

Monitoring the impact of recent price volatility on food group consumption in Rwanda

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This research uses high-frequency food price data from more than 60 Rwandan markets integrated with bi-weekly dietary consumption data collected during two periods in 2021/22 and 2023/24. During these periods considerable price fluctuations were observed, providing a unique opportunity to track consumption responses to large price instability created by global shocks.

- Price data from MINAGRI's eSoko platform, captured significant volatility across food groups, including staples like foods made from grains, pulses, as well as other foods like beef, goat, offal and sheep, coinciding with global instability created by Russia's invasion of Ukraine. Pulses and beef have maintained higher relative prices while whole grains and food made from grains have tempered in late 2024.
- Consumption rates of staple food groups such as whole grains, remained steady, despite price increases, while consumption of foods made from grains and pulses were found to increase with price rises. Conversely, beef, green leafy vegetable, and fruit consumption dropped significantly with rising prices, underscoring their price sensitivity.
- Cross-price substitution analysis reveals that when prices of animal source foods increase, Rwandans shift to consuming relatively cheaper staples like foods made from grains and pulses, highlighting dietary substitution patterns.
- Strategies to better identify own and cross-price substitution effects could be used to promote healthier diets and improve nutritional security and aid in the development of enhanced food systems policy focus.
- Policy implications stress the importance of combining high-frequency price monitoring with consumption data to inform strategies that enhance affordability and access to nutritious foods amidst economic shocks.

This research combines two datasets to better understand prices and consumption responses. On the price side, a detailed food price dataset of over 60 markets is aggregated to monthly price averages of food groups at the district level. On the consumption side, a diet quality questionnaire was employed on a large respondent scale to capture current consumption patterns.

The Diet Quality Questionnaire (DQQ – www.dietquality.org) is a 24-hour recall survey that captures consumption information from 26 food groups, by asking respondents to answer “yes” or “no” to

whether they consumed any food items within each food group, during the past 24 hours. While part of a global initiative for international comparisons, the DQQ food groups are adapted for each country through discussions with local experts. Beyond food group responses, respondents also provide basic socio-demographic (e.g. age, sex) and location (e.g. district) information. The DQQ has been crowdsourced fortnightly across Rwanda, via mobile phones. These data were collected between mid-2021 to mid-2022 and mid-2023 to mid-2024, collecting ~115,000 responses. We aggregated DQQ question level responses to monthly- district level, representing the proportion of respondents in each district who consumed each food group, in each month (August 2021- August 2022; August 2023- May 2024).

Price data were collected from MINAGRI's eSoko (www.esoko.gov.rw) data collection platform, which collates daily prices as an average of wholesale, retail, and farm gate prices, recorded in Rwandan Francs (RWF) per kilo or liter. We coded all products collected via eSoko to respective DQQ food groups. Using this grouping, we then calculated the average price per kilogram/liter of all products within each DQQ group. We were able to aggregate food prices of items into 17 groups that align with DQQ question groups. These prices were aggregated to monthly averages, generating time series data between April 2019 to May 2024. For brevity and policy emphasis, we focus our analysis on six principal groups from the DQQ: foods made from grains (kawunga, rice, chapati, bread, or macaroni); whole grains (sosoma, sorghum porridge, millet porridge, or maize on the cob); pulses (beans, soybeans, peas, or lentils); specific meats, we refer to as beef (beef, goat, offal, or sheep), green leafy vegetables (green amaranth, sukuma wiki, cassava leaves, and spinach), and vitamin a rich fruits (mango, papaya, tamarillo, and passion fruit).

