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Healthy and Sustainable Diets in Bangladesh

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Abstract

An ideal food system is envisioned to provide healthy diets for people and be sustainable for the environment. Such a food system is required to deliver on these goals even as diets are increasingly and disproportionately comprised of high-fat and/or high-sugar foods vis-à-vis nutritious diets. The ideal "planetary health diet," as defined in the EAT Lancet report for several countries, presents trade-offs when contextualized at the local level. Using Bangladesh as the case study, this paper examined the change in diets (between 2000 and 2016) and their greenhouse gas emissions over time and compared the nutritional value and environmental impact to two modeled diets: national food-based dietary guidelines and the planetary health diet/EAT Lancet diet. The analysis finds that despite a change of the diet toward the recommended diet, significant gaps remain from a nutritional perspective. Moreover, meeting the dietary guidelines would increase greenhouse gas emissions by at least 10 percent. Compared to the food-based dietary guidelines, the EAT Lancet diet requires dietary patterns to change even more significantly and would increase greenhouse gas emissions by 23 percent. The policy implications and options from the production and demand sides are complex and require assessing multiple trade-offs.

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Healthy and Sustainable Diets in Bangladesh

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1 Introduction

Diets around the world deviate from what is healthy, nutritious, and sustainable. Overall people are eating poorly; diets are dominated by refined grains and high-fat and/or high-sugar foods, unhealthy oils and beverages, and inadequate amounts of nutritious foods such as fruits, vegetables, legumes, nuts, fish, dairy, eggs, and whole grains. Unsustainable diets indicate that environmental costs are significant externalities not integrated into the current value of diets. This proposed work will describe the quality of diets in Bangladesh considering both the nutritional value and environmental cost of the diet and how these compare to dietary guidelines. As such, this paper describes the dietary changes needed in the country and can help in the design of policy and investment options towards such change.

The EAT-Lancet report assessed global food consumption and production against human health targets and planetary health boundaries (Willet et al. 2019). The report simulated the impacts of three actions, namely change in production practices, change in diets, and halving food loss and waste. A set of two key targets were identified in that report. The first is to achieve the *planetary health diet* through dietary shifts. Such a shift would avert 10.8 million adult deaths per year. The second target is to transition into sustainable food production which limits six earth system processes: climate change (GHGe), land-system change (cropland use), freshwater use, nitrogen cycling, phosphorous cycling, and biodiversity loss (extinction rate). However, the idea of a single planetary health diet is tenuous, and even so the path towards positive dietary change will vary across countries and require a transformation of the food systems. For example, current diets lack diversity and the shift to healthier sustainable diets will require in many low- and middle-income countries an increase in GHGe and water use due to food production (Kim et al. 2020). The cheapest planetary health diet costs US$2.84 per day, exceeding the household per capita income of 1.58 billion people (Hirvonen et al. 2020) and food expenditure of many more. More than 3 billion people in the world cannot afford a healthy diet (Herforth et al. 2020).

This suggests that more careful analysis at the country level, and particularly among developing countries, is needed to identify a benchmark healthy, nutritious, and sustainable diet in that context, thereby setting long-term targets and aligning adequate strategies both from the supply and demand sides. This will help gauge the gap between current diets and this benchmark diet, and to assess how best to close this gap. More recently, such country-level work has been done in India (Chaudhary 2019; Sharma et al. 2020) and in Indonesia (de Pee et al. 2021). Building on this emerging literature, the focus of this paper is to assess the gaps of Bangladeshi diets against an example of a healthy sustainable benchmark—the EAT Lancet diet and to Bangladesh's food based dietary guidelines (FBDG).

Diets in Bangladesh have been changing over time, albeit slowly (Waid et al. 2017). Over the 25 years from 1985 to 2010, the consumption of starches and pulses have decreased by seven percent and 32 percent, respectively. In contrast, consumption of other foods has increased. Over the same period, fruit consumption increased by 91 percent, vegetables by 24 percent, eggs by 67 percent, meat by 124 percent, and oils by 169 percent. Yet current diets still fall below the nutritionally recommended diets, or national dietary guidelines (Dizon et al. 2020). In 2016, consumption of starchy staples was still too high, at 137 percent of the recommended amount. On the other hand, vegetable consumption was only 54 percent of the recommended amount, fruits only 23 percent, and dairy still only 13 percent. More so, current national dietary guidelines typically address a health and nutrition target, and not a sustainability target. This is true even for national dietary guidelines among the G20 (Loken and DeClerck 2020).

An emerging body of work assesses diets against *both* human health and planetary health objectives at the country level. The point is that a planetary health diet is likely to be different in different contexts— that the planetary health diet is not a universal benchmark. For example, meeting the planetary health diet as defined in the EAT-Lancet would imply different environmental impacts for different countries (e.g., land use, biodiversity, anti-microbial use). If GHGe are considered, a recent analysis shows that in low- and middle-income countries, agricultural GHGe would increase by 12–283 percent while globally the total GHGe would still decrease substantially (Kim et al. 2020). This is also the case for Bangladesh, and a result in this paper; instead of decreasing GHGe, meeting the planetary health diet would increase emissions. GHGe from food consumption varies across countries based partly on the country of origin of the food products (i.e., where food is imported from), because different countries would have different emissions for the same food item produced. As such, global production practices and trade policies should be considered in country-level analysis of diets. Besides the planetary health diet, there are multiple diet configurations which can work better for one country but might be less ideal for another. For example, a study calculated GHGe and water footprints for current diets and nine alternative plant-forward diets for each of 140 countries (Kim et al. 2020). The GHG footprint of a given diet varies largely by country.[1]

This paper looks at how diets have changed in their nutritional value and their GHGe over time, and what an aspirational diet would look like for Bangladesh— one which improves nutritional value and limits environmental costs. It particularly assesses the environmental costs and nutritional value if people consumed as per the national food based dietary guidelines, or if people consumed as per the planetary health diet. This paper also assesses whether a dietary shift towards some aspirational diet is feasible given the trajectory of change in diets in the past.

