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# Yam urban market characteristics and consumer preferences in Bukavu City, eastern D.R. Congo

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Demand-led breeding is essential for developing crop varieties that suit market requirements. This study employed surveys targeting both yam (*Dioscorea* spp.) traders and consumers in Bukavu city, eastern Democratic Republic of Congo (DRC), to assess yam market characteristics and trait preferences. The results showed that the yam market operates predominantly informally and is dominated by women traders. The peak supply period occurs from March to May, characterized by relatively stable prices, while yam availability gradually decline and rare from August to January, prompting price increases of approximately 23% towards October. Income from yam trade plays crucial role in meeting family basic needs, including food, child education, and healthcare expenses, underscoring its importance for food and income security in the community. Market surveys, household interviews, and regression analyses consistently identified taste, softness, tuber flesh color, tuber shape, and tuber size as primary varietal preference criteria in urban settings, with slight differences across gender and age groups. Socioeconomic factors such as household location, education level, dietary integration of yam, and awareness of its nutritional benefits emerged as key drivers of urban yam consumption, regardless of gender and age categories. Our study helped to differentiate four market segments and develop corresponding target product profiles (TPPs) to inform yam breeding initiatives tailored to the needs of eastern DRC. These findings provide valuable insights into yam market characteristics, its role in sustaining livelihoods, and priority traits that should be addressed by plant breeding to enhance urban consumption.

## KEYWORDS

trait preference, market segment, trait product profile, breeding opportunities, urban setting

## 1 Introduction

Yam (*Dioscorea* spp.) is an important staple crop in most tropical and subtropical regions, where its importance is expected to expand owing to its resilience to climate change (Agre et al., 2022; Owusu Danquah et al., 2022; Mondo et al., 2024a). It is a good source of carbohydrates, vitamins, essential minerals, and proteins, making it an important healthy nutritious food (Argaw et al., 2024; Lebot et al., 2023, 2024). In addition to its nutritional and therapeutic values, yam plays an important role in local African socio-cultural and economic fabrics (Kiba et al., 2020; Ema et al., 2023; Kouakou et al., 2023). In the Democratic Republic

of Congo (DRC), yam farming faces significant socioeconomic, cultural, agronomic, and ecological challenges that hinder its extensive cultivation despite existing favorable biophysical conditions (Mondo et al., 2024b). Due to the above challenges and limited institutional support, yam has been listed among neglected and underutilized crop species in DRC (Mondo et al., 2021; Adejumobi et al., 2022, 2023). For instance, yam had the least annual production volume among root, tuber and banana (RTB) crops in DRC for the year 2022 with only 0.12 million tons produced from 27,104 ha compared to cassava, plantain and cooking banana, banana, sweet potato that had 48.8, 4.9, 0.81, and 0.59 million tons, respectively (Dhekney et al., 2025). Besides, the average yield recorded between 2015 and 2023 was  $3.8 \text{ t ha}^{-1}$  for yam that is significantly lower compared to its African average ( $8.7 \text{ t ha}^{-1}$ ) for the same period.<sup>1</sup> Previous studies suggested that breeding suitable varieties could serve as a backbone in addressing challenges facing yam in DRC, and therefore, unlock its potential for food security and wealth creation (Adejumobi et al., 2022, 2023; Mondo et al., 2024b). However, developing such varieties and ensuring their rapid uptake among farmers and consumers requires that the trait preferences of both farmers and consumers be considered.

Most studies assessing yam varietal preferences mostly focus on farmers, overlooking consumers and other end-users, mainly those from urban settings (Barlagne et al., 2017; Adejumobi et al., 2022; Kalu et al., 2023; Mondo et al., 2024b). As argued by Mondo et al. (2024b), promoting yam in eastern DRC requires that farmers are connected to elite and urban populations with high purchasing power. These represent a particular niche market with specific requirements and needs that are not necessarily met by traditional varieties, leading to low interest among urban populations. Furthermore, with evolving eating habits among elite and urban populations in Africa, food processing plays a crucial role, and technological attributes should be considered when developing varieties for this market segment (Barlagne et al., 2017; Dufour et al., 2020; Osunbade et al., 2023; Argaw et al., 2024). For instance, leveraging urban and export markets led to a surge in yam production in West Africa in the six last decades (1961–2018), with an estimated 60% of production sold for cash, and for cross-border trade and exports to Europe and North America [CBI (Confederation of British Industry), 2019; Scott, 2021]. Therefore, we hypothesized that increasing the share of this unique niche market could boost yam production in eastern DRC. Previous studies showed also a gender gap in prioritizing preferred traits among men and women along the yam value chain (Okoye et al., 2023; Mondo et al., 2024b), urging breeders to pay attention to the gender gap while designing new varieties for both rural and urban markets.

This study aimed at (i) assessing yam urban market characteristics and value chain stakeholders, (ii) identifying drivers of yam consumption and trait preferences among urban households, with an outlook on gender and age influences, and (iii) documenting yam breeding opportunities in an urban setting. This research complements our previous study on farmers' varietal preferences in rural areas (Mondo et al., 2024b) and could provide an additional overview of yam varietal preferences to facilitate market segmentation and product profiling to meet both rural and urban populations' expectations in South-Kivu, eastern DRC. Due

to linguistic polymorphism, requiring further studies for proper identification, we called yam all *Dioscorea* species being used for food in eastern DRC. In fact, the tuber color itself (used by populations to describe varieties) was not enough to distinguish yam species in eastern DRC. For instance, yellow flesh color is found in *D. alata*, *D. dumetorum*, and some *D. preahensilis* varieties. On the other hand, there are white flesh varieties among *D. alata*, *D. dumetorum*, *D. preahensilis*, etc. It is noteworthy that contrary to what was reported in the DRC parts covered by Adejumobi et al. (2022), *D. rotundata* and *D. cayenensis* are not present in our study area. *Dioscorea rotundata* is being introduced from Nigeria by the International Institute of Tropical Agriculture (IITA) but is not popular yet among traders and consumers. *Dioscorea dumetorum* is the most popular yam species around Bukavu City, but ethnic groups from the southern parts (Ruzizi plain and Fizi) prefer *D. alata* introduced in DRC from Asia via the Lake Tanganyika centuries ago (Burkill, 1939). In addition, Adejumobi et al. (2022) focus was on rural farmers while our study focused on traders and urban consumers.

