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The Cost of a Nutritious Diet in Bangladesh, Bhutan, India, and Nepal

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Abstract

This paper calculates and compares the minimum cost of a recommended diet across four countries in South Asia. The analysis finds that the cost of a recommended diet is highest in the smaller countries, such as Bhutan and Nepal, but because of differences in purchasing power, more households are unable to afford the cost of a recommended diet in India. Within countries, the cost and affordability vary across urban and rural areas, subnational areas, and seasons of the year. The cost of perishable food items, such as vegetables and fruits, drives the differences across subnational areas and seasons. In a context of constrained resources, this suggests the need for strategic prioritization of investments and service improvements in transport and storage of food and, more broadly, a rethink of food policies.

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1 Introduction

The recent State of Food and Nutrition Security (SOFI) report stressed that access to both food and healthy diets remain paramount global concerns. While the critical link between food security and nutrition hinges on food consumption and diet quality, healthy diets remain too costly and unaffordable to many. Using 2017 price data for 170 countries, the report shows that a healthy diet cost 60 percent more than a diet which only meets essential nutrients and five times more than a diet which only satisfies energy needs via a starchy staple.[1] Globally, it is estimated that 3 billion people are unable to afford the healthy diet. In Africa and South Asia, about 57 percent of the population is unable to afford the healthy diet. In this paper, we estimate the cost and affordability of healthy nutritious diets in Bangladesh, Bhutan, India, and Nepal.

Healthy diets are particularly crucial in South Asia, a region which continues to face various forms of malnutrition. Child undernutrition rates are high in the region. In 2019, 31.7 percent of children under the age of five in South Asia were stunted, comparable to 31.5 percent and 34.5 percent of stunted children in Central Africa and East Africa, respectively. Of the 144 million children stunted globally, 56 million are in South Asia. Child wasting rates are highest in South Asia, with 14.3 percent of children experiencing wasting, double the global prevalence of 6.9 percent (UNICEF/WHO/WB, 2020). Alongside child undernutrition, the prevalence of diet-related non-communicable diseases among adults is also increasing. Between 2000 to 2016, the prevalence of adult overweight has increased from 12 to 18 percent and the prevalence of adult obesity has increased from 2.6 to 5.6 percent (The Global BMI Mortality Collaboration, 2016). Among adults, the prevalence of diabetes in 2014 was 9.4 percent, the prevalence of raised blood pressure in 2014 was 26 percent, and the prevalence of raised cholesterol in 2008 was 29 percent.[2] Many of the countries in the region are not on track to reach the 2025 global nutrition targets.[3] Of the eight targets, Afghanistan, Bhutan, India, and Maldives are on track for none of the targets; Nepal and Sri Lanka are on track for one of the targets; and Bangladesh and Pakistan are on track for two of the targets (2020 Global Nutrition Report, 2020).

Understanding the constraints to healthy diets is becoming a more important concept in development. It is now well understood that simply meeting caloric needs is insufficient. That goal has been largely achieved, while it has not necessarily translated into healthy diets. Understanding the extent of the constraints to healthy diets is important as it helps decision makers gauge how much food security is still at risk. Moreover, the food system as a backdrop becomes key, because

[1] The 2020 SOFI report defined three types of diet: "Energy sufficient diet" provides adequate calories for energy balance for work each day. This is achieved using only the basic starchy staple (e.g. maize, wheat or rice only). "Nutrient adequate diet" not only provides adequate calories (per the energy sufficient diet above), but also relevant nutrient intake values of 23 macro- and micronutrients to prevent deficiencies and avoid toxicity. "Healthy diet" provides adequate calories and nutrients (per the energy sufficient and nutrient adequate diets above), but also includes a more diverse intake of foods from several different food groups to help prevent malnutrition in all its forms, including diet-related non-communicable diseases. The nutritious diet discussed in this paper falls under the "healthy diet" category because it is based on country-specific food-based dietary guidelines (FBDGs), which is an increasingly common practice used by governments to promote healthy diet.

[2] Food Systems Dashboard (https://foodsystemsdashboard.org) from various sources: FNCD Risc http://ncdrisc.org/, and WHO Global Health Observatory https://www.who.int/gho/ncd/risk_factors/blood_glucose/en/, and WHO

[3] Anemia, low birthweight, childhood stunting, childhood wasting, childhood overweight and obesity, adult obesity, and adult diabetes.

achieving healthy diets requires not only improving food production but also ensuring better access.

Over the past few years, a suite of indicators has been developed to measure the affordability of nutritious food consumption (Cost of Nutritious Diets Consortium, 2018). In this paper, we use a method called the Cost of a Recommended Diet or CoRD, defined as the minimum cost of meeting recommended food-based dietary guidelines (FBDGs). This method has been applied elsewhere. The pioneering work on CoRD was conducted in Ghana. There, Herforth et al. (2019) employed the CoRD method to estimate the lowest possible cost to meet the Ghanaian national FBDG. This study found that it was more expensive to meet recommended intake for vegetables and fruits compared to that for starchy staples and the cheapest forms of protein foods, and that Ghanaians underspent on vegetables and fruits. By using food price data collected for monitoring the CPI, the Ghanaian government has streamlined the CoRD calculation and thus tracks CoRD routinely.

CoRD has since been applied to India and Myanmar. In India, Ragunathan et al. (2019) used nationally representative rural price and wage data from 2001 to 2011 to estimate CoRD for rural areas. That paper gauged affordability of CoRD by benchmarking CoRD with female and male wages for unskilled laborers. Although the study showed that nutritious diets became more affordable over time, CoRD still constituted about 50-60 percent (70-80 percent) of male (female) daily wages. Costs of dairy and starchy staples accounted for over half of CoRD in 2011, followed by costs of fruits and vegetables. This paper also noted a strong seasonality of fruit and vegetable prices. CoRD in India was also calculated using 2011 household survey data in a recent report (Dizon & Wang, 2020). This report showed that CoRD was 30 percent higher than what was actually spent on food. In Myanmar, Mahrt et al. (2019) applied a modified version of the CoRD method (called the Food Preferences CoRD-FP) which uses food group prices that reflect typical food consumption preferences. CoRD is a lower-bound estimate because it selects the cheapest items in a food group, without accounting for food preferences, which the CoRD-FP accounts for. Costs of animal-sourced foods and vegetables accounted for half of the CoRD-FP, and 52 percent of the Myanmar households had food expenditures below the CoRD-FP. This study also found that people in Myanmar over-consumed staples and under-consumed nutrient-dense food groups.

This paper presents estimations of the cost and the affordability of healthy nutritious diets in South Asia. It complements the global cross-country analysis on cost of diets by providing more in-depth regional and country-specific assessments to aid policy makers in better understanding diet affordability in their specific context. This paper is an extension of a recent paper which measured the cost of a nutritious diet in four countries in South Asia, namely Sri Lanka, Pakistan, Afghanistan, and Bangladesh (Dizon, Herforth, and Wang, 2019). That previous paper focused on three sets of analyses. First, that paper calculated CoRD in each of the four countries. Second, it compared CoRD against actual food expenditures for the total diet and for each of the different component food groups which form the diet. This allows for a means to assess whether households, on average, are able to afford the recommended FBDGs. Third, it described the subnational differences in CoRD and affordability, thereby aiding policy makers in gauging where cost is a more binding constraint. That paper finds that, across those four countries, households typically overspend on staples and protein foods and underspend on dairy and vegetables, and that the variation in prices across subnational areas is to a larger extent driven by the variability in vegetable prices than by the variability in the staple prices.

Similar to that prior paper, the centerpiece of the analysis is to consider recommended FBDGs as the benchmark healthy diet. FBDGs are a representation of diets that include but also go beyond basic nutrients to encompass foods toward the aim of overall protection of health. Moreover, the official national FBDGs are developed by experts and involve in-country dialogue and careful consideration of the local context, such as considering the availability of certain foods. Thus, an FBDG, not only reflects a science-based benchmark diet, but it reflects one that is context-relevant, built with consensus, and endorsed by the government.

This paper expands on the previous paper in two ways. First, the coverage of this paper is on Bangladesh, Bhutan, India, and Nepal. Both papers combined, therefore, provide consistent and comparable CoRD analysis for seven of the eight countries in the South Asia region (excluding Maldives). Like the previous paper, the analysis includes calculation of CoRD, comparison against actual food expenditures to gauge affordability, and subnational analysis of CoRD and affordability. Second, this paper adds an assessment of how CoRD and affordability vary across seasons of the year.

The contribution of this paper lies in providing policy makers a country-level assessment of the affordability of diets. This paper identifies where and when the cost of diet is high or income is low, and it assesses the differences in the cost of meeting the recommended needs for different food groups.

2 Methodology and data

2.1 Methodology

CoRD is an estimate of the minimum daily cost of achieving the recommended diet for an average adult, based on FBDGs (Cost of Nutritious Diets Consortium 2018).[4] To calculate CoRD, two pieces of information are needed, the price of each food item (section 2.2) and the recommended quantities of consumption of food as per FBDGs (section 2.3). CoRD is calculated as:

$$CoRD = \sum_{i}^{7}((\frac{S_{il} + S_{iu}}{2}) \times (\frac{P_{i1} + P_{i2}}{2}))$$

where for each of seven food groups i, S_{il} and S_{iu} denote the lower and upper bound number of recommended servings for that food group, and P_{i1} and P_{i2} denote the two lowest prices per serving for that food group.

Calculating CoRD is further outlined in Dizon et al. (2019), and involves the following steps:

- *Grouping food items*: categorize each food item in a food list according to the seven FBDG food groups: starchy staples, vegetables, dark green leafy vegetables (or DGL vegetables), fruits, protein foods, dairy, and fats and oils.[5]

[4] Because CoRD is based on FBDGs it is often advised for the general population and may not fully meet those of specific target groups with higher nutrient needs. Only some of the countries we study have gender and age-specific FBDGs. India is the only one with a female-specific FBDG, which precludes us from assessing against a female-specific benchmark. Moreover, while FBDGs consider the culturally acceptable diet, it does not necessarily reflect food preferences.

[5] In case of duplicate food items, only the lowest cost option is kept.

- *Pricing each item*: convert the price for each food item into price per edible serving, measured in grams.
- *Pricing each group*: for each of the seven groups, take the average of the two items with the lowest price per edible serving,[6] and multiply this by the average of the lower- and upper-bound number of servings recommended for that food group.[7]
- *Summing price across groups*: sum the price per recommended grams across the seven food groups.

CoRD is compared across countries. To gauge affordability, it is analyzed against actual food expenditures in a given country. To compare CoRD across countries with different survey years and with different purchasing powers, local currencies are converted into 2011 PPP $.[8] Comparing CoRD to food expenses is a crude but important initial step to gauge affordability.[9] Particularly, we estimate both the *share* and the *number* of households which spend less on food than what it would have cost (at the very least) to meet the recommended diet.[10,11] Within each country, we further evaluate CoRD and affordability across different subnational geographic areas and across different time periods in a year. Various methodological choices in this paper were guided by the goal of presenting a more conservative lower-bound CoRD. This includes the choice to use the average price of the two lowest-cost items instead of the median price in a list of items of a food group, the choice to use household survey data instead of CPI data which have shorter food lists, and the choice to use the median unit value instead of the mean unit value to deduce food prices. These are discussed further below.

2.2 Data

Table 1. Summary of household survey data

Country	Survey/Year	Food items	Sample size	Subnational areas	Time periods in a year
Bangladesh	2016 Household Income and Expenditure Survey (HIES)	82	45,814	64 districts	Four periods: Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec

[6] Except for vegetables, where the three cheapest items are selected, one of which must be a dark green leafy vegetable (DGLV), as specified in the regional FBDGs.

[7] An alternative method is to take the median price in the list of food items in a given group, as opposed to the average price of the two cheapest items. Doing so would nearly double the calculated CoRD (see Dizon et al., 2019).