2 Methodology and data

This work reviewed Bangladeshi household-level consumption data in 2000 and 2016 and, based on those, modeled two benchmark diets — 1) the human health diet recommended by Dietary Guidelines for Bangladesh (FBDG) and 2) the human and planetary health diet recommended by the EAT-Lancet report (hereinafter referred to as EAT-Lancet) (Loken and DeClerck 2020). We analyzed each of the three types of diet from the aspects of average per adult male equivalent (AME) food consumption (by 7 and 10 food groups), macro- and micronutrient intake, and GHGe. Food consumption is derived from household consumption and expenditure data.

[1] Bangladesh was not included in this cross-country study.

2.1 Actual consumption patterns in 2000 and 2016

2.1.1 Consumption calculation

Calculating average daily consumption quantities using the Bangladesh Households Income and Expenditure Surveys (HIES) in 2000 and 2016 involves calculating total consumption by food groups over a certain reference period and standardized estimation units (i.e., per household, per individual, or per AME).[2] The number of food items as well as food groups vary across different HIES years (i.e., HIES 2000 includes 140 items in 17 groups, whereas HIES 2016 has 150 items in the same 17 groups). To build comparable consumption patterns, therefore, we grouped HIES food items into seven broad food groups established by the FBDG, namely starchy staples, vegetables, fruits, protein foods, dairy, fats and oils, and sugars. The protein foods category was further split into pulses, fish, meat, and eggs, which composes the ten-group version with the other 6 food groups. In addition to regrouping the HIES food items, the quantities (i.e., as per household expenditure data) were all converted using the edible portion amount in Food Composition Tables (Waid et al. 2017) and were in grams. Regarding the estimation units, we converted individuals to their AMEs based on Bangladesh bodyweight and activity level as described in Waid and others' work, and summed AME up within households (Waid et al. 2017). Dividing food consumption by number of AME and number of days during the reference period yields grams of food consumed per day per AME for each household. Then the result was averaged and weighted across all the households to produce the national average.

2.1.2 Nutrient intake

Nutrient intake calculation is based on the quantities consumed by HIES food items and nutrient values are derived from from the Food Composition Table for Bangladesh (FCT) (Shaheen et al. 2013) and FoodData Central.[3] Macro- and micronutrient intake were also summed up to the seven broad food groups level by food categories.

2.1.3 Food items

Not all food items in HIES were included in this analysis, considering the necessity of matching HIES items to trade and GHG footprint data for later environmental cost analysis. To guarantee that all dietary models have the same food items, and all these items participate in both nutritional estimation and environmental health estimation, we only kept HIES items that satisfy the following requirements:

1) The item belongs to a group that is in both FBDG and EAT-Lancet benchmarks.
2) The item has counterpart in the corresponding year's Food Balance Sheet (FBS), or at least can be converted to primary equivalents that have trade record in the corresponding year.
3) The item has counterpart in the corresponding year's detailed Trade Matrix (TM) data set. If a given item has FBS record but no TM record, this item is deemed as imported from the

[2] Bangladesh Bureau of Statistics (BBS). Household Income and Expenditure Survey 2000/2016. Ministry of Planning, Government of Bangladesh. Data requests can be made at dg@bbs.gov.bd.
[3] U.S. Department of Agriculture. Food Data Central. Available at: https://fdc.nal.usda.gov/.

"world" instead of from a specific country. Its GHG footprint, regardless of being animal food that has country-specific footprint data or not, will be from the world average.

4) The item can be matched to FCT, or their nutritional values can be found elsewhere.

In this way, all spices were excluded. HIES 2000 and 2016 both have 17 food categories, and each category contains one "Other (specify)" item. We manually assigned specific TM items to 11 out of 17 "Other" items based on the characteristic of the food group (i.e., mixed food group like "Dining out" or a narrow and specific group like "Fish"), high potential in GHGe, and the lowest possible nutritional values to measure the upper bound in environmental cost and the lower bound in nutrient intake. Following these rules, 30 and 37 HIES food items were excluded, accounting for 3.8 percent and 4.5 percent of total consumption by weight, in year 2000 and 2016 respectively (see Annexes 1 and 2). Matching results are shown in Annex 3.

2.2 Scaled consumption patterns

The FBDG-scaled diet was modeled to show changes in each food item consumption after assigning a required amount to each of the 10 food groups classified in the FBDG while controlling for individuals' original dietary preferences. Creating FBDG-scaled diet requires two pieces of information: 1) total grams of food by 10 food groups recommended by the FBDG (see Annexes 4 and 2) actually consumed food items' shares of their food groups. We summed items' recommended amount by 10 groups and assigned these totals to households. Multiplying these assigned amounts with each food item's actually consumed share yields scaled consumption by food items. For example, in the ten-group version, according to the FBDG (see Annex 4), 30 grams of egg was assigned to per AME per day. In both HIES 2000 and 2016, egg category consists of hen egg, duck egg, and other eggs; for an adult male whose actual intake of egg category is 50 percent hen egg and 50 percent duck egg, the FBDG-scaled egg consumption of this dietary pattern will be 15 grams of hen egg and 15 grams duck egg. Consequently, foods that would belong in a specific food group but where 0 grams was consumed, as per HIES, would not be included in the FBDG-scaled diet. Similarly, if only a very small amount of an HIES item was consumed, it would also contribute only a very small amount to that food group's scaled up (or down) 'FBDG-scaled' diet. After scaling quantities consumed to the FBDG recommendations, macro- and micronutrient intake were calculated using the same method as in the actual dietary pattern accordingly.

The EAT-Lancet-scaled diet has the same modeling process as FBDG-scaled diet. Preferences as per HIES were maintained with assigned quantity for each food group. The EAT-Lancet-scaled diet differs from the FBDG-scaled diet in recommended quantities (see Annex 5) and food groupings.

2.3 Environmental cost

Additional to analyzing quantities and nutrient intake, we calculated total GHGe from five sources — land-use change (LUC) CO_2e (CO_2 equivalents) footprints of feed palm for terrestrial animals, LUC of feed soy for terrestrial animals, LUC of soy and palm oils for human consumption, LUC for pasture expansion, and other CO_2e footprints excluding LUC. To calculate GHGe, two pieces of information are needed: 1) item specific (and ideally, country specific) GHG emission footprints; 2) carcass weight for the quantities of food consumed.

