

Spatial variation in the cost and affordability of the global healthy diet basket: Evidence from household surveys in five African countries[☆]

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ABSTRACT

Since 2020, the Food and Agricultural Organization of the United Nations (FAO) expanded its global food security metrics, adding Cost and Affordability of a Healthy Diet (CoAHD). In 2022, they introduced a global Healthy Diet Basket (HDB) standard to estimate countries' CoAHD. This study adopts the HDB method along with prices derived from expenditure modules of 2018-19 household surveys from Burkina Faso, Ethiopia, Mali, Nigeria and Senegal to compute subnational indicators. Findings reveal HDB's efficacy in capturing local consumption patterns when combined with household-level unit prices, making it valuable in the absence of national food-based dietary guidelines. Findings also show that CoAHD indicators derived from national defined basket should be interpreted as lower boundaries, advocating for subnational baskets to guide policies aimed at improving access to healthy diets.

1. Introduction

Since the initial formulation of the cost of subsistence, defined as the “minimum cost of obtaining the amount of calories, proteins, minerals, and vitamins [...] accepted as adequate or optimum” (Stigler, 1945), many studies have estimated the cost of nutrient adequacy. The World Food Programme's “Fill the Nutrient Gap” initiative recently employed large-scale global linear programming techniques for this purpose. Masters et al. (2018) also analyzed access to internationally comparable standard of diet quality, tracking the cost of the lowest-cost way to include at least five food groups, as defined by the Minimum Dietary Diversity for Women (MDD-W) indicator, in Ghana and Tanzania. Other studies developed regional food-based dietary guidelines based on similarities among national dietary guidelines for estimating cross-country comparable cost of a recommended diet (CoRD) (Dizon and Herforth, 2018; Dizon et al., 2019).

Building on these studies, in 2020, for the first time, FAO introduced global and country level indicators on the cost and affordability of a healthy diet. In 2022, FAO launched a new global Healthy Diet Basket (HDB) standard to estimate and compare countries' national average cost and affordability of a healthy diet (CoAHD). These indicators, now integral components of the global food security and nutrition

monitoring framework, offer national and local governments a starting point to evaluate if their agrifood systems can ensure both physical and economic access to enough nutritious food for their populations to conduct active and healthy lives.

Although the FAO global indicators have garnered attention from many national governments, those estimations give only an overall indication of the agrifood system's status and progress towards universal access to healthy diets. However, they fall short in identifying specific bottlenecks within national agrifood systems. To inform policies and programs targeting specific population segments, governments have turned their focus to subnational estimations.

The use of CoAHD indicators at subnational levels has prompted concerns about applying the FAO HDB methodology (FAO, 2023), originally designed for global estimations, to estimate subnational CoAHD indicators. This paper aims to assess the possibility to use the FAO HDB methodology for estimating subnational CoAHD and investigate two methodological issues.

The first relates to the identification of the composition of a healthy diet basket in subnational estimations. The concern is that the HDB methodology lacks flexibility in item selection to reflect local consumption patterns, because the HDB food groups are fixed based on a selected number of Food Based Dietary Guidelines (FBDGs) (FAO,

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The second methodological issue pertains to the consistency between subnational and national estimations. One would expect that the number of people who cannot afford a healthy diet estimated at subnational levels would add up to the number of people obtained when assessing this at the national level. This is not necessarily the case. The paper discusses how subnational estimates should be aggregate to be consistent with national-level estimates. Similarly, discrepancies between estimations from national studies and global monitoring estimations of the CoAHD have already emerged, questioning the validity of the estimations themselves.

Using 5 case-studies from sub-Saharan Africa, the paper provides insights on these two methodological issues using a subnational analysis conducted at the administrative unit level for which statistical representative data are available. Finally, the paper provides some guidelines on critical elements that must be considered when performing subnational estimation of the cost and affordability of a healthy diet.

2. Methods

2.1. Cost of healthy diet

The cost of a healthy diet is estimated applying the FAO HDB methodology (FAO, 2023). The food basket comprises six food groups and sets a daily caloric requirement based on that of an active adult (2330 kcal/day). The food basket's composition is fixed and the same in terms of food groups for all administrative units and countries analyzed. The basket comprises 2 starchy staples (1160 kcal), 3 vegetables (110 kcal), 2 fruits (160 kcal), 2 animal source foods (300 kcal), 1 legume, nut or seed (300 kcal), and 1 oil or fat (300 kcal). However, the specific food items in the basket differ across countries and administrative units. In fact, for each administrative unit, the least-cost item(s) in each food group is selected. The least-cost item is the item whose price paid to buy enough quantity to meet the HDB food group caloric requirement is the lowest in that food group.

The two elements needed to compute an item's cost are a nutrient conversion table and market prices. This paper utilizes prices derived from household survey food expenditure modules (Section 3.2) and nutrient conversion tables specifically prepared by the FAO Statistics Division for each survey. These tables mainly draw data from the FAO/INFOODS Food Composition Table for Western Africa (2019) and follow FAO/INFOODS food matching guidelines (November 2012).

As prices are derived from self-reported expenditure, the assumption is that, in each administrative unit, prices of the most commonly consumed items are reported, and unreported items are considered unavailable or uncommon in that administrative unit. Consequently, the use of unit values from household surveys means that the basket composition reflects local prices, availability, and local consumption patterns of each subnational unit of analysis, although household preferences are not systematically accounted for, as done by Mahrt et al. (2019).

To calculate each item's cost, the amount of each food that would need to be purchased to satisfy the recommended calories for the entire HDB food group was calculated, accounting for the edible portion. Then, the daily cost of each item was computed by multiplying the price by the quantity to be purchased and dividing that by the number of items per group. Furthermore, to ensure intra-group food diversity, when different varieties of the same food (such as imported rice, local rice and long-grain rice) are available, only the least-cost variety is included in the selection. Once the least-expensive items - in terms of cost per day - in each food group are identified, the costs of all 11 items are summed to obtain the cost of a healthy diet in each administrative unit of each country.

2.2. Affordability of a healthy diet

The affordability of a healthy diet refers to people's capacity to acquire sufficient nutritious foods for a healthy life. This indicator measures economic access, quantifying the number of people lacking economic resources, either through own food production or income, to acquire a healthy diet. It does not assess the number of people actually not eating a healthy diet (FAO, IFAD, UNICEF, WFP and WHO, 2023).

To determine affordability, the cost of a healthy diet is compared with a standard of income. While Hirvonen et al. (2019) and Bai et al. (2021) estimate affordability by comparing diet costs to household total income, the SOFI reports adjust for non-food expenses, assuming 48 percent of expenditures are allocated to non-food expenditures. In this paper, similar to SOFI reports and to FAO (2023), to compute the affordability indicator the daily cost of a healthy diet basket is compared with a portion of income that can be credibly reserved for food. It is assumed that a minimum income must be reserved for non-food expenditures to satisfy other essential needs, like clothing, housing, health, and education.

However, there is not an obvious and straightforward way to quantify the income that can be credibly reserved for food. Different methods have been adopted. For example, following Ravallion (1998), there are many examples in the literature where the non-food component of a poverty line is set by observing the share of non-food expenditure of households whose total expenditure is equal to (or close to) the food poverty line. Similarly, the World Food Programme (2020) suggests identifying the reference household cohort by combining different criteria such as households with acceptable food consumption scores, who do not adopt negative coping strategies or receive in-kind food assistance. The cost-of-basic-needs approach (CBN) define a consumption bundle (including non-food goods) deemed to adequately satisfy certain basic needs, and then estimates its cost. For example, Allen (2017) includes in the non-food bundle housing, fuel, lighting, clothing and soap, intentionally leaving out education and medical care. Headey et al. (2023) propose an extension of Allen's method to systematically predict non-food expenditure requirements across countries and show why it may be problematic to assume that non-food costs are a fixed portion of food costs.

This paper identifies the reference cohort by using income quintile of each administrative unit analyzed. In particular, following Holleman and Latino (2023), it considers the lowest income quintile's average food expenditure share. The choice aligns with Herforth et al. (2020), where the average food expenditure share of the bottom quintile in low-income countries is assumed to be the portion of income that can be credibly reserved for food. However, and differently, in this paper, this share is allowed to vary across subnational units, acknowledging possible different levels of economic development and/or different needs within a country. In a cross-country analysis, Headey et al. (2023) warn about the risk of assuming that non-food costs are a fixed portion of food costs, and Holleman and Latino (2023) argues that the use of a national metric (food expenditure share by national income quintile) in a subnational analysis can be imprecise as the cost of non-food essential needs may significantly vary within a country. Furthermore, Holleman and Latino (2023) explore the possibility to use average food expenditure share of each national income quintile to define the income that can be credibly reserved for food; however, results proved to be less effective due to limited variability across income groups and even violations of Engel's Law in some countries.

