

PRODUCTION, COMMERCIALIZATION AND CONSUMPTION OF TRADITIONAL SORGHUM BEER ("IKIGAGE") AND ITS IMPACT ON LOCAL FARMERS' WELFARE IN RWANDA

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ABSTRACT

This paper attempted to examine the performance of traditional sorghum beer production in Rwanda. Qualitative and quantitative data were collected from a sample of 595 individuals (409 traditional sorghum beer brewers and 186 consumers) using a structured questionnaire. Descriptive statistics, mainly frequencies and percentages in well-organized tables and on figures, were used in intent of data analysis. Results showed that the majority of traditional sorghum beer producers get the totality of sorghum grain from the market, while the main source of funds is their savings. Results from the margin analysis indicate that the production of traditional sorghum beer is profitable, with a net margin of Rwf 9,663 per week, from weekly sales of 234 liters on average. The majority of the consumers started consuming when they were less than 15 years. They reported influence of adults, curiosity, and peer pressure as the main reasons that pushed them to take sorghum beer for the first time. They reported also that they consume the sorghum beer two or three times per week (43.6 per cent), while 22.6 per cent take it every day. The majority of the consumers appreciated the quality of traditional sorghum beer. Based on the results of this study, we suggest that (1) research be directed towards optimizing production and improving quality using local raw materials and traditional techniques, (2) standards adapted to the local context be developed for better quality control of traditional beers and be respected by local producers, (3) scenarios to ensure the sustainable profitability of the local brewing sector, by meeting the specific needs of producers, be established in a participatory manner and (4) lastly sorghum beers be brewed also by processing factories using modern technologies.

Key words: Traditional sorghum beer, Ikigage, Production, Commercialization, Consumption Rwanda.

RESUME

PRODUCTION, COMMERCIALISATION ET CONSOMMATION DE LA BIÈRE TRADITIONNELLE DE SORGHO (" IKIGAGE ") ET SON IMPACT SUR LE BIEN-ÊTRE DES AGRICULTEURS AU RWANDA

Cet article a tenté d'examiner les performances de la production traditionnelle de bière de sorgho au Rwanda. Des données qualitatives et quantitatives ont été recueillies auprès d'un échantillon de 595 individus (409 brasseurs traditionnels de bière de sorgho et 186 consommateurs) à l'aide d'un questionnaire structuré. Des statistiques descriptives, principalement des fréquences et des pourcentages dans des tableaux bien organisés et sur des chiffres, ont été utilisées dans l'intention de l'analyse des données. Les résultats ont montré que la majorité des producteurs traditionnels de bière de sorgho obtiennent la totalité du grain de sorgho du marché, tandis que la principale source de fonds est leur épargne. Les résultats de l'analyse des marges indiquent que la production de bière de sorgho traditionnelle est rentable. La majorité des consommateurs ont commencé à consommer quand ils avaient moins de 15 ans. Ils ont signalé l'influence des adultes, la curiosité et la pression des pairs comme les principales raisons qui les ont poussés à prendre de la bière de sorgho pour la première fois. Ils ont également indiqué qu'ils consommaient de la bière de sorgho deux ou trois fois par semaine (43,6 pour cent), tandis que 22,6 pour cent en prenaient tous les jours. La majorité des

consommateurs ont apprécié la qualité de la bière traditionnelle de sorgho. Sur la base des résultats de cette étude, nous suggérons que (1) les recherches soient orientées vers l'optimisation de la production et l'amélioration de la qualité en utilisant les matières premières locales et des techniques traditionnelles ; (2) les normes adaptées au contexte local soient établies pour un meilleur contrôle de la production et qualité bières traditionnelles et qu'elles soient respectées par les producteurs locaux ; (3) des scénarii pour assurer la rentabilité durable de la filière brassicole locale, en répondant spécifiquement aux besoins des producteurs, soient établis de façon participative ; et (4) enfin, les bières de sorgho soient brassées également dans les unités ou des usines de transformation utilisant des technologies modernes.

Mots clés : bière traditionnelle de sorgho, Ikigage, production, commercialisation, consommation, Rwanda.

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INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench], native to Africa (3000-5000 BC) with many cultivated forms, is one of the most important cereal crops globally after wheat, maize, rice, barley (Srinivas *et al.*, 2009) and is one of the most important drought tolerant crops (Fetene *et al.*, 2011). It adapts to all soils (dry, wet or high salinity) and is resistant to hot and dry agro-ecologies. These qualities give it a considerable advantage over other cereal crops (compared to other major cereals) in tropical and semi-arid regions of Africa and Asia (Fliedel *et al.*, 1996; Taylor, 2003).

Sorghum has been considered among the crops that enhance food security especially in low-rainfall areas in Africa (Taylor, 2003; Mwalu & Mwangi, 2013). Rohrbach & Obilana (2003) emphasized that possibilities of alternative uses of sorghum is creating new opportunities that have potential to increase market demand and income to farmers in Asia. These authors pointed that market opportunities for alternative uses of sorghum with special reference to alternative novel food products, livestock feed, starch and brewing and/or distilling industries are very important to enhance the utilization of sorghum that would lead to its sustained market demand. This, in turn, would ensure increased income and better livelihoods for the resource-poor sorghum and pearl millet farmers in the semi-arid tropical countries. According to the Food and Agriculture Organization, the world Sorghum Production was 57.9 million tons in 2019, including about 28.62 million tons for Africa, where it covers 4% of arable land (FAOSTAT, 2019).