2.3.1 GHG footprints

Life cycle assessment (LCA) is a widely used technique for environmental impacts evaluation of products and processes over a full life cycle. However, life cycle inventory data are often decentralized and very difficult to harmonize (Green et al. 2020). Hence, we used data that represent averaged production methods in a given country or in the world instead of using LCA data that are specific for a production method. In the absence of LCA data, the less ideal GHG footprints data should be both item specific and country specific. However, such information was not available for all items in our analysis. Thus, we categorized our items into country specific (CS) items and non-country-specific (NCS) items. Within each of the two categories, the items were further grouped into animal food items, and plant-based food items plus other non-animal food items. CS footprint data come from GLEAM-i[4] tool as made available in Kim et al. (2020) which only reports animal food items. Therefore, CS items are all animal food items whereas NCS items are mostly plant-based food plus several insects and aquatic products. For NCS items, as CS footprints were not available and unapplicable, we used items' footprints distribution (Kim et al. 2020) and substituted item specific footprints with world weighted average footprints. These imported NCS items are deemed to be imported from the "world" in terms of GHG footprints, even though they might have trade records indicating their country of origins (COOs) in FBS or TM data sets.

2.3.2 Trade patterns

To account for varying GHG footprints in different production systems, we traced food items back to their COOs. We used the two-step method (Kim et al. 2020) described below to decompose consumptions into quantities imported from all COOs. The imported quantities are proportional to COOs' shares of total domestic supply, which can be obtained from FBS and TM data sets.[5,6]

STEP 1. Using FBS trade data to allocate the share of each FBS item *f* consumed in country *c* (Bangladesh) between imports and domestic production.

$$\%imported_{f,c} = \frac{imports_{f,c}}{domestic\ production_{f,c} + stock\ changes_{f,c} + imports_{f,c} - exports_{f,c}}$$

STEP 2. Using the share of TM items *t* exported from *e* into *c* to allocate the imported share of FBS item *f* among exporting countries.

$$\%imported_{f,c,e} = \%imported_{f,c} \times \frac{\sum imports_{t,c,e}}{\sum imports_{t,c}}$$

[4] All the GLEAM-i data in this work refer to the data acquired from FAO's GLEAM-I tool version 2.0 accessed in December 2017 and made available in Kim et al.' s supplementary data.
[5] FAO. FAOSTAT Trade Matrix database. Available at: https://www.fao.org/faostat/en/#data/TM, accessed 24/12/2021.
[6] FAO. FAOSTAT Food Balance Sheet. Available at: https://www.fao.org/faostat/en/#data/FBS, accessed 24/12/2021.

$\%imported_{f,c,e}$ indicates the percentage of a given FBS item f consumed in Bangladesh imported from country e. Applying this percentage to corresponding FBS item's carcass weight will yield all COOs from which this item was imported and its respective imported quantities.

For a given FBS item, the percentage of domestic supply that is domestically produced was used as a proxy for the percentage of consumption that is domestically produced. In this way, food loss and waste were implicitly included.

$$\%produced_{f,c} = \frac{domestic\ production_{f,c}}{domestic\ production_{f,c} + stock\ changes_{f,c} + imports_{f,c} - exports_{f,c}}$$

$$production_{f,c} = \%produced_{f,c} \times carcass\ weight\ of\ actual\ consumption_{f,c}$$

where the f is a specific FBS food item and c represents country, Bangladesh in this case.

2.3.3 Carcass weight

Regarding quantities to be applied with GHG footprints, converting actual consumption to carcass weight requires two additional steps. We firstly converted edible portion to their raw weights using cooking yield factors (Bogna 2002 and USDA 2014). Secondly the raw weights were converted into carcass weights using extraction rates in Bangladesh (FAO 1997).

2.4 Data

2.4.1 Data on household consumption

Household-level consumption data are from HIES 2000 and HIES 2016,[7] which provide food items, quantities consumed, item values, and individuals' basic information in a 14-day reference period. HIES 2000 includes 63 districts and 7,437 households with an average household size of 5.3 people. AME per household is 4.1 on average. HIES 2016 was designed to sample 46,076 households. But due to missing data of 94 households, the actual number of households used for calculations is 45,982 from 64 districts. The average household size was 4.1 people and AME per household was 3.3.

2.4.2 Data on nutrients

In addition to macronutrients, we focused on six micronutrients, namely calcium, iron, zinc, Vit. A, Vit. B_{12}, and folate, in terms of nutritional analysis. We based our decision of micronutrients on level of deficiency and availability of a micronutrient's unit amount as a component of Bangladeshi local foods. Previous studies including Nutrients Background Paper (Talukder et al. 2015) and National Micronutrients Status Survey (ICDDR'B et al. 2013) mostly focus on Vitamin

[7] Bangladesh Bureau of Statistics (BBS). Household Income and Expenditure Survey 2000/2016. Ministry of Planning, Government of Bangladesh. Data requests can be made at dg@bbs.gov.bd.

A, Ca, Iodine, Iron, Zn, and Folate (Dizon et al. 2019, Ahmed et al. 2016). According to comprehensive nutrient gap assessment (GAIN 2021), except Folate, the other five micronutrients have high to moderate burden gap with high or moderate level of evidence certainty. Folate and Vit. B_{12} deficiencies are more concerned among non-pregnant non-lactating women, with all strata sharing similar deficiency levels at around 23 percent (25 percent in slums). Iodine's data is unavailable, so we focused on the other six micronutrients.

Macro- and micronutrient values used for dietary patterns' analysis are mostly from FCT. FoodData Central portal[8] was also used because FCT does not contain data for Vitamin B_{12}. For measuring the sufficiency of nutrient intake from our modeled diets, we created minimum requirement for macronutrient intake (Annex 6a) using total energy per AME (2,430 kcal)[9] provided by the FBDG and shares of energy that come from protein, fat, and carbohydrate recommended by FAO. According to the recommendations of FAO (2008), for an adult male aged 19-50, 55 to 75 percent of total energy should come from carbohydrates; 20-35 percent of total energy from fat; and 12 percent of the total energy from protein. With the aim to benchmark dietary patterns' nutrients intake, we used the minimum requirement of energy provision from protein (12 percent), 15 percent from fat and the rest, 73 percent from carbohydrates to create minimum amount of nutrients intake suggested. Since carbohydrates, fat, and protein provide 4 calories, 9 calories, and 4 calories per gram respectively (USDA 2022), applying macronutrients' shares of energy and their unit energy provision to 2,430 kcal per AME produced the desirable macronutrient intake used in Figure 2.