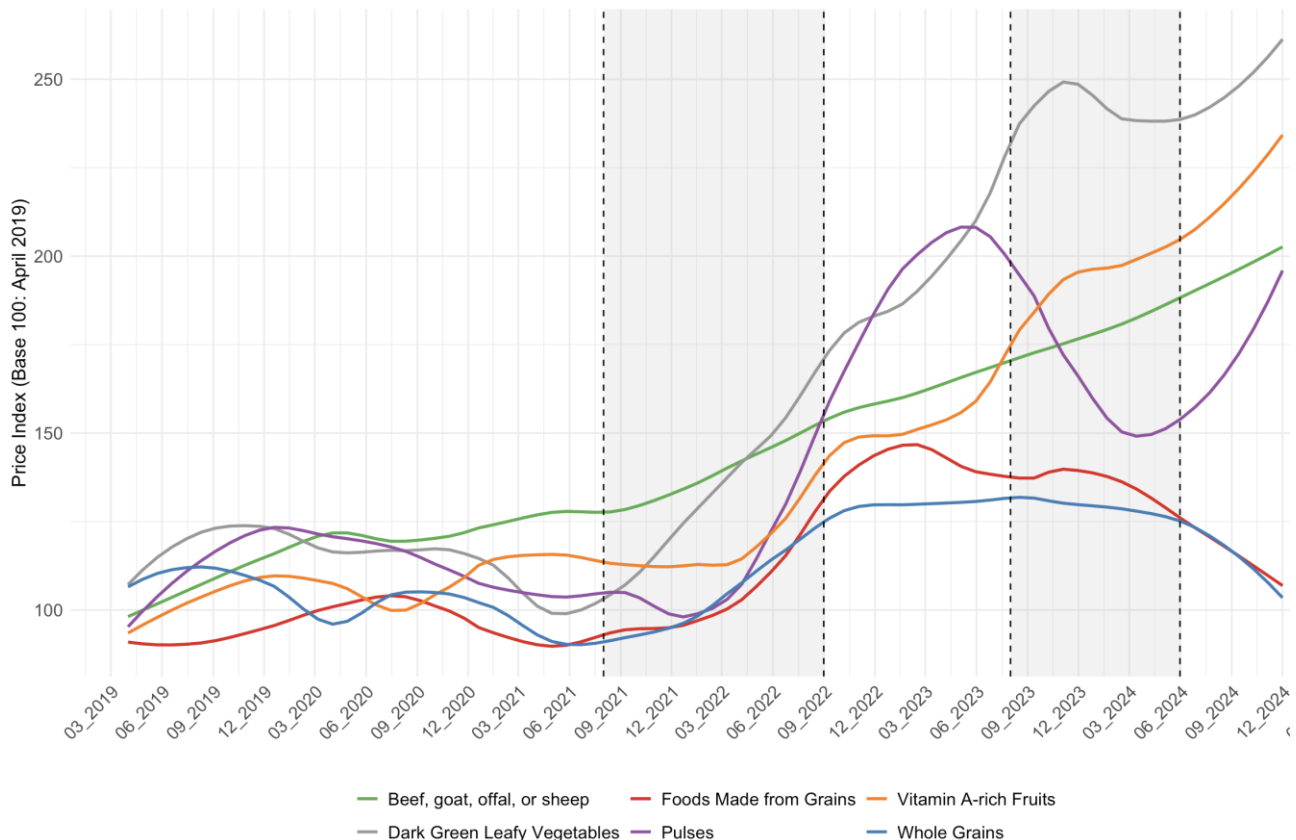
For this research, we aligned temporal (monthly) eSoko price data with the consumption data to measure correlations between the two. The purpose is to better identify how Rwandans respond to price fluctuations in their food consumption patterns via aggregate food groups, assessed by the proportion of respondents who consumed each selected food group. Important for our analysis is that Rwanda experienced significant price volatility for most major food items and subsequently, food groups. For purposes here, we use price trend analysis (Fig. 1), comparative analysis of prices and consumption (Fig. 2), and cross-price substitutions to better understand how Rwandans' consumption responds to price fluctuations (Fig. 3).

Graph 1 depicts six selected nominal food group eSoko price indexes between April 2019 and December 2024, with the shaded grey areas depicting when consumption data were collected. The categorical price data are smoothed and indexed, to better identify relative trends, with an initial indexed value of 100 for all food groups beginning in April 2019. Up until February 2022, relative price stability was observed for the food groups, but sharp aggregate price increases coincide with the escalation of the Russian invasion of Ukraine and resultant global price shocks. Prices accelerate rapidly for foods made from grains and whole grains, but even more so for pulses which do not peak for over a year, essentially doubling in nominal price by May 2023. The trend was more pronounced for dark green leafy vegetables, whose prices continued to increase to December 2023 at 150% of prices in April 2019.

Food made from grains and whole grains prices peaked six months earlier, at about 30% and 50% increases, respectively. Prices of the grain groups were flat or declined somewhat by mid-2023 into 2024. However, the meat food group maintains steady increases, and almost doubles in price over the entire study period (2019-2024), with fruits and vegetables showing similar long-term patterns. The graph shows that even though all prices rose in response to global shocks, pulses, meats, leafy vegetables, and fruits remain relatively higher in late 2024, roughly double the prices of April 2019. Therefore, while all prices were increasing during 2023, some were increasing more rapidly than others, and the beef, vegetable, and fruit categories did not cycle downward. In the context of

consumption responses, both absolute and relative price increases are important. Using individual category price and consumption variables, we explore own market price correlations in Figure 2 for our selected variables of interest, and Figure 3 depicts the interrelationships between our selected groups and all categories more generally.