## 2 Materials and methods

### 2.1 Description of the study area

This study was conducted in Bukavu, the capital city of the South-Kivu province, eastern DRC. Bukavu is located between  $28^{\circ}48' - 28^{\circ}54'$  E, between  $2^{\circ}27' - 2^{\circ}34'$  S, and at an altitude of 1,428–2,080 m above sea level (Figure 1). It lies on the south-western shore of the Lake Kivu and covers an area of 43 km<sup>2</sup>. Bukavu borders Rwanda to the east, and its strategic location makes it a key area for cross-border trade between DRC, Rwanda, and Burundi. Bukavu experiences a tropical mountainous climate (AW3 according to the Köppen-Geiger classification), characterized by moderate temperatures throughout the year ( $16 - 25^{\circ}\text{C}$ , with an average of  $21.6^{\circ}\text{C}$ ). The city receives a significant amount of annual rainfall (1,000–1,500 mm), with the rainy season extending from September to May. Bukavu is densely populated ( $\sim 19,800$  inhabitants km<sup>-2</sup>), with an estimated population of  $\sim 1.2$  million. This population is diverse, comprising several ethnic groups with different cultures, languages, social practices, diets, etc. (Chuma et al., 2024). Cross-border trade and the informal sector play a crucial role in the local economy though poverty, high unemployment, and inadequate infrastructure are major development challenges (Beitze et al., 2024; Balasha et al., 2024).

### 2.2 Assessment of urban yam market characteristics

Surveys were conducted in all three municipalities of the Bukavu city, namely Bagira, Ibanda, and Kadutu where respondents were selected based on cluster sampling, a method that offers a balance between data representativeness and efficient management of available resources (Qureshi et al., 2024). Once clusters had been selected, sampling within them was carried out using a simple random sampling approach to select individuals to interview in each cluster. In each selected municipality, we mapped the main markets (sales outlets) and randomly selected 18 yam sellers per municipality. Data were collected using a structured questionnaire,

<sup>1</sup> <https://www.fao.org/faostat/en/#data>

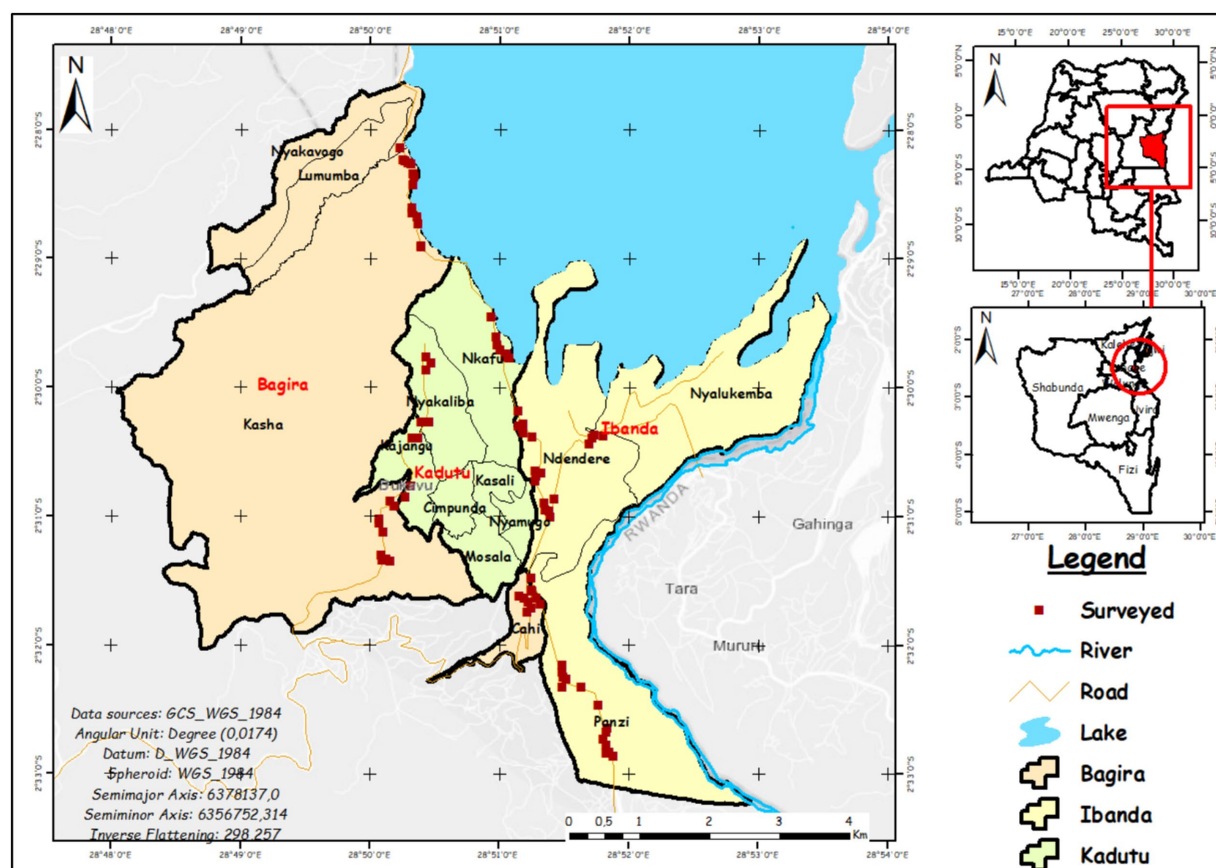


FIGURE 1  
Presentation of the study area, Bukavu City, South-Kivu, Eastern DRC.

coded in the KoBoCollect application, and included the following major sections: (a) yam traders' socio-economic background (gender, marital status, level of education, age, and experience in selling yams); (b) supply circuit (yam origin and involved value chain stakeholders); and (c) market information (sales unit, pricing, customer preferences, destination of income from sales, customer gender and age categories, reasons of buying yams, traders' knowledge of yam nutritional and therapeutic values, challenges encountered in yam marketing, and recommendations for future improvement).

To estimate the quantity sold and price fluctuations over time, bi-weekly market surveys were conducted at various sales outlets (from April 2024 to March 2025). Tuber weights were recorded using a precision scale (as yams are sold in pieces/individual tubers or piles/bulk in Bukavu), and the corresponding prices were extrapolated to United States (US) dollars per kg. At the time of the survey, the exchange rate varied between 2,800 and 2,850 Congolese francs to the US dollar.

The city was surveyed to carry out an inventory of yam-based by-products being marketed in different markets and supermarkets. Selling points of processed yam by-products were identified using the snowball sampling method, in which one respondent led to the next (Etikan et al., 2016). For the inventory of yam by-products, 24 selling points (including markets, supermarkets, and food enterprises) were visited, and relevant information was recorded.