Desirable micronutrient intake (Annex 6b) for benchmarking in Figure 3 is from the study Desirable Dietary Pattern for Bangladesh, which adapted recommended nutrient intake (RNI) of micronutrients from FAO 2004 (Nahar et al. 2013). Regarding Ca, Vit. A, Vit. B_{12}, Folate, we chose RNI for males aged 19-65; we also took the lowest bioavailability (5 percent) for micronutrients Fe and Zn for adult males between 19 and 65.

2.4.3 Data on trade

Two trade data sets were used to allocate shares of imported consumption — FBS and TM data sets from FAOSTAT.[10,11] FBS 2016 and TM 2016 were used for GHG emission calculations in 2016 whereas FBS 1998 and TM 1998 were used for year 2000, due to the unavailability of FBS and TM in 2000. FBS and TM have their own food coding systems which are different from HIES. FBS differs from TM in that FBS defines food items by their primary equivalents and thus it contains fewer food items than HIES and TM. Moreover, FBS does not show COOs for imported items. Both datasets contain data for imports and exports whereas FBS also has data for population, domestic production, stock variation, and domestic supply. As shown in section 2.3.2, FBS together with TM are essential for calculating shares of production by COO.

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[8] U.S. Department of Agriculture. Food Data Central. Available at: https://fdc.nal.usda.gov/.

[9] The recommended energy intake of 2,430 kcal per AME is from FBDG of Bangladesh in 2013, which is lower than 2,854.1 kcal per AME (age between 30 and 59) with a moderate activity level, found by Waid and others in their study in 2017.

[10] FAO. FAOSTAT Trade Matrix database. Available at: https://www.fao.org/faostat/en/#data/TM, accessed 24/12/2021.

[11] FAO. FAOSTAT Food Balance Sheet. Available at: https://www.fao.org/faostat/en/#data/FBS, accessed 24/12/2021.

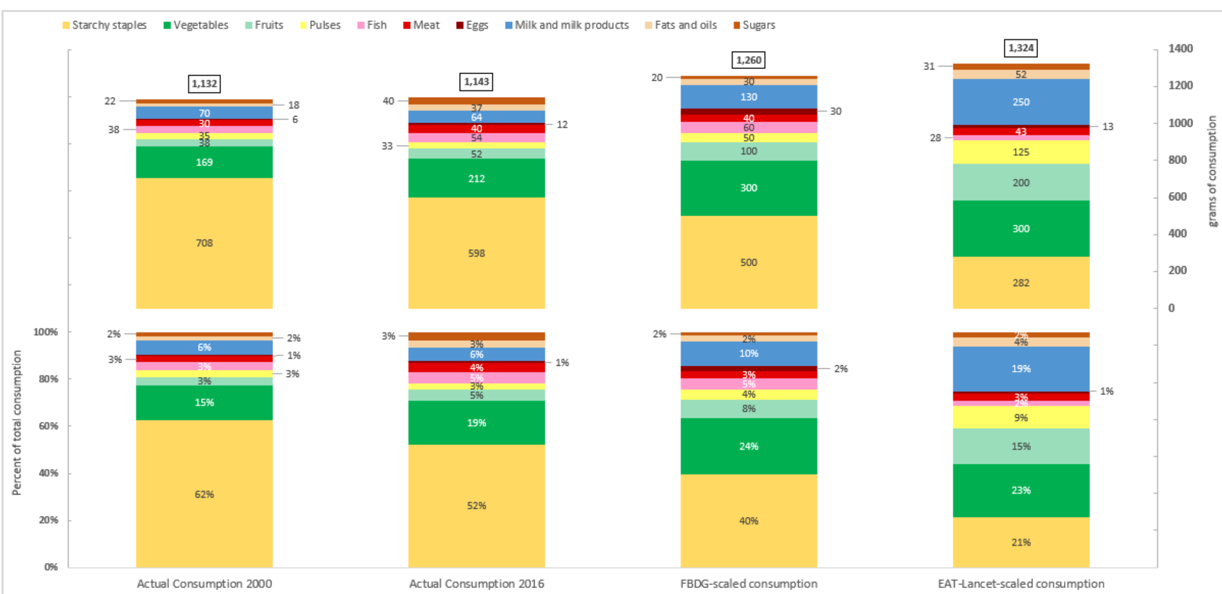
2.4.4 *Data on GHG footprints*

GLEAM-i and literature search are two sources for GHG footprint data. These data were taken directly from the study done by Kim et al. in 2020, in which GLEAM-i data were obtained through FAO 2017 GLEAM-i v2.0 and were used for terrestrial animal products (i.e., bovine meat, eggs, milk etc.). The GLEAM-i dataset provides five types of GHG footprints for each terrestrial animal product by COO. But in the case of Bangladesh, the GLEAM-i dataset only contains data for 13 FBS items. Therefore, for all other food items excluded from the GLEAM-i database, mainly plant foods and aquatic animals accounting for 46 FBS items. Kim et al. 2020 collected item-specific data from a wide range of literature. Data from literature search are not generated by a consistent methodology across all countries. Therefore, these data cannot be treated as country-specific data. To account for the heterogeneity issues imposed by literature search, weighted average footprint for each FBS item was used as the only footprint for the given item.

3 Results

3.1 Diets in 2000 and 2016, compared to national dietary guidelines and the planetary health diet

Figure 1 Diets in 2000 and 2016 compared with FBDG and EAT Lancet diet (in grams)



Overall, when comparing the diets between 2000 and 2016, consumption has increased for vegetables, fruits, and for fish, meat, and eggs; but it has also slightly increased for sugars and fats/oils. The consumption of starchy staples has decreased while that of dairy remained unchanged (Figure 1).

We then compare actual diets to a locally adapted benchmark for a healthy diet: the national dietary guidelines. The consumption data compared to dietary guidelines shows that Bangladeshis are overconsuming staples, fats/oils, and sugars; while they are under consuming vegetables, fruits, fish, eggs, and dairy (Figure 1).