Sorghum grains are an important source of energy, protein vitamins and minerals for millions of people in Asia and Africa; therefore, it acts

as the basic food for the poorest and most underprivileged populations living in these regions (Klopfenstein and Hosney, 1995). In this way, sorghum plays a crucial role in the world food economy as it contributes to rural household food security (Timu *et al.*, 2012). However, the nutritional constraints to the use of sorghum in the human diet are the insufficiency of certain essential amino acids such as isoleucine and lysine (Neucere and Sumrell, 1979; Afify *et al.*, 2012), poor protein digestibility (Duodu *et al.*, 2003) and the significant presence of tannins (Soetan & Oyewole, 2009; Kumar *et al.*, 2010). Thus, Improving the nutritional quality of sorghum is of great importance in these regions where populations frequently face the problem of malnutrition. Several studies on sorghum reported that the fermentation increases the protein content and improves its digestibility, provides a better composition of essential amino acids, decreases the tannin content and increases the vitamin content (El Tinay, 1979; Chavan *et al.*, 1989; Hassan and El Tinay, 1995; Osman, 2004; Noha *et al.*, 2011). Fermentation is also an ideal approach for maintaining and improving the organoleptic properties of foods in developing countries (Holzapfel, 2002).

Since immemorial time, sorghum is used in Sub-Saharan Africa for the production of traditional beers after a fermentation step. Generally, African traditional sorghum beers are brewed with pigmented sorghum varieties (red or brown). The white varieties are always mixed with red sorghum because consumers prefer to drink colored beers which they believe to be healthy (Kayodé *et al.*, 2005). These African sorghum beers are not a clear, sparkling liquid, but opaque with suspended solids (5-7%). The produced beers have a rather low alcohol content (2-4.5% v/v), a pH between 3.3 and 4 and a lactic acid

rate of about 0.26%. Their color varies from a pale buff to a pinky brown according to the ingredients used. Usually, African sorghum beers have a touch of fruitiness added to their fermentation odor. The traditional beers are consumed in an actively fermenting state and therefore their shelf life is quite short (Lyumugabe *et al.*, 2010). However, African traditional beers vary in their denomination and their production processes according to their geographic localisation. Lyumugabe, *et al.*, (2012), described the manufacture process of the different types of African traditional beers brewed with malted sorghum. These various kinds of traditional alcoholic beverages have a central role in peoples' cultures and play fundamental socioeconomic function (Konfo *et al.*, 2015). Mugula *et al.* (2011) proved that sorghum value addition may contribute towards alleviation of poverty, malnutrition and economic stagnation. Rogerson (2019) demonstrated the shrinking spaces of production of the formal economy of sorghum beer as the industry moved from serving narrow localized markets to concentrated production for wider regional and national markets.

Unlike Western beers brewed from barley malt, the fermentation leading to the production of African sorghum is uncontrolled (spontaneous or pitching wort with a portion of previous brew) and characterized by a lactic fermentation followed by alcoholic fermentation in which initially, lactic acid bacteria, and later yeasts, play the dominant role. Lactic acid bacteria create an acid environment favorable to the proliferation of yeasts. These yeasts produce vitamins and increase other factors, such as amino acids, to aid the growth of lactic acid bacteria (Novellie, 1982; Kayodé *et al.*, 2005; Lyumugabe *et al.*, 2010). Unfortunately, African sorghum beer always carries a residual microflora originating mainly from its ingredients (Lyumugabe *et al.*, 2010) and other microorganisms coming from the operations post-fermentation process (water used for dilution, utensils, etc.). Therefore, African beer is infected at varying levels with yeasts and bacteria, which makes it microbiologically unstable. This is reflected by a short shelf life and organoleptic variations, which constitute a major problem to the producers for the sorghum beer commercialization (Lyumugabe *et al.*, 2012). Mugula *et al.* (2011) also reported that the commercialization of sorghum traditional products is limited due to poor quality, safety