[8] The conversion factor is equal to $(inflation_0/inflation_t) \div p$, where $inflation_0$ denotes the inflation index in a country in 2011, $inflation_t$ denotes the inflation index in a country in the year when the household survey used here was conducted, and p denotes the PPP (private consumption) per 2011 $ for that country in 2011. Inflation index data was acquired from the IMF World Economic Outlook Database (https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx) and 2011 PPP $ data was acquired from the World Bank International Comparison Program (https://datacatalog.worldbank.org/dataset/international-comparison-program-2011).

[9] An alternative method is to compare CoRD against total household expenses, as opposed to food expenses. Doing so would drastically bring down the share of households spending less than CoRD (See Dizon et al., 2019).

[10] For each country, we calculated per AME food expenses spatially adjusted at the stratum level and household weights were used. The AME scale for Bangladesh (Waid et al. 2017) was applied to all the countries.

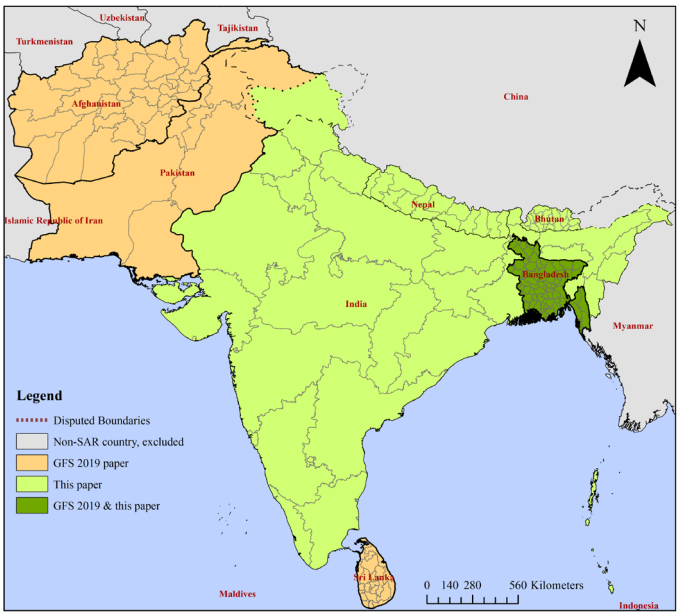
[11] To make it comparable to CoRD, our measure of food expenses similarly excludes expenses on food items under the food categories sweets, spices, and beverages.

Bhutan	2012 Bhutan Living Standards Survey (BLSS)	95	11,618	20 districts	No time periods reported
India	2011 National Sample Survey (NSS)	87	101,662	35 states	Three periods: Nov-Feb (Winter), Mar-June (Summer), July-Oct (Monsoon)
Nepal	2016/17 Annual Household Survey (AHS)	52	4,496	14 zones	Four periods: Dec to Mar (Winter), Mar to Jun (Pre-monsoon), Jun-Sep (Monsoon), Sep- Dec (Post-Monsoon)

Note: For Nepal, all seasons are captured from the middle of the initial month to the middle of the end month.

Food consumption and prices are calculated from four household surveys (see Table 1). While all surveys were conducted within the past 10 years, the data for Bhutan and India are much less recent (2011/12) than the data from Bangladesh and Nepal (2016/17). We note that the Nepal household survey has fewer food items in its food list than that for Bangladesh, Bhutan, and India.[12] Thus, the results should be interpreted with these limitations in mind. All household surveys are nationally representative, and are representative at certain subnational areas, including for districts in Bangladesh and Bhutan, for states in India, and for zones in Nepal. This allows for evaluation of CoRD in subnational areas. Except for Bhutan, each of the other household surveys provide data separately for given periods within a year, allowing for an evaluation of CoRD across seasons.

Figure 1. Data geographical coverage



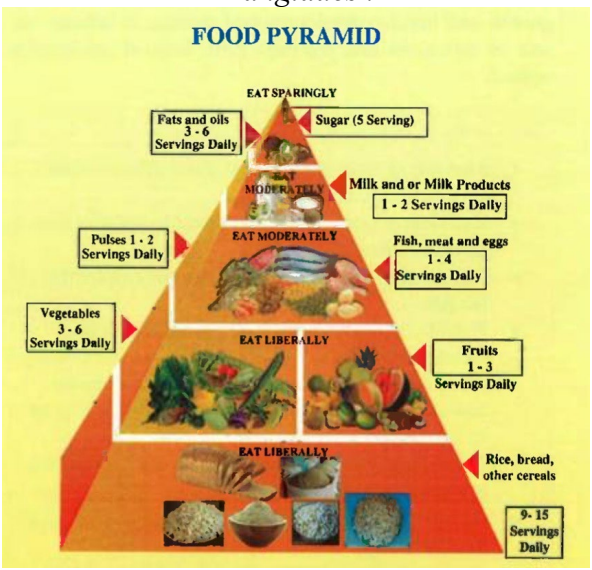
[12] The number of food items by food group for each country is presented in Annex Table A1.

Figure 1 shows the geographical coverage of this paper and the data used, against the coverage in the earlier paper from Dizon et al. (2019). The earlier paper covered four countries: Afghanistan, Pakistan, Sri Lanka, and Bangladesh. This current paper covers four countries: Bangladesh, Bhutan, India, and Nepal. Bangladesh is covered in both papers, which allows us to track whether any minor methodological changes between the papers leads to differences in results. Together, this and the earlier paper cover seven of the eight countries in South Asia, excluding only Maldives from the analysis.

Food prices are deduced from *unit values* in the food consumption module of the household surveys.[13] To calculate a unit value for a given food item, we divide the total amount spent by the total amount consumed for each household. We then take the median unit value across households nationally, as well as across households at the subnational level or across seasons.[14,15]

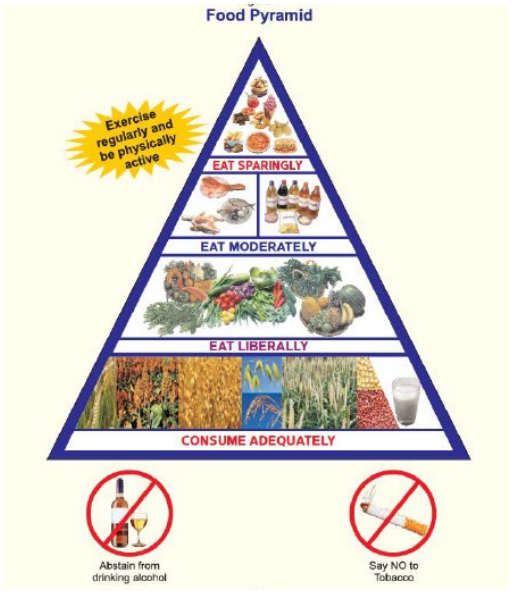
Figure 2. Food pyramids

Bangladesh



Source: Dietary Guidelines for Bangladesh 2013.

India



Source: Dietary Guidelines for India 2011.

FBDGs were reviewed for the five countries in South Asia which had national FBDGs: Afghanistan, Bangladesh, India, Nepal, and Sri Lanka. The FBDG review is detailed in Dizon et al. (2019). Of the five countries, only Bangladesh, India, and Sri Lanka have quantitative guidelines.[16] To ensure comparability across countries in this paper, a regional FBDG is adapted and applied to all countries assessed. In Dizon et al. (2019) the regional FBDG was based on guidelines for Bangladesh, India, and Sri Lanka. In this paper, the FBDG was based on guidelines for Bangladesh and India, since Sri Lanka was not included in the analysis here. This results in

[13] An alternative data source for food prices is the CPI. There are some key differences between using household survey unit values and CPI price data, for example the number of food items in a household survey food list is longer than a CPI list. Using CPI data, which typically has fewer food items, will increase CoRD (See Dizon et al., 2019).
[14] An alternative method is to calculate the mean of food item unit values, as opposed to the median. Doing so would result in slightly higher food prices, and therefore a higher CoRD (see Dizon et al., 2019).
[15] Unit values are used to calculate CoRD which is then compared against spatially-adjusted per AME food expenditures.
[16] Afghanistan only has key messages and a food guide, but no quantitative amounts or guidelines document yet available.

only a minor difference in the regional FBDG used here versus that in Dizon et al. (2019). Namely, the FBDG used here recommends 15 grams more protein-rich foods (taking pulses for example) and 15 grams less fats & oils (see Table A3). The food guide pyramids from Bangladesh and India used in this paper to generate a regional FBDG are presented in Figure 2. The regional FBDG is detailed in Annex Table A3.

3 Results

We present results in this section. We present the results on diet quality in section 3.1, on CoRD across countries in section 3.2, across different subnational areas in section 3.3, and across different seasons in section 3.4. In sections 3.1 and 3.2, the earlier results from Dizon et al. (2019) are also presented to allow for comparison with other countries in South Asia.

3.1 Diet Quality

Figure 3 presents average consumption against FBDG by food group and by country. Consumption of starchy staples exceeded recommendations for all four countries. Consumption of starchy staples was 137 percent, 128 percent, 112 percent, and 102 percent of FBDG for Bangladesh, Bhutan, Nepal, and India, respectively. Consumption of fats and oils met or exceeded recommendations for all four countries. Consumption of fats and oils was 161 percent, 122 percent, 112 percent, and 96 percent in Bhutan, Bangladesh, Nepal, and India, respectively.

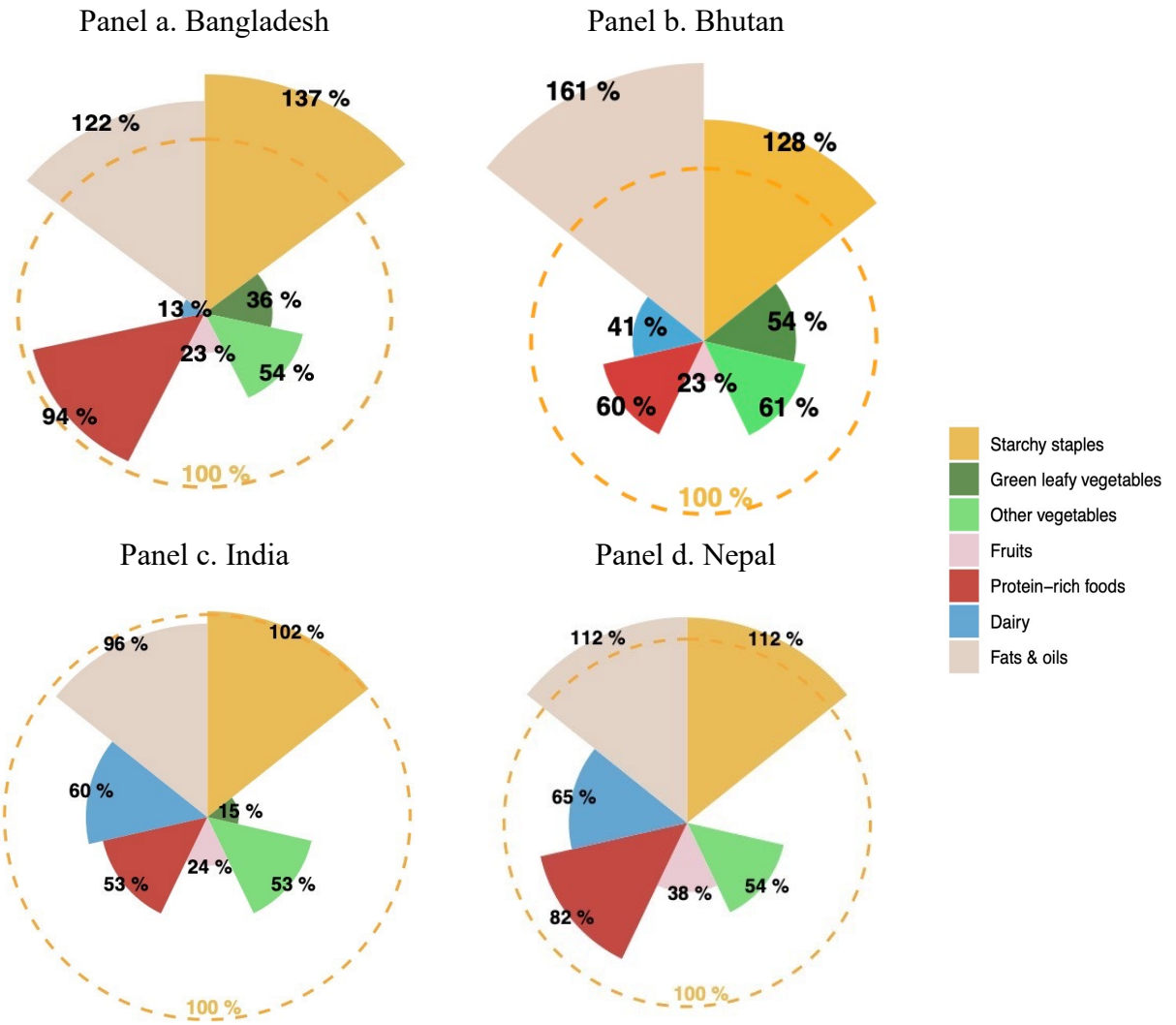
Apart from starchy staples and fats and oils, consumption of the other five food groups falls short of the FBDG. Across the four countries, India had the lowest consumption of green leafy vegetables. Consumption of other vegetables was similar across all four countries, where consumption was around 53 to 61 percent of the FBDG. Fruit consumption was considerably low but was slightly higher in Nepal (38 percent of FBDG) than in Bangladesh, Bhutan and India (ranging from 23 to 24 percent of FBDG). Consumption of protein-rich foods was lowest in India (53 percent of FBDG) and Bhutan (60 percent of FBDG), and it was substantially higher in Nepal (82 percent of FBDG) and Bangladesh (94 percent of FBDG). In contrast, dairy consumption was lowest in Bangladesh (13 percent of FBDG) and slightly higher in Bhutan, India, and Nepal with 40, 60, and 65 percent of FBDG, respectively.

