

Implication of the Russo-Ukrainian crisis on food security and poverty in Bukavu, eastern Democratic Republic of Congo

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Abstract

This study analyzes the impact of the Russo-Ukrainian crisis on food security and poverty in Bukavu. Despite global instability due to the war in Ukraine, Bukavu suffered from a shortage of gasoline, mainly imported from Kenya, Tanzania and Rwanda. From March 2018 to November 2022, the average price per cubic meter of gasoline rose from 1,299,471 to 2,068,991 FC, affecting transport and the costs of essential products. In addition to the Covid-19 challenges, the Russo-Ukrainian crisis then added to local crises such as the state of siege and the resurgence of the M23 war, isolating Bukavu from its main North Kivu food supply, leading to scarcity and rising food prices. Statistical analyses of 384 households showed acceptable food consumption (score of 47.31), but a significant proportion in food insecurity (19.88% food secure, 6.43% borderline food secure, 4.68% moderately food insecure and 69.10% severely food insecure in relation to the FAO threshold of 2120 Kcal). Factors such as level of education, household size, number of workers, income-generating activities, economic disruption, food stocks and home comfort influenced this situation. The Foster-Gréer-Thorbecke index reveals a high prevalence (83%) of food poverty, with an average gap of 44% and a food poverty severity index of 26.51%.

1. INTRODUCTION

The link between economy and war is a complex one, with both being, in turn, ends and means (Jacques & Liliane, 2004) and states, according to (Porter, 1994), largely find their origins and development in the crucible of war. Two contradictory ideas are linked to the thinking behind the effects of war: the "war revival" idea argues that war can have a positive effect because it reduces the power of extraordinary interests, brings innovation and improves economic efficiency by increasing human capital (Benoit, 1973), and the "war ruins" idea, which sees war as a devastating event with no economic benefit (Kang, 2005). The negative socio-economic consequences of war are undeniable. It has been observed that the growth rate of countries is generally 2.2 percentage points lower during a civil war than in peacetime (UNDP, 2022). It has been estimated that at the end of a civil war lasting typically 7 years, incomes are around 15% lower than they would have been had the war not broken out, implying a 30% rise in the incidence of absolute poverty (World Bank, 2016).

The war in Ukraine triggered by Russia in turn is taking place on geopolitical, strategic and economic levels (Okouada, 2022). This is causing a food, energy and financial crisis that is affecting the world's most vulnerable people, countries and even economies (ILO, 2022). For some African economies subject to Russian and Ukrainian markets, soaring food and energy prices pose a serious threat to food security (Gourdon & Ubeda, 2022). With, of course, trends compromising poverty reduction, undermined by the impact of the COVID-19 pandemic.

In many respects, African countries do not have the same capacity for resilience as the major powers (Machrouh, 2022). Indeed, (Baudoin, 2022) believes that the inflation rate in 2022 should reach 16% in Africa, compared with 7% in developed countries.

Instead, the reality in the Democratic Republic of Congo reveals a complex, multifaceted typology with crisis curves that are multimodal, flat, asymmetrical, but in any case not "Gaussian", (Kalala & Mwine, 2019). In the light of the current economic crisis, which has just been aggravated by the war in Ukraine and could have repercussions on the acute food insecurity into which more than a quarter of the Congolese population is plunged (Mukandila & Mukadi, 2022; Franck, 2022).. These crises are characterized by low income and food deficit, natural or man-made crisis situations for six consecutive years from 2013 to 2018, or for ten years between 2007 and 2016, and place the DRC on the list of countries requiring external food aid, with more than 10% of total official development assistance received in the form of humanitarian aid between 2006 and 2014 (FAO; FIDA; WHO; WFP; UNICEF, 2017) a state of fragility that hinders inclusive growth within the country (IMF, 2022).

On the one hand, the DRC's economic outlook is encouraging despite the Russian-Ukrainian conflict, with GDP growth in 2022-23 reaching 6.4%, driven by mining and the revival of non-extractive activities (ADB, 2022). On the other hand, the country's economy is suffering the aftershocks of the war in Ukraine, which has pushed up the cost of living (IMF, 2022). Despite renewed economic growth, poverty in the DRC is far from being a controlled problem (Mardochée, 2019) poverty is estimated at 72.5% (IMF, 2022). In the face of the RussoUkrainian war, moderate effects on the balance of payments and potentially more pronounced effects on inflation and household welfare are being felt. One of the reasons for this inflation is the DRC's heavy dependence on imports (Kana, 2022). Russia and Ukraine are strategic partners in the trade of goods with the DRC. A number of strategic products are imported from these countries, including wheat, sulphur, rubber-working machinery, fresh, chilled and frozen meat and edible offal. (INS, 2022).

