Quantitative Assessment of the Affordability of Target Foods in Ethiopia, Kenya, Mozambique and Nigeria

Final Project Report

Rachel Gilberta, Leah Costlowa, William Mastersa, Flaminia Ortenzib, Wendy b Gonzalez, Ty Bealc

a Friedman School, Tufts University, Boston, USA

b Global Alliance for Improved Nutrition, Geneva, Switzerland

c Global Alliance for Improved Nutrition, Washington DC, USA

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# Executive Summary

## Glossary

**Affordability of a Healthy Diet:** Affordability of a healthy diet refers to a suite of possible methods to determine whether the least-cost healthy diet (Cost of a Healthy Diet) can be purchased without causing financial strain or hardship. Affordability is measured by comparing the CoHD to the income available for food.

**Bottom of Pyramid consumers**: Consumers living in households spending between $2.15 and $3.65 per person per day in 2017 international dollars.

**Consumption aggregate**: the total monetary value of goods and services consumed or purchased by a specific household over a specified period. It is a key indicator used to assess a household's standard of living and economic well-being.

**Cost of a Healthy Diet (CoHD):** The least expensive combination of available foods that would meet food-based dietary guidelines.

**Extreme poor:** Consumers living in households spending less than $2.15 per person per day in 2017 international dollars.

**Non-poor:** Consumers living in households spending more than $3.65 per person per day in 2017 international dollars.

# Background and Motivation

Determining whether healthy diets are affordable has become central to global nutrition research, policy, and programming. Increased attention to the relationship between affordability and accessibility of healthy diets has led to substantial advances in frameworks for measuring the cost and affordability of healthy diets in recent years. A leading example is the Cost and Affordability of a Healthy Diet (CoAHD) metric, which has been adopted by the United Nations as a food security metric and underlies the Food and Agriculture Organization (FAO) finding that more than 3 billion people around the world cannot afford to buy even the least-expensive combination of foods that meets guidelines for a healthy diet (FAO, 2023). When high-quality retail price data are available, least-cost diet calculations such as CoAHD facilitate monitoring access to healthy diets. However, there is room for increased nutrition sensitivity within methods like CoAHD, which are based on analyses at the food group level without directly accounting for differences in the nutrient profiles of foods within the same food group. This report presents a new variation on the CoAHD approach that allows for cost and affordability comparisons between baseline least-cost diets and those that require the inclusion of specific nutrient-rich foods, even where they are not the least-expensive option, using retail price and consumer expenditure data. We present results from analyses in four case study countries where GAIN seeks to increase the consumption of target foods: Ethiopia, Kenya, Mozambique, and Nigeria.

Recent research on the affordability of nutritious foods has focused on identifying foods of critical importance to vulnerable populations, such as nutrient-dense foods for use in complementary infant feeding (Ortenzi & Beal, 2021). Related work has estimated the affordability of nutritious complementary foods relative to household food expenditure, with a focus on identifying the most affordable food sources of essential vitamins and minerals (Ryckman, Beal, Nordhagen, Chimanya, et al., 2021; Ryckman, Beal, Nordhagen, Murira, et al., 2021; Ryckman et al., 2022). Other key research includes a recent article reviewing definitions, data requirements, and assessment methods underlying affordability (Djimeu et al., 2022), as well as informative reports detailing the value chain dynamics for targeted foods in each of the proposed case study countries (Farrell, 2021; LaRose et al., 2020; Minten et al., 2020). These recent works have identified affordable foods best suited for meeting nutrient needs in various countries, focusing on the youngest consumers.

GAIN teams working in case study countries have synthesized evidence from supply chain analyses, agricultural and consumer surveys, and other data sources to identify foods with a high potential to address localized nutrient shortfalls in the general population or among vulnerable groups (Table 1). In Ethiopia, GAIN has identified dairy foods, including liquid milk and yogurt, as foods with significant potential to improve dietary intake of nutrients such as calcium and vitamins A and B12 (Farrell, 2021). Supply and value chain constraints pose challenges to efforts to increase consumption, as dairy products are not always available and may be unaffordable in some regions and times of the year. Eggs may be a powerful tool for reducing child malnutrition in Nigeria, as they provide a concentrated source of energy, protein, and multiple micronutrients (LaRose et al., 2020). Previous research suggests that eggs are readily available and affordable in certain GAIN focus regions of Nigeria (e.g., Kaduna State), though not everywhere and not for all consumers (Blum et al., 2023; Morris et al., 2018). In addition, eggs are not typically fed to children, partially because of existing myths or taboos. In Kenya, vegetable intake has remained well below WHO recommendations despite more than a decade of substantial economic growth (Nicholson & Monterrosa, 2021). Barriers to increasing demand for vegetables include availability, affordability, and low social desirability. Finally, in Mozambique, dried fish and chicken pieces are the most widely available sources of animal protein that are also dense in key micronutrients such as iron and vitamin A (Ryckman, Beal, Nordhagen, Chimanya, et al., 2021).

Table 1. Target foods in each country.

|  |  |  |
| --- | --- | --- |
| Country | Target Food | Target Nutrients |
| Ethiopia | Dairy | Protein |
| Calcium |
| Vitamin A |
| Zinc  Vitamin B12 |
| Nigeria | Eggs | Energy |
| Protein |
| Multiple micronutrients |
| Kenya | Vegetables | Multiple micronutrients |
| Mozambique | Dried Fish | Protein |
| Iron |
| Vitamin A |
| Chicken Pieces | Calcium  Vitamin B12 |

Across all four countries, low baseline consumption of these target foods is likely due to a combination of challenges, including relative unaffordability. The analyses in this report provide insight into the extent to which these foods are out of reach for consumers at the bottom of the pyramid (BoP) in each country. These results suggest challenges and trade-offs in efforts to promote consumption of these foods, which may inform policy and program implementation in these countries. This report also describes an Excel-based user tool that may be adapted for similar comparisons in other countries and with other target foods.

# Methods

This analysis uses retail food price data, measured in local currency units (LCU) per unit of each item observed at various places and times, to estimate the total cost per day of the combination of least-cost items available that would be needed for a healthy diet. Healthy diets are defined by food-based dietary guidelines (FBDGs), which are explicitly designed to guide consumers in selecting nutrient-adequate diets in a behaviorally realistic way, and consistently recommend eating a diet that is diverse both within and across food groups. We analyze the relative cost of target foods by comparing the cost of including the target foods in a least-cost diet to the cost of including substitute foods (e.g., foods within the same food group) that would otherwise be selected as a least-cost item. This approach allows us to assess the accessibility of target foods relative to least-cost substitutes within food groups and in relation to the overall diet, and to maintain broader healthy diet principles in a strategy that promotes the consumption of specific nutrient-rich foods.

To measure the affordability of target foods, we combine cost calculations with consumption expenditure aggregates from household surveys, using food expenditure shares of bottom-of-the-pyramid consumers to develop a household’s available food budget as the standard for affordability.

## Cost and Affordability of a Healthy Diet

Least-cost diets are the most affordable combination of foods that meet the criteria for a healthy diet, calculated at each time and place as a measure of food system performance in making healthy diets accessible (Herforth et al., 2020). The Cost of a Healthy Diet (CoHD) is defined as the lowest-cost set of items available at each time and place that meet requirements for each food group specified in food-based dietary guidelines (FBDGs) or some other quantitative dietary standard. Quantitative dietary standards that facilitate costing specify the expected number and size of servings from each recommended food group. Such standards are designed to provide sufficient diversity and quantity within and across food groups, and to achieve nutrient adequacy while protecting against diet-related diseases. This report uses the Healthy Diet Basket (HDB), which represents broad commonalities across quantitative FBDGs from around the world (Herforth et al., 2022). The HDB framework (Table 2) was designed as a global standard for calculating and comparing the cost and affordability of healthy diets across countries and as such is better suited for this analysis than any single national FBDG.

Table 2. Healthy Diet Basket composition.

|  |  |  |  |
| --- | --- | --- | --- |
| Food Group | Number of food items selected | Total energy content (kcal) | Typical weights of example foods (g) |
| Starchy staples | 2 | 1160 | 322 g dry rice |
| Vegetables | 3 | 110 | 270-400 g |
| Fruits | 2 | 160 | 230-300 g |
| Animal-source foods | 2 | 300 | 210 g egg |
| Legumes, nuts, seeds | 1 | 300 | 85 g dry bean |
| Oils and fats | 1 | 300 | 34 g oil |
| Total | 11 | 2330 |  |
| Source: Herforth et al., 2022. | | | |

As shown in Table 2, a basket of foods meeting HDB criteria in each time and place is composed of eleven locally available items in sufficient quantities to maintain energy balance at 2,330 kcal across six food groups. This reflects the energy needs of an active, healthy adult woman and is similar to the average energy requirement for all sex-age-year groups aged three years and older (Herforth et al., 2022; Schneider & Herforth, 2020). Substitution between items within energy balance allows for variation in the volume and water weight of items in each food group while maintaining a balanced diet in terms of diversity within and between food groups.

