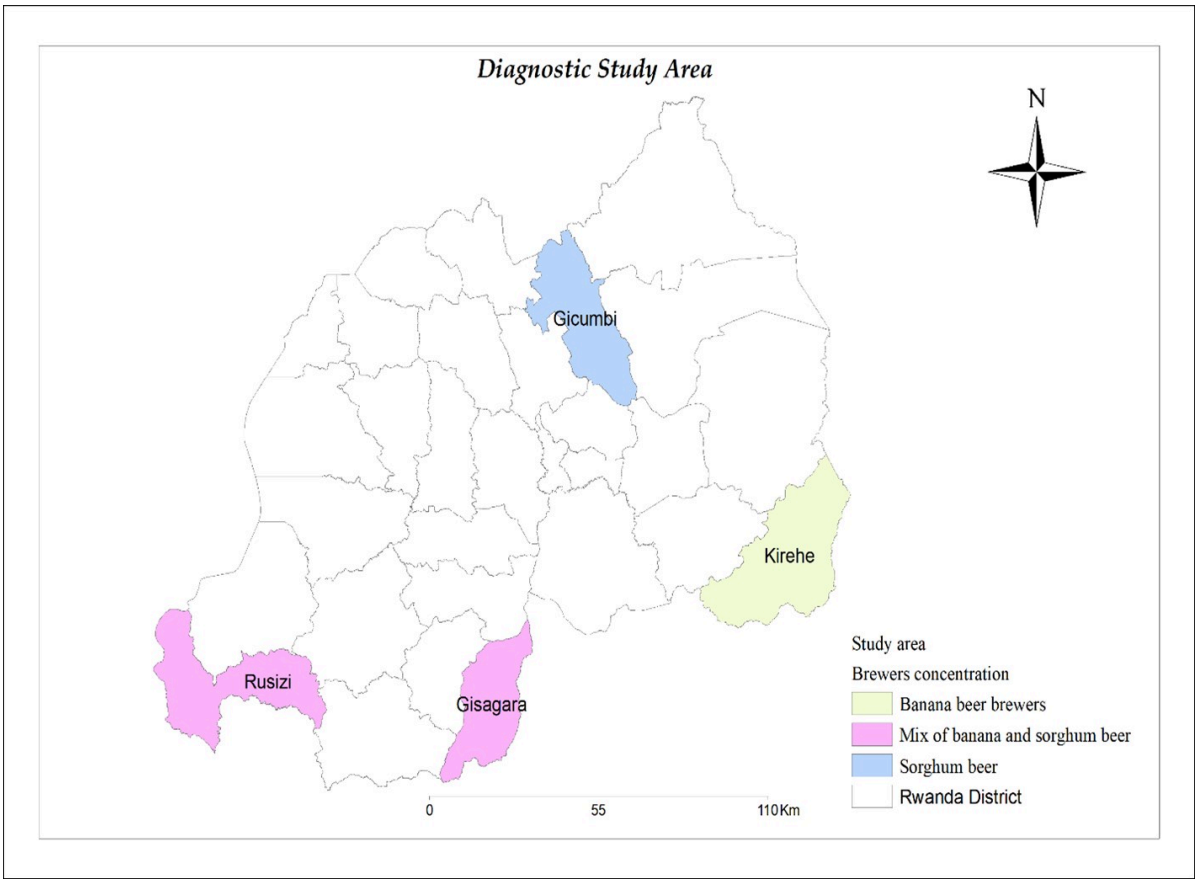
$$ln\left[\frac{p(Y)}{1-p(Y)}\right]$$

is the natural log odds of the outcome,
Y is the dependent variable,
X is a set of the independent variables
β_0, β_1, β_2, ..., βn are coefficients indicating different degrees of association between the dependent variable and each of the independent variables (Boateng & Abaye, 2019)

Description of the study area

The data for the present research paper was collected from four districts: Gicumbi, Gisagara, Kirehe, and Rusizi. Gicumbi district is located in the northern province, Kirehe in the eastern province, Rusizi in the western province, and Gisagara in the southern province. Considering the availability of raw materials based on agroclimatic conditions, Gicumbi was identified as the primary district with high potential for sorghum beer production, while Kirehe specializes in banana beer production. In the remaining two districts, Gisagara and Rusizi, a nearly balanced mixture of producers engaged in both banana and sorghum beer production is observed.