For Bangladesh, consumption of dairy and fruits are the most deficient, with consumption falling below 25 percent of FBDG. For Bhutan, consumption of dairy and fruits are the most deficient. For India, consumption of green leafy vegetables and fruits are the most deficient, with consumption for both falling below 25 percent of FBDG. For Nepal, consumption of fruits and other vegetables are the most deficient. But relative to the other three countries, Nepal consumes the most fruits.

The results on food consumption from Afghanistan, Pakistan, and Sri Lanka from the earlier paper are presented in Annex Figure A1. Notably, comparing across seven countries, the average household in Afghanistan and Pakistan overconsumes starchy staples the most, whereas the average household in Nepal and Sri Lanka consumes the least. Vegetable consumption is highest in Bangladesh, Bhutan, and Nepal, and lowest in Pakistan. Fruit consumption is highest in

Afghanistan, Nepal, and Sri Lanka, and lowest in India and Pakistan. Dairy consumption is highest in Nepal, and lowest in Bangladesh and Sri Lanka.

Figure 3. Food consumption for each food group against FBDGs



Source: Authors' calculations from Bangladesh HIES 2016, Bhutan BLSS 2012, India NSS 2011, and Nepal AHS 201-17.
Note: Food consumption was measured in edible grams per AME, and compared to recommended consumption from the harmonized regional FBDG.

3.2 Cost of a Recommended Diet (CoRD) across countries

Table 2 presents CoRD across the four countries, and also appends the results from the earlier paper.[17] Among the four countries analyzed, CoRD was highest in Bhutan at $2.9 per adult per day in 2011 $PPP, while it was relatively similar across the other three countries. CoRD was $1.6 in Bangladesh, $1.7 in India, and $1.8 in Nepal per adult per day, in $2011 $PPP. When comparing across the seven countries, CoRD was lowest in Bangladesh, India, and Nepal at between $1.6 to $1.8, it was slightly higher for Pakistan at $2.0, and it was highest for Afghanistan, Sri Lanka, and

[17] The two lowest cost food items selected for each food group and each country are presented in Annex Table A2.

Bhutan at between $2.5 to $2.9. The diet established by CoRD effectively meets the requirements for energy and essential nutrients (see Table A4).

Table 2. Cost of a recommended diet and mean household food expenditure

Country	Survey	CoRD LCU	CoRD 2011 PPP$	Mean per adult male equivalent daily food expenditure	Percent of households spending less on food than CoRD
Analysis from this paper					
Bangladesh	HIES 2016	54	1.6	1.9	46%
Bhutan	BLSS 2012	54	2.9	2.7	64%
India	NSS 2011	25	1.7	1.2	86%
Nepal	AHS 2016/17	74	1.8	2.2	55%
Analysis from Dizon et al. (2019)					
Afghanistan	ALCS 2011	44	2.5	3.3	41%
Bangladesh	HIES 2016	58	1.7	1.8	53%
Pakistan	HIICS 2015-16	71	2.0	1.4	83%
Sri Lanka	HIES 2016	149	2.8	2.7	64%

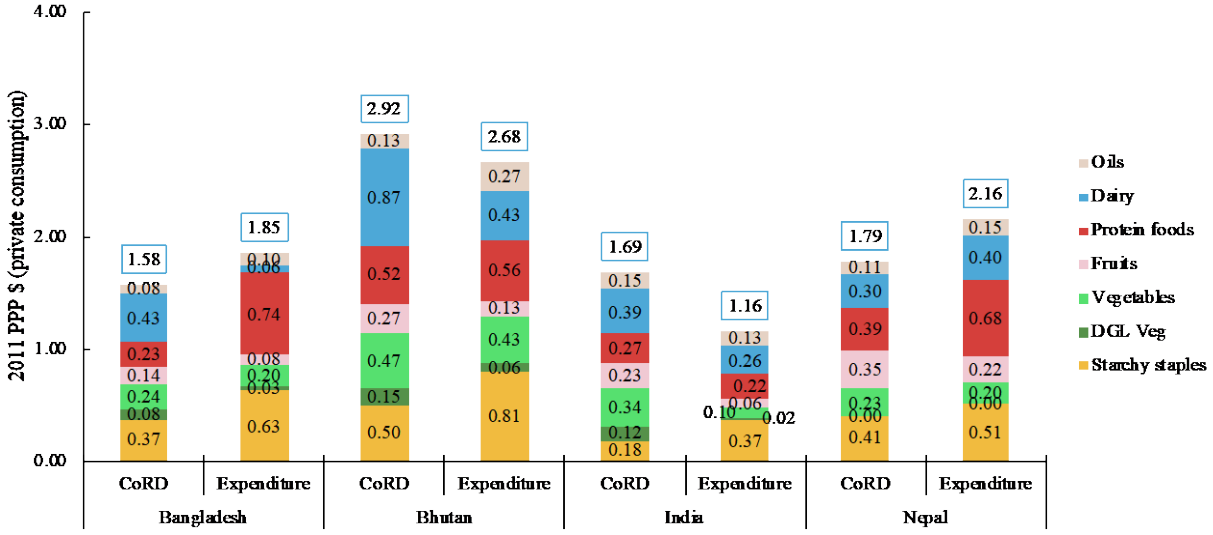
Notes: LCU refers to Local Currency Units, which are Bangladeshi Taka (DBT), Bhutanese Ngultrum (BTN), Indian Rupee (INR), and Nepalese Rupee (NPR), Afghan Afghani (AFN), Pakistani Rupee (PKR), and Sri Lankan Rupee (LKR). The differences in the Bangladesh result is due to minor methodological differences. First, this paper uses a slightly different regional FBDG. Second, this paper uses the Bangladesh-specific food composition table, instead of the USDA food composition table, resulting in some changes to a food item's edible portion.

We further compare CoRD against the mean daily food expenses in each country to gauge the affordability of a nutritious diet. In India, 86 percent of households spend less on food than CoRD, the highest such ratio across the four countries. In Bangladesh 46 percent of households spend less on food than CoRD, in Nepal 55 percent, and in Bhutan 64 percent. When comparing across the seven countries, a nutritious diet was most affordable in Afghanistan, Bangladesh, and Nepal at between 41 to 55 percent of non-affordability, it was less affordable in Bhutan and Sri Lanka at 64 percent, and it was least affordable in India and Pakistan at 83 and 86 percent of non-affordability. Comparing CoRD against total expenses would result in lower proportions of non-affordability. The share of CoRD to food expenses and to total expenses is presented in Table A6.

Figure 4 compares CoRD against actual expenditures for each of the seven food groups and Annex Figure A2 presents the cost share of each food group to CoRD. The share of the cost to meet starchy staples needs to total CoRD is lowest in India (11 percent) and Bhutan (17 percent) and highest in Bangladesh and Nepal, but still under 25 percent of total CoRD. The combined share of fruits and vegetables takes a large share of CoRD. In Bangladesh, India, and Nepal, this ranges between 29 to 32 percent and in India it is 41 percent of total CoRD. The share of protein food cost to total CoRD is close to a fifth, at 15 percent in Bangladesh, 16 percent in India, 18 percent in Bhutan, and 22 percent in Nepal. The share of dairy cost to total CoRD varies across countries, at 17 percent in Nepal, 23 percent in India, 27 percent in Bangladesh, and 30 percent in Bhutan. The cost share of fats and oils is around 5 to 10 percent of total CoRD across all the countries.

Across all four countries, households overspend on starchy staples. Actual expenditures are higher than CoRD in Bangladesh by 69 percent, in Bhutan by 60 percent, in India by 100 percent, and in Nepal by 24 percent. Households on average also overspend on fats and oils. Expenditures are higher than CoRD in Bhutan by 117 percent, in Nepal by 32 percent, and in Bangladesh by 24 percent. However, unlike for these three countries, households in India spend less on fats and oils than CoRD. Consistent with this result, it is the only country among the four which consumes exactly (and not more than) the recommended amount of fats and oils as per the FBDG.

Figure 4. CoRD and household food expenses by food group



In contrast to starchy staples and fats and oils, households on average spend less than CoRD on fruits, vegetables, and dairy, except for Nepal where households on average spend more than CoRD on dairy. Since households in Nepal, on average, do not meet the FBDG for dairy, this suggests that households are purchasing more expensive sources of dairy needs than the lowest cost options. In Bangladesh, expenditures are less than CoRD by 40 percent for fruits, 16 percent for vegetables, 64 percent for DGL vegetables, and 86 percent for dairy. In Bhutan, expenditures are less than CoRD by 52 percent for fruits, 10 percent for vegetables, 62 percent for DGL vegetables, and 51 percent for dairy. In India, expenditures are less than CoRD by 72 percent for fruits, 70 percent for vegetables, 87 percent for DGL vegetables, and 34 percent for dairy. In Nepal, expenditures are less than CoRD by 36 percent for fruits and 13 percent for vegetables.

In the case of protein foods, the average household in Bangladesh, Bhutan, and Nepal spends more than CoRD. In Bangladesh, the average household spends 220 percent more than CoRD on protein foods, but it meets still only 94 percent of the protein food requirement. In Bhutan, the average household spends seven percent more than CoRD on protein foods, but it meets still only 60 percent of the protein food requirement. In Nepal, the average household spends 76 percent more than CoRD on protein foods, but it meets still only 82 percent of the protein food requirement. These results indicate that households are choosing more expensive sources of protein food requirement than the lowest cost options. Unlike in these three countries, India is the only country which spends less than CoRD on protein foods, but it also has the lowest consumption of protein

foods across the four countries. In India, the average household spends 17 percent less than CoRD on protein foods, and it meets only 53 percent of the protein food requirement.

In all countries studied in this paper, no animal sourced foods (ASFs) were selected for the protein food group based on the current harmonized FBDG, but ASFs may have consequences for the bioavailability of minerals and protein quality. Thus, we calculated an alternative ASF version of CoRD based on an alternative harmonized FBDG which has an additional restriction for the protein food group: one ASF must be selected in the final food basket.[18] The ASF CoRD leads to a considerable increase in the cost of protein foods (see Annex Figure A3 and Table A5).

The SOFI 2020 reported higher costs of a healthy diet than the estimates from this study.[19,20] This may be due to differences in methodology (for each country, SOFI 2020 calculated 10 costs of healthy diet using 10 FBDGs and took the average as the final estimate, possibly inflating the costs) or differences in data (our study used unit values derived from household surveys, which when compared to CPI data, for example, tends to produce lower estimates). Despite different cost estimates, this study conveys similar messages as SOFI 2020 does. Both studies do acknowledge huge temporal and geographical variations in costs of a nutritious diet within countries, with the cost of vegetables driving this variation.