As a result, South Kivu is considered one of the country's poorest provinces, alongside Équateur and Bandundu (An et Wim, 2010). Compared to the national average of 66%, the poverty line is 87%. The reality is more pronounced both in the city of Bukavu (89.7%) and in the interior of the province (84.2%) (Marivoet, De Herdt, & Ulimwengu, 2019). Since the establishment of the state of siege and the resurgence of the M23 war in May 2021 in the far north of the country, the province of South Kivu has found itself isolated and disconnected from its main source of supply of foodstuffs of agricultural origin, notably flour, potatoes, beans, ... food products that originate in North Kivu have become scarce and their prices have risen on the market in Bukavu (South Kivu). Some traders attribute this price hike to the suspension of lake traffic between Goma and Bukavu since the occupation of the provincial capital of North Kivu by the M23 rebellion. REBELS (OCHA, 2012).

Coupled with the challenges posed by the possible disconnection between the city of Bukavu and its rural areas, the effects of the war between Russia and Ukraine herald the possibility of a devastating social crisis. Since March 2022, for example, there has been a shortage of gasoline in the city of Bukavu, whose fuel is imported from Kenya, Tanzania and, above all, Rwanda (Walker, 2022). On the Feu rouge and Nyawera markets, a 50-kilo sack of sugar that cost \$43 a short while ago is trading at \$60 today. A 20-liter can of oil has risen from \$30 to \$45, and a 25-kilo bag of rice from \$18 to \$25. "A loaf of bread that used to cost 1,000 Congolese francs now costs 1,200 FC. The "average commercial border price" (paid on entering the country) has risen from \$762.5 to \$900.7 for a tanker truck. These increases are due, however, to the rise in fuel prices, which has "repercussions on transport and on the price of basic necessities". Because of the war between Russia and Ukraine, two major grain exporting countries, orders placed by traders are not being honored", while some operators are holding back stocks, waiting to see how the world market will evolve. This too is driving up prices" in Bukavu (AFP, 2022).

Numerous studies carried out in the province of South Kivu, and particularly in the city of Bukavu, have revealed that the latter is facing a variety of challenges with growing effects on food security and household poverty. This analysis comes at a time when new areas, once in a precarious situation, are taking on a decisive role. Accordingly, this article sets out to analyze recent trends in food security and poverty (the latter approached from the angle of food poverty) among households in the city of Bukavu in relation to the Russo-Ukrainian crisis, which began in February 2022.

2. METHODOLOGY

2.1. Study area

The study was carried out in the three communes of the city of Bukavu: Kadutu, Ibanda and Bagira. With a surface area of 60 km², Bukavu is the capital of South Kivu province, located between 2°31' south latitude and 28°50' east longitude, in the east of the Democratic Republic of Congo. Its population, currently close to 2000000 inhabitants according to recent statistics from the Bukavu Town Hall, rose from 137885 to 1514282 inhabitants in 1970 and 2020 respectively (Samir & Ahobangeze, 1981; Bisoka, Mudinga, & Herdt, 2021).. Bukavu's economic sector, notably agriculture, livestock breeding, housing and the service sector, is in a state of disrepair. (Faily, 2000) and precarious for several years due to social inequalities and repeated wars in eastern DRC, was exacerbated by the advent of Covid-19 and again by the Russian-Ukrainian crisis.

2.2. Sampling

This article uses stratified random sampling. The reason for this choice is related to the distribution of the Bukavu population in the three communes taken as strata or sub-groups. The relevant information was collected by means of a questionnaire sent to the heads of households in the city of Bukavu. Households were then randomly selected in each stratum, with each household having an equal and known chance of being selected (50%). The following formula was applied:

$$\sqrt{varvec{n}} = \frac{\sqrt{varvec{p}}(1 - \sqrt{varvec{p}}) \sqrt{varvec{t}^2 \sqrt{varvec{d}^2 \sqrt{varvec{\alpha}}}}}{\sqrt{varvec{d}^2}}$$

With: **n** = sample size

t = 1.96; approximate value corresponding to a 95% confidence level and $\alpha = 5\%$.

p = estimated proportion of households = 50%.

d = 0.05 standard value with 5% margin of error.

$$n = \frac{0,5 (1 - 0,5) * 3,84}{0,0025} = 384$$

2.3. Measurement of study variables

1) Dependent variables

Two dependent variables were selected: food consumption score and food poverty.