## 2.3 Assessment of yam consumption trends and trait preferences among urban households

A household survey was conducted across the Bukavu city's municipalities to determine the level of yam use and consumer trait preferences among urban populations. Discussions covered aspects related to the household's socio-economic profile, the quantity of yam consumed per household, frequency of consumption, reasons for consuming or not consuming yam, types of yam products and by-products consumed, trait preference criteria, willingness to pay for specific traits under precise conditions, etc. A total of 575 randomly selected households were surveyed across the three municipalities of Bukavu city in March and October 2024. The sample size was determined by a probabilistic saturation sampling technique (Pires, 1997), in which the survey ceases when interviews of new participants no longer reveal further information.

## 2.4 Assessment of yam breeding opportunities and market segmentation

Discussions with consumers, traders, and resource persons (researchers from the National Agricultural Research Organization (INERA), the seed regulation agency (SENASA), universities,

food technologists, etc.) allowed us to identify major challenges to the yam value chain in Bukavu city. Urban information was complemented with those previously collected from rural South-Kivu farmers (Mondo et al., 2024b) to ensure that suggested ideotype varieties simultaneously meet farmers, urban traders, households, and other end-users' trait preferences for rapid uptake. These challenges and trait preferences were later translated into breeding opportunities to identify existing market segments and design target product profiles for each of them. As suggested by Donovan et al. (2022), the following criteria were used for market segmentation: yam species, material types (landrace/improved varieties), sub-region, end-user requirements, tuber flesh color, production environment, production systems, and seed maturity classes. The CGIAR's SOP (standard operating procedure) to create an Inclusive Target Product Profile (TPP) was followed in the process of designing TPPs for each market segment. This SOP comprises the following seven key process steps: (1) obtain market segments; (2) identify TPP development team members; (3) assess the competitive product landscape; (4) review regulatory and product registration requirements; (5) develop the TPP for each market segment; (6) communicate the TPP to all stakeholders; and (7) review and update the TPP. Identified market segments and corresponding TPPs were subjected to validation by a stakeholder meeting and to devise implementation strategies.

## 2.5 Data analysis

Market survey data were subjected to descriptive statistics using R Studio 4.3.2 software (R Core Team, 2020). Frequencies (converted to percentages) were calculated for qualitative variables, while means followed by standard deviations were generated from quantitative data. The  $\chi^2$  test was used to compare the independence/dependence among qualitative variables, while the ArcGIS 10.7 Esri-TM software was used to map the supply chain for yams.

Household survey data were analyzed by descriptive statistics and a multinomial logit model using SPSS 25 (Verma, 2012; Alili and Krstev, 2019). The  $\chi^2$  test was used to assess the independence between gender, the decision to use yam, and other variables, including socioeconomic characteristics and yam consumption preferences. Logistic regression analysis was used to analyze the socio-economic characteristics and households' decision to consume yam (El Sanharawi and Naudet, 2013). The dependent variable was binary, with 1 for a household that consumes yam and 0 if otherwise. This model was estimated by keeping the dependent variable 1 (i.e., yam consumers) as the reference category.

The general framework of utility was used to consider the household's decision of whether or not to consume yam.

$$\gamma_{ij} = \beta'_j X_{ij} + \varepsilon_{ij}$$

Where  $\gamma_{ij}$  is the utility of household  $i$  derived from yam consumption  $j$ ,  $X_{ij}$  is a vector of factors that affect the decision to use yam  $j$ , and  $\beta'_j$  is a set of parameters that reflect the impact of changes in  $X_{ij}$  on  $\gamma_{ij}$ . The disturbance terms  $\varepsilon_{ij}$  are assumed to be independently and identically distributed. If households consume yam, then  $\gamma_{ij}$  is the maximum among all possible utilities. This means that:

$$\gamma_{ij} > \gamma_{ik, k \neq j}$$

The choice of  $j$  depends on  $X_{ij}$ , which includes aspects specific to the household socio-demographic factors.

$$\Pr[Y_i = j]$$

Where  $\Pr$  is a probability of deciding to consume yam (dependent variable);  $j = 0, 1; i = 1, 2, 3, \dots, 575$

$$P_{ij} = e^{\sum_{j=1}^k \alpha + \beta_{ij} X_{ij}}$$

$$P_{ij} = \sum_1^j e^{\sum_{j=1}^k \alpha + \beta_{ij} X_{ij}}$$

We can write the model in terms of odds as:

$$\frac{P_i}{(1 - P_i)} = \exp(\beta_0 + \beta_1 x_i)$$

The odds are defined as the ratio of the probability of an event occurring to the probability of it not happening. We assumed that any factors with positive influence on yam consumption had a negative impact on non-consumption and vice versa (Supplementary Table 1).

## 3 Results

### 3.1 Market characteristics and yam market value chain stakeholders in Bukavu city

There were no significant differences among locations for any of the traders' socioeconomic variables ( $p > 0.05$ ). The yam market is predominantly informal and exclusively operated by women (100%), aged above 30 years old (81%), most of whom are married (80.9%), and have low levels of education (Table 1). Approximately 48% of traders are itinerant, while about 39% operate stationary stalls in the city's major markets and public squares, including Nyawera, Kadutu, Feu Rouge, Essence (Major Vangu), Kamagama, Beach Muhanzi, Place de l'Indépendance, and the Institut de Bagira. The remaining 13% of yam sellers alternate between stationary and itinerant trading, depending on the circumstances encountered in the market.

Yam marketing circuit in Bukavu city is provided in Figure 2 and Supplementary Figure 1. Four categories of stakeholders are involved in yam commercialization in Bukavu city: (a) yam producers who generally sell their harvest directly, while their yams are still in the field growing, through verbal agreements between producers and customers (urban wholesalers) or intermediaries. Transactions typically occur by heap/bulk (Figure 3a), counting the yams after grading based on the tuber size, or marking off the field before harvest. (b) Rural wholesalers are mostly producers who do not sell directly from their farms. These producers transport yams themselves to



TABLE 1 Socio-demographic characteristics of yam merchants in Bukavu city.