In summary, in this paper a healthy diet is considered unaffordable when its cost exceeds the average food expenditure share of households belonging to the lowest quintile in each administrative unit. The percentage of people who cannot afford a healthy diet in each administrative unit is then calculated as a poverty headcount ratio; that is, the fraction of people whose share of income that can be credibly reserved for food is below the cost of a healthy diet. The number of people who cannot afford a healthy diet is obtained by multiplying these proportions

by the survey-estimated population in that administrative unit.

2.3. From subnational to national estimation

When a subnational analysis of the cost and affordability of a healthy diet is conducted, national level estimates are also usually presented, and further compared with FAO global monitoring estimations.

While some discrepancies may emerge between different studies, it is expected that the number of people who cannot afford a healthy diet in subnational units would add up to the national-level estimates within the same analysis. To investigate this, we compute national estimates following two approaches.

In the first approach, the national cost of a healthy diet is computed following the methodology described in section 2.1, but applying it at the national level. This involves defining a national healthy diet basket by selecting the least-cost item(s) in each food group nationally and summing the cost of the 11 items selected. Items' costs are obtained from national food item prices, which are derived as geometric mean of unit values reported in the entire country when at least three observations exist. The cost of the national healthy diet basket is then compared with the income households can credibly reserve for food. The food expenditure share of households in the bottom quintile of the national income distribution is used to identify this income. Finally, these percentages are multiplied by the survey-estimated national population to obtain the number of people who cannot afford a healthy diet.

In the second approach, national estimates of the cost of a healthy diet are obtained as a population-weighted average of each administrative unit's cost. Similarly, the percentage of people who cannot afford a healthy diet at country level is obtained as a population-weighted average of the percentages estimated in each administrative unit, while the number of people is calculated by summing the estimations from each administrative unit.

3. Data

3.1. Household surveys

The cost and affordability of healthy diets are estimated for five sub-Saharan countries (Burkina Faso, Ethiopia, Mali, Nigeria and Senegal), building on our earlier research on variations in the cost and affordability of a healthy diet along the rural-urban continuum (Holleman and Latino, 2023). Household surveys data from the Living Standards Measurement Studies, all conducted between 2018 and 2019, are utilized.

All surveys are representative at first administrative level, which is used in this analysis (see Appendix 1 for the list of administrative units).

The datasets include detailed food expenditure modules that allow deriving food prices for a large number of items (see Section 3.2 for more details), along with total household expenditure.

3.2. Food prices: variable construction and descriptive statistics

Food prices used for the calculation of the cost of a healthy diet are derived from household survey expenditure modules.

Household unit values were preferred to market prices for two main reasons. First, they are the source of the household expenditure data used for affordability calculations. Second, as mentioned in section 2.1, they allow for a self-selection of commonly consumed items in each subnational unit, providing insights into actual purchasing behaviors, and capturing a more nuanced understanding of consumer preferences and market trends. Furthermore, in a first exploratory analysis for our earlier research (Holleman and Latino, 2023), market prices were either unavailable or deemed insufficient due to quality concerns.

Each survey contained a detailed food expenditure module where households reported the quantity and the cost of each food item purchased in the previous 30 days (Burkina Faso, Mali, Nigeria, and Senegal) or 7 days (Ethiopia). For each purchase, the unit value is

Table 1
Number of food items – minimum, average, and maximum number across subnational unit and by food group.

Country	National		Sub-national administrative unit																				
	All food items		All food items		Staple foods		Vegetables		Fruits		Animal source foods		Pulses, seeds and nuts		Fats and oils								
	total		min	mean	max	min	mean	max	min	mean	max	min	mean	max	min	mean	max						
Burkina Faso	92		62	78	86	13	16	18	11	14	17	6	7	9	4	8	10	4	6	7			
Ethiopia	52		41	45	47	11	13	17	6	6	6	4	4	5	4	5	7	10	12	2	2		
Mali	94		75	83	88	16	19	21	14	17	18	5	7	9	15	18	20	4	7	9	5	6	
Nigeria	72		66	68	69	18	18	19	7	7	7	7	8	8	13	15	17	9	11	12	3	4	5
Senegal	94		77	82	89	15	17	22	14	17	18	6	7	9	17	19	21	7	9	11	5	7	8

Note: Only items suitable for a healthy diet are included. Items whose matching with food composition tables was considered poor are not included. The "National" column reports the total number of food items at country level. Columns under "Subnational administrative unit" heading report the minimum, average and maximum number of food items available in an administrative unit both when considered all together and by food group. Source: Authors' calculation.

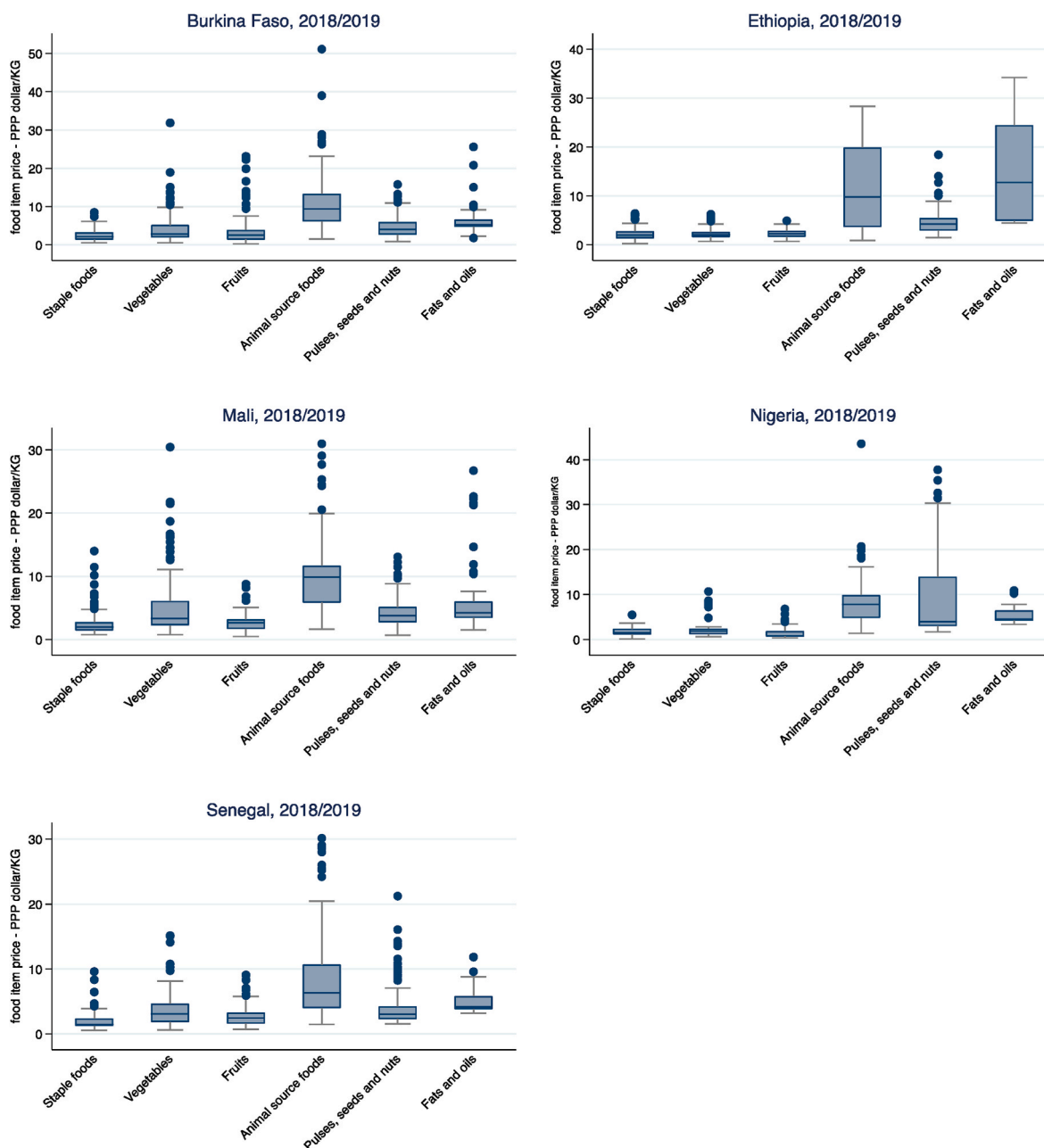


Fig. 1. Administrative level food prices by food group and country. Note: Each bar displays the median, 25th and 75th percentile range, and whiskers of 1.5 times that range of the administrative unit prices of all food items available for the 6 food groups. Only items suitable for a healthy diet are included. Items whose matching with food composition tables was considered poor (Level C2 as defined by FAO/INFOODS food matching guidelines (FAO, 2012)) are not included. Source: Authors' calculation.

estimated by dividing the amount spent by the quantity purchased. Unit values are then temporally deflated using the monthly food Consumer Price Index (CPI) before running the outlier detection, as data was collected in different months. The outlier detection is performed in two steps: first at the item and unit of measure level (that is, grouping food item purchases reported with the same unit of measure) and second at the item level (after converting all quantities to a standard unit of measure).