Food consumption score

The food consumption score is a proxy indicator of household food access and is used to classify households into different groups according to the adequacy of food consumed during the week preceding the surveyors' visit (WFP, 2014).

The following formula was applied to the data collected:

$$\text{Score} = \text{cereal} * \text{xcereal} + \text{legume} * \text{xlegume} + \text{vegetable} * \text{xvegetable} + \text{fruit} * \text{xfruit} + \text{animal} * \text{xanimal} + \text{sugar} * \text{xsugar} + \text{milk} * \text{xmilk} + \text{oil} * \text{xoil}$$

- *a* = Weight assigned to food group
- *x* = Number of days of consumption for each food group (≤ 7 days).

This score provides information on food accessibility and the quality of food consumption. The groups are plotted on a scale from 0 to 112. Thresholds of 28 and 42 were used to determine the three household food consumption classes: food consumption is deemed poor when the score is less than or equal to ($\leq$) 28, it is deemed borderline when the food consumption score is greater than ($>$) 28 and less than or equal to ($\leq$) 42, and it is deemed acceptable when the score is greater than ($>$) 42.

Food poverty

This variable is discrete and binary, taking the value 1 if the household or individual has a daily calorie consumption below the set minimum threshold (2120 kcal) and taking the value 0 if the household has a daily calorie consumption above the set minimum daily threshold.

2) Independent variables

Table 1
Independent variables

N°	Variables	Explanations
1	Age	Number of years head of household has been alive
2	Gender	Distinguishing factor between a man and a woman (Male = 0, Female = 1).
3	Education level	Level of education achieved by head of household (0 = not educated, 1 = primary, 2 = secondary, 3 = university)
4	Household size	Number of people living in the household
5	Household income	Monthly amount received by the household. It takes into account salary, bonus and various other sources.
6	Change in income	Fluctuation and change in household income during the Russian-Ukrainian crisis (down = 0, constant = 1, up = 1)
7	Active household members	Number of active (able-bodied or employed) members of the household during the Russo-Ukrainian crisis
8	Disruption of the head of household's activities	Disruption of the head of household's activities due to the Russian-Ukrainian crisis (business activities, employment).
9	Food stocks in times of crisis	Availability of stocks within households (Yes = 1, No = 0)
10	Share capital	Head of household's ownership of a financial asset (savings) with an MFI during the Russian Ukrainian crisis. (Yes = 1 or No = 0)
11	Land	Extent of land or plots available to the head of household during the crisis period: these may be rented out or used for any other income-generating activity.
12	Furniture	Possession of movable assets that could earn the head of household money in the period of the Russian-Ukrainian crisis. It is coded Yes = 1, if the head of household

This article considers that the following variables could influence the food security and poverty of households in the city of Bukavu during the Russian-Ukrainian crisis: Age, Sex, Level of education, Household size, Household income, Variation in income, Active persons in the household, Disruption of the activities of the head of household, Food stock, Social capital, as well as Land and Furniture owned by the household during this period of crisis.

2.4. Data analysis approach

This article uses descriptive statistics, analysis of variance and a logistic regression model to study variable sensitivity.

The **Foster-Gréer-Thorbecke FGT index** was used to measure the incidence, depth (providing a better view of the poverty situation that is not taken into account in the first index) and severity (also known as Poverty Gap Squared, this measure is often described as indicative of the severity of poverty) of food poverty in the city of Bukavu.

$$\text{Incidence of poverty } P_0 = \frac{1}{n} \sum_{i=1}^n \left(\frac{y_i - z}{z} \right)^0$$

Where z is the food poverty line set in terms of calorie costs (\$1.90 or 2562.5), y_i represents household food expenditure, n is the sample size, q is the proportion of households in food poverty and α is the degree of poverty aversion (is an integer greater than or equal to 0).

Thus:

$$1. \text{ Incidence of poverty } : P_0 = H = \frac{q}{n}$$

$$2. \text{ Poverty Severity Index } : P_1 = \frac{1}{n} \sum_{i=1}^q \left(\frac{y_i - z}{z} \right)^1$$

$$3. \text{ Poverty severity Index } : P_2 = \frac{1}{n} \sum_{i=1}^q \left(\frac{y_i - z}{z} \right)^2$$

3. RESULTS

The results of the study are grouped under 5 headings: profile of households surveyed, source of income and structure of expenditure; nutritional status of households, food consumption score and caloric intake of foods; poverty analysis and FGT index.