Variables/ Modalities	Municipalities (%)				Khi <sup>2</sup>	p-value
	Bagira	Ibanda	Kadutu	Pooled		
Gender						
Men	0.0	0.0	0.0	0.0	-	-
Women	100.0	100.0	100.0	100.0		
Marital status						
Single	10.0	7.1	0.0	4.8	8.16	0.226 ns
Divorced	10.0	0.0	0.0	2.4		
Married	60.0	92.9	83.3	81.0		
Widow	20.0	0.0	16.7	11.9		
Education level						
Literacy training	10.0	7.1	5.6	7.1	2.03	0.916 ns
Primary	50.0	71.4	55.6	59.5		
No formal education	30.0	14.3	22.2	21.4		
Secondary	10.0	7.1	16.7	11.9		
Age (years)						
18–30	20.0	21.4	16.7	19.1	1.48	0.830 ns
30–50	50.0	28.6	44.4	40.5		
>50	30.0	50.0	38.9	40.5		
Experience (years)						
1–5	40.0	42.9	50.0	45.2	0.51	0.972 ns
5–10	20.0	21.4	22.2	21.4		
>10	40.0	35.7	27.8	33.3		

ns: not significant ( $p > 0.05$ ).

nearby rural markets. At rural yam markets, the selling units are the basin (an open circular plastic vessel, [Figure 3b](#)), kilogram, or 50 kg bags. Street vendors and retailers from the Bukavu city come to source yams from this category. (c) Urban sellers of their own yam production. These are made of farmers geographically close to the city (suburban areas); they cultivate yams and benefit from transport infrastructure that allows them to easily access urban markets where the price is high. (d) Itinerant traders/urban retailers who procure yams either from rural markets or directly from the third category (with waived prices). The selling unit is usually per piece (individual tuber) for this category ([Figure 3c](#)).

The trader's location had no influence on urban yam market characteristics ([Table 2](#)). In contrast to rural areas where yams are traded raw by heap (38.1%), by basin (28.6%), and sometimes by arrangement (selling yams per unit area while still in the field (26.2%)); urban traders mostly trade yams per piece and rarely by heap ([Figure 3](#)). Often cooked yams are traded and conditioned for direct consumption ([Figure 3d](#)). It is noteworthy that cooked yam markets are often close to avocado markets since boiled yam and avocado constitute a popular food recipe in the region. The quantity sold per day is seasonal (59.5%). Customers acquire yams mainly for their taste (66.7%). The income from sales is used mainly to cover the trader's family basic needs such as food provision (42.9%), child education (14.3%), and healthcare expenses (9.5%). Though traders are exclusively women, customers are from both genders (80.9%) regardless of the age categories (64.3%), although elderly men were

slightly dominant clients. These customers purchase yam for food (45.2%) and medicinal purposes (33.3%). We also found that most traders (64.3%) were aware of the medicinal values of yams, particularly as glycemic index regulator of insulin-dependent diabetes (76.2%), a major public health concern in eastern DRC.

Though yam is present at the urban markets all-year round (as the region enjoys a multitude of microclimates), prices followed the law of supply and demand across months of the year ([Table 3](#)). Highest supplies are recorded in March to May with much stable prices (~1.3\$ kg<sup>-1</sup>) while yam is gradually rare from August to January, prompting price increases of up to ~23% towards October.

The main challenges encountered by yam traders in Bukavu city included excessive taxation and harassment (59.5%), the lack of allocated sales outlets (11.9%), scarcity of customers (11.9%), short tuber shelf life (9.5%) as well as uncoordinated markets and high transportation costs. The majority of these traders recommended decision-makers to allocate specific yam sales outlets (76.2%) to prevent itinerant trades and to provide capacity building in adequate yam conditioning and packaging (21.4%).

### 3.2 Commercialized yam byproducts in the Bukavu city

After investigation, it was found that no processed yam byproducts were traded in Bukavu's markets, sales outlets, or supermarkets. As for

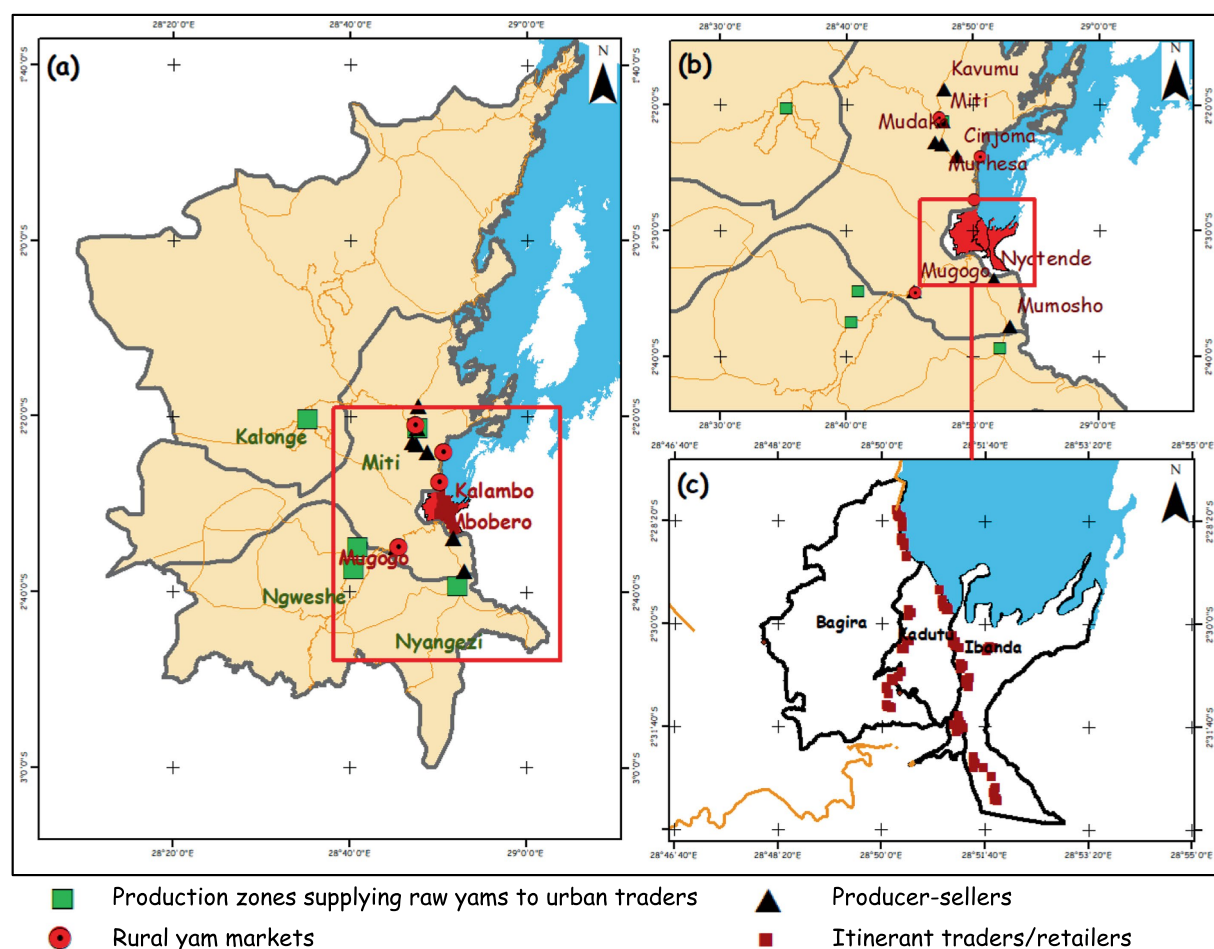


FIGURE 2

Spatial distribution of selling points and supply chains of yam marketed at Bukavu urban markets: (a) main production zones (in green), (b) main rural yam markets, (c) sales outlets in Bukavu.