## Cost of a Healthy Diet

The general steps to calculate the Cost of a Healthy Diet are summarized in Figure 1:

Figure 1. Method for calculating the Cost of a Healthy Diet.

A chart of a variety of items

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We first convert retail food prices from price per unit (e.g., liter, bunch) to price per kilogram. This requires detailed information on conversions for local or non-standard units. We then match each food item in the food price list with food composition data, for information on energy density (kcal per 100 grams of edible matter) and edible fraction, and assign each food a food group based on those outlined in the Healthy Diet Basket. We convert price per kg to price per kcal, which allows us to calculate the cost per day to meet food group calorie targets, accounting for the number of food items recommended and available within the food group at each time and place. Items are ranked by of cost per day within each food group at each time and place, and we select the least-cost item(s) in each food group to meet the number of foods required per day. Finally, we calculate the Cost of a Healthy Diet by summing the cost per day of each selected least-cost item at each time and place.

This method is readily adapted to identify the cost premium and change in affordability (if combined with household consumption expenditure aggregates) when including target foods. When ranking items within each food group, we re-rank such that the least cost item classified as a target food replaces the most expensive food that is still selected within the target food’s food group. In some cases, target items may be selected more than once.

### Excel user tool and Stata code

This report is accompanied by an Excel-based tool that allows users to assess the cost of target foods within the context of a healthy diet, using price data for their country/ies and time period(s) of interest. The Cost of Target Foods Excel Workbook is designed for staff, project analysts, or researchers and is best suited for relatively small datasets. It is designed as a monitoring tool that can be used to calculate cost metrics every month or monitoring period. However, it can be used for one-time analyses to aid identification of target foods to promote in programmes, or to evaluate the food environment and security situation of each time and place of interest to the analysts. The tool and a complete set of user instructions, as well as a video tutorial, are available at X. For monitoring affordability across many locations and periods, we recommend using statistical software like Stata. Example Stata code is available at the same link to guide analysts in assessing the cost and affordability of target foods, including how to use expenditure data from household surveys to assess affordability more rigorously.

### Retail price data

Retail food prices are collected regularly by national governments to monitor inflation. National statistical offices (NSOs) are typically responsible for the monthly collection of prices for a standardized list of food and non-food items at representative market locations (Bai et al., 2021). The food price data from inflation monitoring is an ideal price data source for calculating the cost of healthy diets and target foods, but the data is rarely made available to the public in full. Some countries share prices for selected foods or aggregated average prices on their websites or in regular bulletins, but price lists for least-cost diet calculations should include at least 50-60 distinct items from all food groups. The prices used may reflect either averages or prices at varying degrees of subnational specificity. When prices are available over longer periods and at a subnational level, least-cost diet calculations may be compared across seasons and geographies.

As an alternative to NSO food prices, the World Bank's International Comparison Program (ICP) collects retail food prices in local currency units (LCUs) to develop purchasing power parity (PPP) exchange rates. These datasets include a list of specific, globally comparable foods whose prices are collected in all participating economies, as well as lists reflecting foods of regional importance. The ICP data provides one national average price per item in 2017. While this dataset does not allow for direct comparison over time and space, it does allow us to compare baseline healthy diets with those that include target foods, and for comparison across countries. Price datasets used in this analysis are described in Table 3.

Table 3. Metadata for retail food prices.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Country** | **Data source** | **Food items**  **(N)** | **Geographic scale (N)** | **Period** |
| Nigeria | National Bureau of Statistics | 234 | State (36) | January 2016 – May 2021 |
| Ethiopia | Ethiopian Statistical Service | 127 | Woreda (102)\* | April 2022 – March 2023 |
| Kenya\*\* | International Comparison Program | 680 | National (1) | 2017 (annual average) |
| Mozambique\*\* | International Comparison Program | 680 | National (1) | 2017 (annual average) |
| \* Data was not collected from the Tigray Regional State for some periods included in this analysis due to the ongoing conflict.  \*\*Subnational retail prices from NSOs were not readily available in the proper format or in full for Kenya and Mozambique, so national average prices from the 2017 International Comparison Program were used as the best available alternative. | | | | |

## Affordability of a Healthy Diet

The Affordability of a Healthy Diet refers to a suite of possible methods to determine whether a least-cost healthy diet (i.e., Cost of a Healthy Diet, CoHD with target foods) can be purchased without causing financial strain or hardship. We compare healthy diet costs with a measure of income available for food to determine whether or not households can afford to purchase the selected foods (Figure 2).

Using an estimated food budget rather than actual food expenditure avoids confounding descriptive statements about whether a household spent a certain amount on food with normative statements about whether incomes are sufficient to afford healthy diets, while accounting for a reasonable share of income needed for non-food expenditures.

Figure 2. Method for calculating the Affordability of Healthy Diets.

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To calculate an available food budget for each household, we estimate the share of income that should reasonably be set aside for food. Since we are most interested in affordability for BoP households, and because poorer households spend a larger share of their income on food, the median share is based on expenditures of households that are relatively low-income but are still meeting their basic needs. We estimate the median share of expenditures on food for a reference group that meets this criteria, at the relevant subnational level.

Then, we estimate the income available for food for each household as their total expenditure multiplied by the median share of expenditure on food calculated in the step above. Households whose available food budget is greater than or equal to the CoHD calculated in their location of residence are classified as able to afford a healthy diet, while those whose available food budget is less than the local CoHD are classified as unable to afford a healthy diet.

### BoP consumers as a reference population

BoP consumers are an appropriate reference population because they are more likely than poorer households to successfully meet food needs at current spending levels, and less likely than wealthier households to be spending on non-essential non-food items. The percentage of the population categorized as BoP ranges from 15% in Mozambique to 31% in Nigeria, while food expenditures among BoP households range from 50% of total expenditures in Mozambique to 82% in Ethiopia (Table 4).

Table 4. National average share of the population in each poverty category and median share of expenditure on food.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Share of population** | | | |  | **Share of expenditure on food** | | | |
|  | **Eth** | **Nig** | **Ken** | **Moz** |  | **Eth** | **Nig** | **Ken** | **Moz** |
| Non-poor | 18.4 | 38.7 | 32.8 | 26.6 |  | 80.4 | 53.9 | 75.4 | 34.3 |
| BoP | 25.8 | 30.7 | 29.0 | 15.0 |  | 82.3 | 61.2 | 77.2 | 49.7 |
| Extreme poverty | 55.9 | 30.7 | 38.2 | 58.4 |  | 82.4 | 64.2 | 78.5 | 56.9 |
| Total | 100.1 | 100.1 | 100.0 | 100.0 |  | 82.0 | 59.3 | 77.1 | 49.8 |

Notes: BoP = Bottom of Pyramid. Population sampling weights used. Expenditures were adjusted for inflation across survey years before shares were calculated. Ethiopia and Nigeria surveys were conducted in 2018-19; Kenya 2015-16; and Mozambique 2019-20.

### Household survey data

Combining retail food price data with household surveys sheds light on the affordability of healthy diets relative to income. We use representative household surveys that include extensive demographic, consumption, and expenditure data (Table 5). Published survey data include household-level variables and variables aggregated from questions about individual household members, both of which are needed for estimating consumption aggregates.

Household consumption expenditure is commonly used where income data is either unavailable or unreliable. For example, income is difficult to quantify for households heavily reliant on subsistence agriculture, whose cash incomes vary throughout the year, or who rely on the informal economy, as is the case for many households in Ethiopia, Nigeria, Kenya, and Mozambique.

Consumption and expenditures across all food and most non-food categories are compiled into consumption aggregates reflecting total household expenditure over a given reference period, namely per day for comparability with the Cost of a Healthy Diet metric. In our case study countries, consumption aggregates are calculated by the survey teams and their partners, for example, the Ethiopian Statistical Service and the World Bank in Ethiopia and the Nigerian Bureau of Statistics and the World Bank in Nigeria, such that the exact methodology and items included in each consumption aggregate may vary by country.

Table 5. Household survey metadata.