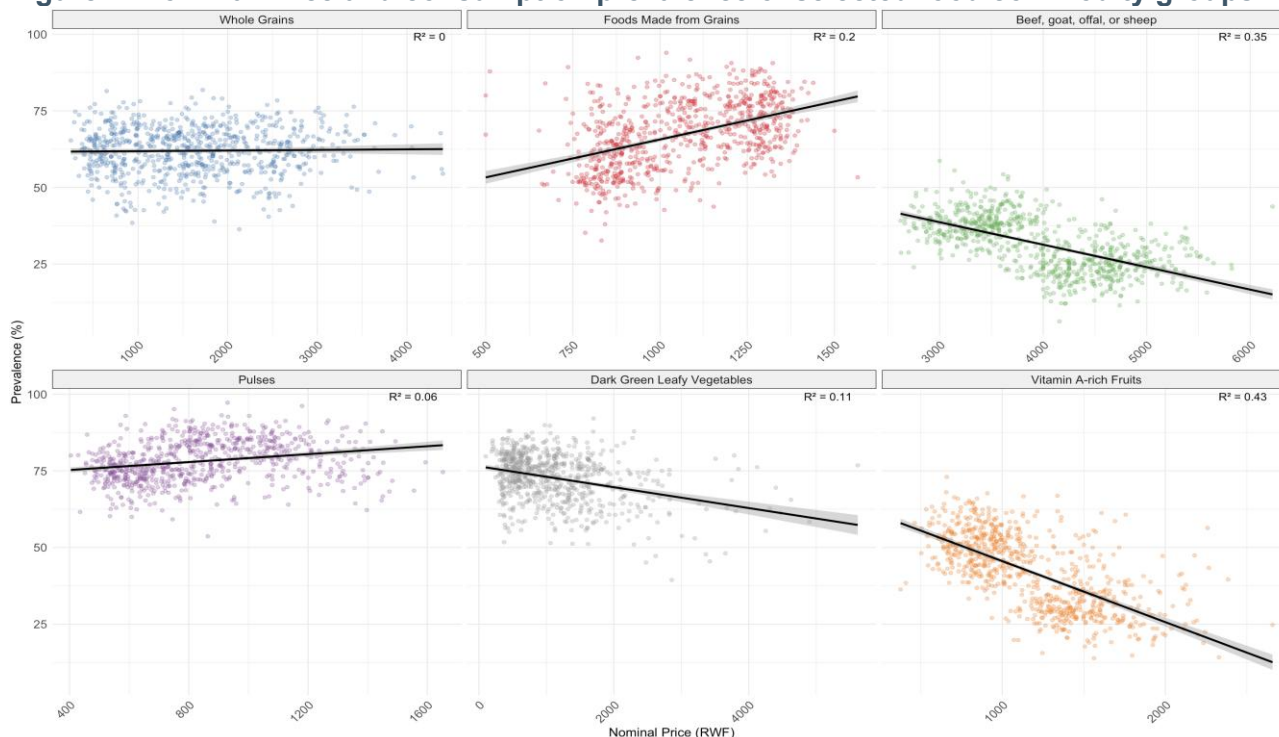
Figure 1. Price Indices for selected groups (2019-2024)



Authors' calculations

Figure 2 depicts each of the six food group categories in Figure 1 by graphing the relative percentage of respondents consuming the category by nominal prices (per Kg of the category). Typical responses are found in the beef category (bottom, right) where higher prices reduce relative consumption. More specifically, consumption in the beef category drops by half, from 50% to 25%, when prices basically double, suggesting price sensitivity and consumers shifting to alternative food groups. Almost identical responses are seen for fruits, with leafy vegetable consumption being marginally less sensitive to prices. However, the other three categories are not as price sensitive given that they focus more on commonly consumed “core diet” categories for typical Rwandans. Prices are less sensitive because these categories are considered more essential to local diets. Whole grains are consumed by about 60% of respondents and are price insensitive, suggesting that they are an important food staple for consumption. Pulses and foods made from grains experience greater consumption, even as prices continued to rise, contrary to the other food groups. We follow up these insights with basic cross-price analysis to better understand how consumers respond (via consumption) to price change across food groups.