food companies involved in yam processing, only one was identified, “Société Congo Agro Future” (SCAF). This small-sized enterprise produces locally a therapeutic yam flour for diabetics, the elderly, and those with high blood pressure. This flour is produced from yellow-fleshed *D. dumetorum* yams from Kalonge and Kabare. The selling price was 8 US\$ per kg of processed flour. This company has not yet set up sales outlets for its product, as it solely relies on home deliveries. Major challenges to this enterprise included supply disruptions (due to production seasonality) and high transportation costs of raw material, pain in hand-peeling tubers (sometimes workers injure themselves), lack of energy for drying, and prohibiting high prices of flour due to high processing cost.

### 3.3 Consumer preferences and uses of yam per gender and age categories

Yam consumers included all gender, age, income, education, and ethnic backgrounds from across all urban municipalities (Supplementary Table 2). Both genders agreed on most traits, 94.4% of households consider yam as an integral part of their diets, with taste (47.5%), tuber flesh color (31.7%), and tuber size (29.8%) as the most

important purchasing criteria (Table 4). Men and women differed on the preferred taste; men were inclined towards bitter yams (65.9%) while women preferred slightly sweet yams (55.4%). Women were more demanding in terms of tuber shape as 76.9% of them required cylindrical tuber shape. Both genders preferred large yellow tubers that are mainly consumed boiled (80.9%), with limited value addition (6.3%). Men and women consume yam occasionally (63.7%), at a per capita consumption of 1 to 2 kg a day (63.8%).

Urban households acquire yam from both local urban markets (82%) and villages (45%). They agreed on the fact that yam is expensive (47.3%), rare (45.6%), and/or seasonal (37.8%). However, there is a high willingness to buy more yam (and frequently) in the case by-products are available and the price is more affordable. Contrary to expectations, yam is both consumed by insulin- and non-insulin dependents in Bukavu City (Table 4).

All age categories knew medicinal and nutritional importance of yams (Supplementary Table 3). Nutritional values were most known among young and middle-aged adults (<40 years old) while therapeutic awareness was highest among seniors (>40 years old), prompting high use rate among seniors. Age categories differed in terms of preference criteria; tuber flesh color being critical to young and middle-aged adults, while taste and softness were favored by



FIGURE 3  
Selling units for yam: (a) heap, (b) basin, (c) piece, (d) yam traded ready for consumption.

seniors (>40 years old). In terms of consumption frequency and quantities, seniors consume yam more frequently (Figure 4b, 3–4 times a week) and in higher quantities (Figure 4a, > 6 kg).

Logistic regression analysis showed that yam consumption among urban households is driven mainly by tuber quality (softness and tuber taste) and yam production zone (which is in some extent associated with the variety's tuber quality, Table 5). On the other hand, socioeconomic factors associated with yam consumption included the household location (tightly linked to the income), education level, consideration of yam as an integral part of household diets, and awareness of nutritional values (Table 5). Gender and age group ( $p > 0.05$ ) had no significant influence on yam consumption at the household level.

### 3.4 Yam breeding opportunities: market segments and target product profiles

Based on market surveys, urban households, and farmers' preferences, we have differentiated four priority market segments based mainly on tuber flesh color, production environment, input

level, consumption form, and seed maturity class. These market segments included: (i) late maturing (~8–12 months) purple flesh yam varieties grown (as intercropped under rainfed conditions) in low or medium altitude humid forest and derived Savannah (Fizi and Uvira territories) for direct consumption as boiled; (ii) early maturing (~6–8 months) purple flesh yam varieties grown (as intercropped under rainfed conditions) in low or medium altitude humid forest and derived Savannah (Fizi and Uvira territories) for direct consumption as boiled; (iii) yellow flesh yam varieties grown (as intercropped under rainfed conditions) in medium to high altitudes (Kabare, Walungu, Kalehe, and Idjwi territories) for direct consumption as boiled; (iv) white flesh yam varieties grown (as intercropped under rainfed conditions) in low to medium altitudes (Kalehe, Fizi, and Uvira territories) for processing as flour for fufu or for direct consumption as boiled. Corresponding TPPs for each market segment are detailed in Table 6 and Supplementary Datasheet 1.

Priority traits include tuber yield that should be improved for all market segments; tuber dry matter and tuber size especially for the processing market segment 4; boiled yam quality (with particular attention to tuber taste and softness) is critical regardless of the market segments since boiling yam is the main consumption form in the

TABLE 2 Urban yam market characteristics in Bukavu City.