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Data source** | **Survey period** | **Level of representativeness** |
| Ethiopia | Ethiopia Socioeconomic Survey 4 | 2018 - 2019 | National  Regional  Rural/urban |
|  |  |  |  |
| Nigeria | Living Standards Survey | 2018 - 2019 | National  Geopolitical zone  State |
|  |  |  |  |
| Kenya | Kenya Integrated Household Budget Survey | 2015 - 2016 | National  County  Rural/urban |
|  |  |  |  |
| Mozambique | Inquérito sobre Orçamento Familiar (Household Budget Survey) | 2019 - 2020 | National  Provincial  Rural/urban |

We incorporate demographic variables including age, sex, and lactation status of household members to adjust total household consumption to account for varying energy needs of the household members using adult equivalents. When calculating the affordability of healthy diets, each household member's energy needs are converted to adult equivalents using 2,330 calories as the denominator, aligning with the energy content of the HDB.

Household surveys also provide information on interview dates and geographic locations for each respondent household, which enables more rigorous and granular inflation adjustment of reported expenditures. Inflation adjustments are done at the lowest level of geographic aggregation feasible for each country; for example, we use the state-level Consumer Price Index (CPI) in Nigeria and regional CPIs for Ethiopia.

### Inflation adjustment

Inflation adjustment using Consumer Price Indices (CPI) is a critical step when working with household survey data and price data from different time periods. Inflation adjustment accounts for changes in the purchasing power of money over time and is vital for accurate comparisons and analyses of changes in income, poverty, and consumption patterns across different periods. It is also necessary to compare prices collected in one period with expenditure data from a different period, as in the affordability analyses presented here.

We adjust each household's consumption expenditure for inflation using monthly values of food and non-food CPI to obtain real expenditure values in a constant base period. Wherever possible, we adjust food and non-food expenditures using the sub-national food and non-food CPIs, respectively. The inflation-adjusted food and non-food expenditures are summed to yield total expenditure for the calculation of expenditure shares. Where sub-national non-food CPIs are not reported, we use the general CPI to adjust non-food expenditure. In this analysis, we use:

* monthly regional food and non-food CPI available from ESS for Ethiopia;
* monthly state-level food and general CPI available from NBS for Nigeria;
* monthly national food and general CPI available from FAOSTAT for Mozambique; and
* monthly national food and general CPI available from FAOSTAT for Kenya.

As the last step of this process, we convert each household's consumption expenditure to 2017 international dollars using PPP exchange rates for Households and NPISHS (non-profit institutions serving housholds) Final Consumption Expenditure, which is necessary for identifying BoP households based on international poverty lines.

## Nutritional Value Scores

TBD

# Results

## Baseline CoAHD results

In Nigeria, the share of households that cannot afford a healthy diet varied substantially at the state level while fluctuating significantly over the 8 years of data in this analysis (Figure 3). In 2023, the states with the highest unaffordability shares were Ebonyi, Enugu, and Jigawa, with more than 80% of households unable to afford the least-cost healthy diet, while nine states had shares below 20%. Nationwide, this share fell from 58% in 2016 to 41% in 2023, reaching its lowest point at 28% in 2020. Detailed baseline results for CoAHD are also shown in the Supplementary Annex.

Figure 3. Share of Nigerian households unable to afford a healthy diet by state, 2016 and 2023.

A map of countries/regions with red and orange shades

Description automatically generated

In Ethiopia, the share of households that cannot afford a healthy diet varied regionally but within a far smaller range and at a higher average level than in Nigeria (Figure 4). Over the 12 months of data in the analysis, shares ranged from 41% in Harari in September 2022 to 86% in Somali in the first quarter of 2023. Nationwide, the prevalence of unaffordability fluctuated between 66 and 70 percent (see Supplementary Annex).

Figure 4. Share of Ethiopian households unable to afford a healthy diet by region, April 2022 and March 2023.

A map of the states of america

Description automatically generated with medium confidence

In Kenya, variation in the prevalence of unaffordability was similar to Ethiopia, with shares ranging from 32% in Nairobi County to 92% in Busia County (Figure 5). As a result, an average of about 68% of households could not afford a healthy diet at the national level. These estimated shares are based on a single cost estimate from national average prices, combined with expenditure shares calculated at the county level.

Figure 5. Share of Kenyan households unable to afford a healthy diet by county, 2017.

A map of kenya with different shades of orange

Description automatically generated

In Mozambique, the national average share of unaffordability was about 87% in 2017 (Figure 6). The prevalence of unaffordability was above 80% in all provinces except the capital city of Maputo and the surrounding province, where it was half that (44%) in the city and 52% in the province. As with Kenya, affordability in Mozambique is based on a single CoHD estimate based on national average prices from the 2017 ICP combined with expenditure shares calculated at the provincial level.

Figure 6. Share of Mozambique households unable to afford a healthy diet by province, 2017.

A map of the state of mozambique

Description automatically generated

## Changes in cost and unaffordability with target foods

We assess the affordability of target foods first by describing whether they are least-cost items at each time and place. In cases where target foods are not least-cost items, diets using target foods (CoHD+T) are more expensive than least-cost diets without additional constraints. However, in some cases, target foods are already selected as least-cost items in the baseline CoHD basket, so that CoHD and CoHD+T are equivalent. In these cases, we perform additional analyses to compare the cost of including the target food’s close substitutes in the diet basket.

Figure 7. Percentage change in the Cost of a Healthy Diet including eggs by state in Nigeria, 2016 and 2023.

A map of nigeria with different colored areas

Description automatically generated

In Nigeria, eggs were already selected as least-cost foods in about 25% of baskets across all states between 2016 and 2023, meaning that they were more affordable than most other animal-source foods on a cost per day basis. In states where eggs were not already selected, including eggs in least-cost diets imposed a cost premium ranging in magnitude in different states and different years (Figure 7). In 2016, inclusion of eggs imposed a cost premium of 10% or more in the states of northwestern Nigeria. In 2023, the cost premium was less than 10% for all but two states in west-central Nigeria, with the national average cost premium for eggs ranging between about 2% and 5% of baseline costs.

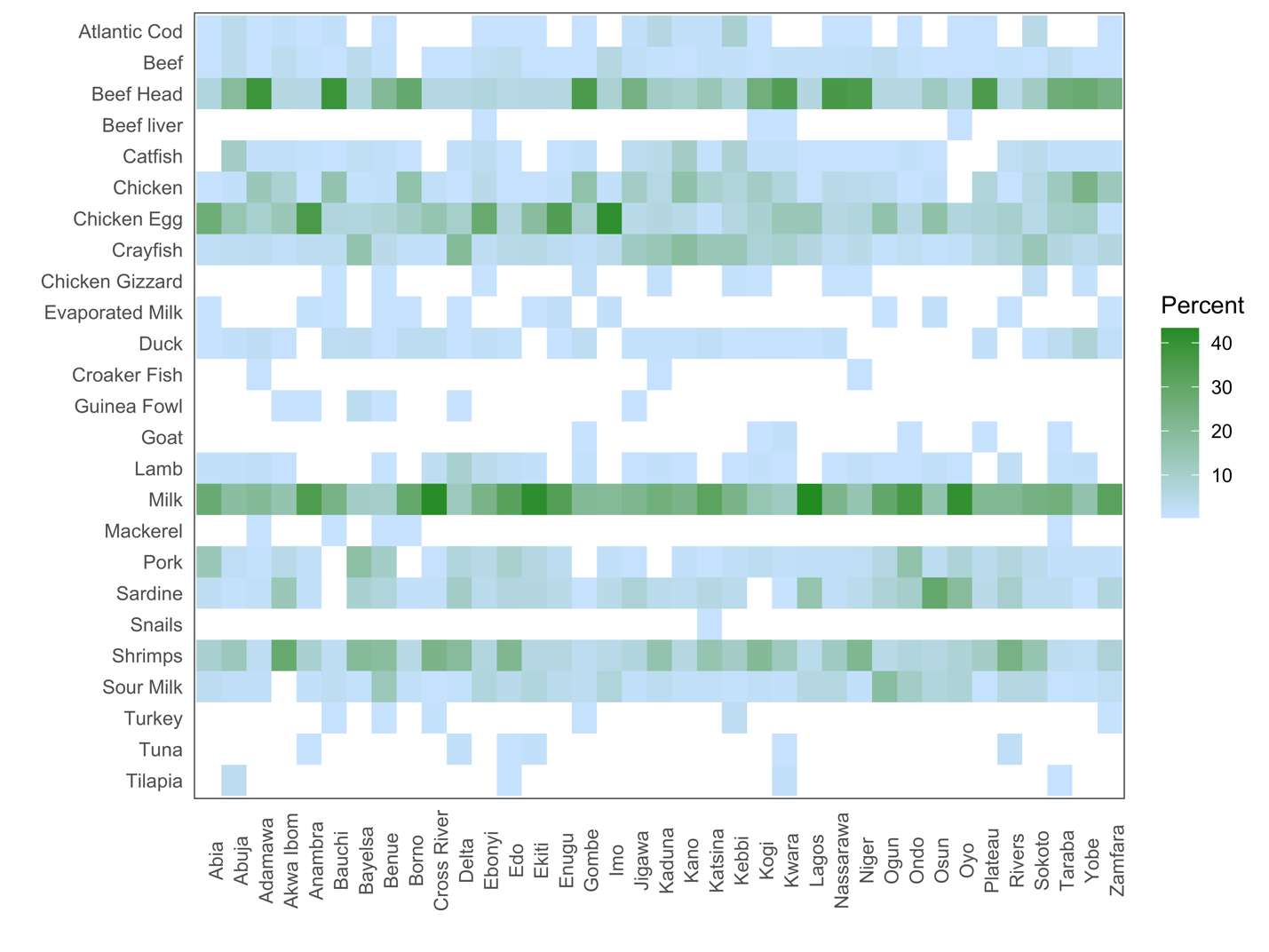
Between 2016 through the end of 2020, the cost of healthy diets using eggs was slightly higher than the baseline CoHD, according to the national average calculated using population sampling weights (Figure 8). In 2021, overall and food inflation began to accelerate in Nigeria and around the world, resulting in a steep increase for both sets of diet costs. While the overall cost of a healthy diet rose at lower rate than food and other goods and services overall, egg prices rose at a higher rate than least-cost diets. In early 2022, average egg prices were rising faster than food inflation overall; as a result, higher egg prices also resulted in a slightly larger premium for diets using eggs between 2021 and 2023.