Figure 1: Geographical location of the study area



Results presentation and discussions

Descriptive statistics

As indicated on Table 2, a comprehensive statistical presentation was employed to delineate the socio- demographic, economical and institutional factors descriptively. Gender distribution indicated 69% male respondents, with notable male dominance in Kirehe (89.8%), Rusizi (80%), and Gicumbi (61.5%), except for Gisagara, where dominance of female (59.5%) was observed. This discrepancy underscores potential gender-based economic disparities in indigenous beer production. Marital status analysis showed also that 86% of producers were married, consistent across districts, reaching 96% in Kirehe. This suggests traditional beer production is primarily undertaken by married couples, contributing to their family support.

With regard to education attainment, 83%, representing 110 respondents who are involved in the traditional beers production, have attended formal education of different levels, with the majority (76%) who completed primary education. Looking at the district level, the findings suggest a varied educational landscape among traditional beer producers, with a predominant emphasis on

primary education. Additionally, results on age distribution revealed that 44% of producers aged 35 to 49, 34% aged 50 and above, and 21% are in the youth demographic (18 to 35 years). With these results, it is clear that adults and elderly class individuals play a more prominent role than youth in traditional beer production across four (4) districts of the study, as there are the ones who possess land and often involved in agricultural activities. Notably, Kirehe District (2%), a region of the Eastern part of the country historically recognized as the primary producer of banana beer, has the majority of its land and banana plantations owned by the adults and elderly, which limit youth participation in the traditional of beer brewing activities. Additionally, the data on household size indicated that the majority (51%) of the surveyed producers' households have a number of 4 members and (27%) with more than 4. As also profiled in the results of the diagnostic study, instances of larger households indicated the prevalence of larger families in traditional beer production.

The primary occupation of traditional beer producers is in the agriculture sector, with 68% working either farmers on their own land or as casual laborers for others (1%). Furthermore, a significant portion (30%) is involved in non-agricultural activities, mainly in business, while a small percentage (2%) participates in diverse fields like carpentry and building. The distribution across study districts indicates that producers primarily source raw materials (banana and sorghum) for beer production through their own agricultural activities.

In rural areas of Rwanda, land ownership is crucially important in cultivation and availability of the raw materials for the traditional beer production, with 59% of producers having title deeds and 41% not. The highest land ownership percentages are found in Gicumbi and Gisagara Districts (73% each), followed by Kirehe (49%) and Rusizi (40%). However, while Gisagara and Gicumbi share a lower number of producers without land at 27%, Kirehe and Rusizi districts exhibit a significant proportion of producers without land ownership (51%), posing challenges in securing raw materials and introducing uncertainties in the value chain due to an almost equal number of farmers with and without secure land tenure.

In terms of land size owned by traditional beer producers, a majority of those interviewed possess land exceeding the national average of 0.4 hectares, particularly notable in Gicumbi, Rusizi, and Kirehe. However, Gisagara District is distinctive for having both the smallest and largest land sizes, falling below and above the national average of 0.4 hectare. It is important to note that, in Rwanda, the production of traditional beers occurs sporadically in different households, particularly depending on cultural events and the days of local markets gatherings when producers anticipate a higher number of consumers. The occasional nature of the traditional beers production may be attributed to the limited land ownership or smaller land sizes may restrict the availability and access to sufficient quantities of raw materials.

The Fisher test, as indicated by the P-Value [0.0767> 0.05], substantiates the findings of homogeneity in terms of land owned by producers in all four districts. This no major disparity in land size distribution among the surveyed districts persistently underscores insignificant variations in land ownership patterns in all four districts of the study and reflects also the similar situation in terms of size of the land owned by the producers. A part from the homogeneity in household size, education and land ownership, the results indicate that producers exhibited heterogeneity across all four districts, as confirmed by the validity of the F-test.

Table 2: Descriptive summary of socio-economic variables of producers of traditional beers