3.3 CoRD across subnational areas

Figure 5 compares CoRD between urban and rural areas, and by food groups. Across all countries, CoRD is higher in urban areas than in rural areas, by 14 percent in Bangladesh, 24 percent in Bhutan, 14 percent in India, and 20 percent in Nepal. This is because prices are typically higher in urban areas. In Bangladesh, the largest difference between urban and rural CoRD is for fruits, which has a 36 percent higher minimum cost in urban areas than in rural areas, and for dairy, which has a 21 percent higher minimum cost in urban than rural areas. In Bhutan, the largest urban-rural CoRD difference is for protein foods (72 percent higher in urban areas), and for dairy and fruits (27 and 22 percent higher in urban areas, respectively). In India, the largest urban-rural CoRD difference is for protein foods (23 percent higher in urban areas). In Nepal, the largest urban-rural CoRD difference is for fruits (58 percent higher in urban areas) and for vegetables (44 percent higher in urban areas).

[18] To derive the alternative ASF version of CoRD, we divided the protein food group into pulses and ASFs (eggs, poultry, meat, and fish) and selected the food item with the lowest price per serving within each sub-group. We then took the average of the two prices selected as the price for the protein group.

[19] Converting our results into 2017 PPP$, CoRD is 1.93, 3.70, 1.88, and 2.53 respectively in Bangladesh, Bhutan, India, and Nepal. In contrast, the SOFI 2020 report estimates the cost of a healthy diet at 3.54, 4.87, 3.41, and 4.16 in 2017 PPP$ for the same countries, respectively.

[20] In contrast the WFP's FNG analysis in Bangladesh yielded a lower estimate. The FNG estimate was 44 BDT in 2016, whereas the CoRD estimate here is 54 BDT per adult per day. CoRD relies on FBDGs which is a higher benchmark of dietary quality than the nutritious diet costed by the FNG analysis.

Figure 5. CoRD by whether urban or rural

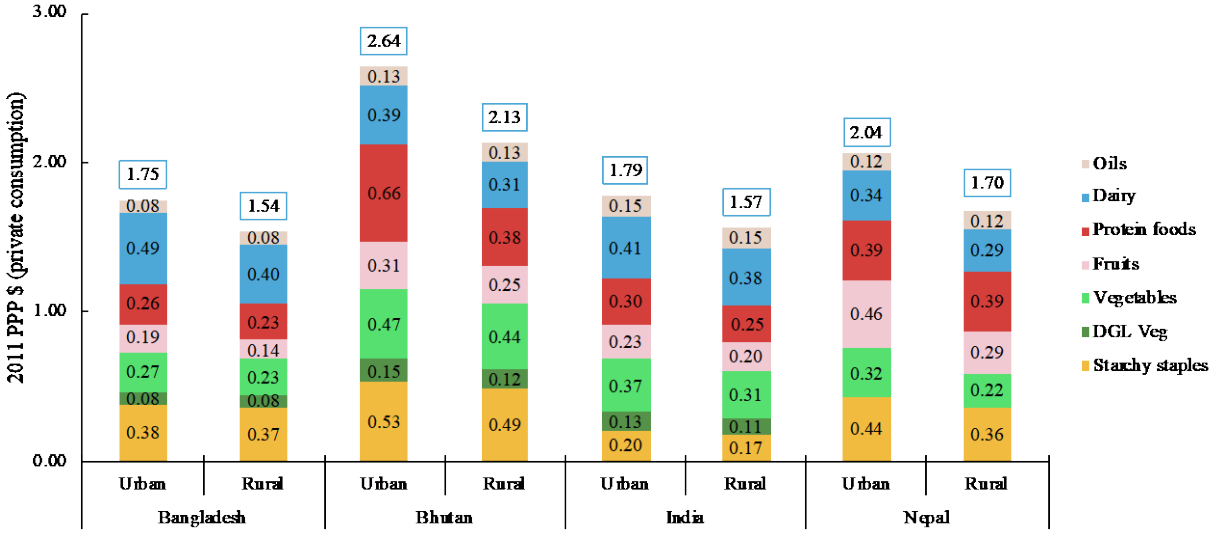
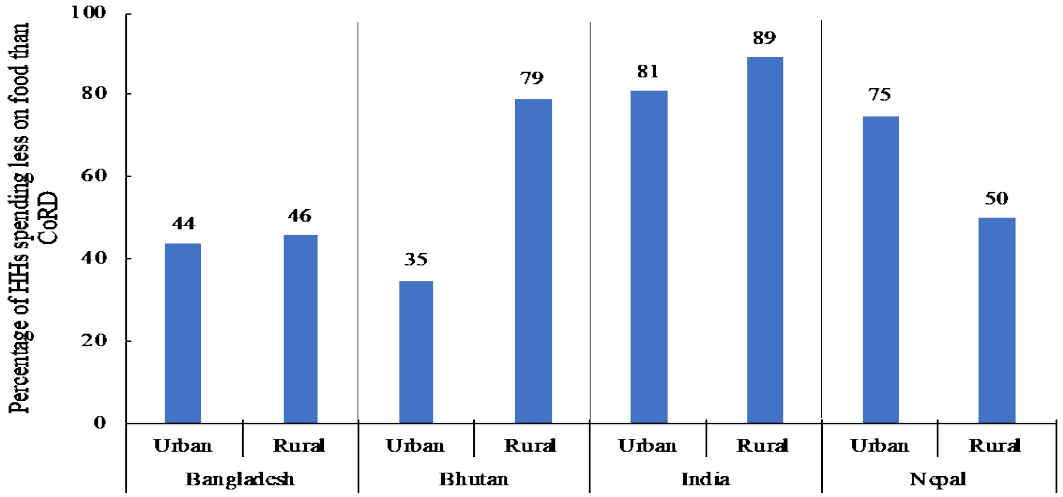


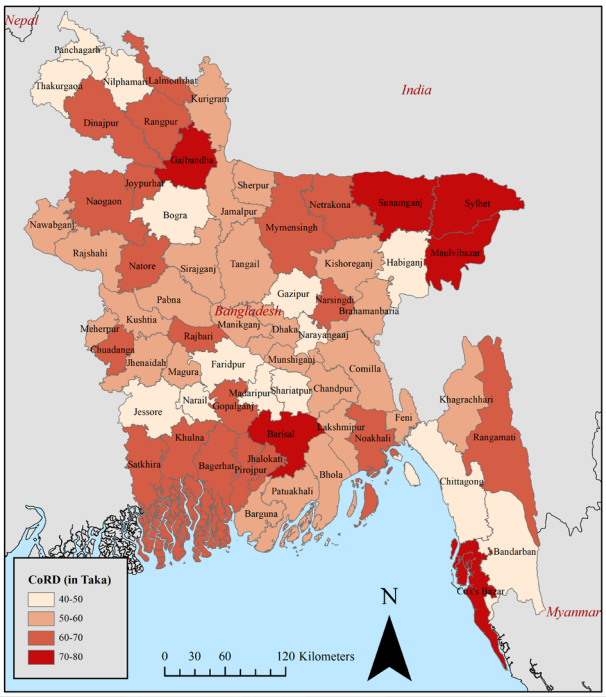
Figure 6. Percentage of HHs spending less on food than CoRD by whether urban or rural



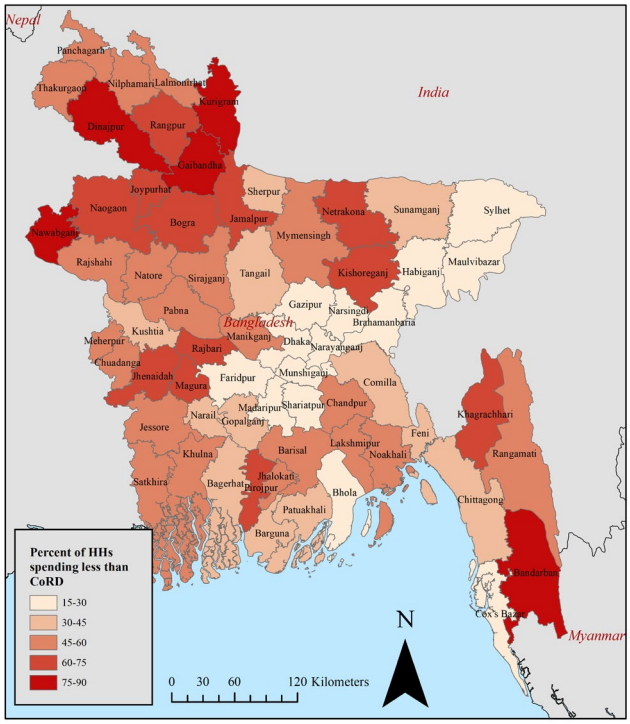
However, while CoRD is higher in urban areas than in rural areas, the recommended diet is more affordable in urban areas than in rural areas for all countries except Nepal (see Figure 6). For Bangladesh, Bhutan, and India, the low food expenditures in rural areas drives up non-affordability. This is most stark in Bhutan where 35 percent of households in urban areas spend less on food than CoRD against 79 percent in rural areas. In Nepal, however, the non-affordability in urban areas is still higher than in rural areas, suggesting that food expenses are anyway more or less similar between urban and rural areas in that country.

Figure 7. CoRD and households spending less on food than CoRD, by districts in Bangladesh

Panel A. CoRD



Panel B. Proportion of households



Panel C. Number of households

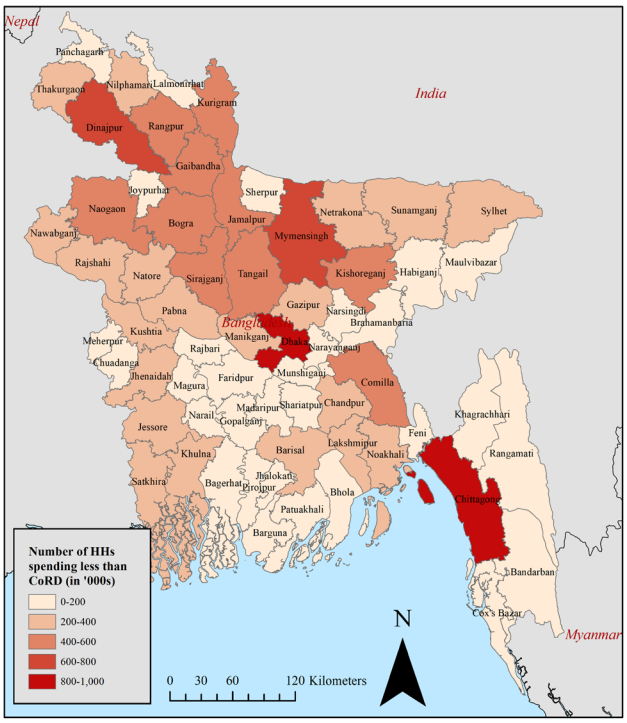
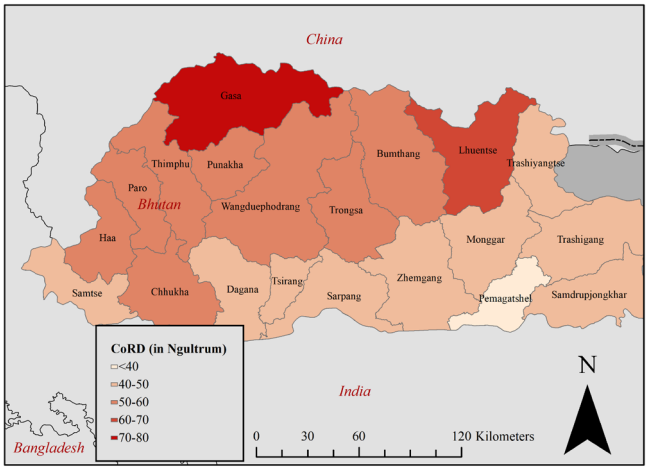
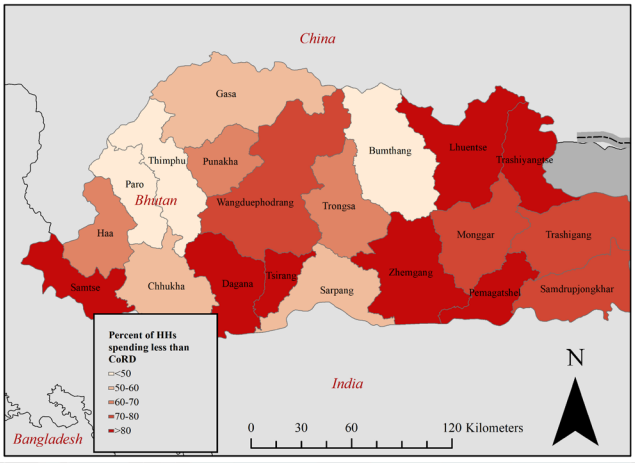