Due to high fluctuation in unit values of same food item across households in a specific geopolitical unit of analysis, a food item price is obtained as the geometric mean of the unit values in each administrative unit, as well as at the national level, provided there is a minimum of three observations of the same item; otherwise, they are excluded. Similarly, food items not reported in a specific administrative unit are

not imputed from other spatial units (e.g., national); rather, they are considered unavailable in that area. Finally, items with poor matching with food composition tables (that is level C2 according to FAO/INFOODS guidelines (FAO, 2012)) are excluded from the computation of the cost of a healthy diet. Table 1 reports summary statistics on the number of food items available for this calculation, while Fig. 1 shows the price variability within country by each food group.

Fig. 1 reflects both intra-group variability (different prices within each food group) and within-country variability (varying prices for the same food item across administrative units). Animal source foods always exhibit the highest variability, and Fig. 2 shows that it is mainly due to intra-group price variations.

Note that data was collected across different months, averaging out the effect of seasonality on price levels. The least-cost items chosen for

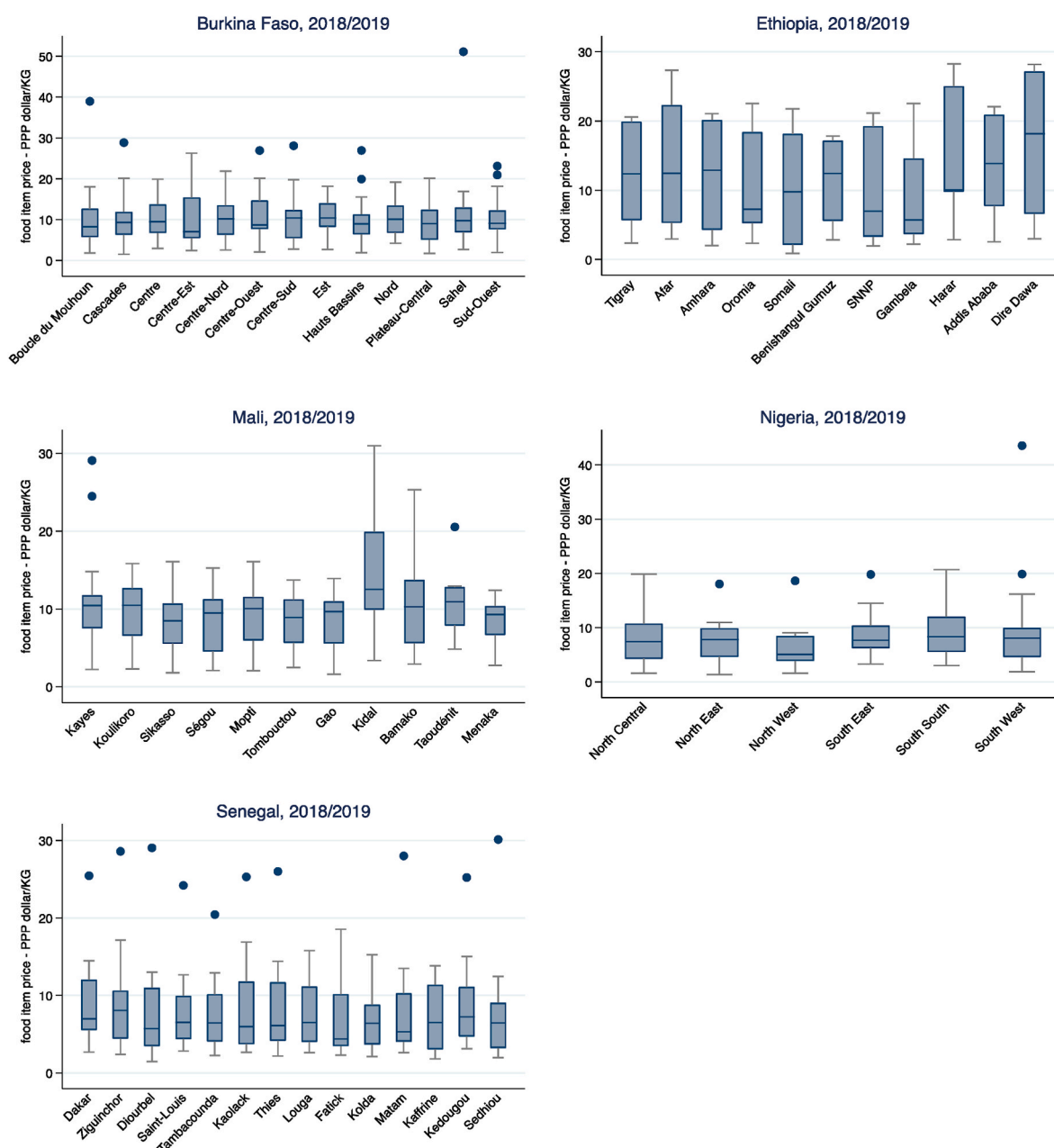


Fig. 2. Food price variation of items in “Animal source foods” group by region and country. Note: Each bar displays the median, 25th and 75th percentile range, and whiskers of 1.5 times that range of the administrative unit prices of all food items available for the 6 food groups. Only items suitable for a healthy diet are included. Items whose matching with food composition tables was considered poor (Level C2 as defined by FAO/INFOODS food matching guidelines (November 2012)) are not included. Figure shows that variability is mainly explained by the intra-group price variations. For example, in the region of Fatick in Senegal, in the animal source foods group you can find fresh fish (sardinella) for 2.3 PPP dollar/kg and cheese for 18.5 PPP dollar/kg. At the same time, the price for fresh fish (sardinella) range between 2 PPP dollar/kg in Sedhiou region and 3.5 PPP dollar/kg in Matam region. Source: Authors’ calculation.

the healthy food basket are therefore the least-cost items in each administrative unit during the year. While a seasonality analysis is important, it was not feasible here as only a few observations were available by season, or not even collected for all seasons, thus impeding obtaining robust price estimates.

The prices computed should be interpreted as crowdsourced prices. These may deviate from those collected in market surveys and from official CPI prices. In the analysis, high fluctuation in unit values of the same item do not necessarily reflect market volatility, but rather variations in quantity (as market prices vary according to the quantity purchased - for instance, bulk purchases versus single packages) and quality (as surveys ask for generic item rather than a specific brands or specific

varieties), other than market price. In other words, in household surveys, items are not standardized as in the price data collection run by governments. Thus, the quality and variety of a food item purchased is likely to be different across households, reflecting access, availability, and preferences. If the purpose of the analysis is to capture the lowest cost of food items that are being consumed, therefore ensuring they are accessible, available, and preferred, then using prices obtained from unit values of household surveys may be preferred.

There are some shortcomings in using unit values from household surveys. For example, as self-reported prices based on food expenditure recall, they are more susceptible to greater margins of error. Furthermore, household surveys occur only every three or more years, limiting

Table 2
Food expenditure share of households in the lowest income quintile by administrative unit and country.

	Burkina Faso	Boucle du Mouhoun	Cascades	Centre	Centre-Est	Centre-Nord	Centre-Ouest	Centre-Sud	Est	Hauts Bassins	Nord	Plateau-Central	Sahel	Sud-Ouest
Ethiopia	national	49%	49%	41%	40%	53%	47%	47%	50%	44%	49%	49%	58%	47%
		Tigray	Afar	Amhara	Oromia	Somali	Benishangul Gumuz	SNP	Gambela	Harar	Addis Ababa	Dire Dawa		
Mali	69% national	67%	67%	68%	72%	70%	72%	68%	75%	54%	55%	58%		
		Kayes	Koulikoro	Sikasso	Ségou	Mopti	Tombouctou	Gao	Kidal	Bamako	Menaka			
Nigeria	60% national	54%	59%	53%	66%	65%	59%	60%	62%	50%	61%			
		North Central	North East	North West	South East	South South	South West							
Senegal	70% national	71%	69%	71%	68%	68%	62%							
		Dakar	Ziguinchor	Diourbel	Saint-Louis	Tambacounda	Kaolack	Thies	Louga	Fatick	Kolda	Matam	Kaffrine	Sedhiou
	53%	50%	50%	52%	57%	50%	54%	51%	54%	52%	49%	58%	52%	47%

Note: Food expenditure shares for Ethiopia are obtained using authors' calculation on household food and total expenditure, rather than the consumption aggregates provided directly in the LSMS dataset. See [Appendix 3](#) for more details.

Source: Authors' calculation.

their utility for systematic monitoring or capturing current situations. Despite these shortcomings, however, using unit prices has been found useful in a recent study with a policy focus ([Adewopo et al., 2021](#)). They have also been used in various studies to compute the cost of a healthy diet ([Mahrt et al., 2019](#); [Mekonnen et al., 2021](#)). Furthermore, [Alemayehu et al. \(2023\)](#) identified similar basket compositions for all Ethiopian regions, although retail food price data collected by the Ethiopian Statistics Service were used to select the least-cost items in each food group.