Figure 8. Changes in food and all consumer prices, egg prices, and CoHD in Nigeria, 2016 - 2023.

A graph of a number of people

Description automatically generated with medium confidence

Figure 9. Frequency of selection for animal source foods by state in Nigeria (percentage of markets and dates).



Eggs were frequently selected as a least-cost item in markets across Nigeria, as shown in Figure 9. The other most commonly selected least-cost animal source foods were beef head and milk. Other foods were selected with some frequency in specific states, such as chicken, crayfish, pork, sardines, and shrimp, while other types of fish and poultry were selected only rarely regardless of geographic location.

Figure 10. Change in the prevalence of unaffordability (CoHD vs. CoHD+T) by state in Nigeria, 2016 and 2023.

A map of different countries/regions

Description automatically generated

The share of households unable to afford a healthy diet including eggs as one of two animal-source foods increased the most in northwestern Nigeria (2016) and central Nigeria (2023), as shown in Figure 10, which mirrors the findings on cost premiums highlighted above. The increase in the share of unaffordability was less than or equal to 1% in about 14% of the state-level sample.

In Ethiopia, some form of dairy was selected in 98% of baskets between April 2022 and March 2023. In areas where target foods were already among the most affordable options in retail markets, the inclusion of target foods does not impose a premium on subnational diet costs or influence the prevalence of unaffordability.

There are a limited number of locations and months where price lists did not include price data for target foods, indicating that no target foods were available in those markets at those times. Out of 1,196 woreda-months in the Ethiopia dataset, dairy items were unavailable in only 23 or 2% of all woreda-months. Approximately 85% of these cases were in Southern Nations, Nationalities, and People's Region (SNNPR) (Southwestern Ethiopia) and Benishangul-Gumuz (Northwestern Ethiopia) regions, followed by the Amhara, Oromia, and Somali regions. However, given the high levels of home production and consumption of dairy in rural areas, low availability in markets may not be a major barrier to consumption of the target foods (Abegaz et al., 2018; Hoddinott et al., 2015); that may be less true in regions such as Beninshangul-Gumuz, where a smaller share of households own livestock and fewer households reported dairy consumption from own-production (CSA & World Bank, 2020).[[1]](#footnote-2)

Since dairy foods are commonly selected as a baseline least-cost item in Ethiopia, additional insights come from comparing the costs to purchase different items within the dairy group. We use box plots to compare the distribution in cost per day to purchase each dairy item as one of two animal-source foods (Figure 11). Across all markets and time periods in the analysis, powdered milk was the most expensive dairy item on a cost per day basis, while cow milk was the least expensive. Goat milk and yoghurt were not substantially more expensive on average. However, cheese – including both cottage cheese and more highly processed forms – had the largest variation in cost per day. These results indicate that while powdered milk is an appealing shelf-stable option for increasing dairy consumption even when fresh milk is not available, it is far from being the most affordable option within the dairy food group.

Figure 11. Distribution of cost per day for dairy items in Ethiopia, April 2022 - March 2023.

A graph of blue rectangular objects

Description automatically generated with medium confidence

Note: Data shown are costs to purchase the daily amount (150 kcal) of each dairy item, with medians (black bar), interquartile range (area inside box), 1.5 times the interquartile range (whiskers and adjacent values), and outliers.

Figure 12. Frequency of selection for animal source foods by region in Ethiopia (percentage of markets and dates).

A screenshot of a graph

Description automatically generated

Dairy items were the most commonly selected animal source foods in Ethiopia, and cow milk was the most frequently selected dairy item, including both unpasteurized and pasteurized forms (Figure 12). Yoghurt was frequently selected in many regions, as were cheese, cottage cheese, and eggs, although to a lesser extent. Certain foods were selected more frequently in specific regions, such as camel milk and eggs in Harari and beef and powdered milk in Benishangul-Gumuz. Compared to other items, however, beef, goat milk, powdered milk, and sardines did not commonly appear in markets as least-cost foods.

In Kenya, since the target food (vegetables) is itself a recommended food group within the HDB and other dietary guidelines, we instead focus on showing variation in cost (Figure 13) and affordability (Table 7) of least-cost diets when different items are selected into the vegetable group. In Table 6, Column 1 shows diet costs for the reference basket composed of the baseline CoHD item selection, where carrots, green cabbage, and onions are the first, second, and third least-cost items available in the national dataset. In keeping with selecting the least-cost basket, we substitute the most expensive of the three vegetables selected in the CoHD with alternative vegetable options, and indicate the percentage change in the CoHD when incrementally more expensive vegetables are included in the basket. Note that in this approach, the two least-expensive vegetables (carrots and green cabbage) always remain in the CoHD, and only the third vegetable (onion) is substituted; the premium to include different vegetables in the diet basket instead of onions ranges from 3.9% for green beans to 13.1% for green pepper.

Table 6. Change in CoHD with alternative higher-cost vegetables selected to replace the third-least-cost vegetables in Kenya (2017).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Ref.** | **Green Beans** | **Eggplant** | **Peas** | **Tomato** | **Cucumber** | **Green Pepper** |
| Change in CoHD (%) | 0 | 3.85 | 5.04 | 6.74 | 9.23 | 12.54 | 13.07 |

Table 7 shows variation by rural, urban, and peri-urban regions of Kenya in the prevalence of unaffordability with the selection of different vegetable items. Columns indicate different combinations of vegetables as above. Unaffordability is lowest in urban regions of Kenya, ranging from 38% of households for the reference basket to 46% of households when green pepper is selected instead of onion. Unaffordability is highest in rural regions, ranging from 71% to 77%, and only moderately lower in peri-urban regions, where it ranges from 65% to 71%.

Table . Share of Kenyan households that cannot afford a healthy diet, with variation in third-least-cost vegetable selected (%).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Ref.** | **Green Beans** | **Eggplant** | **Peas** | **Tomato** | **Cucumber** | **Green Pepper** |
| Peri-Urban | 65 | 67 | 67 | 68 | 70 | 71 | 71 |
| Rural | 71 | 73 | 73 | 74 | 75 | 76 | 77 |
| Urban | 38 | 40 | 41 | 42 | 43 | 45 | 46 |
| Total | 61 | 63 | 64 | 64 | 66 | 67 | 67 |

Note: Population sampling weights used. Price data used for CoHD and CoHD+T calculations are national average prices from the 2017 International Comparison Program.