3.1. Household profile

Table 2
Sex; age; marital status of the respondent and level of education

Ter	ms and conditions	Three communes in Bukavu			
		Bagira	Ibanda	Kadutu	Total
Gender	<i>Female</i>	65 (16.96)	94 (24.56)	94 (24.56)	254 (66.08)
	<i>Male</i>	34 (11.11)	43 (14.04)	54 (33.92)	130 (33.92)
Age	<i>Mean</i>	38.15909	40.47541	36.72727	38.4539233
	<i>Std.Dev.</i>	8.452172	11.32344	10.56197	10.1125273
	<i>Min</i>	23	21	22	21
	<i>Max</i>	60	60	59	60
Civil status	<i>Single</i>	15(4.1)	36 (9.36)	52 (13.52)	103 (26.8)
	<i>Divorced</i>	7 (1.75)	2 (0.58)	4 (1.17)	14 (3.6)
	<i>Married</i>	72 (18.71)	94 (24.56)	79 (20.47)	245 (63.74)
	<i>Widowed</i>	4 (1.17)	4 (1.17)	14 (3.51)	22 (5.85)
	<i>Total</i>	98 (25.73)	136 (35.67)	149 (38.60)	384 (100)
Level st udy	<i>Uneducated</i>	7 (1.75)	2 (0.58)	14 (3.51)	23 (5.90)
	<i>Primary</i>	22 (5.85)	27 (7.02)	31 (8.19)	81 (21.05)
	<i>Secondary</i>	47 (12.28)	49 (12.87)	49 (12.87)	145 (38.01)
	<i>University/Higher education</i>	22 (5.85)	58 (15.20)	54 (14.04)	135 (35.09)
	<i>Total</i>	99 (25.73)	137 (35.67)	148 (38.60)	384 (100)

As shown in this table, households surveyed in the commune of Kadutu are the most represented in the sample, i.e. 38.60%, the commune of Ibanda 35.67% and the commune of Bagira 25.73%. The average age of the heads of household surveyed is 38, with a maximum age of 60 and a minimum age of 21. There is a wide dispersion in the average ages of the heads of household, with a gap of 10 years. The age ranges vary from commune to commune, with the highest average age for heads of household in Ibanda (40 years). Women were the most represented, at 66.08% versus 33.92% of men; this can be explained by the fact that women are more familiar with the food situation of their households than men. Married people represent more than half of our respondents, i.e. 63.74%. This is because they have important information on the food situation and play a very crucial role in the survival of their households. The majority of respondents have educational qualifications. Many of the men have a higher level of education than the women. Most of them, however, have a secondary school education; and generally speaking, it is the commune of Ibanda that has more qualified respondents than the other communes, given that it is totally urban, while Bagira and Kadutu are often considered semi-urban with a rural connotation. The study considers that the diet could improve with a high level of education on the part of the head of household.

Table 3
Household size and composition

Variables	Bagira		Ibanda		Kadutu		Bukavu	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Household size	6.48	2.95	6.46	2.09	5.89	1.40	6.28	2.15
Number of men	2.98	1.70	3.31	1.27	3.35	1.27	3.21	1.42
Number of women	3.52	1.93	3.19	1.84	2.54	1.13	3.09	1.63
Household composition	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Number of children in less than 5 years	1.18	0.97	1.37	0.80	1.39	0.84	1.31	0.87
Number of children aged 6 to 14	1.27	1.09	1.66	1.08	1.61	0.86	1.51	1.01
Number of people aged 15 and over	3.93	2.92	3.46	1.88	2.89	0.93	3.42	1.91

The average household in Bukavu is made up of 6 people, including 3 girls and 3 boys, 1 child under 5, around 2 children aged 6 to 14 and 3 people over 15. The differences in household size between the 3 communes are not very great. We can see that the majority of the household size is made up of people over 15 years of age rather than any other category of people in the household, which would be an asset for the diversification of income sources within the household.

3.2. Source of income and expenditure structure

Table 4
Source of income

Professional activities of households by commune	Communes			Total
	Bagira	Ibanda	Kadutu	
Agent de l'Etat	2.92	4.68	2.92	10.53
Artisan	1.75	1.75	0.00	3.51
Teacher	5.85	2.34	6.43	14.62
Contractor	1.75	4.09	2.92	8.77
Doctor/Nurse	1.75	2.92	2.34	7.02
Retailer	8.77	19.88	20.47	49.12
Travel retailer	2.92	0.00	3.51	6.43
Total	25.73	35.67	38.60	100.00

This table shows that most households (49.12%) engage in trade as a professional activity.