Location	Gicumbi	Gisagara	Kirehe	Rusizi	Total	P-Value	
Variables						Chi^2	F-Test
Gender						.0000***	N/A
Female	10(38.5%)	22(59.5%)	5(10.2%)	4(20%)	41(31%)		
Male	16(61.5%)	15(40.5%)	44(89.8%)	16(80%)	91(69%)		
Age						.01837	.0050**
18-35	12 (46%)	13 (35%)	1 (2%)	3 (15%)	29 (22%)		
35-49	7 (27%)	14 (38%)	30 (61%)	7 (35%)	58 (44%)		
>-50	7 (27%)	10 (27%)	18 (37%)	10 (50%)	45 (34%)		
Marital status						.01836	.0054**
Divorced	1 (4%)	1 (3%)	1 (2%)	0 (0%)	3 (2%)		
Living with partner	0 (0%)	2 (5%)	0 (%)	0 (0%)	2 (2%)		
Married	23 (88%)	24 (65%)	47 (96%)	19 (95%)	113 (86%)		
Single	2 (8%)	5 (14%)	0 (0%)	0 (0%)	7 (5%)		
Widow	0 (%)	5 (14%)	1 (2%)	1 (5%)	7 (5%)		
Education						.08681	.0722*
None	3 (12%)	4 (11%)	10 (20%)	5 (25%)	22 (17%)		
Primary	19 (73%)	29 (78%)	37 (76%)	15 (75%)	100 (76%)		
Secondary	4 (15%)	4 (11%)	0 (%)	0 (0%)	8 (6%)		
TVET	0 (0%)	0 (0%)	2 (4%)	0 (0%)	2 (2%)		
Profession						.0000	.0000***
Farmer	6 (23%)	21 (57%)	48 (98%)	15 (75%)	90 (68%)		
Merchants	18 (69%)	16 (43%)	1 (2%)	4 (20%)	39 (30%)		
Other	2 (8%)	0 (0%)	0 (0%)	1 (5%)	3 (2%)		
Household size						.7583	.7814
< 4	6 (23%)	10 (27%)	9 (18%)	5 (25%)	30 (23%)		
= 4	5 (19%)	9 (24%)	17 (35%)	4 (20%)	67 (51%)		
>4	15 (58%)	18 (49%)	23 (47%)	11 (55%)	35 (27%)		

Land ownership							
No	7 (27%)	10 (27%)	25 (51%)	12 (60%)	54 (41%)	.0174**	N/A
Yes	19 (73%)	27 (73%)	24 (49%)	8 (40%)	78 (59%)		
Size of the land							
<0.4 ha	0 (0%)	4 (15%)	0 (0%)	0 (0%)	4 (5%)	.0467	.0767*
>0.4 ha	19 (100%)	23 (85%)	24 (100%)	8 (100%)	74 (95%)		

Statistical significance at the 99% (***), 95% (**) and 90% (*) confidence levels. Chi-square and Fisher tests are used interchangeably for categorical variables.

The analysis of other economic and institutional factors in production of traditional beers

In the current study, the analysis of the other economic factors that are, in turn, shaped by the institutional factors such as government policies and organizational structures have been taken into consideration in order to understand their effect on production of traditional beers in Rwanda. In this context, access to financial services and the availability of raw materials are considered as economic factors, while access to accurate and adequate information, as well as membership in a cooperative, are categorized as institutional factors**.** In reference to Table 3, the descriptive analysis shows that the majority represented by more than 70% of the surveyed producers across four districts neither belong to any cooperative and nor have access to accurate information related to the traditional beer brewing industry. Furthermore, limited access to information, linked to the low level of collective structures in form of cooperatives (Christian et al., 2024; Costa & Franco, 2024), the limited access to information hinders the access to the innovative markets (Cheyo et al., 2023) and other supportive mechanisms such as collective resources and knowledge sharing (Kommey & Fombad, 2023), thereby further limiting brewers' opportunities to improve their brewing activities. However, the availability of raw materials used in the brewing is reported by 75% while access to financial services, which considers, not only having a bank account and excludes semi formal and informal financial services but also access to financial products (e.g. deposits and loans) at a reasonable cost (Aston & Saghir, 2017; Ndlovu & Toerien, 2020), was reported by 82% of surveyed traditional beers producers across the districts. Additionally, while cooperative membership is homogeneous (P=0.8132), producers of traditional beer exhibit heterogeneity, particularly in access to information (p= 0.0018), access to finance (p=0.0489) and availability of raw materials (p=0.0000) across all four districts.

Table 3: Other economic and institutional characteristics of the producers of the traditional beers

Location Variable		Gicumbi	Gisagara	Kirehe	Rusizi	Total	P_Value	
							Chi^2	F-Test
Cooperative membership	No	20 (77%)	30 (81%)	37 (75%)	14 (70%)	101 (76%)	.8177	.8132
	Yes	6 (23%)	7 (19%)	12 (25%)	6 (30%)	31 (24%)		
Access to information	No	25 (96%)	29 (78%)	34 (69%)	20 (100%)	108 (82%)	.0038	.0018***
	Yes	1 (4%)	8 (22%)	15 (31%)	0 (100%)	24 (18%)		
Access to finance	No	2 (8%)	12 (32%)	6 (12%)	4 (20%)	24 (18%)	.0424	.0489**
	Yes	24 (92%	25 (68%)	43 (88%)	16 (80%)	108 (82%)		
Availability of raw materials	No	9 (35%)	19 (51%)	0 (0%)	5 (25%)	33 (25%)	.00000	.0000***
	Yes	17 (65%)	18 (49%)	49 (100%)	15 (75%)	99 (75%)		

Statistical significance at the 99% (***), 95% (**) and 90% (*) confidence levels. Chi-square and Fisher tests are used interchangeably for categorical variables.