Although this analysis uses only a single national average price for each food item, the prevalence of unaffordability rises by county according to the amount of income available for food when higher-cost vegetables are selected into the diet basket (Figure 13). Nairobi City County is the most vulnerable to higher food costs, with the prevalence of unaffordability rising by nearly 10% when green beans are selected and by nearly 35% when green peppers are selected. Other vulnerable counties include Mombasa, Narok, Homa Bay, and Nyeri, where the cost premium for more expensive vegetables ranges from about 3% to as much as 17.4%.

Figure 13. Change in the prevalence of unaffordability (CoHD vs. CoHD+T) by county in Kenya (2017).

A map of different types of vegetables

Description automatically generated

Table 8 compares the cost per day to purchase each vegetable in Kenya with cost per day in Uganda, reflecting the assumption that high-level similarities in agrifood systems in these two neighboring countries may provide insights into how well each food system provides nutrient-rich vegetables at an affordable cost. Costs are converted to 2017 international dollars per daily portion, which is 36.67 kcals to total 110 kcals across the three vegetables selected in the final basket. In Kenya, carrots are the least expensive vegetable available, while cabbage is only marginally more expensive. In Uganda, cabbage is the least expensive vegetable in terms of cost per day, followed by eggplant, carrots, and onions. The cost per day to purchase carrots, onions, green beans, and peas is lower in Kenya, while the cost per day to purchase cabbage, eggplant, tomatoes, cucumber, and green pepper is lower in Uganda. However, the four most expensive vegetables are the same in both countries, although at lower cost per day in Uganda: peas, tomatoes, cucumber, and green pepper. This simple comparison suggests that Kenya and Uganda have similar capacities to provide low-cost vegetables to consumers, but that more expensive vegetables that are unlikely to be selected into least-cost diets tend to be even more expensive in Kenya.

Table 8. Cost per day by vegetable in Kenya and Uganda (2017 PPP).

|  |  |  |
| --- | --- | --- |
|  | Cost per day  (2017 international dollars) | |
| Vegetable | Kenya | Uganda |
| Carrots | **0.14** | 0.22 |
| Cabbage | 0.15 | **0.11** |
| Onions | 0.22 | 0.23 |
| Green beans | 0.34 | 0.36 |
| Eggplants | 0.37 | 0.20 |
| Peas | 0.42 | 0.54 |
| Tomatoes | 0.50 | 0.39 |
| Cucumber | 0.60 | 0.41 |
| Green pepper | 0.61 | 0.59 |

In Mozambique, the cost of least-cost diets increases by 2.5% when dried fish are included and by 4.7% when chicken pieces are included. The increased cost to include dried fish is notable, as the reference scenario CoHD basket includes both dried shrimp and fresh small sardines. In the national average price data, fresh fish is less expensive than dried on a cost per day basis, but subnational price data would likely reveal spatial variation in whether fresh or dried fish are selected as least-cost items. The increase in the CoHD when target foods are included results in a 1 percentage point increase in the prevalence of unaffordability at the national level.

Figure 14. Change in the prevalence of unaffordability (CoHD vs. CoHD+T) by province in Mozambique (2017).

A map of dried fish

Description automatically generated

Figure 14 shows that including either chicken or dried fish in a healthy diet increases the prevalence of unaffordability by the largest margin in Maputo and Nampula Provinces. At the national level, 87% of households cannot afford the reference basket of healthy foods, 88% cannot afford the basket including chicken pieces, and 87% cannot afford the basket including dried fish. At the subnational level, the prevalence of unaffordability rises the most in Maputo Cidade, increasing from 44% to 47% (chicken) and 45% (dried fish). In the provinces with the highest levels of baseline unaffordability, inclusion of target foods increases unaffordability by a smaller margin or not at all, as in the case of Cabo Delgado, Gaza, and Niassa Provinces. As in Kenya, these changes are driven by differences in available income across provinces, since the analysis for these countries uses only a national estimate for CoHD and CoHD+T.

There is considerable variation in ability to afford healthy diets across income categories in different countries (Table 9). Compared to the other case study countries, a slightly smaller share of BoP consumers in Nigeria cannot afford the least-cost healthy diet that includes the target food, at nearly half (48%) of BoP Nigerians. In Ethiopia, 51% of BoP consumers cannot afford a healthy diet that includes at least one dairy item, though there is large variation in affordability among BoP households at the woreda level.

Table 9. Average share of households that cannot afford a healthy diet (CoHD vs. CoHD+T) by poverty category and country.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Ethiopia** | |  | **Nigeria** | |  | **Kenya** | |  | **Mozambique** | | |
|  | **Base** | **Target** |  | **Base** | **Target** |  | **Base** | **Target** |  | **Base** | **Target: fish** | **Target: chicken** |
| Non-poor | 2 | 2 |  | 7 | 8 |  | 10 | 14 |  | 50 | 52 | 54 |
| BoP | 51 | 51 |  | 41 | 48 |  | 90 | 92 |  | 100 | 100 | 100 |
| Extreme poor | 100 | 100 |  | 88 | 93 |  | 100 | 100 |  | 100 | 100 | 100 |
| Total | 69 | 69 |  | 42 | 47 |  | 68 | 69 |  | 87 | 87 | 88 |

Note: Base = baseline CoHD without mandatory inclusion of target food. BoP = Bottom of Pyramind. Population weights used. Kenya Target column shows affordability for diet costs with fourth least-expensive vegetable (green beans).

The results for Kenya and Mozambique show that healthy diets are out of reach for 90 to 100% of BoP households regardless of whether target foods are included. This is likely an artifact of the retail price data source, as the ICP dataset only provides a single national average price for each item included, obscuring subnational variation and seasonality in prices. The ICP price list is also limited to globally and regionally comparable foods that are likely to be more expensive than the items included in retail price data collected by NSOs for inflation monitoring.

## Changes in cost and affordability when accounting for NVS

TBD

# Discussion

Comparing CoAHD and CoAHD+T allows for identifying relative degrees of affordability for target foods, especially when detailed subnational price data are available. In Nigeria, eggs impose a cost premium in about 75% of markets where they are not already selected as a least-cost food. This cost premium results in a substantial increase in the share of households that cannot afford to purchase the selected basket of foods, especially in northwestern and central states. This highlights the importance of geographic variation in diet costs and affordability, which can only be identified with subnational data on retail prices and consumer expenditures. Locations where the target foods are not the least-cost options may be flagged as priority areas for providing additional support. Alternatively, initiatives to promote the consumption of target foods in these areas should perhaps be reconsidered in favor of promoting lower-cost alternatives within the food group. In Ethiopia, the target foods are already included in least-cost diets for most markets and times of price collection, which means that including target foods does not impose a premium on diet costs or affect the prevalence of unaffordability. In Kenya, the target food is better conceived as a target food group that is always included in least-cost diet calculations, and as such also does not impose a premium on diet costs. However, the results shown here provide insight into the relative cost to include different vegetables and whether including different vegetables providing different nutrient profiles would result in greater unaffordability. In Mozambique, diet costs increase by a comparatively small margin when target foods are required. The effect of this cost increase varies widely by geographic region, reflecting both the data limitions in the present analysis of national average prices and the important fact that consumer purchasing power varies widely across the country.

These results collectively generate a few important highlights: the target foods GAIN has identified are frequently the least-expensive items within their food group, especially for dairy in Ethiopia, meaning that these foods are relatively affordable compared to close substitutes within food groups. This analysis serves as an economic counterpoint to studies based on other scientific and cultural insights suggesting that the target foods should be consumed in greater amounts.

Secondly, despite the low cost of the target foods relative to their counterparts, they are still unaffordable for most people when examined in the context of an overall healthy diet and available food budgets. In 2 of the 4 case study countries, about half of BoP consumers are unable to afford a healthy diet, with or without the target foods. This finding underscores the importance of increasing incomes available for food through safety nets and social protection or improving the supply and distribution of least-cost foods and target foods to lower prices. Targeting BoP consumers with demand creation approaches is only helpful if households are capable to purchase or produce the recommended foods to achieve healthier diets, or producing them themselves.

Finally, this analysis shows that even among the poorest people in the case study countries, healthy diets and target foods can be accessible. In Nigeria, about 12 percent of those defined as extremely poor can afford a healthy diet at current expenditure levels and food prices. If those households that can afford a healthy diet choose not to consume them, programming and policy can seek to understand and change preferences to improve consumption of healthy diets or examine other barriers to consuming healthy diets beyond food prices and incomes, such as meal preparation costs, local taste and preferences, food safety concerns, taboos, and more.