Other professional activities exercised by households include teaching and entrepreneurship, which are gaining in importance, as are government employees, doctors and nurses. We can see that a household had at least 4 sources of income. As shown in Fig. 1, food accounts for a large share of household income, 53% of the total, and is estimated at 273630FC (\$130). These results show that food expenditure accounted for a significant share of total household's income in Bukavu during the crisis of the Russo-Ukrainian wars.

3.3. Price trends for food products

In the city of Bukavu, despite the change in the exchange rate from 2000 FC to 2500 FC during the Covid-19 pandemic and the war between Russia and Ukraine, there has been a significant increase in prices for various agrifood products. This rise in prices, even with a fluctuating exchange rate, indicates constant pressure on household purchasing power. Logistical challenges and disruptions on global and local markets are likely to have contributed to this trend, highlighting the economic difficulties faced by the people of Bukavu.

Despite the change in the exchange rate from 2000 FC to 2500 FC during the period of Covid-19 and the RussoUkrainian war, strong price growth is observed in Bukavu. This trend is particularly marked for certain products: semolina flour has risen from \$14 to \$30, a growth rate of 116%, while other products such as potatoes have risen from \$0.6 to \$1, a growth rate of 66.7%. The price of bread rose from \$0.5 to \$0.8, an increase of 60%. A third category saw prices rise by 50%, such as a can of oil, which went from \$30 to \$45. These high growth rates underline the significant impact of global events on the local economy, highlighting the additional challenges faced by consumers and households in the city of Bukavu.

3.4. Analysis of food safety and caloric intake

Food consumption is captured here by the food consumption score, which indicates the frequency with which a food or food group is consumed, and the diversity of food consumption. This indicator primarily reflects the accessibility of a food item to an individual or household. This analysis also refers to the Direct Caloric Intake (DCI) approach to food, with the aim of identifying households that are in a situation of food poverty, i.e. households that do not compensate for their daily energy requirements, and those that are not in a situation of food poverty.

Table 5
Share of food groups in food consumption

Food groups	Score Bukavu	% of total score Bukavu
<i>Tubers</i>	7,26	15,35
<i>Cereals</i>	8,87	18,74
<i>Pulses</i>	9,17	19,38
<i>Vegetables</i>	3,30	6,76
<i>Fruits</i>	1,68	3,56
<i>Meats</i>	6.34	13.40
<i>Fish</i>	5.40	11.41
<i>Milk</i>	1,89	4,00
<i>Oil</i>	3,5	7,40
<i>Total</i>	47,31	100

As shown in this table, households in the city of Bukavu have an acceptable food consumption score of 47.31±42. As for the contribution of each food group to the total score, cereals and legumes were commonly consumed in Bukavu with a score of 9.17 and 8.87 respectively, i.e. 19.38% and 18.74%. The

minimum daily calorie consumption threshold chosen was 2120Kcal/day/person. Thus, an individual is considered to be in a situation of food poverty when he or she consumes less than this threshold.

Table 6
Caloric intake of food groups during the crisis

Food	Kcal/day/person in Bukavu
<i>Tuber</i>	700,191
<i>Cereals</i>	2067,1
<i>Pulses</i>	1265,17
<i>Vegetables</i>	136,3
<i>Fruits</i>	414,3
<i>Meats</i>	280,47
<i>Fish</i>	74,78
<i>Milk</i>	15,2

As shown in this table, Bukavu's inhabitants consume less than the minimum threshold set by the FAO. However, cereals followed by pulses and tubers provide Bukavu households with more calories consumed.

Table 7
Household food security and poverty in Bukavu.

Indicator	Food energy deficit
Food safety (1)	19,88%
Food safety limit (2)	6,43%
Moderate food insecurity (3)	4,68%
Severe food insecurity	69,10%

Thus, 19.88% of households are in a food security situation, i.e. they consume more than the minimum threshold recommended by the FAO (2120 Kcal), 6.43% are in a borderline food security situation, 4.68% are in a moderate food insecurity situation, while 69.10% of households are in a severe food insecurity situation. Households in the food security category have a consumption of over 2120Kcal/day/person; those in the borderline food security category have a consumption below 2120kcal but above the country's minimum energy requirement threshold (1750 for the DRC); moderately food-insecure households consume more than 1750 kcal but less than the median between this threshold of 1750 and 20120 kcal; and households in severe food poverty consume less than the national minimum energy requirement threshold of 1750 kcal.