Figure 2. Nominal Price and consumption prevalence of selected food commodity groups



Authors' calculations

The plot below maps out cross-price elasticities of the 17 different food categories to better understand how consumers choose between food categories based on relative prices. The heat map (Figure 3) depicts how an increase in the aggregate price of a food group (along the horizontal axis) affects consumption of food categories portrayed along the vertical axis. Shaded brown areas depict the relative intensity of reduced consumption caused by a one percent increase in price. This response suggests that the goods are compliments as consumers reduce consumption with the increased price of the other food group. Conversely, the green segments suggest that an increase in price of food group X creates greater consumption of the food group Y, which is commonly referred to as a substitute food category. For example, if the price of beef (goat, offal, or sheep) category increases (first column along the horizontal axis) there is a relatively strong decrease in egg demand, suggesting that the food groups are compliments. However, the same increase in beef prices causes an increase in the consumption of foods made from grains category, signifying the two groups are substitutes. Overall, Figure 3 provides several insights that are important for understanding consumption responses to price changes and are relatively consistent with other countries of similar levels of economic development.

Cross price substitution analysis indicates a general pattern of increased consumption of staple foods in the context of price increases. More specifically, we observed no intra-substitution patterns within most categories of animal sourced food (ASF) items, with a slightly less negative impact with the fish category. Other food groups like vitamin A rich foods and citrus fruits had consistently negative consumption responses. On the other hand, substituting towards pulses, and foods made from grains, and to a lesser extent, whole grains and roots and tubers indicate a probable contraction of dietary diversity in the studied food inflationary environment. Preliminary analysis of the full datasets suggests diet quality reduces as prices increase (research forthcoming). While additional research is needed, these responses seem expected and consistent with other countries' experiences. These surveyed responses outline dietary consumption responses in the face of significant food inflation caused by international price shocks and are consistent with a variety of research on economic shocks and consumer responses.

Consumption shifts and likely consolidation around specific food groups, suggest clear nutritional implications, where, in the face of rising prices and deteriorating real purchasing power, consumers are moving to their traditional, and relatively more affordable, options. An exception might be the growing importance of rice in the processed whole grains category. Additional research is warranted, but rice demand appears to be rising rapidly in Rwanda and it may be, at least in part, due to higher prices in the pulses category.

Figure 3. Cross Price substitution by major food group



Authors' calculations

Conclusions and Recommendations

In response to recent global economic instabilities, particularly the Russian Ukrainian conflict, this research investigates Rwandan dietary responses to significant food price inflation and volatility. Utilizing comprehensive datasets, encompassing high-frequency price information from over 60 national markets and monthly dietary data from the Diet Quality Questionnaire, the research tracks changes in consumption patterns between 2021/2024. These data reveal important contrasts in price sensitivity among food groups.

In the food staple categories, such as whole grains and pulses, consumers maintain consistent consumption levels despite price increases, demonstrating their critical role in the Rwandan diet. Based on this data, and other recent analysis, we believe that rice is becoming a more important component of the typical Rwandan diet. In contrast, consumption of animal source foods, such as beef and related products, fruits, and vegetables decline with price hikes, underscoring their price sensitivity and consumer shift toward relatively more affordable categories like whole or processed foods from grains and pulses.

The cross-price substitution analysis highlights further complexities in dietary adaptation, with notable shifts in consumer behavior towards relatively less expensive, staple substitutes when faced with rising prices across food groups. This trend reflects a broader finding from the datasets, where periods of instability/hardship lead consumers to prioritize affordability over diversity, ultimately affecting diet quality.

There is a critical need for integrated price monitoring and consumption data systems to better inform strategies to enhance food security and accessibility. These findings underscore the importance of tailored policies to support nutritional security, such as promoting healthier diets and improving food systems resilience, this is particularly crucial in navigating the challenges of volatile global market dynamics.

Finally, these findings reinforce the benefits of the Government of Rwanda's commitment to high-frequency collection of price data. However, it also demonstrates the unique benefits of simultaneous demand/consumption data to generate nuanced insights. This highlights, once again, the need for greater policy focus on the affordability of healthy diets and the need to increase the overall purchasing power of consumers through broad and inclusive economic transformation.

We suggest the following policy implications:

- **Enhance Price Monitoring Systems:** Strengthen high-frequency price monitoring system to capture real-time data across prices and markets. This can help policymakers respond quickly to price fluctuations and identify trends.
- **Track food consumption trends:** As we hypothesize with rice in the food made from grains category, detailed analysis of production, imports, exports and local consumption patterns could be used to better triangulate how Rwandan consumption is changing over time. This is particularly relevant for age, gender and rural/urban categories.
- **Diversify food supply chains:** Encourage the diversification of food supply chains to minimize the impacts of price volatility. This could include supporting alternative sourcing strategies and improving food systems infrastructure and transportation.
- **Market dynamics and price integration of various food groups:** Review how different markets interact and local consumers' ability to access healthy diets.

Better understanding of price sensitivity and cross-price substitution: Support further research on consumer behavior and price responsiveness to refine understanding of dietary responses to price changes, which can inform targeted policy solutions.

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