### Programmatic application

Program design and implementation can incorporate the CoHD+T method to identify target foods or validate the selection of target foods chosen for their nutrient profiles. In the case of Ethiopia, where dairy was the food group of interest, this method allows analysts to determine which specific dairy items are least expensive in each location and month or season. For example, unpasteurized cow's milk may be the best choice in most regions, but powdered milk may be a better target food in specific woredas where the supply of fresh milk is inconsistent. Furthermore, if there are issues with one type of target food, for example, food safety considerations, it is possible to look at how the cost would change by using the second least-expensive dairy product for programmatic focus.

This method also allows program managers and policy makers to identify places where different interventions may be indicated. If prices for target foods are high or if target foods are not least-cost items within their respective food groups, programs and policies can focus on reducing prices through supply-side interventions, including own production. Where diet costs and target food prices are relatively low, but a large share of households is unable to afford a healthy diet, an emphasis on increasing income or making more money available for spending on food through transfers, vouchers or a reduction in non-food spending may be preferable. Program managers and policy makers can consider a focus on behavior change, preferences, or other aspects of food choice beyond price and income where healthy diets and target foods are affordable but not consumed widely. Where markets do not provide target foods or complete healthy diets, increasing own production and improving infrastructure may be the best intervention goals.

Finally, CoHD and CoHD+T can be monitored regularly using existing food price data if governments are willing to share it, or if teams can collect their own retail price data for specific program sites. The latter can be time-consuming and expensive, so GAIN teams could consider investing in relationships with NSOs to obtain regular price data for the locations of programmatic interest. In general, NSOs have a mandate to make their data publicly available, but are often resource-constrained and may need support to share the data on a routine basis. The Excel Workbook was designed for monitoring CoHD and CoHD+T to guide programming and assessing program success. For example, the Workbook can help assess the affect of interventions that aim to improve availability or reduce the cost of specific foods or a healthy diet overall, such as through agricultural production and market or other infrastructure development. It distinguishes between items that are sold in different units, so it is possible to assess whether items sold in smaller pack sizes or in larger bulk quantities are more commonly available and less expensive on a per unit basis across market locations, an important consideration for BoP consumers. This tool provides a framework for assessing costs of foods relative to other foods within the same food group, and in terms of cost per day to meet dietary recommendations, rather than simply in terms of price. However, high quality subnational price data for foods in all recommended food groups and target foods is a necessary input for this analysis. It is clear that national average prices are insufficient for decision-making at a programmatic level, as demonstrated by the results for Kenya and Mozambique.

### Limitations

There are some important limitations to the CoAHD methods used in this analysis, primarily related to data availability and interpretation at several stages. Analysts must have access to detailed price and household expenditure data for these methods to yield useful and accurate results. Although NSOs usually collect monthly retail price data, household expenditures are typically available only for a one-year period and are not updated frequently. This analysis uses CPI data to inflate expenditure shares from the household survey period to the retail price period, which involves the strong and likely incorrect assumption that households do not shift their spending patterns over time. However, this is the only feasible approach given the data available. Item inclusion in retail price data is a central limitation for the calculation of least-cost diets in general and is even more relevant when testing the effect of including target foods. The retail prices used for inflation calculation typically reflect standardized baskets of commonly consumed foods and may omit foods that are seasonally or sporadically available. This is particularly true for the ICP prices as disussed in the case of Kenya and Mozambique, but the same phenomenon may appear even in relatively detailed subnational retail prices. Similarly, if specific items are occasionally missing from the data, this may indicate that those items were unavailable for purchase, or it may simply indicate an error in food price collection for that market period. Missing price data may be interpreted as indicating a food was unavailable, but such interpretations should be qualified. Finally, this approach only accounts for the retail availability of foods and does not accommodate the role of own production, informal trade, or wild foods in improving access to healthy diets.

# Conclusion

The results presented here illustrate how the CoHD and CoHD+T methods may be useful for nutrition policies and interventions directed at BoP consumers in focus countries. These methods allow for the identification of relatively affordable foods and food groups in each time and place for which food price data are available. Comparisons of items within food groups, as in the case of vegetables in Kenya and dairy in Ethiopia, provide insights into the relative cost of foods that serve as close substitutes. When combined with insights from the NVS analysis, this approach reveals whether foods of high nutritional value can be obtained at relatively low cost. Finally, where household expenditure data is also available, affordability analyses of diet costs relative to income and income available for food provide more nuanced insights into whether healthy diets and target foods are affordable for BoP consumers, and whether interventions to increase consumption should focus more on prices or incomes. These methods are also useful to validate and contextualize the choice of target foods in cases where program designers have already identified target foods based on previous evidence, local knowledge, or other sources of information.

# References

Abegaz, G. A., Hassen, I. W., & Minten, B. (2018). *Consumption of animal-source foods in Ethiopia: Patterns, changes, and determinants* (ESSP Working Paper 113). International Food Policy Research Institute (IFPRI) and Ethiopian Development Research Institute (EDRI). https://doi.org/10.2499/1020502793

Bai, Y., Costlow, L., Ebel, A., Laves, S., Ueda, Y., Volin, N., Zamek, M., Herforth, A., & Masters, W. A. (2021). Review: Retail consumer price data reveal gaps and opportunities to monitor food systems for nutrition. *Food Policy*, *104*, 102148. https://doi.org/10.1016/j.foodpol.2021.102148

Blum, L. S., Swartz, H., Olisenekwu, G., Erhabor, I., & Gonzalez, W. (2023). Social and economic factors influencing intrahousehold food allocation and egg consumption of children in Kaduna State, Nigeria. *Maternal & Child Nutrition*, *19*(1), e13442. https://doi.org/10.1111/mcn.13442

CSA & World Bank. (2020). *Ethiopia Socioeconomic Survey (ESS) 2018/19 Survey Report*. Central Statistics Agency of Ethiopia & World Bank. https://microdata.worldbank.org/index.php/catalog/3823/related-materials

Djimeu, E. W., Nordhagen, S., Beal, T., Kelahan, H., & Morris, S. S. (2022, March). *GAIN Working Paper Series 27—Conceptualising and assessing food affordability*. Home. https://www.gainhealth.org/resources/reports-and-publications/gain-working-paper-series-27-conceptualising-and-assessing-food

FAO, I. (2023). *The State of Food Security and Nutrition in the World 2023: Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum*. FAO, IFAD, UNICEF, WFP, WHO. https://doi.org/10.4060/cc3017en

Farrell, J. (2021, October). *GAIN Briefing Paper Series 7—Dairy in Ethiopia*. Home. https://www.gainhealth.org/resources/reports-and-publications/gain-briefing-paper-series-7-dairy-ethiopia

Herforth, A., Bai, Y., Venkat, A., Mahrt, K., Ebel, A., & Masters, W. (2020). *Cost and affordability of healthy diets across and within countries: Background paper for The State of Food Security and Nutrition in the World 2020*. Food & Agriculture Org. https://doi.org/10.4060/cb2431en

Herforth, A., Venkat, A., Bai, Y., Holleman, C., & Masters, W. A. (2022). *Methods and options to monitor the cost and affordability of a healthy diet globally: Background paper for The State of Food Security and Nutrition in the World 2022* [FAO Agricultural Development Economics Working Pape]. FAO. https://doi.org/10.4060/cc1169en

Hoddinott, J., Headey, D., & Dereje, M. (2015). Cows, Missing Milk Markets, and Nutrition in Rural Ethiopia. *The Journal of Development Studies*, *51*(8), 958–975. https://doi.org/10.1080/00220388.2015.1018903

LaRose, E., Shindler, M., Erhabor, I., Poonawala, A., Deo, A., Ojo, M., Gonzalez, W., & Falla, A. (2020). *Eggs make kids: A market-driven approach to promote eggs as a nutritious food for young children in Nigeria* (GAIN Working Paper 10). Global Alliance for Improved Nutrition (GAIN). https://www.gainhealth.org/resources/reports-and-publications/gain-working-paper-series-10-eggs-make-kids-market-driven

Minten, B., Habte, Y., Tamru, S., & Tesfaye, A. (2020). The transforming dairy sector in Ethiopia. *PLoS ONE*, *15*(8), e0237456. https://doi.org/10.1371/journal.pone.0237456

Morris, S. S., Beesabathuni, K., & Headey, D. (2018). An egg for everyone: Pathways to universal access to one of nature’s most nutritious foods. *Maternal & Child Nutrition*, *14*(Suppl 3), e12679. https://doi.org/10.1111/mcn.12679