3.3. Income: variable construction and descriptive statistics

This paper uses household expenditure (from the same 5 household surveys used to derive food item prices) as proxy for income to determine the share of income a household can credibly spend on food (that is, after they have satisfied other essential needs). Per capita income is obtained from the ready-to-use total household expenditure variable provided in the LSMS datasets, except for Ethiopian food expenditure shares, which are calculated separately (see [Appendix 3](#) for details). The variable is spatially deflated and accounts for gift, in-kind payments and own production.

The shares of expenditure that can be credibly reserved for food is set equal to the average food expenditure share of households in the lowest quintile of each administrative unit (see [Table 2](#)).

4. Results and discussion

4.1. Does the composition and cost of the healthy diet basket vary by administrative unit to reflect local consumption patterns?

FBDGs, developed by national governments, advise consumers on healthy eating based on various factors like a country's food production, sociocultural influences, food composition data, and accessibility. As they are context-specific, they are usually the starting point in identifying the composition of a healthy food basket in a cost and affordability analysis.

Nevertheless, quantified FBDGs are available for only a few countries. Thus, the HDB methodology applies recommendations of 10 quantified FBDGs, defining food group amounts as the median amounts of each food group recommended in these guidelines. The choice of the guidelines was based on the recency of their publication, full quantifiability, and being from diverse world regions. The resulting food group proportions approximate a larger range of FBDGs than the original ten and capture commonalities across national guidelines ([FAO, 2023](#)). Nevertheless, in subnational studies, the FAO HDB methodology's ability to reflect local consumption pattern has been questioned.

Although the use of national FBDGs should be always preferred, results from this study show that combining the FAO HDB methodology with crowdsourced prices allows for the selection of different items based, in part, on different consumer habits and food availability, even in a country like Ethiopia with limited food price data.

[Table 3](#) and [Table 4](#) report the detailed composition of the subnational healthy diet baskets in Ethiopia and Mali, as well as national baskets, identified following the methodology described in section [2.1](#) (see [Annex 1](#) for other countries).

With fewer food items available in each Ethiopian administrative unit (on average 45) compared to Mali (on average 83) (see [Table 1](#)), the basket composition shows greater within-country variability in Mali. This is particularly true for vegetables, as the three least-cost items in Ethiopia are the same across all administrative unit. Nevertheless, despite the limited number of items available, subnational baskets in Ethiopia show some variability within food groups, except "fats and oils".

The variability in basket composition is very similar to what was found in a recent study on the cost and affordability of a healthy diet in Ethiopia ([Alemayehu, et al., 2023](#)), which defined the basket using the

Table 3
Healthy diet basket composition in Ethiopia by administrative unit.

Administrative unit	Starchy staples		Vegetables		Fruits			Animal source foods		Legumes, nuts and seeds	Oils and fats
Tigray	Maize	Sorghum	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Beetroot	Onion	Avocado	Banana	Milk	Eggs	Linseed	Oils (processed)
Afar	Maize	purchased bread/ biscuit	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Beetroot	Onion	Avocado	Banana	Milk	Eggs	Sunflower	Oils (processed)
Amhara	Maize	Millet	Beetroot	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Carrot	Avocado	Mango	Milk	Eggs	Sunflower	Oils (processed)
Oromia	Maize	Millet	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Beetroot	Onion	Avocado	Mango	Cheese	Milk	Haricot Beans	Oils (processed)
Somali	Sorghum	Maize	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Beetroot	Onion	Banana	Mango	Cheese	Milk	Field Pea	Oils (processed)
Benishangul Gumuz	Maize	Sorghum	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Beetroot	Onion	Avocado	Mango	Milk	Eggs	SESAME	Oils (processed)
SNNP	Godere	Millet	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Beetroot	Onion	Avocado	Mango	Cheese	Milk	Haricot Beans	Oils (processed)
Gambela	Sorghum	Godere	Beetroot	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Onion	Avocado	Mango	Cheese	Milk	Vetch	Oils (processed)
Harar	Maize	Sorghum	Beetroot	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Onion	Avocado	Banana	Milk	Poultry	Haricot Beans	Oils (processed)
Addis Ababa	purchased bread/ biscuit	Maize	Beetroot	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Onion	Avocado	Banana	Milk	Cheese	Horsebeans	Oils (processed)
Dire Dawa	Maize	Sorghum	Beetroot	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Onion	Avocado	Mango	Milk	Eggs	SESAME	Oils (processed)
National level	Godere	Maize	Beetroot	kale, cabbage, Pumpkin Leaf, Lettuce, spinach	Onion	Avocado	Banana	Cheese	Milk	Haricot Beans	Oils (processed)

Note: The order of the food item in each food group is given by the rank cost, with the first item being the least-cost item in the group. National level refers to the national basket identified using the national prices of all food item available in the country. Grouping of multiple items in a column reflects the way in which food expenditures were grouped and reported in the survey.

Source: Authors' elaboration

Ethiopia's newly developed FBDG (2022), retail food price data from the Ethiopian Statistics Service, and the same methodology of this paper (i.e. the basket is defined by the least expensive combination of locally available items needed to meet dietary recommendations, per individual, per day). Although HDB used in this paper reflects commonalities across several national guidelines, while Alemayehu et al. (2023) adhered closely to the Ethiopian guideline, (FAO, 2023), the items selected within each food group are often the same. Both studies found a lack of cross-region variability in the “vegetables” group, with beetroot, cabbage and onion identified as least-cost vegetables in almost all regions. Milk emerged as a commonly selected least-cost item both in the “animal source foods” group of this study and in the “milk and dairy foods” group of Alemayehu et al. (2023), and avocado was consistently chosen as one of the least-cost fruits across all regions in both studies. For the “starchy staple” group, Alemayehu et al. (2023) report even a lower cross-region variability in the item definition than this study.

Geography seems to play a role in Mali. For example, “pork meat” is only included in the baskets of the three bordering regions: Sikasso, Ségou and Bamako, while “curd, yogurt” appears in three other bordering regions: Mopti, Timbuctú and Gao. Similarly, for fruit and vegetable, avocado appears only in the baskets of western regions and “nalta jute (Fakoye)”, a green leafy vegetable, solely in the basket of Sikasso, Ségou and Bamako.

Within-country variability highlights how using a nationally defined basket in subnational analysis could result in certain food items being included in areas where they are unavailable or more expensive. For example, “godere”, a starchy root, is in the Ethiopian national basket despite being consumed in only two of the ten administrative units analyzed. The second starchy staple, “maize”, would also be imposed in SNNP even though its costs was 20% higher than the second least-cost starchy staples in the region.

Similarly, in Mali, “pork meat” is one of the two animal source foods

Table 4
Healthy diet basket composition in Mali by administrative unit.

Administrative unit	Starchy staples		Vegetables			Fruits		Animal source foods		Legumes, nuts and seeds	Oils and fats
Kayes	Corn kernels	Sorghum	Dry okra	Dried tomato	Spinach leaves	Avocado	Mango	Powdered milk	Dried Fish	Shelled Peanuts	Cottonseed oil
Koulikoro	Sorghum	Corn kernels	Dry okra	Spinach leaves	Dried tomato	Avocado	Dates	Powdered milk	Cheese	Shelled Peanuts	Cottonseed oil
Sikasso	Corn kernels	Sorghum	Dry okra	Nalta jute (Fakoye)	Bean leaves	Mango	Avocado	Powdered milk	Pork Meat	Dried peas	Cottonseed oil
Ségou	Corn kernels	Mil	Dry okra	Dried tomato	Nalta jute (Fakoye)	Dates	Mango	Pork Meat	Powdered milk	Shelled Peanuts	Cottonseed oil
Mopti	Corn kernels	Mil	Dry okra	Dried tomato	Eggplant, Squash/ Zucchini	Mango	Dates	Powdered milk	Curd, yogurt	Coconut	Other oils n.e. s. (corn, soya, etc.)
Tombouctou	Mil	Sorghum	Dried tomato	Dry okra	Bean leaves	Dates	Mango	Powdered milk	Curd, yogurt	Shelled Peanuts	Cottonseed oil
Gao	Corn kernels	Sorghum	Dried tomato	Bean leaves	Dry okra	Dates	Mango	Powdered milk	Curd, yogurt	Shelled Peanuts	Other oils n.e. s. (corn, soya, etc.)
Kidal	Corn flour	Local or imported wheat flour	Dried tomato	Fresh onion	Potato leaves	Dates	Mango	Powdered milk	Cheese	Shelled Peanuts	Refined palm oil
Bamako	Corn kernels	Sorghum	Dry okra	Nalta jute (Fakoye)	Potato leaves	Avocado	Dates	Powdered milk	Pork Meat	Coconut	Red palm oil
Menaka	Sorghum	Corn kernels	Dry okra	Dried tomato	Green bean	Dates	Mango	Powdered milk	Smoked fish (catfish)	peanut paste	Refined palm oil
National level	Corn kernels	Sorghum	Dry okra	Dried tomato	Nalta jute (Fakoye)	Avocado	Dates	Pork Meat	Powdered milk	Shea nuts	Other oils n.e. s. (corn, soya, etc.)