and short shelf-life. This may be improved by up-scaling and using appropriate bio-enrichment technologies such as optimized malting and extrusion technologies. These technologies will lead to diversification of products such as quality malt, clear-malt drink and malted extruded snacks. This product diversification will help to increase the demand for this crop, create new opportunities for enterprise development and improve livelihoods of key players. The use of suitable starters in combination with the local plant extracts as natural preservative agents was proposed as good methods to reduce organoleptic variations and microbiological instability of African sorghum beers (Konfo *et al.*, 2015; Lyumugabe *et al.*, 2017). Orr *et al.* (2020) analyzed the business and the commercialization strategy for sorghum in East and Southern Africa. Results pointed to stronger sorghum business (limited to traditional beer) thanks to its greater impact on poverty and food security. Demand for improved varieties is driven primarily by the need for early maturity that shortens the hungry period. Orr *et al.* (2017) reported that 91 % of sorghum in selected Eastern and Southern African (ESA) countries (Ethiopia, Eritrea, Mozambique and Tanzania) are used as food, while the rest is used for seed, animal food and waste; they emphasized that the share of sorghum used by the commercial sector is small, and utilization is dominated by a single value chain that processes grain into flour. Mugula *et al.* (2011) also highlighted that the use of quality malt, clear malt beverage and malted extruded snacks will be promoted to increase sorghum utilization and income generation. Different approaches such as marketing research, business technology incubation centres and public-private partnership will be used as main pathways to technology diffusion and product commercialization. Among the best outcomes there are the creation of new enterprises and employment, the improved competitiveness of sorghum products, the increased incomes to smallholder farmers and consequently, the improved welfare of the rural poor.

In Rwanda, the annual production of maize (421,218 tons), sorghum (159,626 tons), banana for beer (805,783 tons) and wheat (15,687 tons) was estimated at 1,402,314 tons in 2019, according to the National Institute of Statistics of Rwanda (NISR, 2019). Besides its food use in the form of grain or fruit, these raw materials are used for centuries in Rwanda to produce traditional alcoholic beverages commonly known

as "Ikigage" and "Urwagwa". Apart their socio-cultural importance, Ikigage beers are very rich in calories, vitamin B and essential amino-acids and constitute an income source for the local brewers who produce them at household scale by using the traditional technologies (Lyumugabe *et al.*, 2012). However, number of constraints are hindering the development of this business sector. On the one hand, the production remains strictly artisanal and the know-how is passed from generation to generation with the processing being optimized through trial and error. On the other hand, their microbiological and organoleptic instabilities constitute a major handicap to their marketing, unlike Western-style beers made at Bralirwa (Gisenyi) or the SKOL Brewery (Kigali).

The purpose of this article is to examine the performance of Rwandan traditional sorghum beer "ikigage" production. It aims specifically to assess socio-economic impact of Ikigage production to the local brewers, to analyze its commercialization, to identify the producers and consumers' levels of appreciation of the sorghum beer quality, and to collect different suggestions for sustainable supply of sorghum beer in Rwanda.

MATERIALS AND METHODS

SOURCES OF DATA

Qualitative and quantitative data used in this study were collected using a structured questionnaire conducted to a random sample of 409 traditional sorghum beer producers and 186 consumers in rural areas of Rwanda. This sample was determined following Angelsen *et al.* (2011) who recommended a minimum sample of 100 units as well as in terms of the law of large numbers (Sedor, 2015). The sampling was gone through three stages. The first stage was to select 4 rural provinces (Eastern, Northern, Southern and Western provinces). The second was to select one district in each province, where

Kirehe, Gicumbi, Gisagara, and Rusizi districts were selected respectively. The third stage was to select the respondents in each district selected. The sample size was determined based on the importance of sorghum exploitation in the study area and their availability of the respondents during the survey period. Data collected on local brewers concerned their socio-economic characteristics (age, sex, education level, social situation and funding sources), and production (main raw materials, production process, quantity per year and unit price) and consumption (quantity and consumer's opinion on quality) of traditional "Ikigage" beers). As for traditional beer consumers, we collected data on consumption (quantity and consumer's opinion on quality). Besides, a short training was organized in order to provide to the data collectors the instructions and strategies or approaches for them to gather required data in appropriate and accepted procedure.

DATA ANALYSIS

In intent of data analysis, descriptive statistics and budgetary techniques were used. Descriptive statistics, mainly frequencies and/or percentages in tables and on figures were presented (van Elst, 2019). We used also a budgetary technique for computing gross margin and net margin (Gietema, 2006; Maniriho *et al.*, 2021; Maniriho, 2021) to determine the level of profitability of the production of traditional sorghum beer.

RESULTS

PROFILE AND SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

This study dealt with two categories of respondents, traditional beer producers and consumers. The Table 1 presents their distributions by sex, by district, by the level of education, and by the marital status.

Table 1. Socio-demographic characteristics of respondents.*Caractéristiques sociodémographiques des répondants.*

Characteristics		Traditional sorghum beer producers		Traditional sorghum beer consumers	
		Frequency	Per cent	Frequency	Per cent
Sex	Male	202	49.39	127	68.28
	Female	207	50.61	59	31.72
District	Gicumbi	64	15.65	45	24.19
	Gisagara	142	34.72	46	24.73
	Kirehe	150	36.67	49	26.34
	Rusizi	53	12.96	46	24.73
Education level	No education	109	26.65	39	20.97
	Primary	230	56.23	108	58.06
	Secondary	36	8.80	28	15.05
	University	2	0.49	9	4.84
	Other	32	7.82	1	0.54
	Not stated	0	0.00	1	0.54
Marital status	Single	18	4.40	67	36.02
	Married	292	71.39	101	54.30
	Widowed	81	19.80	11	5.91
	Separated	17	4.16	7	3.76
	Not stated	1	0.24	0	0.00