Nicholson, C., & Monterrosa, E. (2021). *Assessing the Impacts of Potential Interventions on Vegetable Consumption in Urban Kenya Using Participatory Systems Modelling*. Global Alliance for Improved Nutrition (GAIN). https://doi.org/10.36072/wp.22

Ortenzi, F., & Beal, T. (2021). Priority Micronutrient Density of Foods for Complementary Feeding of Young Children (6–23 Months) in South and Southeast Asia. *Frontiers in Nutrition*, *8*. https://www.frontiersin.org/articles/10.3389/fnut.2021.785227

Ryckman, T., Beal, T., Nordhagen, S., Chimanya, K., & Matji, J. (2021). Affordability of nutritious foods for complementary feeding in Eastern and Southern Africa. *Nutrition Reviews*, *79*(Supplement\_1), 35–51. https://doi.org/10.1093/nutrit/nuaa137

Ryckman, T., Beal, T., Nordhagen, S., Murira, Z., & Torlesse, H. (2021). Affordability of nutritious foods for complementary feeding in South Asia. *Nutrition Reviews*, *79*(Supplement\_1), 52–68. https://doi.org/10.1093/nutrit/nuaa139

Ryckman, T., Codjia, P., Nordhagen, S., Arimi, C., Kirogo, V., Kiige, L., Kamudoni, P., & Beal, T. (2022). A subnational affordability assessment of nutritious foods for complementary feeding in Kenya. *Maternal & Child Nutrition*, *n/a*(n/a), e13373. https://doi.org/10.1111/mcn.13373

Schneider, K., & Herforth, A. (2020). Software tools for practical application of human nutrient requirements in food-based social science research. *Gates Open Research*, *4*, 179. https://doi.org/10.12688/gatesopenres.13207.1

# Supplementary results

Table S1. Share of Nigerian households that cannot afford a healthy diet, by state (2016 – 2023).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| State | Share of households (%) | | | | | | | |
| 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
| Abia | 65.1 | 37.6 | 57.7 | 41.9 | 36.5 | 58.9 | 58.6 | 69.8 |
| Abuja | 46.2 | 28.4 | 41.9 | 37.1 | 26.0 | 27.5 | 14.4 | 11.6 |
| Adamawa | 81.9 | 71.4 | 74.9 | 63.6 | 48.3 | 61.2 | 64.9 | 71.3 |
| Akwa Ibom | 69.0 | 35.5 | 46.1 | 39.8 | 24.9 | 30.1 | 35.8 | 30.2 |
| Anambra | 49.2 | 27.3 | 43.9 | 35.6 | 31.1 | 41.6 | 46.5 | 59.2 |
| Bauchi | 66.2 | 54.5 | 56.7 | 45.5 | 41.0 | 48.6 | 55.2 | 50.3 |
| Bayelsa | 49.9 | 18.9 | 34.2 | 25.5 | 7.3 | 19.6 | 23.2 | 15.9 |
| Benue | 43.7 | 25.3 | 44.5 | 35.4 | 28.2 | 30.5 | 19.9 | 17.6 |
| Borno | 74.0 | 61.3 | 69.8 | 60.5 | 47.3 | 50.6 | 55.0 | 52.9 |
| Cross River | 77.7 | 33.7 | 48.2 | 40.9 | 24.3 | 38.5 | 40.2 | 37.4 |
| Delta | 45.2 | 13.1 | 19.0 | 14.0 | 1.6 | 14.4 | 14.0 | 7.2 |
| Ebonyi | 92.3 | 82.7 | 90.0 | 88.8 | 83.3 | 90.8 | 89.7 | 92.7 |
| Edo | 39.8 | 16.0 | 22.9 | 13.0 | 6.6 | 15.7 | 15.1 | 13.4 |
| Ekiti | 57.6 | 36.7 | 40.3 | 37.8 | 27.6 | 17.8 | 39.1 | 53.1 |
| Enugu | 86.7 | 63.2 | 83.7 | 74.7 | 67.7 | 79.8 | 82.3 | 87.9 |
| Gombe | 71.1 | 59.9 | 65.3 | 48.2 | 42.5 | 50.1 | 54.5 | 55.2 |
| Imo | 71.9 | 42.7 | 66.5 | 55.4 | 54.2 | 65.1 | 70.6 | 72.7 |
| Jigawa | 90.0 | 80.8 | 84.1 | 78.0 | 60.4 | 79.5 | 84.0 | 81.8 |
| Kaduna | 58.7 | 56.6 | 58.9 | 56.3 | 31.6 | 55.5 | 63.9 | 59.8 |
| Kano | 57.5 | 45.8 | 50.5 | 35.3 | 5.6 | 36.5 | 54.3 | 42.9 |
| Katsina | 33.7 | 30.5 | 30.1 | 21.0 | 15.5 | 25.7 | 40.9 | 30.3 |
| Kebbi | 56.0 | 52.4 | 60.7 | 51.5 | 23.3 | 40.9 | 55.3 | 51.3 |
| Kogi | 44.4 | 29.0 | 49.6 | 42.2 | 15.8 | 13.9 | 6.1 | 1.1 |
| Kwara | 43.6 | 20.2 | 29.9 | 25.8 | 12.8 | 17.6 | 3.9 | 1.4 |
| Lagos | 39.9 | 15.8 | 17.0 | 12.8 | 9.1 | 13.1 | 11.6 | 10.7 |
| Nassarawa | 70.3 | 46.3 | 58.8 | 51.2 | 32.9 | 38.6 | 15.5 | 21.6 |
| Niger | 71.6 | 55.5 | 71.9 | 62.8 | 45.8 | 58.1 | 18.2 | 31.5 |
| Ogun | 40.4 | 16.1 | 22.6 | 21.9 | 12.5 | 13.2 | 24.2 | 26.3 |
| Ondo | 26.0 | 17.6 | 26.1 | 21.7 | 8.6 | 6.8 | 12.9 | 15.1 |
| Osun | 42.6 | 21.1 | 32.9 | 22.2 | 13.3 | 16.3 | 37.9 | 30.1 |
| Oyo | 24.6 | 15.4 | 17.1 | 15.7 | 6.0 | 9.4 | 16.6 | 23.3 |
| Plateau | 72.3 | 53.1 | 64.4 | 57.9 | 46.2 | 51.9 | 34.1 | 41.8 |
| Rivers | 62.9 | 40.0 | 49.3 | 42.5 | 17.4 | 32.2 | 43.4 | 36.4 |
| Sokoto | 85.2 | 80.8 | 88.9 | 84.2 | 64.0 | 74.3 | 84.3 | 81.0 |
| Taraba | 88.6 | 83.6 | 86.5 | 78.7 | 73.9 | 80.2 | 82.4 | 80.8 |
| Yobe | 76.2 | 66.5 | 69.7 | 52.1 | 46.3 | 48.4 | 54.6 | 59.2 |
| Zamfara | 55.3 | 56.8 | 59.0 | 50.0 | 19.8 | 50.6 | 65.5 | 54.9 |
| Total | 57.6 | 41.1 | 49.3 | 41.5 | 27.9 | 38.4 | 42.0 | 40.8 |

Note: Population sampling weights used.

Table S2. Share of Ethiopian households that cannot afford a healthy diet, by region (April 2022 – March 2023).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Region** |  | **2022** | | | | | | | | | **2023** | | |
|  | **April** | **May** | **June** | **July** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** |
| Addis Ababa |  | 51.9 | 52.6 | 54.6 | 51.9 | 55.4 | 54.2 | 53.5 | 53.8 | 54.3 | 51.7 | 52.2 | 55.0 |
| Afar |  | 62.6 | 64.9 | 64.8 | 65.5 | 67.2 | 67.4 | 69.6 | 70.5 | 66.9 | 70.1 | 71.4 | 72.4 |
| Amhara |  | 78.9 | 79.2 | 79.7 | 78.7 | 79.8 | 81.5 | 80.1 | 79.0 | 80.9 | 82.4 | 81.1 | 79.6 |
| Benishangul Gumuz |  | 67.5 | 67.3 | 66.0 | 77.4 | 71.9 | 65.9 | 62.5 | 59.5 | 63.3 | 54.0 | 58.6 | 54.6 |
| Dire Dawa |  | 58.5 | 57.1 | 63.5 | 52.7 | 56.7 | 53.6 | 54.4 | 55.9 | 53.3 | 53.8 | 55.2 | 54.0 |
| Gambela |  | 65.4 | 68.6 | 71.7 | 67.4 | 72.1 | 69.9 | 69.6 | 69.4 | 66.7 | 69.1 | 69.1 | 65.7 |
| Harar |  | 47.6 | 51.5 | 57.6 | 52.1 | 45.2 | 41.3 | 39.8 | 55.9 | 45.2 | 52.0 | 51.3 | 44.5 |
| Oromia |  | 64.4 | 64.9 | 63.9 | 60.8 | 59.9 | 59.6 | 59.1 | 57.8 | 58.9 | 59.4 | 61.1 | 60.5 |
| SNNP |  | 75.5 | 74.5 | 73.1 | 70.7 | 72.4 | 71.0 | 71.4 | 72.6 | 72.2 | 71.7 | 73.1 | 73.8 |
| Somali |  | 79.6 | 81.9 | 84.6 | 82.9 | 81.6 | 84.0 | 82.4 | 83.7 | 84.7 | 85.6 | 86.0 | 86.1 |
| Total |  | 70.6 | 70.8 | 70.5 | 68.4 | 68.8 | 68.8 | 68.2 | 67.7 | 68.6 | 69.0 | 69.7 | 69.3 |

Note: Population sampling weights used.