Note: The order of the food item in each food group is given by the rank cost, with the first item being the least-cost item in the group. National level refers to the national basket identified using the national prices of all food item available in the country. Grouping of multiple items in a column reflects the way in which food expenditures were grouped and reported in the survey.

Source: Authors' elaboration.

in the national basket, yet its consumption is not reported in eight out of ten regions.

[Table 3] [Table 4] The different composition of healthy diet baskets together with the availability of subnational prices allow analyzing within-country cost variability, as shown in Fig. 3. This information is crucial for policy and programming, aiding in identifying and prioritizing areas of intervention. Furthermore, it can be decomposed to examine cost composition and understand major drivers of the diet cost.

Given the paper's focus on methodological issues, we will not discuss trends, similarities, or divergence across administrative units, but we only point to a commonality across the 5 case studies: the cost of the national healthy diet basket, defined using national price of all food items available in a country, is generally lower than subnational costs. The reason is purely a technical one and quite intuitive, as for each food group the least-cost item in the entire country is picked.

4.2. The national cost and affordability of healthy diet: how subnational estimates should be aggregate to be consistent with national level estimates?

Table 5 reports the results from two methods for computing the national cost and affordability of a healthy diet, as described in section 2.3.

The first method (column *a*, *c*, *e*) computes the cost and affordability by defining the composition of a national basket using the least-cost item (*s*) in each food group at the country level. With the second method (columns *b*, *d*, *f*), a national basket is not identified. Instead, it computes national cost and affordability indicators as population-weighted average of those estimated for each administrative unit.

In all case studies, the cost of a healthy diet basket is lower with the first method. Indeed, as mentioned in Section 4.1, this is because the least-cost item across the entire country is picked for each food group, resulting in the basket comprising the cheapest options available. Consequently, the first method estimates a lower share and number of

people unable to afford a healthy diet.

Although one might expect the numbers of people estimated at subnational levels to add up to the number obtained when affordability is assessed at national level, that is columns *c* and *d* would be the same, this is not the case in any of the five case studies.

This should not be surprising, as the composition of the national food basket differs from that of the subnational food baskets. What column *c* is actual counting is the share of people unable to afford the cheapest combination of items in the country. This is a hypothetical situation, as people in each administrative unit likely do not have access to that specific combination of food items. Therefore, (1) a national estimation based on a national healthy diet basket (column *c*) should be interpreted as the lower boundary of the affordability indicators, and (2) when conducting a subnational analysis, a national estimation should be obtained as population-weighted averages of subnational estimations.

4.3. Should national estimations derived subnationally and global monitoring estimation be the same?

Discrepancies between estimates of the cost and affordability of a healthy diet from national studies and the ones published every year by the FAO have already emerged, questioning the validity of the estimations themselves. Furthermore, the national estimations conducted in this study (see Table 5) differ from those reported in SOFI 2023; FAO, IFAD, UNICEF, WFP and WHO, 2023, with the latter being clearly higher. While both national estimations and the global monitoring follow the same methodology, the results are not directly comparable due to differences in data sources for prices and income distribution used in the calculation. Thus, discrepancies are not inconsistencies.

In the global monitoring estimations reported in SOFI, income distributions used for estimating affordability indicators are from the World Bank's Poverty and Inequality Platform, whereas this paper uses total household expenditure from household survey data as a proxy for income distribution.

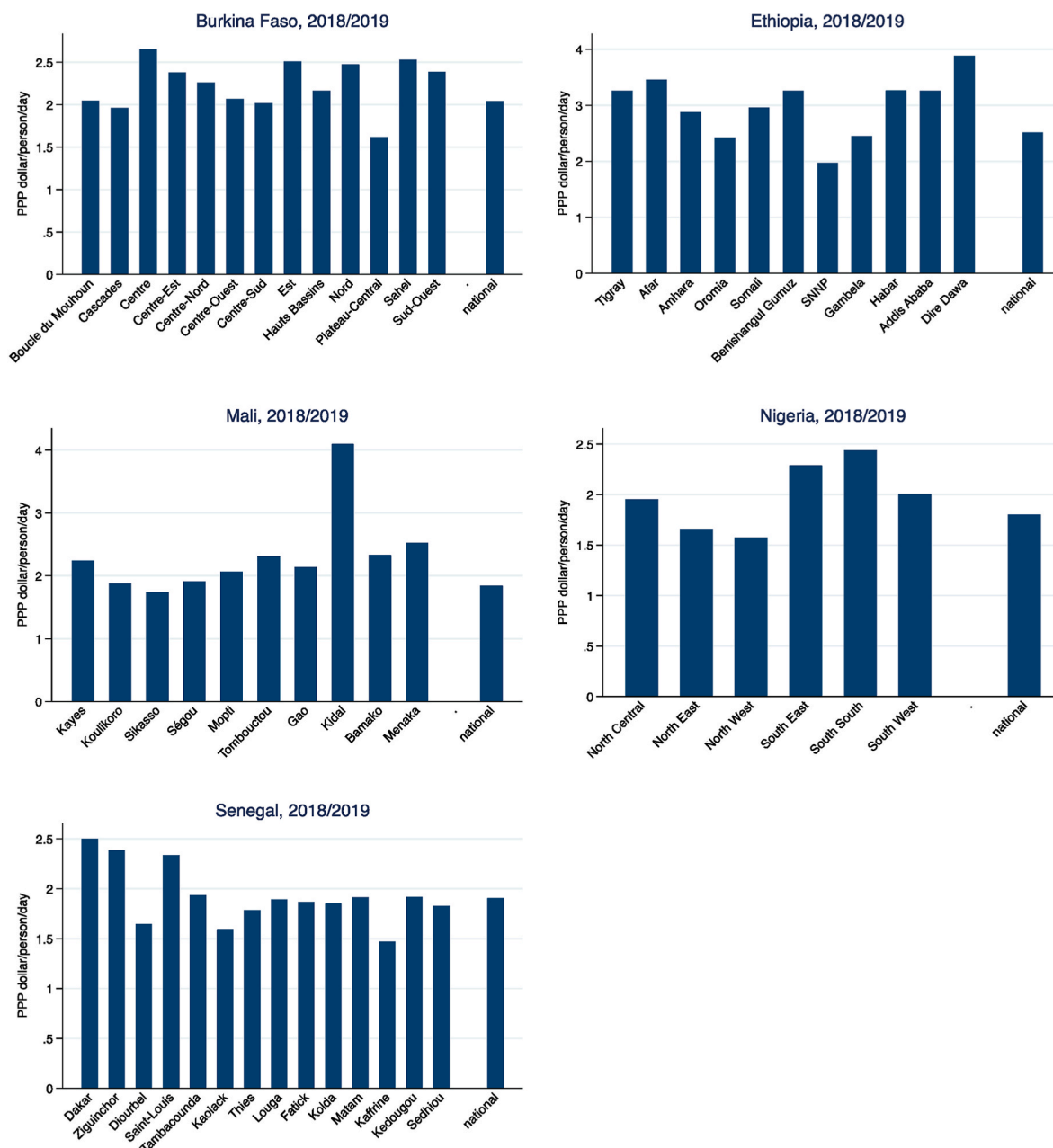


Fig. 3. National and subnational cost of a healthy diet basket by country. Note: the bar “national” in each panel refers to the cost of a national healthy diet basket identified using national price of all food item available in a country, which is the first approach described in section 2.3.

Source: Authors’ calculation.

Table 5

A comparison of national cost and affordability of a healthy diet using different methods.

Country	Cost of a healthy diet		People unable to afford a healthy diet			
	(PPP/dollars/day)		(%)		(millions)	
	national healthy diet basket (a)	subnational aggregation (b)	national healthy diet basket (c)	subnational aggregation (d)	national healthy diet basket (e)	subnational aggregation (f)
Burkina Faso	2.042	2.286	67.5%	74.4%	13.6	15.0
Ethiopia	2.511	2.572	73.0%	73.5%	67.9	68.4
Mali	1.844	2.035	28.1%	35.6%	5.5	6.9
Nigeria	1.804	1.914	44.3%	47.7%	66.0	71.1
Senegal	1.907	1.999	32.6%	34.2%	5.2	5.5

Note: The share and number of people who cannot afford a healthy diet in columns a and b do not include the region of Taoudénit in Mali.

Source: Authors’ calculation.

FAO global monitoring estimations use food item prices from the World Bank's International Comparison Program (ICP), whereas prices in this paper are derived from household surveys. The ICP was established for performing cross-country comparisons, collecting prices for "comparable" products that are often more expensive than the equivalent domestic item normally purchased by households. Consequently, ICP items prices generally do not capture locally consumed items, like teff in Ethiopia, and ICP feature fewer item compared to country food price monitoring systems or household consumption surveys.