In complement with the information in Table 1, it is important to note that the mean age of sorghum beer consumers is estimated to 42.7, while the majority of the producers (84.6 per cent) are aged 35 years and above. Respectively, the mean household size of sorghum beer producers is estimated to 5.1. The producer respondents are not equally distributed in the sampled district. The low number in Rusizi is explained by the fact that sorghum is marginally grown in this district. The traditional sorghum beer producers are required to mix sorghum flour with maize flour, and the big amount of sorghum consumed in this area is bought from other districts such as Nyamasheke. Different aspects are observed in Gicumbi district, even though sorghum is abundantly grown in this area. Traditional sorghum beer is mainly produced by professional wholesalers: each wholesaler produces 200 litres of sorghum beer per day. Traditional sorghum beer retailers get the product

from the wholesalers. In the same way, individuals who organize ceremonies prefer to get sorghum beer from the wholesalers. Given that the wholesalers produce high quality traditional sorghum beer, consumers testify that they cannot substitute it for industrial beers like mutzig or primus.

PRODUCTION AND COMMERCIALIZATION OF SORGHUM AND SORGHUM BEER

The sorghum beer producers presented the origins of the sorghum grains used to produce traditional sorghum beer in Rwanda. The results on the Figure 1 showed that the majority of producers (87.5 per cent) get the totality of sorghum grain from the market. Besides, 8.6 per cent of traditional sorghum beer get only part of sorghum grains from the market, while the great amount of sorghum grain come from own production.

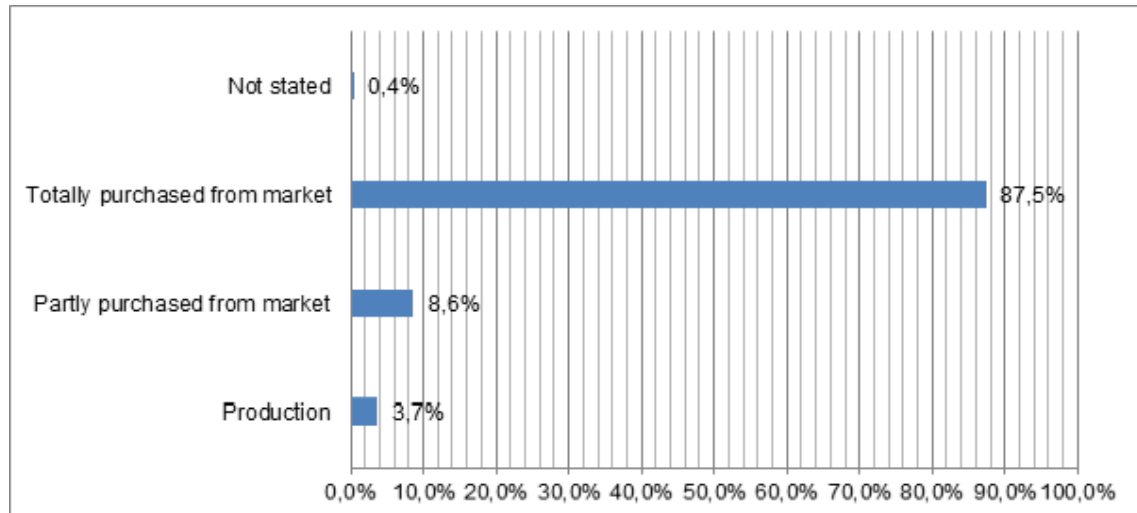


Figure 1. Origins of sorghum grains used in beer production process.

Origines des grains de sorgho utilisés dans le processus de production de la bière.

The production of traditional sorghum beer requires the producers to have some amount of money to invest in the process. The majority of interviewed traditional sorghum producers reported that the main source of funds is their

savings (49.4 per cent) followed by the financing from saving and credit associations (39.6 per cent). The details on the financing modes of traditional sorghum beer producers are presented in table 2.

Table 2. Sources of funds for sorghum beer producers.

Sources de financement des producteurs de bière de sorgho.

Sources of funds	Frequency	Percentage
Own funds (savings)	202	49.39
Saving and credit associations	162	39.61
Bank loans	15	3.67
Aid from friends/relatives	10	2.44
Other sources	18	4.40
Not stated	2	0.49

Note: There was possibility to use more than one source of funds for one producer

The one round (or one-day) production cost of traditional sorghum beer was estimated to RwF 16,924 on average (that is, RwF 12,602 for sorghum grains, RwF 725 for grinding the grains, RwF 1,231 for firewood, RwF 417 for water, RwF 955 for rent, and RwF 994 for miscellaneous costs). The dominant components of sorghum beer production cost are the expenses on sorghum gains (74.5 per cent) and cost of firewood (7.3 per cent). As the gross margin was estimated to RwF 20,145, the net margin was estimated to RwF 3,221, which confirms that sorghum beer production is among the livelihood