Table S3. Share of Mozambiquan households that cannot afford a healthy diet, by province (2017).

|  |  |  |  |
| --- | --- | --- | --- |
| **Province** | **Reference Basket** | **Baskets with Target Foods** | |
| **Chicken Pieces** | **Dried Fish** |
| Cabo Delgado | 96 | 96 | 96 |
| Gaza | 94 | 95 | 94 |
| Inhambane | 84 | 84 | 84 |
| Manica | 87 | 88 | 88 |
| Maputo Cidade | 44 | 47 | 45 |
| Maputo Provincia | 52 | 54 | 53 |
| Nampula | 92 | 93 | 93 |
| Niassa | 93 | 93 | 93 |
| Sofala | 89 | 90 | 90 |
| Tete | 86 | 87 | 87 |
| Zambezia | 95 | 96 | 95 |
| Total | 87 | 88 | 87 |

Note: Population sampling weights used. Price data used for CoHD and CoHD+T calculations are national average prices from ICP 2017.

Table S4. Share of Kenyan households that cannot afford a healthy diet with variation in third-least-cost vegetable selected, by county (2017).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Ref.** | **Green Beans** | **Eggplant** | **Peas** | **Tomato** | **Cucumber** | **Green Pepper** |
| Baringo | 74 | 75 | 75 | 76 | 77 | 78 | 78 |
| Bomet | 87 | 89 | 89 | 89 | 90 | 92 | 92 |
| Bungoma | 83 | 84 | 84 | 85 | 85 | 86 | 86 |
| Busia | 92 | 93 | 93 | 94 | 95 | 95 | 95 |
| Elgeyo Marakwet | 82 | 85 | 85 | 85 | 87 | 88 | 88 |
| Embu | 68 | 73 | 73 | 73 | 74 | 75 | 75 |
| Garissa | 83 | 85 | 86 | 86 | 87 | 89 | 89 |
| Homa Bay | 60 | 63 | 64 | 65 | 66 | 69 | 70 |
| Isiolo | 75 | 77 | 77 | 78 | 79 | 80 | 80 |
| Kajiado | 66 | 68 | 68 | 69 | 69 | 71 | 72 |
| Kakamega | 75 | 77 | 78 | 79 | 80 | 82 | 82 |
| Kericho | 77 | 80 | 81 | 81 | 82 | 85 | 86 |
| Kiambu | 55 | 58 | 58 | 59 | 60 | 62 | 62 |
| Kilifi | 76 | 77 | 77 | 77 | 77 | 78 | 79 |
| Kirinyaga | 55 | 59 | 59 | 60 | 61 | 62 | 63 |
| Kisii | 83 | 84 | 85 | 86 | 86 | 87 | 87 |
| Kisumu | 75 | 76 | 76 | 77 | 79 | 80 | 81 |
| Kitui | 81 | 81 | 82 | 82 | 83 | 84 | 85 |
| Kwale | 76 | 77 | 78 | 78 | 78 | 79 | 79 |
| Laikipia | 68 | 69 | 70 | 70 | 72 | 72 | 72 |
| Lamu | 58 | 61 | 61 | 62 | 64 | 65 | 66 |
| Machakos | 58 | 59 | 60 | 61 | 61 | 65 | 66 |
| Makueni | 74 | 76 | 77 | 78 | 79 | 80 | 80 |
| Mandera | 89 | 90 | 91 | 91 | 92 | 92 | 92 |
| Marsabit | 88 | 89 | 89 | 90 | 90 | 91 | 91 |
| Meru | 58 | 60 | 60 | 61 | 63 | 64 | 64 |
| Migori | 81 | 84 | 84 | 85 | 86 | 87 | 87 |
| Mombasa | 42 | 44 | 44 | 45 | 47 | 49 | 49 |
| Muranga | 68 | 70 | 70 | 71 | 71 | 73 | 73 |
| Nairobi | 32 | 36 | 37 | 38 | 39 | 44 | 44 |
| Nakuru | 57 | 60 | 61 | 61 | 64 | 65 | 65 |
| Nandi | 79 | 80 | 81 | 81 | 83 | 84 | 85 |
| Narok | 58 | 61 | 63 | 64 | 66 | 68 | 68 |
| Nyamira | 73 | 75 | 75 | 76 | 78 | 80 | 80 |
| Nyandarua | 65 | 66 | 67 | 67 | 69 | 70 | 71 |
| Nyeri | 50 | 53 | 53 | 54 | 56 | 58 | 58 |
| Samburu | 87 | 89 | 89 | 89 | 90 | 90 | 90 |
| Siaya | 65 | 66 | 67 | 68 | 70 | 71 | 71 |
| Taita Taveta | 68 | 70 | 70 | 71 | 72 | 73 | 73 |
| Tana River | 84 | 85 | 85 | 85 | 86 | 86 | 86 |
| Tharaka Nithi | 68 | 70 | 70 | 71 | 73 | 75 | 75 |
| Trans Nzoia | 76 | 77 | 77 | 77 | 78 | 79 | 79 |
| Turkana | 85 | 85 | 85 | 85 | 86 | 87 | 87 |
| Uasin Gishu | 71 | 74 | 74 | 75 | 76 | 79 | 79 |
| Vihiga | 83 | 84 | 85 | 85 | 86 | 87 | 87 |
| Wajir | 92 | 93 | 93 | 93 | 94 | 94 | 94 |
| West Pokot | 88 | 90 | 90 | 91 | 92 | 92 | 92 |
| Total | 68 | 69 | 70 | 71 | 72 | 74 | 74 |

Note: Population sampling weights used. Price data used for CoHD and CoHD+T calculations are national average prices from ICP 2017.

Table S5. National average Cost of a Healthy Diet (Naira/day) in Nigeria (2016 – 2023)

|  |  |  |
| --- | --- | --- |
| Period |  | Average (SD)  CoHD (Naira/day) |
| 2016 |  | 217 |
|  |  | (51) |
| 2017 |  | 201 |
|  |  | (41) |
| 2018 |  | 258 |
|  |  | (48) |
| 2019 |  | 260 |
|  |  | (43) |
| 2020 |  | 247 |
|  |  | (57) |
| 2021 |  | 338 |
|  |  | (71) |
| 2022 |  | 422 |
|  |  | (99) |
| 2023 |  | 489 |
|  |  | (138) |
| Total |  | 292 |
|  |  | (111) |

Table S6. National average Cost of a Healthy Diet (birr/day) in Ethiopia (April 2022 – March 2023)

|  |  |  |
| --- | --- | --- |
| **Period** |  | **Average CoHD (SD)**  **(ETB/day)** |
| April 2022 |  | 57 |
|  |  | (11) |
| May 2022 |  | 58 |
|  |  | (12) |
| June 2022 |  | 63 |
|  |  | (13) |
| July 2022 |  | 65 |
|  |  | (17) |
| August 2022 |  | 66 |
|  |  | (16) |
| September 2022 |  | 68 |
|  |  | (16) |
| October 2022 |  | 70 |
|  |  | (18) |
| November 2022 |  | 69 |
|  |  | (15) |
| December 2022 |  | 72 |
|  |  | (18) |
| January 2023 |  | 73 |
|  |  | (18) |
| February 2023 |  | 75 |
|  |  | (17) |
| March 2023 |  | 77 |
|  |  | (19) |
| Total |  | 68 |
|  |  | (17) |

1. The authors conducted a simple analysis of whether households reported any consumption of dairy from own-production (0/1) in the 2018-19 ESS to support this claim. [↑](#footnote-ref-2)