Then, we compare actual diets against an example of a global benchmark for a healthy and sustainable diet: the EAT Lancet diet. Against this benchmark, Bangladeshis are overconsuming starchy staples and sugars, in fact starchy staples make up 50 percent of the current diet, while they are under consuming vegetables, fruits, and dairy. This is similar to the comparison with dietary guidelines.

Actual consumption vs the EAT Lancet diet shows that pulses are largely under consumed, while fish is over consumed, and meat is slightly over consumed. Comparing FBDG and EAT Lancet diets, the starchy staples are just half the amount from the FBDG in the EAT Lancet diet, whereas amounts of fruit, pulses and dairy are twice as high in EAT Lancet as compared to FBDG diets.

3.2 Nutritional value of diets in 2000 and 2016, compared to national dietary guidelines and the planetary health diet

Figure 2 Nutritional value of diets in 2000 and 2016 and of FBDG and EAT Lancet diets as a share of national requirements (macronutrients)

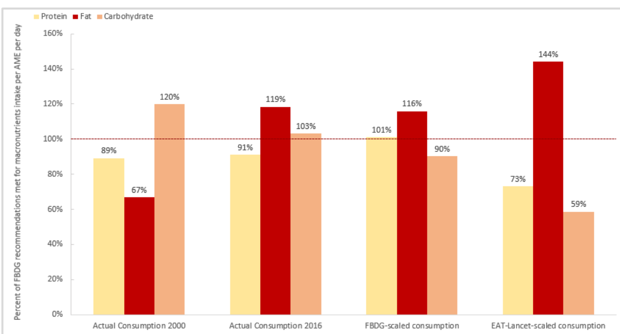
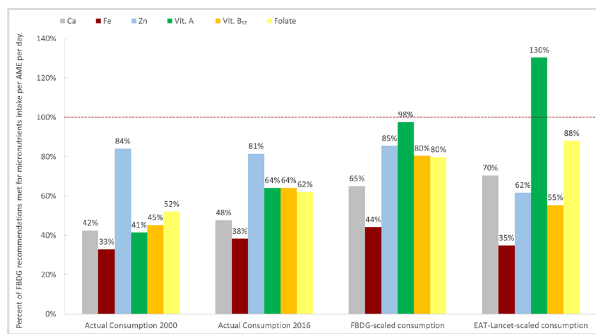


Figure 3 Nutritional value of diets in 2000 and 2016 and of FBDG and EAT Lancet diets as a share of national requirements (micronutrients)



Between 2000-2016, there has been an increase in the fat intake and a decrease in carbohydrate intake, with fat intake being more than the minimum recommended intake, while carbohydrate intake is more in line with the recommendations. Protein intake has largely remained unchanged. Despite overall increases in the intake of most micronutrients (with the exception of Zn), there are still significant intake gaps across all micronutrients, falling short of the recommendations (Figure 2 and Figure 3).

All diets were compared to assess whether the FBDG recommendations were met (Figure 2 and Figure 3). In terms of macronutrients, the actual diet from 2016 and the FDBG scaled consumption were close to meeting the requirements, the actual diet from 2016 falling short for protein and higher for fat, whereas the FBDG scaled diet also meets the minimum requirement for fat and protein requirements and fell short on carbohydrates. The EAT-Lancet diet does not meet fat or carbohydrate requirements but meets the minimum requirements for fat. In terms of micronutrients, the FBDG scaled up consumption was closest to meeting the requirements, but all diets fell short on meeting the micronutrient requirements, particularly for iron. Vitamin A requirements were nearly met for the FBDG scaled up consumption and met the requirements in the EAT Lancet modeled diet.

The planetary health diet would mean *lower intakes for* protein and carbohydrates and *higher intake* of fat relative to actual diets in 2016. The planetary diet falls short for proteins and carbohydrates when compared with the intake recommendations, whereas it is more than the minimum requirement for fats. The planetary health diet also results in lower intakes of iron, zinc, and vitamin B12 than current diets, whereas it would result in higher intakes of other micronutrients, such as calcium, vitamin A, and folate (Figure 2 and Figure 3).

3.3 GHGe of diets in 2000 and 2016, compared to national dietary guidelines and the planetary health diet

Figure 4 GHGe of diets in 2000 and 2016 compared with national dietary guidelines and planetary health diets (in kg emissions).

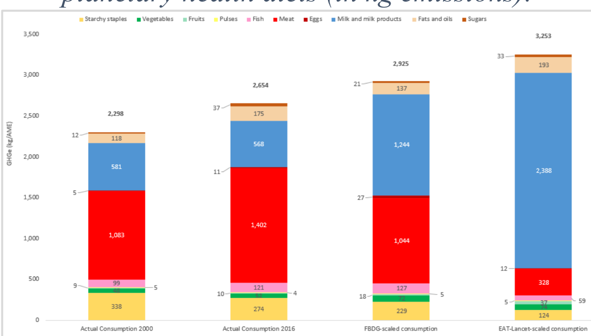
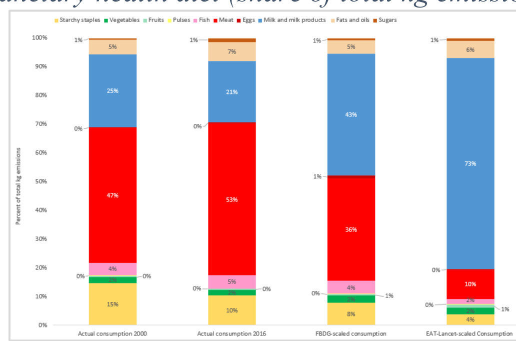


Figure 5 GHGe of diets in 2000 and 2016 compared with national dietary guidelines and planetary health diet (share of total kg emission)



Between 2000-2016, GHGe from food consumption has increased by 15 percent. More than half the emissions continue to come from the consumption of meat, followed by dairy, then by starchy staples, which is largely rice. Vegetable and fruit consumption contribute a very small share of total emissions. Increased consumption of meat represents most of the observed increase in emissions between 2000-2016 (Figure 3 and Figure 4). Meat is the dominant contributor to GHGe, while other protein-rich foods such as pulses, fish, and eggs have relatively negligible contributions to GHGe. Among different types of meat, emissions from bovine meat are much higher than mutton, goat, and poultry (Figure 6 and Figure 7).