Already, [Headey et al. \(2023\)](#) have noted that diet costs based on ICP prices appear higher than those estimated from other national price sources, such as prices collected for the CPI. In turn, prices from the CPI and those derived from household surveys differ. However, no unidirectional pattern has been found ([Schneider, 2022](#)). [Headey et al. \(2023\)](#) also show that some ICP countries have shorter food lists than others and this "product coverage bias" likely biases upwards the costs of several food groups.

Furthermore, many ICP products are only available in large urban stores and are unavailable in rural areas, thus neglecting significant price variations within countries. In contrast, prices derived from household survey expenditure modules better reflect typical household purchases and capture variations in price levels and item availability along the rural-urban continuum.

Difference in food price sources lead to another important divergence between global monitoring estimates and the national estimates in this paper: the composition of the food basket. The choice of the items comprising the basket is in fact driven by item costs. The composition of the national baskets is therefore different in the two estimations.

Finally, other than data sources, another divergence between global monitoring estimations and national estimations in this paper is in the calculation of income. While both estimations are based on the same assumption, in this paper the share of income that can be credibly reserved for food varies by administrative unit and is set equal to the average food expenditure share of households in the lowest income quintile in each administrative unit. In global monitoring estimations, this share is set equal to 52 percent for all countries, based on the average share of food expenditure in low-income countries reported on the national account expenditure data from the World Bank ICP.

Given these differences, discrepancies between global monitoring and national estimations should not be unexpected. On the other hand, any similarity should be interpreted as a coincidence, with divergences likely playing a compensating role.

5. Conclusion

In this paper we have explored some methodological issues related to the subnational estimation of cost and affordability of a healthy diet, providing evidence supporting the use of the FAO HDB methodology for subnational estimations.

The analysis of cost and affordability of healthy diet requires a non-trivial amount of information, which become even more burdensome when a subnational analysis is undertaken. An ad-hoc data collection would be ideal, but often it is necessary to rely on existing data, which presents significant challenges.

The first consideration is the existence of a national FDBG. Although a recent, quantifiable national FDBG should always be preferred, often this is unavailable. In these cases, the FAO HDB methodology can be effectively utilized. Contrary to concerns, our paper shows that when combined with crowdsourced food prices, the FAO HDB methodology allows for enough variation in item selection to partially reflect local consumption patterns.

The second element is the level of analysis. Should the basket be defined nationally or at subnational level? We found that the cost of a national healthy diet basket, based on a national identified basket, is generally lower than the subnational costs and always lower than the national estimation obtained by aggregating subnational costs. This

happens because in a national basket for each food group the least-cost item in the entire country is picked. The consequence is an underestimation of the people who cannot afford a healthy diet because people in a given administrative unit will likely not have access to the combination of the cheapest food items identified at national level.

Two lessons derive from this finding. First, ideally the item selection should always be done at subnational level and not a national level. Constructing a healthy diet basket at the national level may "impose" certain items in some geographical areas where they are culturally inappropriate, unavailable or, simply, not the least-cost solution. Secondly, when conducting a subnational analysis, national estimation should be obtained as population-weighted averages of subnational estimations. Cost and affordability of a national defined basket (where item selection is done at national level) should be interpreted as a lower bound of the cost and affordability indicators.

The third element that inevitably the analyst will look into is the source of food prices. In section 4.3, we discussed the advantages and limitations of using prices derived from household surveys versus prices collected by NSOs for the CPI calculations or the ICP program. [Herforth et al. \(2022\)](#) widely discuss different mechanisms and possible data sources for monitoring the cost of a healthy diet, including the possibility of establishing a short list of sentinel foods for which NSOs would share timely data. This list could come from the HDB item selection. However, extensive empirical testing and analysis are needed to make recommendations for the appropriate methodologies for specific countries to monitor subnational CoAHD.

Finally, the paper highlighted that the apparent inconsistency between national estimations from subnational studies and global monitoring estimations published annually by FAO are likely due to the different data sources used. This inevitably raises the question of which estimate is correct. This depends on the purpose of the analysis. National and global estimations have different objectives. Global monitoring aims to provide global evidence on people's capacity to afford a healthy diet and to increase countries' accountability towards the goal of making healthy diets affordable for all people at all times. Conversely, national and subnational analysis are meant to guide policy and programmes in defining specific areas along the agrifood chain where interventions can improve household's access to healthy diets.

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CRediT authorship contribution statement

Lucia Latino: Data curation, Formal analysis, Visualization, Writing – original draft. **Cindy Holleman:** Conceptualization, Formal analysis, Investigation, Methodology, Supervision, Validation, Visualization, Writing – review & editing. **Carlo Cafiero:** Validation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix 1. Household surveys

The cost and affordability of healthy diet are estimated for five sub-Saharan countries: Burkina Faso, Ethiopia, Mali, Nigeria and Senegal. Household surveys data from the Living Standards Measurement Studies, all conducted between 2018 and 2019, are utilized.

Table below report the administrative unit for which statistical representative indicators for the cost and affordability of a healthy diet were computed.

Table
Household surveys

Country	Survey	Geopolitical zone analyzed	Total number of households in the survey	Total estimated population
Burkina Faso	Enquête Harmonisée sur le Conditions de Vie des Ménages 2018–2019	13 (Boucle du Mouhoun, Cascades, Centre, Centre-Est, Centre-Nord, Centre-Ouest, Centre-Sud, Est, Hauts Bassins, Nord, Plateau-Central, Sahel, Sud-Ouest)	7010	20,151,668
Ethiopia	Socioeconomic Survey 2018–2019	11 (Tigray, Afar, Amhara, Oromia, Somali, Benishangul Gumuz, SNNP, Gambela, Harar, Addis Ababa, Dire Dawa)	6435	91, 245, 295
Mali	Enquête Harmonisée sur le Conditions de Vie des Ménages 2018–2019	10 (Kayes, Koulikoro, Sikasso, Ségou, Mopti, Tombouctou, Gao, Kidal, Bamako, Menaka)	6434	19,496,532
Nigeria	General Household Survey, Panel 2018–2019, Wave 4	6 (North Central, North-East, North-West, South-East, South-South, South-West)	4976	149,016,944
Senegal	Enquête Harmonisée sur le Conditions de Vie des Ménages 2018–2019	14 (Dakar, Ziguinchor, Diourbel, Saint-Louis, Tambacounda, Kaolack, Thies, Louga, Fatick, Kolda, Matam, Kaffrine, Kedougou, Sedhiou)	7156	15,967,381

Note: The region of Taoudénit in Mali is excluded from the analysis because there were not enough items in the fruit group. “Total number of households” refers to households used in the analysis.

Source: Authors’ elaboration.

Appendix 2. Healthy diet basket (HDB) composition by country and administrative unit

Table 7
Healthy diet basket composition in Burkina Faso by administrative unit

Administrative unit	Starchy staples		Vegetables		Fruits			Animal source foods		Legumes, nuts and seeds	Oils and fats
Boucle du Mouhoun	Mil	corn kernels	Dried tomato	Moringa, cassava leaves, taro leaves and other leaves	Eggplant, Squash/ Zucchini	Mango	Watermelon, Melon	Fresh milk	Beef Meat	Fresh peanuts in shell	Cottonseed oil
Cascades	corn kernels	Mil	Dried tomato	Eggplant, Squash/ Zucchini	Dry okra	Sweet Banana	Mango	Fresh milk	Dried Fish	Fresh peanuts in shell	Shea Butter
Centre	corn kernels	Sorghum	Eggplant, Squash/ Zucchini	Dry okra	Green bean	Avocado	Watermelon, Melon	Powdered milk	Dried Fish	Shelled Peanuts	Other oils n. e.s. (corn, palm kernel oil, soy
Centre-Est	corn kernels	Mil	Eggplant, Squash/ Zucchini	Dry okra	Moringa, cassava leaves, taro leaves and other leaves	Mango	Avocado	Beef Meat	Dried Fish	Cowpeas/ Dried beans	Other oils n. e.s. (corn, palm kernel oil, soy
Centre-Nord	Mil	corn kernels	Dried tomato	Eggplant, Squash/ Zucchini	Dry okra	Mango	Watermelon, Melon	Powdered milk	Dried Fish	Shelled Peanuts	Other oils n. e.s. (corn, palm kernel oil, soy
Centre-Ouest	Sorghum	corn kernels	Dried tomato	Eggplant, Squash/ Zucchini	Dry okra	Watermelon, Melon	Mango	Powdered milk	Dried Fish	Shelled Peanuts	Other oils n. e.s. (corn, palm kernel oil, soy
Centre-Sud	Sorghum	corn kernels	Dried tomato	Eggplant, Squash/ Zucchini	Dry okra	Avocado	Watermelon, Melon	Powdered milk	Beef Meat	Coconut	Other oils n. e.s. (corn, palm kernel oil, soy
Est	corn kernels	Mil	Eggplant, Squash/ Zucchini	Dry okra	Baobab Leaves (fresh or dried)	Watermelon, Melon	Avocado	Powdered milk	Dried Fish	Cowpeas/ Dried beans	Peanut Oil