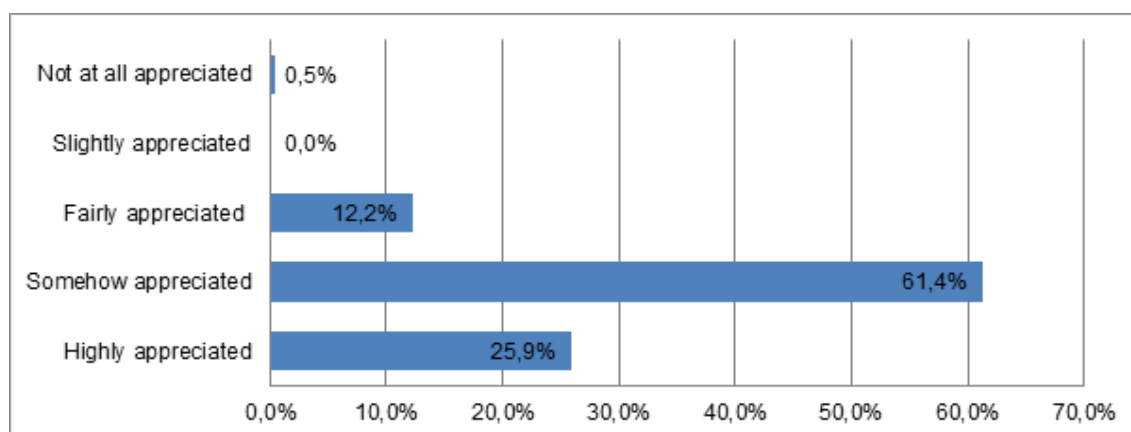
sources of traditional sorghum beer brewers. Since the sorghum beer brewers reported that they sold traditional sorghum beer 3 times a week on average, this margin comes to RwF 9,663 per week. The In Gicumbi district where traditional sorghum beer is produced by professional wholesalers, they witnessed that they have got different assets (such as cars, and houses) and pay school fees from the money gains from traditional sorghum beer production. The Table 3 provides the details on the weekly profitability of traditional sorghum beer in Rwanda.

Table 3. The level of weekly profitability of traditional sorghum beer in Rwanda.*Le niveau de rentabilité de la bière traditionnelle de sorgho au Rwanda.*

Parameters	Value (RwF)	Percentage
Gross Margin	60,435	--
Cost of sorghum grains	37,806	74.46
Cost for grinding sorghum grains	2,175	4.28
Cost of firewood	3,693	7.27
Cost of water	1,251	2.46
Rental cost	2,865	5.64
Other costs	2,982	5.87
Net Margin	9,663	--

Now that the production of traditional sorghum beer seems to be an additional livelihood source of sorghum beer producers, their appreciation of the quality of sorghum beer was assessed. Results indicate that the majority of traditional sorghum beer producers appreciate its quality:

25.9 per cent highly appreciate the sorghum beer quality, and 61.4 per cent somehow appreciate its quality. The details on the sorghum beer producers' appreciation are presented on the Figure 2.

**Figure 2.** Producers' appreciation of the quality of traditional sorghum beer.*Appréciation par les producteurs de la qualité de la bière traditionnelle de sorgho.*

CONSUMPTION OF SORGHUM BEER

We investigated the age of the consumers at the first consumption of traditional sorghum beer. The results prove that the majority of the consumers starting consuming the traditional

sorghum beer at early age: more than 75 per cent consumed sorghum beer at the first time when they were less than 15 years. The table 4 presents in details the distribution of sorghum consumers by age group at the first consumption.

Table 4. Age at first consumption of traditional sorghum beer.*Âge à la première consommation de bière traditionnelle de sorgho.*

Age group	Frequency	Percentage
Below 5 years	58	33.33
Between 5 and 10 years	41	23.56
Between 10 and 15 years	36	20.69
Between 15 and 20 years	25	14.37
Above 20 years	14	8.05
Total	186	100.00

Besides, we examined the reasons for which they consumed sorghum beer at the first time (Figure 3). Results pointed to different reasons

such as influence if adult people (62 per cent), curiosity (22 per cent), peer pressure (7 per cent), and miscellaneous (not specified) reasons (9 per cent).