Following the dietary guidelines would lead to a diet with 10 percent higher GHGe relative to actual consumption in 2016. This is driven mostly by the higher dairy consumption recommended by the guidelines, which leads to a doubling of emissions from dairy. In contrast, the recommended increase in other protein-rich foods does not increase GHGe, as this is driven by increases in foods with lower emissions, such as fish, eggs, pulses (Figure 3 and Figure 4).

The planetary health diet would result in 23 percent additional GHGe compared to the actual diets in 2016. However, dairy would most significantly contribute to the GHGe in the planetary diet compared to the actual diets in 2016 where more than half of the contribution to GHGe comes from meat (Figure 3 and Figure 4).

When comparing all the diets, the FBDG-scaled up and EAT-Lancet scaled up diets have a higher proportion of vegetables, fruits and dairy and less starchy foods when compared to the actual diets from 2000 and 2016. The EAT Lancet diet is composed of more fruits, dairy, pulses and fats and oils and less starchy foods, eggs and fish when compared to the FBDG diet (Figure 3 and Figure 4).

Figure 6 Consumption by types of meat for diets in 2016 compared with national dietary guidelines and planetary health diet

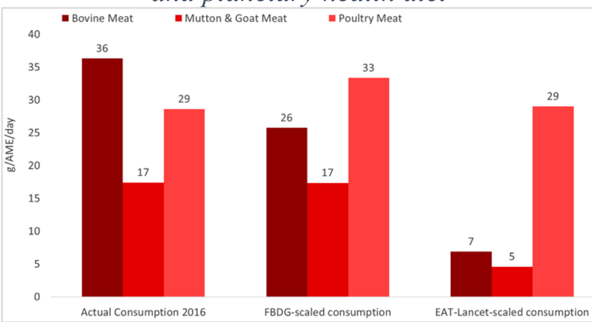
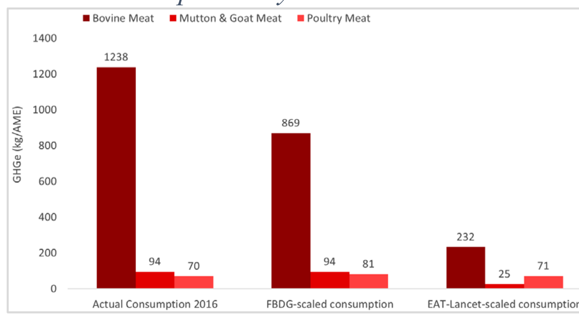


Figure 7 GHGe by types of meat for diets in 2016 compared with national dietary guidelines and planetary health diet



3.4 GHGe and domestic versus imported sources of food

The bulk of GHGe comes from meat and dairy consumption, and both are almost entirely sourced domestically (Figure 7). This indicates that the high GHGe coming from meat consumption are due to emissions from domestic production of meat and dairy. For example, of the total emissions from meat consumption of 1,402 CO_2e kg/AME/year, only 6 CO_2e kg/AME/year is due to emissions from its biggest meat trading partner, Saudi Arabia (Figure 8). One could envision two strategies to curb emissions. First, Bangladesh can adopt lower-emission strategies to meat and milk production. This could include, for example, enhancing productivity and lowering food loss in the value chain. Second, there would be potential to reduce emissions by sourcing more from trade partners which have lower emissions or by adopting similar methods from these lower emission countries, as opposed to producing domestically without changing the current and most prevalent production practices and technologies. While emissions from bovine meat are not lower in Saudi Arabia, they are lower in Malaysia, the UAE, and Australia, which are the other main trade partners in meat for Bangladesh (Figure 10). Similarly, Bangladesh's main trade partners for milk, Australia, Denmark, France, and the Republic of Korea, have lower emissions from milk production than that for Bangladesh, indicating that the country could learn from the milk production processes of its trading partners to lower emissions. These emissions, however, do not include emissions from transport from the exporting country to Bangladesh, which would still need to be accounted for. Transport is anyway more difficult for more perishable items such as meat and milk.

In contrast to meat and dairy, less perishable fats and oils are largely imported, and there are differences in emissions by trade partner. For example, of the major trade partners for fats and oils, Argentina and Paraguay have much higher contributions to emissions than Indonesia for the same almost the same level of imports (Figure 9). Fats and oils, however, constitute a much smaller share of emissions than do meat and dairy.