(continued on next page)

Table 7 (continued)

Administrative unit	Starchy staples		Vegetables			Fruits		Animal source foods		Legumes, nuts and seeds	Oils and fats
Hauts Bassins	corn kernels	Mil	Dried tomato	Eggplant, Squash/ Zucchini	Dry okra	Avocado	Watermelon, Melon	Powdered milk	Beef Meat	Fresh peanuts in shell	Cottonseed oil
Nord	corn kernels	Sorghum	Dried tomato	Eggplant, Squash/ Zucchini	Dry okra	Mango	Sweet Banana	Powdered milk	Dried Fish	Cowpeas/ Dried beans	Other oils n. e.s. (corn, palm kernel oil, soy
Plateau-Central	corn kernels	Sorghum	Dried tomato	Eggplant, Squash/ Zucchini	Moringa, cassava leaves, taro leaves and other leaves	Watermelon, Melon	Mango	Smoked catfish, carp	Fresh milk	Coconut	Other oils n. e.s. (corn, palm kernel oil, soy
Sahel	Sorghum	corn kernels	Dried tomato	Eggplant, Squash/ Zucchini	Baobab Leaves (fresh or dried)	Avocado	Dates	Powdered milk	Dried Fish	Cowpeas/ Dried beans	Other oils n. e.s. (corn, palm kernel oil, soy
Sud-Ouest	corn kernels	Mil	Eggplant, Squash/ Zucchini	Dried tomato	Bean leaves	Mango	Sweet Banana	Fresh milk	Dried Fish	Fresh peanuts in shell	Shea Butter
National level	corn kernels	Sorghum	Dried tomato	Eggplant, Squash/ Zucchini	Dry okra	Watermelon, Melon	Avocado	Powdered milk	Dried Fish	Shea nuts	Other oils n. e.s. (corn, palm kernel oil, soy

Note: The order of the food item in each food group is given by the rank cost, with the first item being the least-cost item in the group. National level refers to the national basket identified using the national prices of all food item available in the country. Grouping of multiple items in a column reflects the way in which food expenditures were grouped and reported in the survey.

Source: Authors' elaboration.

Table 8

Healthy diet basket composition in Nigeria by administrative unit

Administrative unit	Starchy staples		Vegetables			Fruits		Animal source foods		Legumes, nuts and seeds	Oils and fats
North Central	Cassava - roots	Guinea corn/ sorghum	Leaves (Cocoyam, Spinach, etc.)	Garden eggs/ eggplant	Onions	Orange/ tangerine	Pineapples	Fresh milk	Fish - smoked	Groundnuts (Shelled)	Palm oil
North East	Cassava - roots	Millet	Garden eggs/ eggplant	Okra - dried	Leaves (Cocoyam, Spinach, etc.)	Mangoes	Avocado pear	Fresh milk	Cheese (wara)	Soya beans	Palm oil
North West	Cassava - roots	Guinea corn/ sorghum	Leaves (Cocoyam, Spinach, etc.)	Okra - dried	Onions	Mangoes	Orange/ tangerine	Cheese (wara)	Fresh milk	Soya beans	Palm oil
South East	Gari - white	Maize (Unshelled/ On the cob)	Okra - dried	Leaves (Cocoyam, Spinach, etc.)	Garden eggs/ eggplant	Mangoes	Pawpaw	Pork	Other meat (excl. poultry) (specify)	Groundnuts (Unshelled)	Other oil and Fat
South South	Gari - yellow	Maize (Unshelled/ On the cob)	Okra - dried	Garden eggs/ eggplant	Leaves (Cocoyam, Spinach, etc.)	Orange/ tangerine	Pawpaw	Mutton	Pork	Groundnuts (Shelled)	Palm oil
South West	Maize (Shelled/ Off the cob)	Gari - yellow	Okra - dried	Garden eggs/ eggplant	Leaves (Cocoyam, Spinach, etc.)	Mangoes	Bananas	Pork	Fish - smoked	Groundnuts (Shelled)	Palm oil
National level	Cassava - roots	Guinea corn/ sorghum	Okra - dried	Leaves (Cocoyam, Spinach, etc.)	Garden eggs/ eggplant	Mangoes	Pawpaw	Cheese (wara)	Fresh milk	Groundnuts (Shelled)	Palm oil

Note: The order of the food item in each food group is given by the rank cost, with the first item being the least-cost item in the group. National level refers to the national basket identified using the national prices of all food item available in the country. Grouping of multiple items in a column reflects the way in which food expenditures were grouped and reported in the survey.

Source: Authors' elaboration.

Table 9
Healthy diet basket composition in Senegal by administrative unit

Administrative unit	Starchy staples		Vegetables			Fruits		Animal source foods		Legumes, nuts and seeds	Oils and fats
Dakar	Corn kernels	Local rice (broken)	Dry okra	Eggplant, Squash/ Zucchini	Fresh onion	Dates	Avocado	Dried Fish (tambadiang, kong)	Powdered milk	Shelled Peanuts	Peanut Oil "ségal"
Ziguinchor	Corn kernels	Imported rice (whole)	Dry okra	Eggplant, Squash/ Zucchini	Cassava leaves, taro leaves and other leaves	Dates	Sweet Banana	Dried Fish (tambadiang, kong)	Fresh fish (yaboy ou obo - sardinelle)	Shelled Peanuts	Peanut Oil "ségal"
Diourbel	Corn kernels	Mil	Dried tomato	Dry okra	Carrot	Dates	Mango	Other smoked fish (kong fumé, yaboy ou obo fumé)	Dried Fish (tambadiang, kong)	Shelled Peanuts	Shea Butter
Saint-Louis	Local rice (whole)	Corn kernels	Dry okra	Eggplant, Squash/ Zucchini	Fresh onion	Dates	Sweet Banana	Dried Fish (tambadiang, kong)	Powdered milk	Shelled Peanuts	Peanut Oil "ségal"
Tambacounda	Sorghum	Mil	Dry okra	Eggplant, Squash/ Zucchini	Bean leaves	Dates	Mango	Dried Fish (tambadiang, kong)	Powdered milk	Shelled Peanuts	Peanut Oil "ségal"
Kaolack	Corn kernels	Mil	Dried tomato	Dry okra	Eggplant, Squash/ Zucchini	Mango	Dates	Other smoked fish (kong fumé, yaboy ou obo fumé)	Dried Fish (tambadiang, kong)	Shelled Peanuts	Peanut Oil "ségal"
Thies	Corn kernels	Mil	Dried tomato	Dry okra	Bean leaves	Dates	Mango	Other smoked fish (kong fumé, yaboy ou obo fumé)	Dried Fish (tambadiang, kong)	Shelled Peanuts	Peanut Oil "ségal"
Louga	Corn kernels	Mil	Dry okra	Bean leaves	Eggplant, Squash/ Zucchini	Dates	Mango	Dried Fish (tambadiang, kong)	Other smoked fish (kong fumé, yaboy ou obo fumé)	Shelled Peanuts	Refined peanut Oil
Fatick	Corn flour	Mil	Dry okra	Eggplant, Squash/ Zucchini	Peas	Dates	Mango	Dried Fish (tambadiang, kong)	Other smoked fish (kong fumé, yaboy ou obo fumé)	Shelled Peanuts	Refined peanut Oil
Kolda	Corn flour	Sorghum	Dry okra	Eggplant, Squash/ Zucchini	Bean leaves	Mango	Dates	Dried Fish (tambadiang, kong)	Other smoked fish (kong fumé, yaboy ou obo fumé)	Shelled Peanuts	Peanut Oil "ségal"
Matam	Corn kernels	Mil	Dry okra	Bean leaves	Eggplant, Squash/ Zucchini	Mango	Dates	Dried Fish (tambadiang, kong)	Other smoked fish (kong fumé, yaboy ou obo fumé)	Shelled Peanuts	Soy oil, vegetable oil (e.g., Ninaal, Jaara, etc.)
Kaffrine	Corn kernels	Mil	Dried tomato	Dry okra	Eggplant, Squash/ Zucchini	Dates	Mango	Other smoked fish (kong fumé, yaboy ou obo fumé)	Dried Fish (tambadiang, kong)	Shelled Peanuts	Refined palm oil
Kedougou	Cassava flours	Corn kernels	Dried tomato	Dry okra	Eggplant, Squash/ Zucchini	Avocado	Dates	Dried Fish (tambadiang, kong)	Other smoked fish (kong fumé, yaboy ou obo fumé)	Shelled Peanuts	Peanut Oil "ségal"
Sedhiou	Corn kernels	Mil	Dry okra	Eggplant, Squash/ Zucchini	Peas	Mango	Sweet Banana	Dried Fish (tambadiang, kong)	Powdered milk	Shelled Peanuts	Refined palm oil
National level	Corn kernels	Mil	Dried tomato	Dry okra	Eggplant, Squash/ Zucchini	Dates	Mango	Dried Fish (tambadiang, kong)	Other smoked fish (kong fumé, yaboy ou obo fumé)	Shelled Peanuts	Peanut Oil "ségal"

Note: The order of the food item in each food group is given by the rank cost, with the first item being the least-cost item in the group. National level refers to the national basket identified using the national prices of all food item available in the country. Grouping of multiple items in a column reflects the way in which food expenditures were grouped and reported in the survey.