Variables/Modalities	Municipalities (%)				Khi <sup>2</sup>	p-value
	Bagira	Ibanda	Kadutu	Pooled		
Supplier selling unit						
Agreement	20.0	35.7	22.2	26.2	7.69	0.261 ns
Per basin	60.0	14.3	22.2	28.6		
Per bag	0.0	7.1	11.1	7.1		
Per heap	20.0	42.9	44.4	38.1		
Quantity traded daily						
Depending on market	50.0	57.1	66.7	59.5	7.21	0.514 ns
All the stock	50.0	42.9	33.3	40.5		
Client preferences						
Taste	60.0	50.0	83.3	66.7	13.15	0.106 ns
Taste + Flesh color	10.0	28.6	0.0	11.9		
Taste + Shape	20.0	0.0	5.6	7.1		
Taste + Size	10.0	7.1	0.0	4.8		
Taste + Size + Flesh color	0.0	14.3	11.1	9.5		
Destination of trade income						
Food provision	40.0	42.9	44.4	42.9	2.66	0.953 ns
Child education	10.0	21.4	11.1	14.3		
Healthcare expenses	20.0	7.1	5.6	9.5		
Saving	10.0	7.1	11.1	9.5		
All the above	20.0	21.4	27.8	23.8		
Client gender						
Women only	10.0	7.1	5.6	7.1	3.15	0.532 ns
Men only	20.0	0.0	16.7	11.9		
All (women and men)	70.0	92.9	77.8	80.9		
Age categories of yam customers						
Elderly men	20.0	0.0	16.7	11.9	3.84	0.871 ns
Youth (of all genders)	10.0	7.1	5.6	7.1		
Elderly women	10.0	7.1	5.6	7.1		
Both elderly men and women	10.0	7.1	11.1	9.5		
All age categories	50.0	78.6	61.1	64.3		
Reasons for buying yams						
Food	20.0	71.4	38.9	45.2	9.15	0.165 ns
Therapeutic values	40.0	21.4	38.9	33.3		
Food and therapeutic values	10.0	7.1	11.1	9.5		
No specific reason	30.0	0.0	11.1	11.9		
Trader's awareness of yam therapeutic values						
No	40.0	42.9	27.8	35.7	0.88	0.642 ns
Yes	60.0	57.1	72.2	64.3		
Known yam therapeutic values (n = 42)						
Diabetes	80.0	78.6	72.2	76.2	3.98	0.679 ns
Diabetes and stomach-ache	0.0	7.1	0.0	2.4		
Diabetes and muscular strength	0.0	7.1	11.1	7.1		
Beneficial for prisoners	20.0	7.1	16.7	14.3		

(Continued)



TABLE 2 (Continued)

Variables/Modalities	Municipalities (%)				Khi²	p-value
	Bagira	Ibanda	Kadutu	Pooled		
Challenges in trading yam						
High transportation cost	10.0	0.0	0.0	2.4	13.17	0.214 ns
Lack of clients	20.0	14.3	5.6	11.9		
Lack of sales outlets	20.0	7.1	11.1	11.9		
Uncoordinated market	10.0	7.1	0.0	4.8		
Tuber short shelf life	0.0	0.0	22.2	9.5		
Excessive taxation and hassle	40.0	71.4	61.1	59.5		
Recommendations						
Capacity building in conditioning and packaging	20.0	21.4	22.2	21.4	3.28	0.511 ns
Allocate specific sales outlets to yam traders	70.0	78.6	77.8	76.2		
Institutional support to the value chain	10.0	0.0	0.0	2.4		

ns: not significant ( $p > 0.05$ ).

TABLE 3 Yam supply and price fluctuations across the year in Bukavu city.

Month	Supply	Average monthly price (\$ kg <sup>-1</sup> )	Fluctuation rate (%)
April 2024	++++	1.24 ± 0.06	−6.03
May 2024	++++	1.40 ± 0.08	6.03
June 2024	++	1.23 ± 0.24	−6.86
July 2024	+	1.27 ± 0.38	−3.93
August 2024	+	1.62 ± 0.15	22.94
September 2024	+	1.54 ± 0.05	16.50
October 2024	+	1.63 ± 0.25	23.45
November 2024	+	1.45 ± 0.17	10.00
December 2024	++	1.35 ± 0.08	2.71
January 2025	++	1.47 ± 0.08	11.49
February 2025	++	1.05 ± 0.06	−20.40
March 2025	++	1.36 ± 0.13	3.49

Data were collected bi-weekly from urban markets from April 2024–March 2025. At the time of survey, the exchange rate was 2,800–2,850 Congolese francs for 1\$. + indicates the degree of yam abundance at urban markets. For market price fluctuation rate, we used the arithmetic means of the months (April and May) where yam is most abundant as the benchmark (1.28\$). Due to its popularity and availability all year round, the price was only estimated from the trifoliate yam (*D. dumetorum*).

region; tuber shelf-life is critical for both consumers and producers since the inter-season lasts 3 to 4 months in most production zones; tuber shape and cooking time should particularly be improved for *D. dumetorum* dominating the market segment 3 (Table 6).

## 4 Discussion

### 4.1 Urban market characteristics and potential of yam as means for income security

The yam market in Bukavu city is predominantly informal and operated almost exclusively by middle-aged women with low levels of education. Improving the yam value chain could play a critical

role in empowering women and other disadvantaged groups with limited access to resources. The yam trade is particularly favorable for women because it requires minimal start-up capital and expertise, with skills primarily limited to conditioning (peeling, packaging, etc.) and boiling yams. Moreover, yam represents a valuable business opportunity for these women and their household income security. The region's diverse microclimates enable all year-round yam production, allowing these women to sustainably depend on yam trade for their livelihoods. It is noteworthy that short yam supply in some months is associated with dry (June–August) and planting (September–November) seasons in agroecological zones surrounding Bukavu city. Additionally, supporting the yam value chain is essential due to its high market value in urban areas, where yam prices remain stable and consistently higher than those of other local staple foods (Mondo et al., 2021, 2024b; Mondo, 2024). Such high market value was also reported in Guadeloupe as a kilogram of yam was three to four times more expensive than a kilogram of rice or pasta (Barlagne et al., 2017). This research also highlighted the importance of yam to improving food and income security in South-Kivu as income from yam trade is critical to meeting the trader's family basic needs such as food provision, child education, and healthcare expenses.

Though traders are exclusively women who also predominate its farming in South-Kivu (Mondo et al., 2024b), customers are from both genders regardless of the age categories, although elderly men are slightly dominant clients. Such a trend is explained by the fact that in the Bukavu region, chronic diseases (such as diabetes and high blood pressure) are high among elderly populations (Katchunga et al., 2022) who rely on such food along with other indigenous foods to regulate their glycemic index (Mondo, 2024). In fact, the literature supports local perception of the therapeutic values of yams as 10 studies reviewed by Alharazi et al. (2022) agreed on the beneficial effects of yam consumption or its extracts (containing dioscin, dioscorin, diosgenin, DA-9801/02 or Chinese yam polysaccharides) in improving blood glucose.

Client trait preferences primarily include taste, softness, tuber flesh color, tuber shape, and tuber size, highlighting the significance of tuber quality in attracting customers and increasing market value. These tuber-related traits, particularly tuber taste and softness, are

TABLE 4 Overview on yam consumption trends among urban households in Bukavu city.