Figure 8 Imported versus domestic production source of consumption in 2016

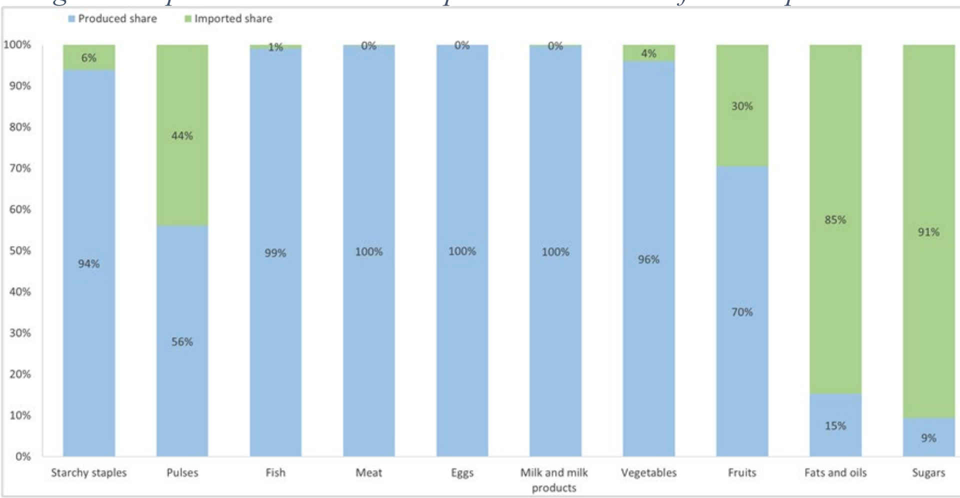


Figure 9 Imported shares and GHGe of top five exporting countries in 2016

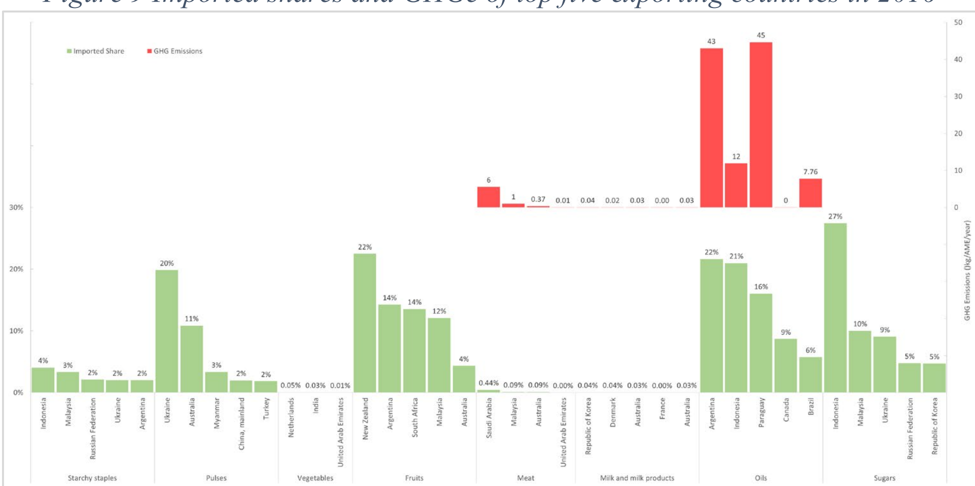
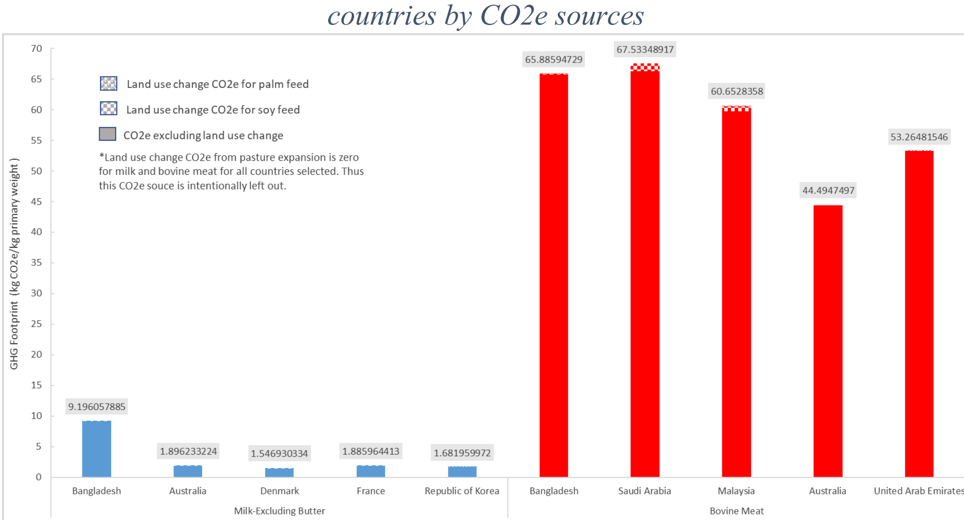


Figure 10 GHG footprint of milk and bovine meat of Bangladesh and top exporting countries by CO2e sources



4 Discussion

As countries address the SDGs and start to design strategies, the interconnectedness between the SDGs becomes more apparent and the need to assess the different outcomes is critical. The relationship between the different SDGs, i.e., poverty reduction (SDG1), zero hunger and zero malnutrition (SDG2), health (SDG3) and climate (SDG13) is complex and involves trade-offs, which often is not fully appreciated.

4.1 Food and nutrition situation in Bangladesh

Bangladesh has made significant progress over the last 20 years to reduce rates of malnutrition among its population and is on its way to meeting SDG2 "End hunger, achieve food security and improved nutrition and promote sustainable agriculture". Yet, poor nutrition continues to be an important challenge and further progress is needed to ensure all Bangladeshis can achieve their highest potential (Cabinet Division of the People's Republic of Bangladesh and WFP 2019). Despite progress, many Bangladeshis are still affected by malnutrition and the country increasingly faces a combined burden of wasting, stunting, overweight and micronutrient deficiencies. In 2019, 28 percent of children under the age of five were stunted as compared to 42 percent in 2013 (BBS and UNICEF 2014 and 2019), 10 percent were still wasted, and 2 percent suffered from overweight. In addition, in 2018, 32 percent of women and 18 percent of men were found to be overweight or obese (NIPORT and ICF 2020). Among those, 7 percent of women, including 1 percent of girls 15-19 years old, and 2 percent of men were found to be obese (NIPORT and ICF 2020). Undernutrition and overweight / obesity are serious nutrition risks that can lead to poor health outcomes, including an increased risk of non-communicable diseases (NCDs). In 2018, NCDs were linked to 67 percent of all deaths in Bangladesh (WHO 2018).

In addition, Bangladeshis are at increased risk of micronutrient deficiencies. While data remains sparse, in 2011-12, the prevalence of vitamin A deficiency and anemia was 20 and 19 percent in preschool-aged children respectively, 21 and 17 percent in school-aged children, and 5 and 26 percent in non-pregnant non-lactating women respectively (ICDDR'B, UNICEF, GAIN, IPHN, 2013). Additionally, the national prevalence of zinc deficiency was 45 percent in pre-school-aged children, and 57 percent for non-pregnant and non-lactating women (ICDDR'B, UNICEF, GAIN, IPHN, 2013).