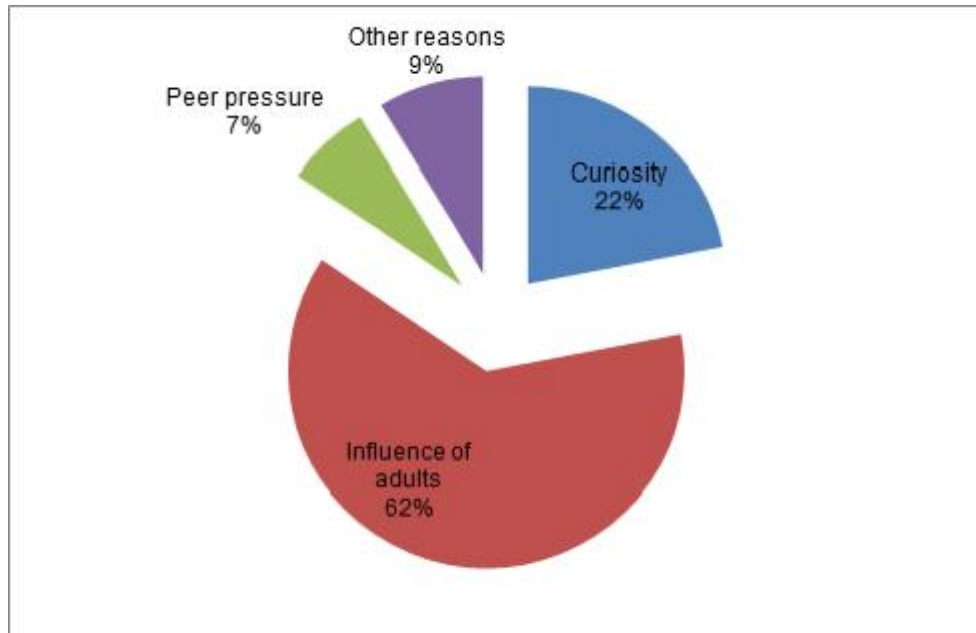


Figure 3. Reasons for the first-time consumption of traditional sorghum beer.

Raisons de la première consommation de bière traditionnelle de sorgho.

After presenting the reasons for sorghum beer consumption at the first time, the frequency of consuming sorghum beer was analyzed. The results show that the majority of consumers take the sorghum beer two or three times per week (43.6 per cent), while 22.6 per cent take it

everyday. For the others, they take sorghum beer on special occasions, once a week, or during weekends only, at the rates of 17.7 per cent, 10.8 per cent, and 4.3 per cent, respectively, whereas 1.1 per cent did not provide any information. The Figure 4 depicts this situation.

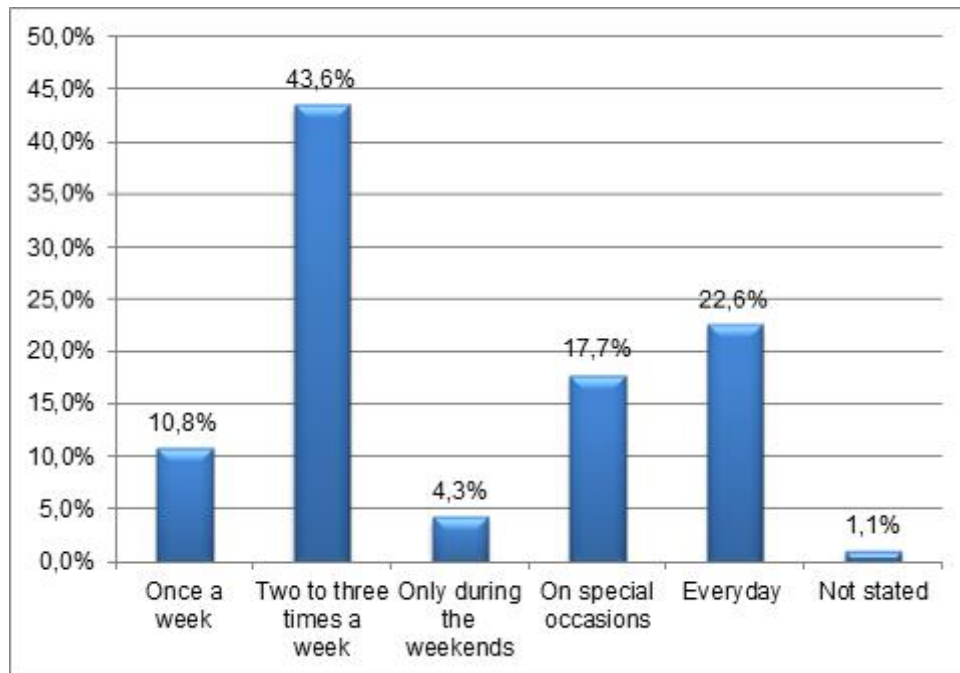


Figure 4. Frequency of traditional sorghum beer consumption.

Fréquence de consommation de bière traditionnelle de sorgho.

The quality of traditional sorghum beer is not only appreciated by the producers (see Figure 2), but also by consumers. The majority of the consumers appreciate the quality of sorghum beer: 46.8 per cent highly appreciate and 38.2 per cent somehow appreciate it. In the same

way, 12.4 per cent fairly appreciate, 2.1 per cent slightly appreciate, while 0.5 per cent do not at all appreciate the quality of traditional sorghum beer. The Table 5 summarizes the extent at which the quality of traditional sorghum beer is appreciated by the consumers.

Table 5. Consumers' appreciation of traditional sorghum beer.

Appréciation par les consommateurs de la bière traditionnelle de sorgho.

Level of appreciation	Frequency	Percentage
Highly appreciated	87	46.77
Somehow appreciated	71	38.17
Fairly appreciated	23	12.37
Slightly appreciated	4	2.15
Not at all appreciated	1	0.54
Total	186	100.00

In supplement to the consumers' appreciation of the quality of traditional sorghum beer, we have also asked them to point the aspects of sorghum beer industry that need special attention for sustainable supply of traditional sorghum beer. In this line, sorghum beer consumers proposed different mechanisms for which the most important are (1) to ensure quality and quality control, (2) to keep using

traditional sorghum yeast (but not industrial yeast), (3) to adopt new technologies for sorghum beer processing, (4) to keep current quality and originality, (5) to think of the way of packaging of sorghum beer for easier transport and storability. The details on the consumers' proposed mechanisms for sustainable supply of traditional sorghum beer are summarized on the Figure 5.