Variables/ modalities	Female	Male	Pooled	Khi <sup>2</sup>	p- value
Yam as integral part of diets					
Yes	93.7	95.2	94.4	0.37	0.603 ns
No	6.3	4.8	5.6		
Purchasing criteria <sup>§</sup>					
Taste	47.6	47.3	47.5	0.002	0.961 ns
Origin	7.5	5.9	6.7		
Tuber flesh color	32.6	30.8	31.7		
Tuber shape	3.7	4.1	3.9		
Tuber size	32.6	26.6	29.8		
Tuber softness	3.7	3.6	3.7		
Preferred taste					
Bitter	41.3	65.9	52.9	12.10	0.002***
Slightly sweet	55.4	29.3	43.1		
Sweet	3.3	4.9	4.0		
Preferred tuber shape					
Irregular	2.4	4.3	3.3	10.40	0.043*
Cylindrical	76.9	46.2	61.5		
Others	20.7	49.5	35.2		
Preferred tuber size					
Large	100	66.7	72.4	2.30	0.103 ns
Medium	0.0	33.3	27.6		
Preferred color					
White	0.0	16.1	12.5	2.50	0.292 ns
Yellow	100	77.4	82.5		
Purple	0.0	6.5	5.0		
Consumption mode					
Boiled	82.2	78.0	80.9	11.90	0.024*
Braised soup	2.3	5.1	3.6		
Chips	0.6	3.2	1.8		
Multiple	14.9	13.7	13.7		
Consumption frequency					
Occasionally	66.9	67.7	67.3	3.36	0.340 ns
2–3 times a month	20.6	24.1	22.2		
1–3 times a week	10.9	5.7	8.4		
1–2 times a day	1.7	2.5	2.1		
Direct consumption (no value added)					
No	5.7	7.0	6.3	0.22	0.640 ns
Yes	94.3	93.0	93.7		
Place of supply <sup>§</sup>					
Local market	82.9	81.0	82.0	0.19	0.662 ns
Rural area	41.7	48.7	45.0		

(Continued)

TABLE 4 (Continued)

Variables/ modalities	Female	Male	Pooled	Khi <sup>2</sup>	p- value
Family members consuming yam					
One parent	46.9	58.2	52.3	4.54	0.103 ns
Both parents only	5.1	5.1	5.1		
Whole family	48.0	36.7	42.6		
Perception on price					
Expensive	48.3	46.2	47.3	4.82	0.090 ns
Prohibitingly expensive	18.4	27.8	22.9		
Affordable	33.3	25.9	29.8		
Perception on availability					
Available all year round	19.4	13.3	16.5	2.32	0.314 ns
Rare	44.6	46.8	45.6		
Seasonal	36.0	39.9	37.8		
Willingness to pay if price lowers					
No	21.4	26.1	23.6	1.02	0.313 ns
Yes	78.6	73.9	76.4		
Consumed quantity (kg)					
1–2	62.7	65.0	63.8	3.73	0.292 ns
2–4	25.5	23.4	24.5		
4–6	7.5	3.6	5.7		
>6	4.3	8.0	6.0		
Existence of by-products					
No	90.6	76.4	83.9	9.65	0.002**
Yes	9.4	23.6	16.1		
Willingness to pay by-products					
No	20.7	22.2	21.4	0.10	0.746 ns
Yes	79.3	77.8	78.6		
Health status of the household head					
Non-insulin- dependent	84.3	85.2	84.7	0.05	0.817 ns
Insulin- dependent	15.7	14.8	15.3		

<sup>§</sup>Respondents were allowed multiple choices. ns: not significant ( $p > 0.05$ ); \*: significant ( $p < 0.05$ ); \*\*: highly significant ( $p < 0.01$ ); \*\*\*: very highly significant ( $p < 0.001$ ).

consistently valued in rural South-Kivu, irrespective of gender, age categories, and agro-ecological zones (Mondo et al., 2024b). Supporting our findings, tuber taste was also deemed more important than other criteria during focus group discussions in Guadeloupe (Barlagne et al., 2017). The main challenges to the urban yam market include excessive taxation, the lack of allocated sales outlets, product seasonality, short tuber shelf life, uncoordinated markets, and high transportation costs. These challenges showcase the need to encourage these urban yam traders to form cooperatives or associations to improve their negotiation power and attract institutional support from governmental and non-governmental structures. For instance,

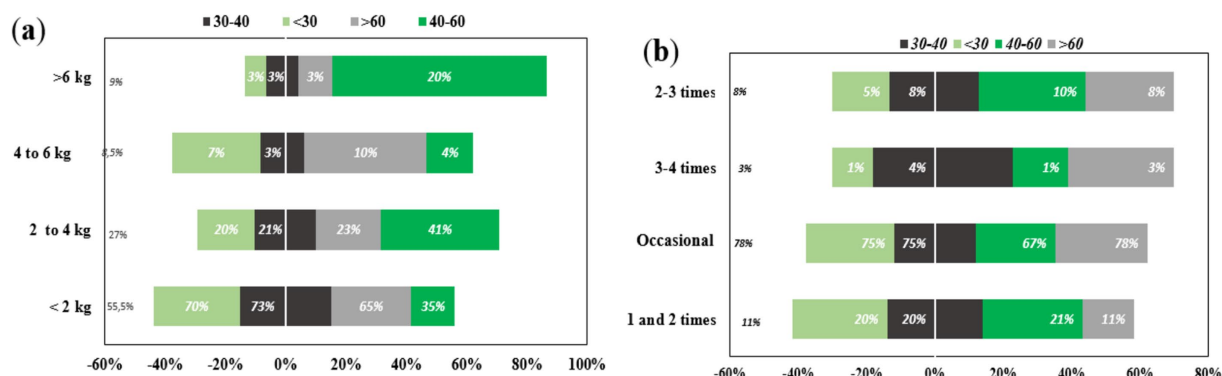


FIGURE 4

Consumption trends among age categories: (a) quantity consumed ( $\chi^2 = 45.43$ ,  $p < 0.001$ ), (b) weekly consumption frequency ( $\chi^2 = 11.34$ ,  $p > 0.05$ ).

TABLE 5 Logistic regression of variables driving yam consumption among urban households.