Figure 8. CoRD and households spending less on food than CoRD, by districts in Bhutan

Panel A. CoRD



Panel B. Proportion of households spending less than CoRD



Panel C. Number of households spending less than CoRD

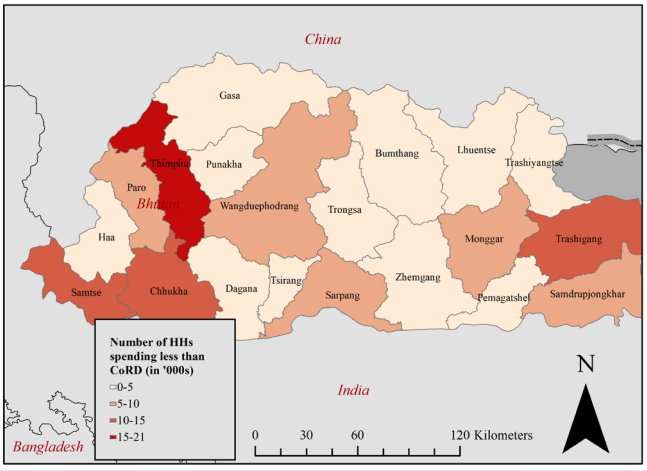


Figure 9. CoRD and households spending less on food than CoRD, by states in India

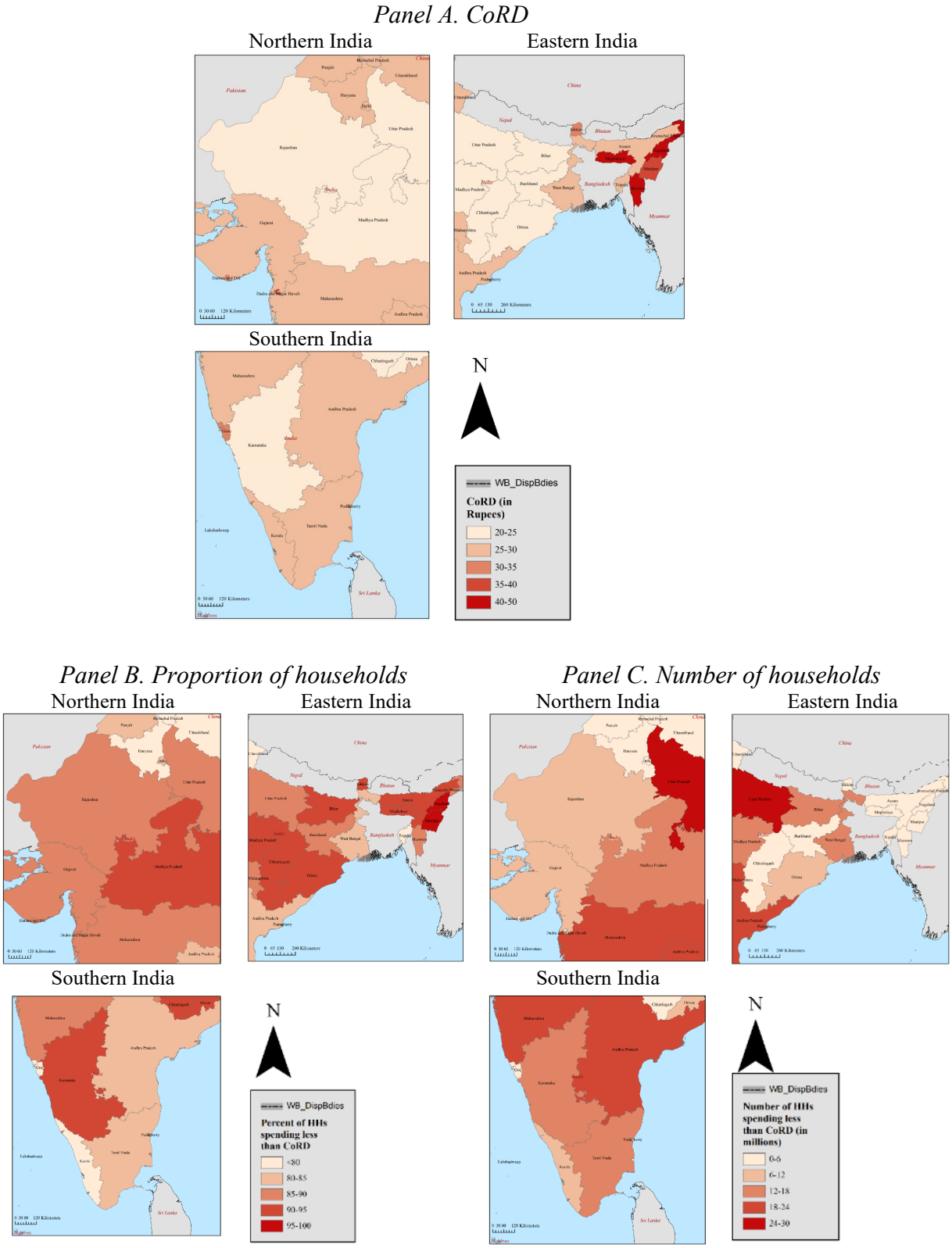
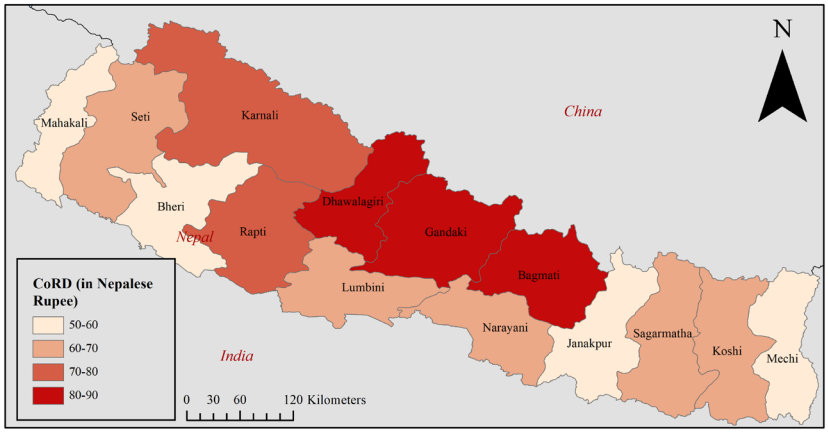
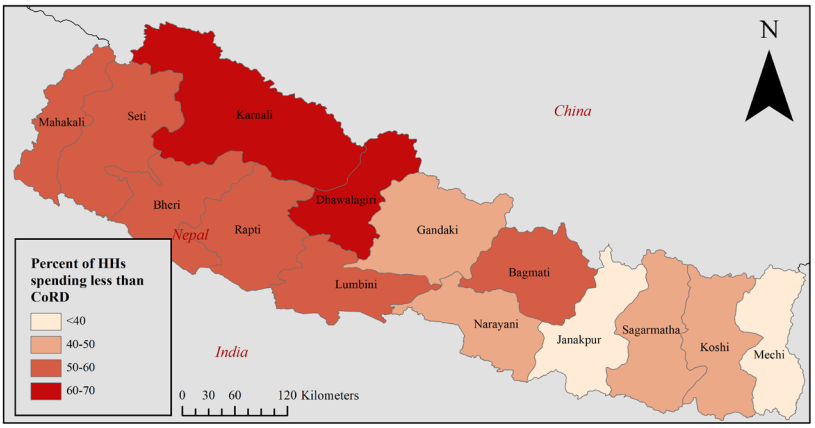


Figure 10. CoRD and households spending less on food than CoRD, by administrative zones in Nepal

Panel A. CoRD



Panel B. Proportion of households spending less than CORD



Panel C. Number of households spending less than CoRD

Across countries, there is significant variation in CoRD across subnational areas. For each country, we present a set of three maps to describe this subnational variation. The first is a map of CoRD (reported as Panel A), the second is a map of the proportion of household which spend less on food than CoRD (reported as Panel B), and the third is a map of the number of households spending less on food than CoRD (reported as Panel C). Results are presented in Figure 7 for Bangladesh by district, in Figure 8 for Bhutan by district, in Figure 9 for India by state, and in Figure 10 for Nepal by administrative zones.[21]

First, across subnational areas there are large differences in CoRD. In Bangladesh, Gaibandha district has the highest CoRD of 79 BDT and Faridpur district has the lowest CoRD of 43 BDT, a difference of 84 percent. In Bhutan, Gasa district has the highest CoRD of 75 BTN and Pemagatshel district has the lowest CoRD of 38 BTN, a difference of 97 percent. In India, the state of Lakshadweep has the highest CoRD of 49 INR and the state of Chhattisgarh has the lowest CoRD of 21 INR, a difference of 133 percent. In Nepal, Dhaulagiri zone has the highest CoRD of 86 NPR and Mahakali zone has the lowest CoRD of 53 NPR, a difference of 62 percent.

Second, affordability is driven by both income and prices, and whether or which of the two is a more binding constraint to affordability varies across subnational areas. By comparing Panel A and Panel B across Figures 7 to 10, we note that some areas which have high CoRD also have higher proportions of households spending less on food than CoRD, but that there also exist other areas which have low CoRD which similarly have higher proportion of households spending less on food than CoRD. For the former case price would be a key binding constraint to affordability, while for the latter case income would be a more binding constraint than price.

The subnational correlation between CoRD and the prevalence of unaffordability varies by subnational area. In Bangladesh the district-level correlation was 0.09 and in Nepal the zone-level correlation was 0.50, suggesting that in these two countries many more districts or zones have price as the likely binding constraint. In contrast, in Bhutan the district-level correlation was -0.55 and in India the state-level correlation was -0.27, suggesting that in these two countries many more districts or states have income as the likely binding constraint.

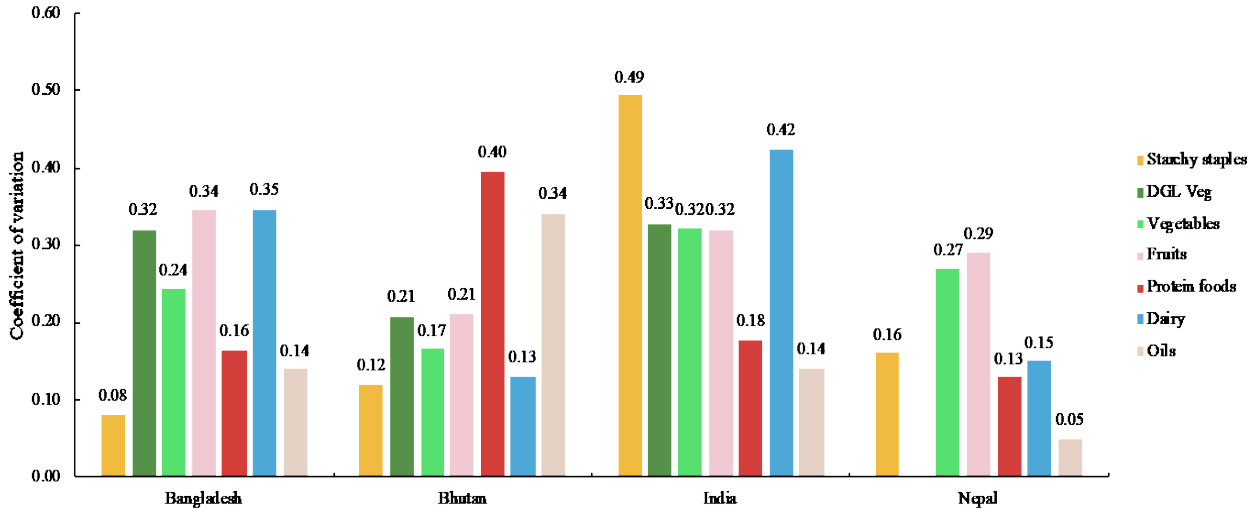
Third, because of variation in population densities across subnational areas, a high prevalence of unaffordability in an area does not imply a large number of households experiencing unaffordability in that area. By comparing Panel B and Panel C across Figures 7 to 10, we note that some areas which have higher proportions of households which spend less on food than CoRD also account for many households in absolute terms. However, there also are areas which have higher proportions of households spending less on food than CoRD but where the number of households experiencing unaffordability is low relative to the national total. For the former case, lowering prevalence of unaffordability will lower national prevalence, whereas for the latter, the lower prevalence of unaffordability will not impact national prevalence.