The analysis of effects of factors on the production of traditional beers

Table 4: Summary of the logistic regression model

	Estimate	Std. Error	z value	Pr (>|z|)
(Intercept)	-3.6669	2.0693	-1.772	0.076380.
Age_18-35	-0.7449	0.7158	-1.041	0.298099
Gender_Male	1.6156	0.6553	2.465	0.013685 *
Mar_St_Not_married	-0.6396	0.8634	-0.741	0.458817
Educ_Primary	-0.1161	0.6497	-0.179	0.858153
Educ_Secondary	0.5009	1.1225	0.446	0.655402
Profession_Non_farmer	-0.735	0.5649	-1.303	0.192635
H_Size_>4	-0.1966	0.7482	-0.263	0.792685
H_Size4	-0.2005	0.7663	-0.262	0.793586
Ownership_Land_Yes	2.6294	1.1131	2.362	0.018165 *
Size_Land_>0.4	0.7884	1.6409	0.480	0.630887
Size_Land_None	3.8638	2.1420	1.804	0.071258.
Avail_raw_mat. _Yes	2.4206	0.6231	3.885	0.000102 ***
Access_Finance_Yes	-1.9100	0.8671	-2.203	0.027615 *
Access_information_Yes	2.6486	0.9194	2.881	0.003965 **
Member_of_cooperative_Yes	-0.7386	0.7131	-1.036	0.300300

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1				

From the Tables 3 and 4 both which summarize the results of the analysis, indicate that five (5) variables are very critically sensitive in the production of the traditional beers in Rwanda. These include availability of the raw materials, access to information and finance, gender and land ownership. With regard to the availability of raw materials, the latter has been characterized by a strong association to the production of the traditional beers in Rwanda. In other words, as depicted in Table 5, exponentiating the log odds of the dependent variable yields an odds ratio

of approximately 11.25 which indicates that producers with access to sufficient raw materials are likely to be more engaged in the production of traditional beers in Rwanda, thus positively influencing the value chain as a whole. This result remains critically important, as indicated by the producers during the diagnostic study, given that producers are no longer able to secure sufficient quantities of raw materials from their respective farms as beer bananas and sorghum are no longer prioritized crops in Rwanda, thereby, influencing land use decisions at the farm level. The importance and impact of the availability of the raw materials in the production and quality of traditional beers brewing has been also recognized in different scientific works conducted elsewhere in Africa. Specifically, in Benin and Ethiopia, both (Sawadogo-Lingani et al., 2021) and (Alemu & Kuyu, 2024), respectively, emphasized that the production and quality of the traditional beers rely on quality and seasonal availability of the raw materials. Meanwhile, (Nnaemeka et al., 2024) focused on their abundance in terms of quantity and affordable prices as a key to added value creation in Nigeria's brewing industry.

With regard to the access to information, the coefficient is positively significant at the 5% level of degree of freedom, holding other factors fixed. In other words, as the positive coefficient of significance has non- zero effect on the production of the traditional beers in the estimated model, there is evidence that increased access to information is positively associated with the high probability of producing beers. This implies that producers with better access to information about traditional brewing methods, ingredients, or market demand are more likely to engage in traditional beer production and consequently, contributing to the performance in the industry (Irakiza et al., 2021).

Access to finance has been widely recognized as a pivotal instrument for poverty reduction in low income countries when, appropriately, it reaches the disadvantaged groups (Saha & Qin, 2023). Conversely, the findings of the current study suggest unexpected outcome regarding the impact of access to finance on traditional beer brewing. In other words, the regression analysis results suggest that, while holding all other factors constant, access to financial services within the study area is unlikely to stimulate growth in the production of the traditional beer brewing industry. This observation is substantiated by the fact that within rural areas, such as for example of Gisagara District, producers with access to financial services transit from the customary production of traditional beer to the consumption of semi- and full industrially crafted beers and hence, allocating the contracted small loans to cater their basic needs rather than production activities of the traditional beers. In this context, our observations align with the perspectives articulated by (Karlan & Morduch, 2010; Nguyen & Canh, 2021), suggesting that while access to formal and informal financial services can be used interchangeably and indeed promote the growth of income-generating activities, in developing countries like Rwanda, small loans are often utilized primarily to cater essential needs rather than supporting small business like traditional beer brewing.