Variables	B	SE	Wald	Sig.	Exp (B)
Location	-0.576	0.327	3.114	0.078	0.562 <sup>§</sup>
Gender	0.135	0.861	0.025	0.875	1.145
Age	-0.363	0.636	0.326	0.568	0.696
Marital status	0.111	0.885	0.016	0.900	1.118
Education level	-1.494	0.819	3.329	0.068	0.224 <sup>§</sup>
Main economic activity	0.322	0.401	0.644	0.422	1.379
Ethnic background	-0.107	1.047	0.010	0.919	0.899
Household size	0.347	0.588	0.348	0.555	1.415
Yam as integral part of diets	-1.189	0.642	3.428	0.064	0.305 <sup>§</sup>
Awareness of the therapeutic values	1.094	0.713	2.352	0.125	2.987
Awareness of the nutritional values	0.941	0.555	2.869	0.090	2.562 <sup>§</sup>
Tuber softness	2.544	0.857	8.816	0.003	12.736**
Tuber flesh color	0.095	0.636	0.022	0.881	1.100
Tuber taste	1.924	0.748	6.615	0.010	6.849*
Tuber size	1.057	0.693	2.325	0.127	2.878
Tuber shape	-0.774	1.242	0.388	0.533	0.461
Production zone	1.556	0.531	8.587	0.003	4.741**

LR  $\chi^2$  (2) = 111.321. Prob >  $\chi^2$  = 0.000\*\*\*. Pseudo  $R^2$  (Cox and Snell) = 0.390. Observations number = 575. <sup>§</sup> $p < 10\%$  probability thresholds; \*, significant ( $p < 0.05$ ); \*\*, highly significant ( $p < 0.01$ ).

Emma et al. (2023) showed that Ubudu yam stakeholders respond to poor public support by informal networking that facilitates bulk buying, selling, transportation, access funding, information, education, and training from public and non-governmental institutions.

## 4.2 Factors influencing yam consumption across urban households, genders, and age groups

Yam value chain could not be sustainably improved and its potential for wealth creation fully unlocked unless factors hindering

TABLE 6 Target product profiles for priority market segments.

Priority traits	Market segments			
	1	2	3	4
Tuber yield	+++	+++	+++	+++
Sprout establishment	++	++	+	++
Tuber dry matter content	++	++	++	+++
Tuber size	+	+	+	+++
Disease resistance	+	+	+	+
Drought resistance	++	++	+	++
Boiled yam quality	+++	+++	+++	+++
Boiled yam color	+	+	+++	+
Boiled yam texture	++	++	+++	++
Tuber shelf-life	+++	+++	+++	+++
Oxidative browning	+	+	++	++
Tuber shape	+	+	+++	+
Cooking time	+	+	+++	+

Further details on TTPs for each market segment are available at the [Supplementary Datasheet 1](#). + indicates priority level that is defined by either its influence on consumption or the pressing need for improvement.

its perceptions among consumers are known and mitigated. Based on this study's results, yam consumers included all gender, age, income, education, and ethnic backgrounds from across all urban municipalities, meaning that it is an integral part of diets in eastern DRC. Both genders agreed on most traits; taste, softness, tuber flesh color, and tuber size as being the most important purchasing criteria among households. Such predominance of tuber quality traits among consumption criteria is supported by existing literature (Barlagne et al., 2017). Men and women differed on the preferred taste; men were inclined towards bitter yams while women preferred slightly sweet yams. Women were more demanding in terms of tuber shape as the overwhelming majority requires cylindrical tuber shape. Men and women showed high willingness to consume yam more frequently if by-products are available and the price is more affordable, as also reported by Barlagne et al. (2017) in Guadeloupe. This study also elucidated differences in preference criteria among age categories; tuber flesh color being critical to youth and middle-aged adults, while taste and softness are favored by seniors (>40 years old).

Nutritional values are most known and much valued among young and middle-aged adults (<40 years old) while therapeutic awareness is highest among seniors (>40 years old), prompting high use rate among them.

Logistic regression analysis supported tuber quality (softness and tuber taste) and yam production zone (which is in some extent associated with the variety's tuber quality) as the main drivers for yam consumption in Bukavu. As mentioned above, this study was conducted with two separate groups: households and traders. Softness was more relevant to consuming households who are end-users while it was less relevant to traders. On the other hand, socioeconomic factors associated with yam consumption included the household location, education level, consideration of yam as an integral part of household diets, and awareness of nutritional values. This study shows that in addition to supplying varieties with good tuber quality, there is a need for campaigns to raise awareness on yam nutritional and therapeutic values as part of strategies to boost its consumption in eastern DRC. Such awareness campaigns should also address knowledge gaps related to cooking mode and processing (Barlagne et al., 2017). However, such information on yam nutritional and therapeutic values is still missing among scientific literature in DRC, calling for further studies to elucidate nutritional and therapeutic contributions of major yam species in the country.

### 4.3 Breeding opportunities

This study supports previous research on yam in eastern DRC that advocated for breeding as the backbone when it comes to promoting wide yam production and consumption in DRC since low attractiveness of yam, as compared to other crops, is attributed to lack of varieties with farmers and consumers' preferred traits (Adejumobi et al., 2022; Mondo et al., 2024b). This study showed that there are four major yam market segments in South-Kivu but overall priority traits for breeding initiatives are tuber yield, tuber dry matter, tuber size, tuber quality before and after processing (with focus on taste and softness), long tuber shelf-life, tuber shape, and cooking time.

## 5 Conclusion

This study sought to analyze urban yam market characteristics and trait preferences and their implication on market segmentation and target product profiles of ideotype yam varieties. There were no association between urban yam market characteristics and the trader's location, underlining the homogeneity of trading practices across the city. The yam market is predominantly informal and exclusively operated by middle-aged women, highlighting its strong association with women and its significant potential to empower them and enhance their livelihood conditions. The yam value chain is, however, facing multiple challenges such as excessive taxation, lack of coordination, and lack of sales outlets, calling for institutional support to improve traders' access to highest-bidding markets, reduce administrative burdens, and provide them with the capacity building they need to maximize their income and ensure the sustainability of their business activity. However, the yam value chain will not achieve its potential for poverty alleviation and food security if varieties meeting farmers' and end-users' needs, especially in terms of tuber quality, are not developed. Once species are properly identified, the

market share of each individual yam species should be determined to complement current findings. Market shares of individual varieties within species will also be useful for future decision-making.

## Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

## Ethics statement

The study protocol was approved by the Interdisciplinary Centre of Ethical Research (CIRE) of the Université Evangélique en Afrique (UEA), Ref: CNES 036/DPSK/322PP/2023. We obtained consent from all resource-persons, traders, and households prior interviews after ensuring the confidentiality in use of data collected and explaining the study objectives, as approved and directed by the above Institutional Review Board.

## Author contributions

JM: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. GM: Formal analysis, Investigation, Methodology, Writing – review & editing, Writing – original draft. GC: Formal analysis, Writing – review & editing, Writing – original draft. PAG: Methodology, Writing – review & editing, Writing – original draft. VB: Validation, Writing – review & editing, Writing – original draft. PAD: Funding acquisition, Project administration, Writing – review & editing, Writing – original draft. AA: Conceptualization, Funding acquisition, Methodology, Project administration, Writing – original draft, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



## Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

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## Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2025.1553876/full#supplementary-material>

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