The subnational correlation between the prevalence of unaffordability and the absolute number of households experiencing unaffordability varies by country. Looking at the two more densely

[21] Sub-national CoRD results for Nepal are presented by administrative zones as it provides more geographical data points (14 entries) than provinces (7 entries). However, we caution that administrative zones no longer exist after Nepal's transition to federalism in 2015.

populated countries, we note that the district-level correlation in Bangladesh was 0.29 and the state-level correlation in India was 0.20, suggesting that districts or states which have higher prevalence also have higher numbers of households experiencing unaffordability. In contrast, looking at the two less densely populated countries, the district-level correlation in Bhutan was -0.44 and the zone-level correlation in Nepal was -0.18, suggesting that districts or zones which have higher prevalence tend to have fewer absolute number of households experiencing unaffordability.

Figure 11. Coefficient of variation of food group CoRD across subnational level



Notes: (a) CV is defined as the ratio of standard deviation to mean. (b) DGL Veg is not available for Nepal.

Figure 11 presents the coefficient of variation of the different CoRD food groups across districts in Bangladesh, districts in Bhutan, states in India, and zones in Nepal. The cost of *starchy staples* is one of the least if not the least variable compared to other food groups across districts in Bangladesh and Bhutan and across administrative zones in Nepal, but it is the most variable across states in India. The high variability in staple prices in India may be due to the nature of spatial variation in India, which is based on much larger spatial distances between states versus the smaller distances in subnational areas in the three other countries. In addition, variation in PDS access and PDS prices in India play a key role. In some states, much fewer households access rice and wheat via PDS, so that CoRD would select a more representative, typically more costly, rice and wheat item. Even comparing areas where many access PDS, there are price differences in the PDS staples, suggesting varying performance at the state level of the PDS. Like starchy staples, the cost of *fats and oils* is one of the least variable across districts in Bangladesh, states in India, and zones in Nepal, but it is one of the more variable costs across districts in Bhutan.

In Bangladesh, the cost of fruits, vegetables, and dairy are the most variable across districts. In Bhutan, the cost of protein foods and fats and oils are the most variable across districts. Bhutan is distinct in that variability is highest for protein foods and fats and oils. It may be the case that this is due to extraordinary difficulty in cross-district transportation due to its mountainous terrain. In India, apart from starchy staples, the cost of dairy is the most variable across states. In Nepal, the cost of fruits and vegetables are the most variable across zones.

3.4 CoRD across different seasons

Figure 12. CoRD for different seasons in a year

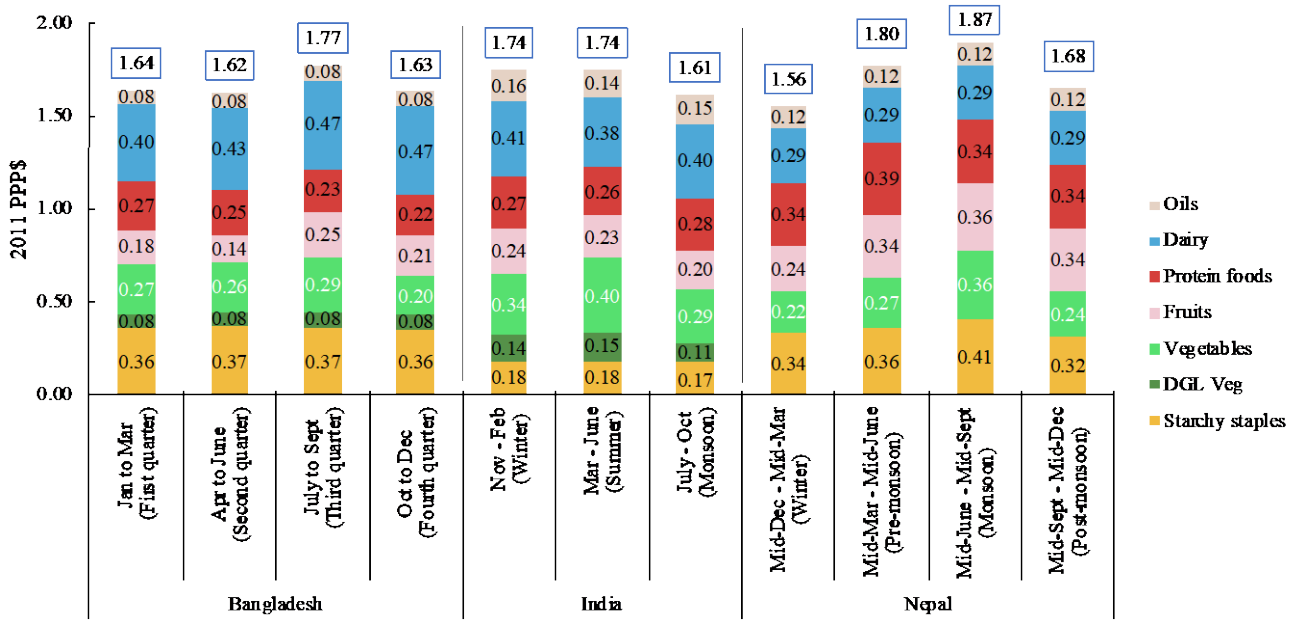


Figure 13. Percentage of HHs spending less on food than CoRD by different seasons

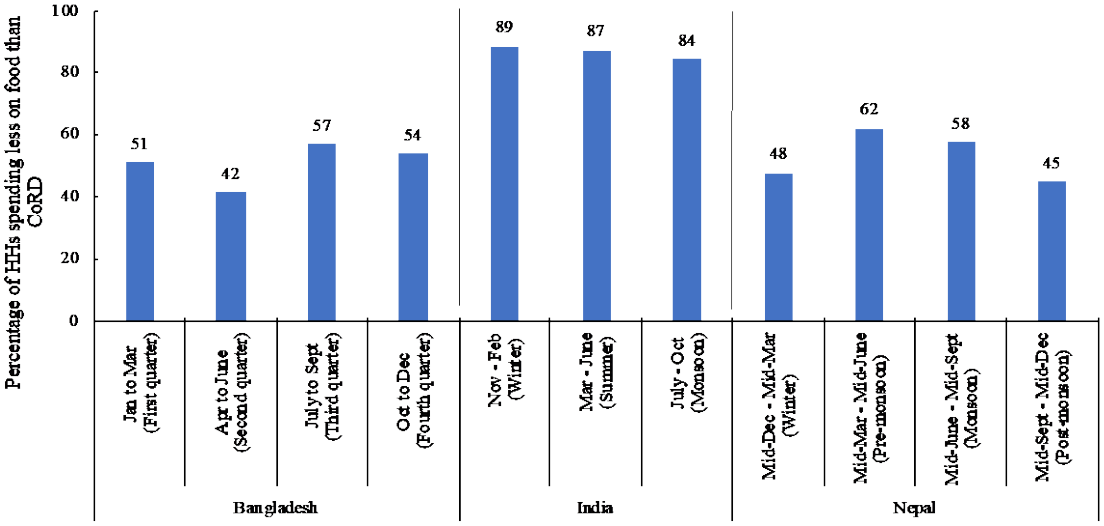


Figure 12 compares CoRD across different times or seasons in a year. In Bangladesh, CoRD is highest during the third quarter of the year from July to September than other quarters of the year. From the second quarter to the third quarter, CoRD increases by 9 percent. This is driven particularly by an increase in CoRD for fruits by 74 percent, for dairy by 10 percent, and for vegetables by 10 percent. In India, CoRD is highest from November to June during the winter and summer months than during the monsoon from July to October. Comparing monsoon to summer, CoRD increases by 8 percent. This is driven particularly by an increase in CoRD for vegetables

by 37 percent, for DGL vegetables by 43 percent, and for fruits by 10 percent. In Nepal, CoRD is highest during the monsoon period from June to September and lowest during winter from December to March. From winter to monsoon, CoRD increases by 20 percent. This is driven particularly by an increase in CoRD for starchy staples by 21 percent, for fruits by 50 percent, and for vegetables by 67 percent.

For all three countries, the season with the highest CoRD coincides with the lean season for fruits and vegetables. In Bangladesh, few vegetables and fruits are harvested in the third quarter, which leads to low availability of fruits and vegetables and higher prices.[22] In India, crops are sown in two main cropping seasons, Kharif (May to July) and Rabi (October to December), and harvested in September to October and February to April, respectively. This leaves the summer months (March to June) with lower availability of fruits and vegetables.[23] In Nepal, most fruits and vegetables are harvested in the winter and pre-monsoon seasons. The monsoon season (mid-June to mid-September) is the traditional agriculture lean season in the country, and it is also the period prone to floods and landslides which damage crops and physical infrastructure.[24]

Figure 13 further shows that in each of the three countries the percent of households which spend less on food than CoRD is highest in seasons when CoRD is highest. In Bangladesh this is during the third quarter of the year from July to August, in India this is during the winter and summer months, and in Nepal this is during the pre-monsoon and monsoon months. This indicates that not only do prices spike during the lean seasons, but that incomes are also low or unchanged.

4 Discussion and policy implications

Diets and affordability

Diets are poor across the South Asian countries assessed here. Relative to dietary guidelines, there is an overconsumption of starchy staples and fats and oils, and an underconsumption of more nutrition-dense food groups, such as vegetables, fruits, protein-rich foods, and dairy. There are some differences across countries in terms of which food groups are more deficient and differences in the extent of this deficiency, thereby highlighting the need for careful country-specific assessments of diets.

The affordability of nutritious diets is a likely constraint across these countries. Our estimate of the minimum cost of a recommended diet (CoRD) is high, at $1.6 in Bangladesh, $1.7 in India, $1.8 in Nepal, and $2.9 in Bhutan per adult per day in 2011 $PPP. Whether or not these minimum costs are attainable for the average household varies by country. The average spending on food per adult per day was $1.9 in Bangladesh and $2.2 in Nepal, which is higher than their respective country-specific CoRD. This indicates that an average household in Bangladesh and Nepal could afford the minimum cost recommended diet. In contrast, the average spending on food per adult per day was $2.7 in Bhutan and $1.2 in India, which is lower than the CoRD for those countries,

[22] A detailed crop calendar for Bangladesh is available in the Bangladesh Yearbook of Agricultural Statistics 2015. Available online: 203.112.218.65:8008/WebTestApplication/userfiles/Image/LatestReports/Yearbook_2015.pdf.
[23] Cropping seasons for India are available online: https://www.daytodaygk.com/know-all-about-agricultural-seasons-in-india/#:~:text=The%20agricultural%20crop%20year%20in,October%2DMarch%20(winter).
[24] The Food Security Atlas of Nepal from 2019 discusses how the agriculture calendar and natural hazards affect food security in Nepal, https://www.npc.gov.np/images/category/Food_Security_Atlas_2019.pdf.

respectively. This indicates that the average household in these two countries would not be able to afford the minimum cost recommended diet. An analogous set of statistics is that more households spend less on food than CoRD in Bhutan and India (64 and 86 percent of households, respectively) than in Bangladesh and Nepal (46 and 55 percent of households, respectively). What is strikingly clear, however, is that those below or even those just right above the poverty line of $1.9 per day will struggle to meet the cost of a nutritious diet, especially given that the $1.9 a day should cover more than just food needs.