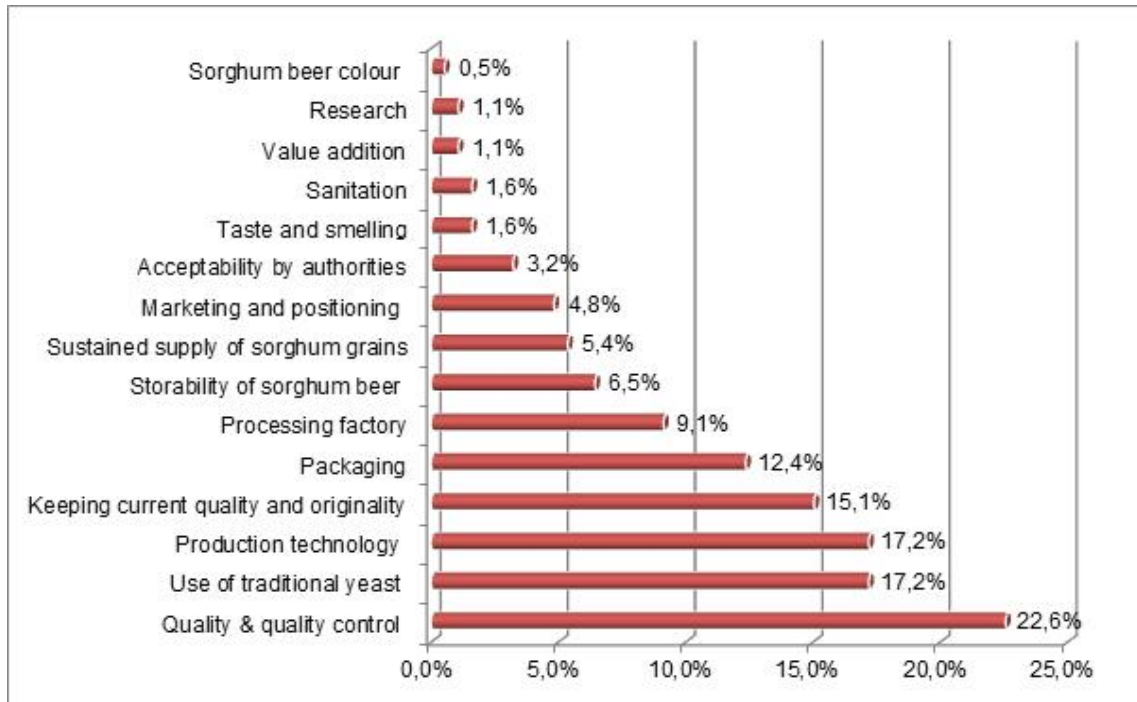


Figure 5. Consumers' views on required mechanisms for sustainable supply of traditional sorghum beer.

Opinions des consommateurs sur les mécanismes requis pour un approvisionnement durable en bière traditionnelle de sorgho.

For further improvement of the quality of sorghum beer quality, different suggestions were provided by the consumers. By the level of importance, they reported that research should suggest to local producers the ways to improve quality using traditional techniques (37.6 per cent), standards

should be set up by authorities and respected by local producers (26.9 per cent), local producers should adopt modern technologies (20.4 per cent), and lastly sorghum beer should be brewed by processing factories using modern technologies. The details on these suggestions are reported in Table 6.

Table 6. Suggestions of traditional sorghum beer consumers for quality improvement.

Suggestions des consommateurs de bière de sorgho traditionnelle pour l'amélioration de la qualité.

Suggestions	Frequency	Percentage
Standards should be set up by authorities and followed by producers	50	26.88
Research should help local producers to improve the quality of ikigage beer using traditional techniques	70	37.63
Local producers of ikigage beer should adopt modern technologies	38	20.43
Ikigage beer should be brewed by companies using modern technologies	28	15.05
Total	186	100.00

DISCUSSION

Results from our analysis proved that the production cost of traditional sorghum beer was estimated to RwF 50,772 per week on average. Access to finance is always vital to the initiation of new businesses. This proves that access to finance should be always integrated into the production networks (van Loon, 2012; Coe *et al.*, 2014). The weekly net margin of RwF 9,663 confirms that production and commercialization of traditional sorghum beer is among the livelihood sources of rural households. This finding supports Orr *et al.* (2020) who revealed that sorghum is important for food security and poverty reduction. It is also supported by Timu *et al.* (2012) who reported that sorghum contributes to rural household food security (Timu *et al.*, 2012).