3.5. Food poverty analysis and Foster-Gréer-Thorbecke index

Table 8
Determinants of poverty and food insecurity during the Russo-Ukrainian crisis

Variables	Coefficient	P-value
Constant	3.741826	0.001*
Household income	.2188808	0.209
Age	.0451353	0.113
Gender	.1440812	0.773
Education level	– .5732327	0.026**
Number of people in household	.4704139	0.005*
Number of working persons in the household	– .3217179	0.017**
Main activity	.1218316	0.406
Other income-generating activities	– .0501983	0.090***
Change in income due to crisis	.1582185	0.472
Business disruption due to the crisis	.8354129	0.022**
Food stocks in times of crisis	-1.147466	0.053***
Ownership of share capital	.2526772	0.717
Number of landholdings	.0581377	0.881
Possession of furniture	– .7684067	0.091***
Chi-square		36.12
Prob>chi2		0.0017*

Our analysis with STATA15.1 (***Significant at 10%, **Significant at 5% and * Significant at 1%)

The results of the logistic regression indicate that the level of education, the number of people in the household, the number of active people in the household, other income-generating activities carried out, the variation in income due to the Russian-Ukrainian war crisis, the disruption of activities, the stock of food and the number of items of furniture owned by a household had a significant impact on food poverty during the crisis period.

Analysis of the Foster-Gr  r-Thorbecke index gives an idea of the incidence of food poverty, the depth of food poverty and the severity of food poverty. This index is calculated on the basis of daily household food expenditure, where the threshold recommended by the FAO is \$1.25 per day/person. The results of this index are as follows:

- **Incidence of food poverty** : $P_0 = \frac{q}{N} = \frac{319}{384} * 100 = 83\%$

This ratio indicates that 83% of households in the city of Bukavu are in a situation of food poverty. Of these food-poor households, 19.71% are in the commune of Bagira, 28.87% in the commune of Ibanda and 34.5% in the commune of Kadutu.

- **Depth of food poverty** : $P_1 = \frac{432960}{984000} * 100 = 44\%$

This index shows that the average gap between food poverty in the population and the poverty line is 44%. Differences in food expenditure between households show that 20.5% are in Kadutu, 14.5% in Ibanda commune and 9% in Bagira.

- **Severity of food poverty** : $P_2 = \frac{256684665600}{968256000000} * 100 = 26,51\%$

This index shows that 26.51% of households in the city of Bukavu at this time are in severe food poverty. This indicator focuses on the poorest of the poor. Of the 26.51%, 11.49% are in the commune of Kadutu, 9.02% in the commune of Ibanda and 6% in the commune of Bagira.

4. DISCUSSION and CONCLUSION

The aim of this article was to analyze recent trends in food security and poverty (the latter approached from the angle of food poverty) of households in the city of Bukavu in relation to the Russo-Ukrainian crisis, triggered since February 2022. To this end, information was collected via a survey questionnaire administered to households. Secondary data were collected through a survey of documents related to the theme. The study universe consisted of the 3 communes making up the city of Bukavu: commune of Kadutu, Ibanda and Bagira, with a total sample of 384 households.

In relation to the profile of the households surveyed, the results show that there is a causal relationship (either ***10%, **5% or significant at *1%) between the level of education, the number of people in the household, the number of active people in the household, other income-generating activities carried out, the disruption of household activities, the stock of food and the number of items of furniture owned by a household and household food security/poverty during

the crisis period. A large proportion of the men surveyed had a higher level of education than the women. Here, the level of education of household heads had a very remarkable impact in the adoption of innovations and/or in the transfer of knowledge, technologies with a view to increasing productivity in all sectors of activity and in decision-making on what food to eat in order to ensure their food security on a daily basis (Tingu, 2019). The authors Vwima & al., (2022) also believe that the level of education of the head of household is a parameter that acts on household food security because, it determines the type of employment and improves his income; which allows him to access food and improve food security within the household. Overall, household size may have an impact on diet, in that the larger the household, the more likely it is to develop and/or employ more severe coping strategies (Tingu, op.cit.). In this study, the households surveyed consisted of an average of 6 people. The average size for the province is estimated at 5.9 persons per household (UNDP, 2009). The report by the ministries of (plan & santé, 2007) also indicates 5.9 people per household in urban areas of the DRC, revised in 2016 and 2017.

With regard to the share of food in household income, this study showed that food accounts for a significant proportion of household income, i.e. 53% of the total, and is estimated at 273630FC (130USD). These results are similar to those of (WFP, 2014 and 2020) in South Kivu, which also shows a share of over 50% of food expenditure in total household income. This percentage is lower than the national average estimated at 67% of household spending on food (CFVSA, 2014). Converging trends are more likely to be found in the WAEMU, where the share devoted to the food function in total consumer spending is the highest. It represents 41.0% for the Bamako household; Niger 36.0% and the lowest proportion is observed in Abidjan with around 23.0% of total consumption (Ibrahima, 2010).