There is variation across countries in which food groups cost most. The cost to meet the recommended consumption of starchy staples is as high as 24 percent of total CoRD in Bangladesh but is as low as 11 percent of total CoRD in India. But, across countries, it is notable that the cost to meet fruit and vegetable needs are quite high. Its share of total CoRD ranges between 29 to 41 percent across countries. The cost to meet protein food and dairy needs ranges between 38 to 48 percent.

Subnational and seasonal variation

Within countries, affordability varies by areas in a country and by seasons in a year. Our calculation of affordability of diets is driven by both food prices and by household incomes, here proxied by actual spending on food. While *urban areas* have a higher CoRD, *rural areas* typically have lower household incomes. As a result, in most of the countries assessed, the lack of affordability is still higher in rural areas. CoRD is higher in lean seasons of the year as food prices increase with lower availability of food. During these lean seasons, affordability is also worse, suggesting that households lack access to opportunities to smooth income and spending throughout the year (i.e. through savings and credit, for example).

Our subnational analysis of the affordability of diets highlights that within countries there is substantial variation in whether *food prices* are likely a more binding constraint than *low incomes*, or vice versa. Location-specific analysis is therefore needed to identify locations with particularly poor diets, and then to assess whether price or income constraints are more binding in those locations, as well as whether supply-side or demand-side barriers are more pressing. While a combination of interventions, policies, and investments is likely optimal, the exact combination and prioritization would vary across different areas within a country. This prioritization should be guided by location-specific assessments.

Given resource constraints, policy makers would also inevitably face trade-offs in choosing to target areas with a *high number* of households experiencing the lack of affordability versus areas with a *high prevalence* of households experiencing the same (but where the size of the local population is small). Our subnational analysis indicates that policy makers are more likely to face such trade-offs in smaller less densely populated countries such as Bhutan and Nepal than in countries such as Bangladesh and India. In Bhutan and Nepal, the areas with a high prevalence of the lack of affordability are more likely to be more sparsely populated areas. Where there are high fixed costs to reaching these remote areas, the per person cost of interventions would be higher when targeting high-prevalence low-density areas.

The variation in CoRD by subnational areas and by seasons is to a significant extent driven by the variation in the cost of *vegetables and fruits*. This pattern would be closely tied to the availability of *transport and storage infrastructure* and the cost of such services. Transporting perishable items across a country is difficult and costly, so that prices are likely lower in areas where vegetables and fruits are produced more abundantly than areas where they are not. Storing perishable items across seasons is similarly costly, thereby driving price increases during lean seasons.

Beyond prices and income

Food prices, incomes, and affordability are, of course, only part of the set of barriers to the consumption of more nutritious diets. For example, our analysis shows that some households consume more expensive sources of proteins, even if more affordable options are available. In addition to price and income constraints, consumers might also lack the information on what a nutritious diet is or what the benefits are of such a diet. Nutritious affordable sources may also be unavailable in specific areas even if consumers are willing and able to afford a nutritious diet.

Particularly where consumers are unaware of what a nutritious diet is and what its benefits are, FBDGs are a fundamental starting point. They establish a national consensus, and a platform and framework for coherent policy action for dietary shifts towards more nutritious food consumption. In South Asia and across the world, many countries have either outdated or unavailable FBDGs. A fundamental step would thus be to develop national FBDGs. For those with existing FBDGs, support is needed to increase their use and dissemination, both among policy makers and consumers.

Rethinking food policies

The results also highlight the reduced relevance of a focus on staple foods that many countries in the region still pursue. Staples do form an important share of CoRD, from say 11 percent of the cost in Pakistan and India to about 23 percent of the cost in Bangladesh and Nepal. However, non-staple nutritious food groups combined (vegetables, fruits, dairy) take a much larger share of CoRD. This is not congruent to national food policies which are focused on managing the prices of grains and cereals. A heavy focus on price controls for individual food items will not make much of a difference on affordability, instead governments would need to pursue policies and interventions to improve availability and reduce prices across a broader set of food groups.

The high prices of certain food groups to some extent do reflect constraints to availability. This would in turn suggest the need to liberalize marketing policies in order to allow for more market-oriented supply. It may also suggest the importance of diversification policies around food production, as opposed to a focus on the production of staples. The low availability and high cost of specific kinds of food also signal the need for more public support to market integration approaches such as productive alliances, to e-vouchers rather than to specific fertilizer subsidies as an income support, and to social safety nets rather than price subsidies to protect poor consumers. Not long ago, one argument for fertilizer subsidies or price subsidies was that they were easier to administer, but advancements in digital technologies have made that argument void.

Finally, the results in this paper also have implications for the type of agricultural innovation strategies that may be pursued. While one might not de-emphasize staple food research programs on rice and wheat, it is obvious that programs on dairy will become more important, but also that countries need to find a way to improve the technological base of all other food groups that make up a healthy diet. In large countries, this might be done through a bigger range of national applied research programs, but it might also be done through more adaptive research in-situ, by improved seed policies (for example for vegetables), and by more on-farm research. This opens up the agricultural innovation systems toolbox for a rethink, of which agricultural research, which has been favored up to now, is just one part.

References

2020 Global Nutrition Report: Action on equity to end malnutrition. Bristol, UK: Development Initiatives.

Cost of Nutritious Diets Consortium. (2018). Indicators and tools for the cost of nutritious diets. Boston, MA: Tufts University (13 pages, 31 May 2018).

Dizon, F., Herforth, A., & Wang, Z. (2019). The cost of a nutritious diet in Afghanistan, Bangladesh, Pakistan, and Sri Lanka. *Global Food Security*, *21*, 38-51.

Dizon, Felipe Jr Fadullon; Wang, Zetianyu.(2020). *Diet Quality and Food Prices in India (English).* Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/141001594870396419/Diet-Quality-and-Food-Prices-in-India

FAO, IFAD, UNICEF, WFP and WHO. 2020. *The State of Food Security and Nutrition in the World 2020. Transforming food systems for affordable healthy diets*. Rome, FAO. https://doi.org/10.4060/ca9692en

Herforth, A., Masters, W., Bai, Y., & Sarpong, D. (2019). The Cost of Recommended Diets: Development and Application a Food Price Index Based on Food-Based Dietary Guidelines (P10-033-19). *Current developments in nutrition*, *3*(Supplement_1), nzz034-P10.

Mahrt, K., Mather, D., Herforth, A., & Headey, D. D. (2019). *Household dietary patterns and the cost of a nutritious diet in Myanmar* (Vol. 1854). Intl Food Policy Res Inst.

Raghunathan, K., Headey, D. D., & Herforth, A. (2020). *Affordability of nutritious diets in rural India* (Vol. 1912). Intl Food Policy Res Inst.

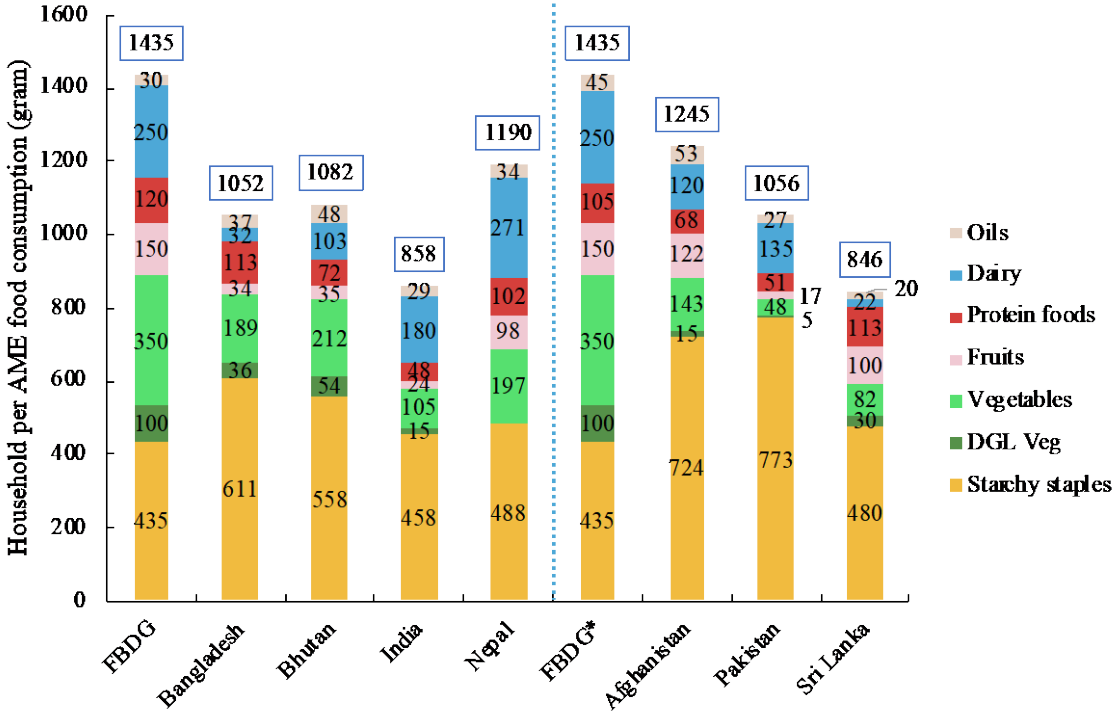
The Global BMI Mortality Collaboration. (2016). Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. The Lancet, 388(10046), 776-786.

United Nations Children's Fund (UNICEF), World Health Organization, International Bank for Reconstruction and Development/The World Bank. *Levels and trends in child malnutrition: Key Findings of the 2020 Edition of the Joint Child Malnutrition Estimates*. Geneva: World Health Organization; 2020. Licence: CC BY-NC-SA 3.0 IGO.

Waid, J. L., Bogard, J. R., Thilsted, S. H., & Gabrysch, S. (2017). Estimates of average energy requirements in Bangladesh: Adult Male Equivalent values for use in analyzing household consumption and expenditure surveys. *Data in brief*, 14, 101-106.

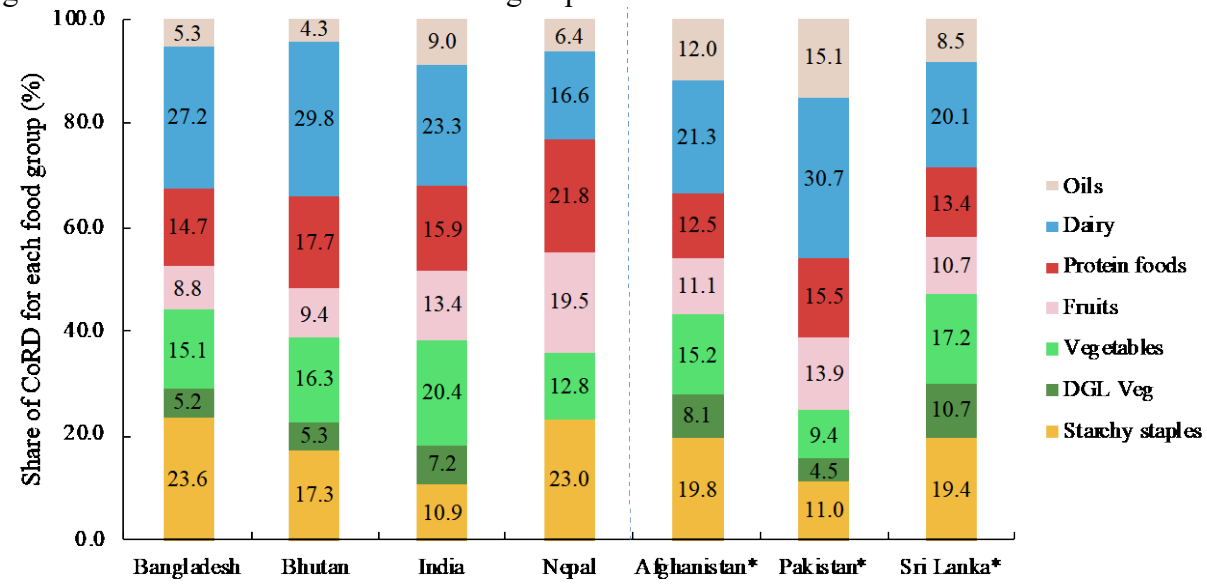
ANNEX

Figure A1. FBDG and household food consumption in grams by food group



Note: *this bar represents the regional FBDG from Dizon et al. (2019).