The production of traditional sorghum beer requires the producers to have some amount of money to invest in the process. The majority of interviewed traditional sorghum producers reported that the main source of funds is their savings (49.4 per cent) followed by the financing from saving and credit associations (39.6 per cent). The fact that the majority of traditional sorghum beer producers finance their activities through their savings, this highlights the importance of "personal wealth in small business finance" (Avery *et al.*, 1998), even though the importance of other sources of funds in business development (such as personal credit, and equity financing) is still recognized (Connolly & Bank, 2018).

The dominant components of sorghum beer production cost are the expenses on sorghum gains (74.5 per cent) and cost of firewood (7.3 per cent). As the gross margin was estimated to RwF 20,145, the net margin was estimated to RwF 3,221. Rohrbach & Obilana (2003) emphasized that possibilities of alternative uses of sorghum is creating new opportunities that have potential to increase market demand and income to farmers in Asia.

The results show that the majority of consumers take the sorghum beer two or three times per week (43.6 per cent), while 22.6 per cent take it everyday. For the others, they take sorghum beer on special occasions, once a week, or during weekends only, at the rates of 17.7 per cent, 10.8 per cent, and 4.3 per cent, respectively, whereas 1.1 per cent did not provide any information. Apart their socio-cultural

importance, Ikigage beers are very rich in calories, vitamin B and essential amino-acids and constitute an income source for the local brewers who produce them at household scale by using the traditional technologies (Maoura & Pourquie, 2009; Lyumugabe *et al.*, 2012).

Results pointed to different reasons such as influence of adult people (62 per cent), curiosity (22 per cent), peer pressure (7 per cent), and miscellaneous (not specified) reasons (9 per cent). This shows that there are the determinants of the demand for a product other than the consumer's income (Samuelson & Marks, 2012). The fact that the demand for traditional sorghum beer among young people is influenced by the adults re-confirms the role of culture in the consumption (Featherstone, 1987; Firat *et al.*, 2013). As for peer pressure, the results of our study approve the vital role of imitation in consumption (Veblen, 1899; Duesenberry, 1967). The curiosity of an influential factor of demand proves that the information is greatly important in the decision making of economic agents (Stigler, 1967; Samuelson & Marks, 2012).

The majority of the consumers appreciate the quality of sorghum beer: 46.8 per cent highly appreciate and 38.2 per cent somehow appreciate it. In the same way, 12.4 per cent fairly appreciate, 2.1 per cent slightly appreciate, while 0.5 per cent do not at all appreciate the quality of traditional sorghum beer. The quality of traditional sorghum beer is ranked differently by different individual consumers. The change in behavior could be explained by the change in tastes and preferences (Alhadeff, 1982; Schotter, 2009; Samuelson & Marks, 2012).

Consumers proposed the setting up of quality and quality control mechanisms and use of traditional (but not artificial) yeast along the production process of traditional sorghum beer. This is aligned to research activities that recommended regulatory environment (Konfo *et al.*, 2015) and the use of quality malt (Mugula *et al.*, 2011) so as to increase sorghum utilization and generation of income.

CONCLUSION AND POLICY SUGGESTIONS

This paper aims to assess the socio-economic importance of traditional sorghum beer brewing in Rwanda. Specifically, it examined the impact

of traditional sorghum beer production to the local brewers' welfare, to analyze the commercialization status of traditional sorghum beer, to look at what extent the quality of traditional sorghum beer is appreciated, and to identify different mechanisms for a sustained supply of sorghum beer in Rwanda. This study used both qualitative and quantitative data collected using a structured questionnaire conducted from a random sample of 595 individuals that includes 409 traditional sorghum beer producers and 186 consumers in rural areas of Rwanda. For collecting data along appropriate and accepted procedure, a short training was organized in order to provide to data collectors the practical instructions and strategies. Data collected on local brewers concerned their socio-economic characteristics and production. As for consumers, the information on consumption of traditional sorghum beer was gathered. Data were analyzed through descriptive statistics and budgetary techniques.

Results emphasized the importance of access to finance, especially personal wealth and savings, in the production activities, especially for small-scale family businesses. Results from margin analysis proved that traditional sorghum beer is one of the livelihood sources. For them to maximize their profit, traditional sorghum beer brewers should control their expenses, mainly the costs of sorghum grains and firewood. For consumers, the majority reported that they take the sorghum beer everyday (22.6 per cent), or two to three times a week (43.6 per cent), given the great socio-cultural importance affected to traditional sorghum beer "Ikigage". In the same way, the majority reported that they started consuming sorghum beer at early age. The primary reasons for taking traditional sorghum beer for the first time include the influence of adult people, curiosity, and peer pressure. This was due to cultural norms, the imitation effect, and the importance of information in the decision-making of economic agents. Consumers appreciated the quality of traditional sorghum beer, even though they ranked it differently. This difference could be explained by the differences in tastes and preferences.

In line with the research results and the discussion above, we suggest that (1) research be directed towards optimizing sorghum production and improving the quality of sorghum beers using local raw materials and traditional techniques, (2) standards adapted to the local context be developed for better quality control

of traditional beers and be respected by local producers, (3) scenarios to ensure the sustainable profitability of the local brewing sector, by meeting the specific needs of producers, be established in a participatory manner and (4) lastly sorghum beers be brewed also by processing factories using modern technologies.

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