Furthermore, the results indicate that land ownership at the household level is positively associated with the production of traditional beers across all four districts of the study area. As the land ownership affects not only the use rights (Mbudzya et al., 2023) but also, the agricultural productivity (Abdilahi Ali et al., 2023; Séogo & Zahonogo, 2023), this implies that, in Rwanda, the population with land is likely to be 13.87 times higher involved in the production of the traditional beers as they, partly, source the raw materials such as banana and sorghum from their farms. In other words, land ownership remains as one of the key factors that provide resources, stability, or opportunities that contribute to the likelihood of traditional beers production in Rwanda.

Considering gender, in the estimated logistic model, the positive log odds coefficient (1.6156) suggests that being males are likely associated with the production of brewing traditional beers compared to being female. As also illustrated on Table 5, keeping all other variables constant the odds ratio for males are approximatively 5.03 times higher in comparison to females. In other words, the significance association of gender with the outcome of the estimated model, is the mirror reflecting generally inequalities and differences in production and productivity (Abdisa et al., 2024; Puskur et al., 2023) stemming from the inequal access to resources and involvement in the decision making at the household level (Adu Boahen et al., 2024).

Table 5: Forest plot of the odds ratio corresponding to the maximum likelihood estimates

Variable		N	Odds ratio	p
Age	>35	103	Reference	
	18-35	29	0.47 (0.11, 1.89)	0.298
Gender	Female	41	Reference	
	Male	91	5.03 (1.45, 19.43)	0.014
Mar_St	Married	113	Reference	
	No_married	19	0.53 (0.09, 2.81)	0.459
Educ	None	22	Reference	
	Primary	100	0.89 (0.24, 3.11)	0.858
	Secondary	10	1.65 (0.18, 15.63)	0.655
Profession	Farmer	90	Reference	
	Non_farmer	42	0.48 (0.15, 1.45)	0.193
H_Size	<4	31	Reference	
	>4	67	0.82 (0.18, 3.58)	0.793
	4	34	0.82 (0.18, 3.71)	0.794
o_Land	No	54	Reference	
	Yes	78	13.87 (1.74, 146.72)	0.018
S_Land	<0.4	3	Reference	
	>0.4	84	2.20 (0.09, 79.12)	0.631
	None	45	47.64 (0.79, 4311.14)	0.071
Avail_Raw_Mat.	No	33	Reference	
	Yes	99	11.25 (3.54, 42.28)	<0.001
Access_Finance	No	24	Reference	
	Yes	108	0.15 (0.02, 0.73)	0.028
Access_info	No	108	Reference	
	Yes	24	14.13 (2.78, 105.83)	0.004
Member_cooperative	No	101	Reference	
	Yes	31	0.48 (0.11, 1.91)	0.300

Conclusions and policy implications

Traditional beers brewed mainly in banana and sorghum hold cultural and economic importances, particularly in rural areas of Rwanda. With the aim of empirically documenting the factors influencing the brewing of the traditional beers, the present study was conducted, utilizing the data gathered in 2023 from 132 producers of Urwagwa and Ikigage across four districts namely Gisagara, Gicumbi, Kirehe and Rusizi. As result, the study revealed that the production of traditional beers is primarily associated with economic and institutional factors rather than socio-demographic factors

except gender. From an economic perspective, the availability of the raw materials, the access to financial services and land ownership and tenure emerged as the significant determinants shaping the traditional beer brewing in rural areas of Rwanda while institutionally, access to information and cooperative membership play a key role in influencing the sector. With the particular emphasis on the availability of the raw materials, which constitute the main part of the production process of the traditional beers, these materials are primarily obtained in small quantities from self-produced ingredients but also are acquired from various external sources, including neighbours or small local markets.

Furthermore, through the understanding the association of the key factors that affect the traditional beer brewing in Rwanda, the conclusion holds different policy implications that could revitalize the industry brewing specifically in the rural areas. In this context, the results of the study underscore the importance of supporting the industry through different interventions and initiatives aiming to enhance the access to sufficient raw materials through supporting the cultivation of beer banana and sorghum across the country and improving the access to the market of raw materials. Additionally, the initiatives could be extended to the reduction of gender disparities, establishing channels dedicated to the improvement of the access to information on markets and financial services tailored to the needs of the producers. Last but not least, the establishment of the regulatory framework in the traditional beers which outlines all possible requirements related, not only, to the quality standards and compliance, but also to any kind of environmental issue which could be associated with the traditional brewing activities in Rwanda.

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