Source: Authors' elaboration.

Appendix 3. Food expenditure shares in Ethiopia

In this study, the indicator of affordability is obtained by comparing the portion of household income that can credibly be reserved for food with the cost of a healthy diet. Indeed, it is assumed that a minimum of household income must be reserved for non-food expenditures to satisfy other essential needs, such as clothing, housing, health, and education.

Household expenditure is used as a proxy for income and is obtained from the household surveys. The shares of expenditure that can be credibly reserved for food is set equal to the average food expenditure share of households belonging to the lowest quintile of the income distribution of each administrative unit.

For Burkina Faso, Mali, Nigeria and Senegal, variables on total expenditure and food expenditure are the consumption aggregates provided directly in the LSMS dataset. However, for Ethiopia we proceed by calculating the household food and total expenditure from the household expenditure module.

To obtain the total household food expenditure, the non-reported values (such as for gift and own produce) were estimated by multiplying the reported quantities consumed by the median unit values from the smallest spatial unit that includes the household where there was a minimum of three observations of the same item-unit combination. “Chewables” items were not considered as food. To account for outliers and data reporting errors, all per-adult equivalent quantities and values were winsorized at the 98 percent level (cuts at 1 and 99) before and after the non-reported value data were estimated.

To obtain the non-food expenditure, twelve-month non-food expenditures, education expenses, health expenses and rent were included. Estimated rent was imputed to households who didn't report rent. Housing variables were used in a hedonic estimation of the rent. Both the non-food aggregates and the total non-food expenditure were winsorized at the 98 percent level.

Ethiopia dataset was treated differently than the other 4 country dataset because the food expenditure shares obtained by using the consumption aggregates available in the LSMS dataset were considered too high. See Table 10 for a comparison of the food expenditure shares obtained by using either LSMS consumption aggregates or our own calculations.

However, the impact on the final variable of interest, that is the percentage of people unable of afford a healthy diet basket, was marginal (see Table 11), and as expected the use of lower food expenditure shares pushed slightly up the affordability measures.

Table 10

Comparison of food expenditure shares of households in the lowest income quintile by administrative unit in Ethiopia

LSMS consumption aggregates	national	Tigray	Afar	Amhara	Oromia	Somali	Benishangul Gumuz	SNNP	Gambela	Harar	Addis Ababa	Dire Dawa
	83%	79%	81%	83%	85%	77%	85%	82%	78%	80%	69%	81%
authors' consumption aggregates	national	Tigray	Afar	Amhara	Oromia	Somali	Benishangul Gumuz	SNNP	Gambela	Harar	Addis Ababa	Dire Dawa
	69%	67%	67%	68%	72%	70%	72%	68%	75%	54%	55%	58%

Source: Authors' calculation.

Table 11

Comparison of affordability measure in Ethiopia based on different food expenditure shares

	People unable to afford a healthy diet	
	(%)	(millions)
LSMS consumption aggregates	71.1%	66.2
Authors' consumption aggregates	73.5%	68.4

Source: Authors' calculation.

References

- Adewopo, J., Solano-Hermosilla, G., Colen, L., Micale, F., 2021. Using crowd-sourced data for real-time monitoring of food prices during the COVID-19 pandemic: insights from a pilot project in northern Nigeria. *Global Food Secur.* 29, 100523 <https://doi.org/10.1016/j.gfs.2021.100523>.
- Alemayehu, D., Bachewe, F., Genye, T., Gilbert, R., Haile, H., Headey, D., Tessema, M., 2023. Implementation of the Ethiopian food-based dietary guidelines: analysis of cost and affordability of healthy diets, January 2020 - December 2022. *Food Science and Nutrition Research Directorate Scientific Newsletter*. <https://ephi.gov.et/wp-content/uploads/2023/08/Scientific-Newsletter-Analysis-of-Cost-and-Affordability-of-Healthy-Diet-using-Ethiopia-FBDG-.pdf>.
- Allen, R.C., 2017. Absolute poverty: when necessity displaces desire. *Am. Econ. Rev.* <https://doi.org/10.1257/aer.20161080>.
- Bai, Y., Alemu, R., Block, S.A., Headey, D., Masters, W.A., 2021. Cost and affordability of nutritious diets at retail prices: evidence from 177 countries. *Food Pol.* 29 <https://doi.org/10.1016/j.foodpol.2020.101983>.
- Dizon, F., Herforth, A., 2018. The cost of nutritious food in South Asia. In: *World Bank Policy Research Working Paper* (8557). <https://openknowledge.worldbank.org/server/api/core/bitstreams/080fe58a-5c9c-580a-b5ed-a1d767f72c76/content>.
- Dizon, F., Herforth, A., Wang, Z., 2019. The cost of a nutritious diet in Afghanistan, Bangladesh, Pakistan, and Sri Lanka. *Global Food Secur.* 21 <https://doi.org/10.1016/j.gfs.2019.07.003>.
- FAO, 2012. *FAO/INFOODS. Guidelines for Food Matching Version 1.2*. FAO, Rome.
- FAO, 2023. The cost and affordability of a healthy diet (CoAHD) indicators: methods and data sources. Suggested reading in FAOSTAT domain on Cost and Affordability of a Healthy Diet Rome. Online at: <https://files-faostat.fao.org/production/CAHD/Methods/Brief-FAOSTAT-CoAHD-indicators.pdf>.
- FAO, IFAD, UNICEF, WFP, WHO, 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, Rome.
- Headey, D., Hirvonen, K., Alderman, H., 2023. Estimating the Cost and Affordability of Healthy Diets How Much Do Methods Matter? *IFPRI Discussion Paper* 02179.
- Herforth, A., Bai, Y., Venkat, A., Mahrt, K., Ebel, A., Master, W.A., 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. *FAO Agricultural Development Economics Technical Study* (9). <https://doi.org/10.4060/cb2431en>.
- Herforth, A., Venkat, A., Bai, Y., Costlow, L., Holleman, C., Masters, W., 2022. Methods and options to monitor the cost and affordability of a healthy diet globally. In: *FAO (Ed.), Background Paper for the State of Food Security and Nutrition in the World 2022*. Rome.
- Hirvonen, K., Bai, Y., Headey, D., Masters, W.A., 2019. Affordability of the EAT–Lancet reference diet: a global analysis. *Lancet Global Health* 8 (1). [https://doi.org/10.1016/S2214-109X\(19\)30447-4](https://doi.org/10.1016/S2214-109X(19)30447-4).
- Holleman, C., Latino, L., 2023. Variations in the subnational cost and affordability of a healthy diet for selected countries in Africa – background paper for the State of Food Security and Nutrition in the World 2023. In: *FAO Agricultural Development Economics Working Paper*, No. 23-10. <https://doi.org/10.4060/cc9153en>.
- Mahrt, K., Mather, D., Herforth, A., Headey, D., 2019. Household dietary patterns and the cost of a nutritious diet in Myanmar. In: *IFPRI Discussion Paper* (1854). <https://doi.org/10.2499/p15738coll2.133344>.
- Master, W.A., Bai, Y., Herforth, A., Sarpong, D.B., Mishili, F., Kinabo, J., Coates, J.C., 2018. Measuring the affordability of nutritious diets in Africa: price indexes for diet diversity and the cost of nutrient adequacy. *Am. J. Agric. Econ.* 100 (5), 1285–1301. <https://doi.org/10.1093/ajae/aay059>.
- Mekonnen, D., Akerele, D., Achterbosch, T., de Lange, T., Talsma, E., 2021. Affordability of healthy and sustainable diets in Nigeria. *Front. Sustain. Food Syst.* 5 <https://doi.org/10.3389/fsufs.2021.726773>.
- Ravallion, M., 1998. Poverty lines in theory and practice. In: *Living Standards Measurement Study Working Paper* (133). <https://doi.org/10.1596/0-8213-4226-6>.

Schneider, K., 2022. Nationally representative estimates of the cost of adequate diets, nutrient level drivers, and policy options for households in rural Malawi. *Food Pol.* 113 <https://doi.org/10.1016/j.foodpol.2022.102275>.

Stigler, G.J., 1945. The cost of subsistence. *J. Farm Econ.* 27 (2), 303–314. <https://www.jstor.org/stable/1231810?origin=JSTOR-pdf>.

World Food Programme, 2020. Minimum expenditure basket. In: Guidance Note. Rome: WFP. <https://docs.wfp.org/api/documents/WFP-0000074198/download/>.