The study resulted in an acceptable food consumption score of 47.31-42. These results are confirmed by the EFSA survey (2010) in South Kivu, which also indicates that households in Bukavu generally have acceptable food consumption. According to the IPC survey 68% in Bukavu, 65% of households in Gbadolite, 60% in Zongo and 48% in Goma had acceptable food consumption; during the covid-19 period. This survey shows that these towns were able to rapidly develop coping strategies to survive. (IPC, 2020). However, this study found that cereals and pulses are the most consumed in Bukavu, with scores of 9.17 and 8.87 respectively, i.e. 19.38% and 18.74% of the total consumption score. The CFVSA survey reveals a similar situation in households living in Kasai Oriental and Bas-Congo, with a diet made up of cereals (36% and 32% respectively), but the smallest share devoted to tubers (9% and 8% respectively) compared with North Kivu, where expenditure on tubers represents 29%, with a relatively small share of expenditure on cereals. Our results are, however, close to the reality at national level, where cereals and tubers account for 23% and 18% of household consumption (CFVSA, 2014).

Compared to trends observed in the survey (EFSA, 2020) according to which, overall, 67.2% of households in South Kivu province, representing some 5.4 million people, are food insecure, with 33.7% of this population facing severe food insecurity and 33.5% moderate food insecurity, the results obtained tend to show an upward trend in food insecurity, which conversely reflects a decline in household food security. This study shows that in the city of Bukavu, 19.88% of households are food secure, 6.43% are borderline food secure, 4.68% are moderately food insecure, while 69.10% of households are severely food insecure.

Conclusions drawn from a spatial analysis of the distribution of poverty in the DRC show, however, that all regions of the country are affected by this phenomenon. The North-West region (Equateur) and the East region (Bandundu) have reached high poverty rates of over 90% of the population. The country's other provinces are not spared by this phenomenon. Four other provinces: Sud Kivu, Katanga, Bas-Congo and Province Orientale have poverty rates in excess of 70%. In South Kivu and the city of Bukavu in particular, this study shows a food poverty index (P_0) of 83%; P_1 of 44% and P_2 of 26.51%. The poorest households are more likely to be found in the commune of Kadutu (34.5%) than in the commune of Bagira (28.87% and 19.71% respectively).

This being the case, it is recommended to promote sustainable agriculture by providing support to local farmers, including training, quality seeds, and access to markets, encourage crop diversification to ensure food resilience in times of crisis, improve infrastructure, notably agricultural feeder roads to facilitate the interconnection of the city with its rural environments, work in collaboration with international organizations, NGOs and local players to coordinate efforts and maximize the impact of anti-poverty programs, and finally set up a continuous monitoring and evaluation system to measure the effectiveness of programs put in place and adjust interventions in line with changing needs.

Declarations

Contributions of the authors

Conceptualization, data collection and analysis, and writing: Aksanti Ntasma Hefsiba, Mwamuzi Matenga Raphael, Aganze Marhegane Benjamin, Asifiwe Kadorho Rodrigue, Akonkwa Ndagano Eliane, Bisimwa Basengere Espoir.

Clinical trial number

Not applicable.

Ethical approval and consent to participate

Approval and authorization to conduct this research were obtained from the Center for Studies and Research for Rural Promotion (CERPRU/ISDR Bukavu). Ethical protocols were strictly adhered to throughout this research. All the moral and cultural norms of the community were respected. The data were used solely for research purposes.

Consent to participate

All participants gave their informed consent, ensuring that they understood the purpose of the study and their rights. The confidentiality and anonymity of the participants were preserved.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Consent to publish

We confirm that informed consent (both Consent to Participate and Consent to Publish) was obtained from all participants involved in this research. In accordance with the inclusion criteria defined for this study, all participants were aged 18 years or older at the time of the survey. Consequently, consent from a parent or legal guardian was not required, as each informant and author possessed the full legal capacity to provide autonomous consent.

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Author Contribution

Conceptualization, data collection and analysis, and writing: Aksanti Ntasia Hefsiba, Mwamuzi Matenga Raphael, Aganze Marhegane Benjamin, Asifiwe Kadorho Rodrigue, Akonkwa Ndagano Eliane, Bisimwa Basengere Espoir.

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Data Availability

The data supporting the results of this study are available upon reasonable request from the authors, which I hope will satisfy the expectations and requirements of the journal.