Figure A2. Share of CoRD for each food group



Note: * indicates previous results from Dizon, Herforth and Wang (2019).

Figure A3. CoRD and alternative CoRD with animal-source food (ASF)

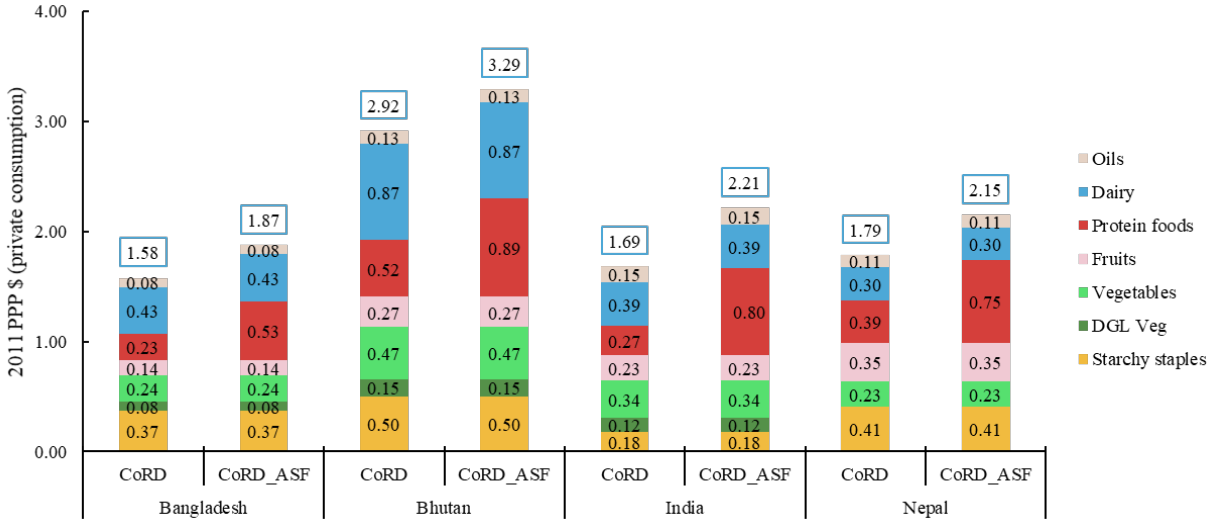


Table A1. Number of food items by food group for HH survey

Food group	*Bangladesh*	*Bhutan*	*India*	*Nepal*
Starchy staples	14	17	22	10
Protein foods	29	20	19	13
Dairy	4	9	4	5
Fruits	16	17	18	7
Vegetables	12	23	14	14
DGL Veg	1	2	1	0
Oils	6	7	9	3
Total	**82**	**95**	**87**	**52**

Table A2. Two lowest cost items for each food group

Food group	Bangladesh		Bhutan	India	Nepal
	Dizon et al. (2019)	*This paper*			
Starchy staples	Coarse rice	Coarse rice	Fine rice	Rice	Potato
	Wheat	Wheat	FCB rice	Wheat	Maize flour
Protein foods	Green gram	Green gram	Pulses	Pea	Soybean
	Pea gram	Pea gram	Walnut	Khesari	Beans
Dairy	Liquid milk	Liquid milk	Liquid milk	Liquid milk	Milk
	Curd	Curd	Milk powder	Curd	Curd
Fruits	Guava	Melon	Guava	Guava	Papaya
	Amra	Palm	Banana	Singhara (water chestnut)	Banana
Vegetables	Pumpkin	Pumpkin	Tomato	Onion	Radish
	Radish	Radish	Radish	Radish	Chayote (ishqus)
DGL Veg	Spinach, Amaranta, Basil	Spinach, Amaranta, Basil	Cabbage	Cabbage	Not applicable
Oils	Soybean oil	Soybean oil	Refined vegetable oil	Margarine	Sunflower oil
	Palm oil	Palm oil	Soya refined oil	Refined oil (sunflower, soybean, etc.)	Soybean oil

Note: The lowest cost fruit items selected for Bangladesh in this paper differ slightly from those in Dizon et al. (2019). This is because this paper updated the edible portion information using the Bangladesh-specific Food Composition Table, leading to changes in the price per serving for a number of fruit items. The Bangladesh-specific Food Composition Table is available online: here.

Table A3. National Food-Based Dietary Guidelines, and Decision on Regional Food-Based Dietary Guidelines

Food Group	Bangladesh		India		Average		Decision for Regional FBDG	Decision for Regional FBDG (Dizon et al., 2019)
	Min	**Max**	**Min**	**Max**	**Min**	**Max**		
Starchy staples	270g (dry)	450g (dry)	270g (dry)	600g (dry)	270g	525g	Use India's guideline amounts (widest range); require 2 unique starches *Serving size = 30 g* *Min servings = 9* *Max servings = 20*	Use India's guideline amounts (widest range); require 2 unique starches *Serving size = 30g* *Min servings = 9* *Max servings = 20*
Vegetables	300g (at least 100g DGLV	600g	300g (at least 100g DGLV)	300g (at least 100g DGLV)	300g	450g	Use Bangladesh's guideline amounts (widest range); require 3 unique vegetables, including one DGLV *Serving size = 100g* *Min servings = 3* *Max servings = 6*	Use Bangladesh's guideline amounts (widest range); require 3 unique vegetables, including one DGLV *Serving size = 100g* *Min servings = 3* *Max servings = 6*
Fruits	100g (one citrus, one vit A-rich)	300g (one citrus, one vit A-rich)	100g	100g	100g	200g	Use average; require 2 unique fruits *Serving size = 100g* *Min servings = 1* *Max servings = 2*	Use rounded average, 100–200g; require 2 unique fruits *Serving size = 100g* *Min = 1* *Max = 2*
Pulses/Fish/ Meat/Eggs	1 serving of pulses (30g) + 1 serving of fish/meat /egg (50g)	2 servings of pulses (60g) + 4 servings of fish/meat/egg (200g)	60g pulses DG says aim for 100–200g/ week fish, but no flesh food required (50g/serving)	120g pulses DG says don't exceed 3 eggs/week	45g pulses Not applicable	90g pulses Not applicable	Use Bangladesh's guideline amounts (widest range); require 2 unique protein sources and do not require meat *Serving size = 30g (pulses); 50g (meat/poultry/fish/egg)* *Min servings = 2* *Max servings = 6*	Use Sri Lanka's guideline amounts (clearest and most comprehensive across protein sources). Require 2 unique protein sources and do not require meat. *Serving size = 30g for pulses, 50g for meat/fish/egg* *Min = 3* *Max = 4*
Dairy	150ml	300ml	300ml	300ml	225ml (or 60g milk powder)	300ml (or 90g milk powder)	Use rounded average, 200ml - 300ml; require 1 dairy source *Serving size = 100 ml (or 30g milk powder)* *Min servings = 2* *Max servings = 3*	Use mean, 200–300ml; require 1 dairy source (e.g., powdered milk, fresh milk, or yogurt) *Serving size = 100ml (or 30g milk powder)* *Min = 2* *Max = 3*
Fats and Oils	15g	30g	20g	40g	17.5g	35g	Use India's guideline amounts (widest range); *Serving size = 5 g* *Min servings = 4* *Max servings = 8*	Use mode, 30–60g *Serving size = 15g* *Min = 2* *Max = 4*

Source: Compiled by authors from *Dietary Guidelines for Bangladesh* 2013; *Dietary Guidelines for Indians – A Manual* 2011.
Note: The blue shading indicates the cells on which the regional FBDG decisions were made. The regional FBDG in Dizon et al. 2019 version was based on Bangladesh, India, and Sri Lanka, whereas the regional FBDG here is based on Bangladesh and India.

Table A4. CoRD food basket percent met of Estimated Average Requirement (EAR) for energy and essential nutrients for a 30-year old male

	EAR	Bangladesh	Bhutan	India	Nepal
Energ_Kcal	2725 (EER)	102%	103%	99%	89%
Protein_(g)	46.2	127%	113%	122%	129%
Lipid_Tot_(g)	61 (no EAR)	79%	147%	79%	106%
Calcium_(mg)	1000 (AI)	68%	65%	52%	67%
Iron_(mg)	6	98%	94%	63%	137%
Magnesium_(mg)	330	127%	138%	81%	195%
Potassium_(mg)	4700 (AI)	92%	77%	67%	148%
Zinc_(mg)	9.4	95%	111%	89%	130%
Vit_C_(mg)	75	123%	311%	297%	261%
Thiamin_(mg)	1	144%	122%	141%	202%
Niacin_(mg)	12	80%	71%	67%	111%
Vit_B6_(mg)	1.1	180%	207%	196%	426%
Folate_Tot_(µg)	320	297%	118%	236%	237%
Vit_B12_(µg)	2	55%	56%	56%	55%
Vit_A_RAE	625	176%	24%	29%	16%
Vit_E_(mg)	12	63%	73%	64%	60%
Vit_K_(µg)	120 (AI)	644%	158%	109%	73%

Notes: Calculated using the National Nutrient Database for Standard Reference (USDA). CoRD has 1,435 grams of food. EAR (Estimated Average Requirement) is the average daily nutrient intake level estimated to meet the requirements of half of the healthy individuals in a group. EER (Estimated Energy Requirement) is the average dietary energy intake that is predicted to maintain energy balance in healthy, normal weight individuals of a defined age, gender, weight, height, and level of physical activity consistent with good health. AI (Adequate Intake) is the recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate. AI is used when an RDA cannot be determined. RDA (Recommended Daily Allowance) is the average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group.

Table A5. CoRD food basket percent met of Estimated Average Requirement (EAR) for energy and essential nutrients for a 30-year old male; comparison between main CoRD results and alternative ASF CoRD results

		Bangladesh		Bhutan		India		Nepal	
	EAR	Main	ASF	Main	ASF	Main	ASF	Main	ASF
Energ_Kcal	2725 (EER)	102%	98%	103%	93%	99%	93%	89%	87%
Protein_(g)	46.2	127%	127%	113%	110%	122%	122%	129%	123%
Lipid_Tot_(g)	61 (no EAR)	79%	84%	147%	95%	79%	74%	106%	126%
Calcium_(mg)	1000 (AI)	68%	79%	65%	64%	52%	53%	67%	60%
Iron_(mg)	6	98%	91%	94%	88%	63%	50%	137%	117%
Magnesium_(mg)	330	127%	120%	138%	111%	81%	74%	195%	169%

Potassium_(mg)	4700 (AI)	92%	87%	77%	75%	67%	61%	148%	136%
Zinc_(mg)	9.4	95%	87%	111%	96%	89%	81%	130%	127%
Vit_C_(mg)	75	123%	121%	311%	310%	297%	294%	261%	259%
Thiamin_(mg)	1	144%	118%	122%	139%	141%	113%	202%	209%
Niacin_(mg)	12	80%	90%	71%	86%	67%	61%	111%	119%
Vit_B6_(mg)	1.1	180%	155%	207%	184%	196%	164%	426%	427%
Folate_Tot_(µg)	320	297%	217%	118%	115%	236%	153%	237%	144%
Vit_B12_(µg)	2	55%	325%	56%	290%	56%	56%	55%	76%
Vit_A_RAE	625	176%	178%	24%	25%	29%	29%	16%	16%
Vit_E_(mg)	12	63%	65%	73%	66%	64%	61%	60%	58%
Vit_K_(µg)	120 (AI)	644%	639%	158%	156%	109%	105%	73%	68%

Table A6. Share of CoRD to food expenses vs to total expenses

Country	Survey	Share of CoRD to food expenses	Share of CoRD to total household expenses
Bangladesh	HIES 2016	85%	32%
Bhutan	BLSS 2012	109%	67%
India	NSS 2011	145%	46%
Nepal	AHS 2016-17	83%	34%