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Footnotes

1. *We recall that the DRC has been torn apart for almost 20 years by a conflict that has caused suffering to millions of men, women and children (Amnystie internationale, 2012). With more than 120 armed groups continuing to affect the living conditions of populations in certain parts of the country, mainly in Ituri, North and South Kivu, Maniema and Tanganyika province, as well as the extreme poverty of the population (Matondo, 2022).*
2. *We invite you to read Célestin Bucekuderhwa and Sylvain Mapatano, "Comprendre la dynamique de la vulnérabilité à l'insécurité alimentaire au Sud-Kivu", Vertigo - la revue électronique en sciences de l'environnement, 2013; An Ansoms and Wim Marivoet, profil socio-économique du Sud-Kivu et futures pistes de recherche, l'Afrique des grands lacs. Yearbook 2009–2010; Wilondja, B, Dépendance alimentaire de la population du Sud-Kivu face aux marchés étrangers, 2022*
3. *Direct Calorie Intake*

Figures

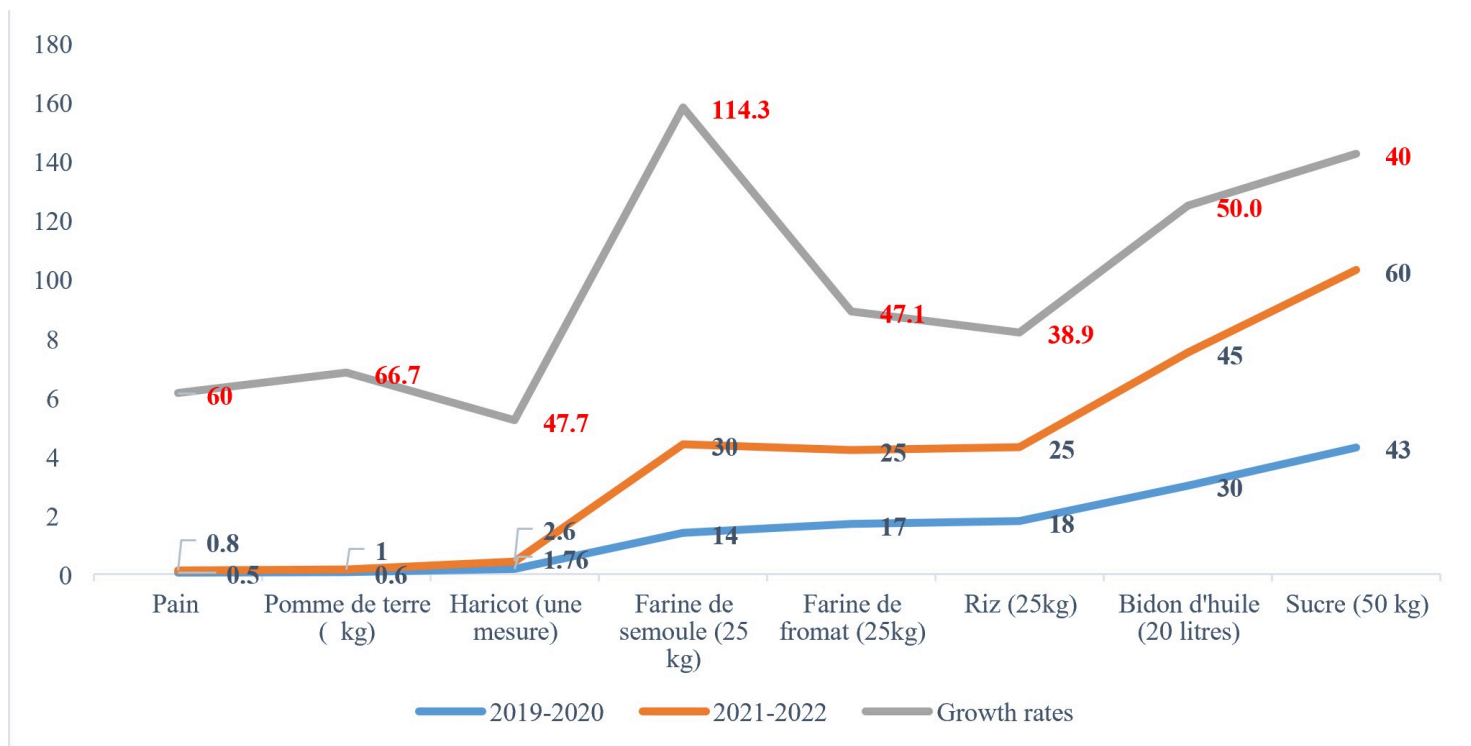


Figure 1

Source: Authors' conception