The quality of Bangladeshi diets has moderately improved and in the past twenty years, the proportion of severely food insecure households has decreased from 21 percent in 2000 to 11 percent in 2018-2020 (FAO, IFAD, UNICEF, WFP and WHO 2021). In 2019, 38 percent of children of 6 to 23 months had adequate dietary diversity as compared to 24 percent in 2011 (NIPORT and ICF 2020). In addition, the share of dietary energy consumption from cereals, roots and tubers has reduced from 81 percent in 2005 to 78 percent in 2017[12] with rice as the most frequently consumed staple. Despite a reduction in the share of dietary energy consumption from rice from 83% in 1991, rice alone still accounted for 68% of dietary energy consumption in 2016 (Cabinet Division of the People's Republic of Bangladesh and WFP 2019). This proportion is high, also compared to the country's FBDGs, which recommend that 55 percent of dietary energy comes

[12] FAOSTAT. FAO Estimates. Last accessed 16/06/2022.

from staple foods (Nahar et al. 2013). The consumption of micronutrient-rich foods for adults aged 20 and over such as vegetables, fruits, nuts, and whole grains remains low compared to recommendations and targets (GNR 2019 and Nahar et al. 2013). Animal source foods are another important source of micronutrients. Consumption of meat, fish and dairy is within recommended intakes and salt, sugar-sweetened beverages, and trans fats is higher than desired for optimal health (GNR 2019). Under the meat category, consumption of bovine meat is the highest, followed by poultry and then goat meat or mutton.

4.2 Comparison with nutrient intake recommendations, modeled diets, and trade-offs

In this analysis, we assessed the diets in Bangladesh in 2000 and 2016 and compared these diets with a modeled scaled up diet to meet the FBDG and the EAT Lancet diet. Between 2000 and 2016, the Bangladeshi diet has overall remained comparable. Notably, the intake of most micronutrients increased, but remains significantly lower than the recommendations. The low intake values for Fe and Zn reflect an assumption of low bioavailability as the current diet is largely plant-based.

The results showed that to meet the recommendations, the level of protein consumption would have to slightly increase, but the minimum requirements for fat and carbohydrate are met and not surprisingly the intake of all micronutrients would also need to increase. Calcium, Vitamin A, Folate and B12 in the actual diet from 2016 are significantly lower than the recommendations. Interestingly in comparison, the EAT-Lancet diet showed a higher share of pulses, dairy and fruit and a lower intake of starchy foods, eggs, and fish, while meat remained unchanged (when compared to the FBDG scaled up diet).

When comparing the environmental cost of the different diets, first a comparison between 2000 and 2016 showed that there has been an increase in the GHGe by 15 percent and this can almost entirely be attributed to increase in the consumption of meat. The FBDG scaled up diet showed a further increase of the GHGe by 10 percent. However, the contribution of the different food groups to the GHGe was different. The overall contribution of milk and milk products was higher, while it was lower for meat, starchy foods, and fish. When the FBDG scale-up and EAT Lancet scale up diets are compared with each other, the contribution to GHGe is significantly higher from dairy and milk products compared to meat.

This case for Bangladesh illustrates that meeting nutritional targets from the current food supply (whether the FBDG or EAT Lancet diet) would require an increase in consumption of foods that have a higher GHG footprint than the current diet. Both modeled diets recommend increasing dairy and milk products, fruits and vegetables and reducing starchy foods. In terms of protein intake, interestingly, the EAT Lancet diet suggests a higher intake of pulses and lower intake of fish and eggs compared not only to the FBDG scaled up diet, but also to the actual diets. Meat intake remains the same across the diets. However, if the ‘meat’ category is further analyzed, among bovine meat, poultry, and goat meat or mutton, the FBDG and EAT Lancet diet both recommend lower bovine meat consumption and comparable levels of poultry consumption to the current diet. The goat meat consumption in the FBDG diet is the same as current levels, but the EAT Lancet diet recommends a lower consumption.

When the actual diets were compared between 2000 to 2016, the trends for fruits and vegetables and starchy foods intake are in line with the modeled diets. The consumption of milk and milk products has gone down between 2000 and 2016, yet both modeled diets show an increase in consumption of dairy. In terms of protein intake, the FBDG diet shows meat and fish intake comparable to the actual diet in 2016; intake for both these groups has increased since 2000 and if this trend continues, i.e., a further increase, it will exceed the dietary recommendation as well as the GHGe contribution.

The EAT Lancet diet suggests almost a doubling of dairy intake, pulses and halving fish and starchy foods compared to the FBDG diet. The implications for such recommendation in a predominantly rice based diet are enormous; perhaps replacing white rice with whole grains/brown rice would assist the shift towards a healthier diet as per the EAT Lancet guidance. Also, the ongoing introduction of fortified rice in social assistance programs increases nutritional value of the diet among a part of the population for whom rice makes up a large component of their diet. The difference between the FBDG and EAT Lancet diets is noteworthy. Even though the direction of change from current diet is similar in both diets, the change is even more pronounced for the EAT Lancet diet, which requires major changes from current food consumption patterns, even more so than the FBDG diet.

4.3 Policy considerations

There are two broad implications to consider from the results of the Bangladesh diet assessment. First, a recent analysis that assessed country specific dietary shifts to mitigate the climate and water crises, while also addressing healthy diets, concluded that achieving healthy and energy and protein adequate diets in many low- and middle-income countries would require an increase in GHGe (Semba 2020). The results from Bangladesh are in line with this conclusion and policy reform and action will require decision making that takes into account that the relationship and interplay between healthy diets, global food systems, and climate is complex and often there are trade-offs. Different environmental aspects can be affected by shifts in dietary change (e.g., land use, biodiversity, anti-microbial use), but in this analysis we have focused on GHGe.

FAO and WHO's simplified definition of sustainable healthy diets states that: 'sustainable healthy diets are dietary patterns that promote all dimensions of individuals' health and wellbeing; have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable" (WHO and FAO 2019). This definition in many contexts is aspirational as a healthy diet does not always imply that it has minimal environmental impact compared to current diets.

Second, it is important to consider the nutritional objectives and optimal diets across different phases of the lifecycle, which were not modeled in the current analyses. Having a baseline provides a starting point for where and what should increase/decrease nutritionally and to what extent and for whom. For example, if the goal is to prevent undernutrition among pregnant and lactating women and young children, a moderate intake of animal source foods and/or fortified foods and supplements are required to ensure adequate intake of good quality protein, vitamins, and minerals and this will likely increase GHGe (de Pee et al. 2021). Such an analysis would further refine policy action.

The results for Bangladesh, particularly with regards to the trade-off between meeting the nutrient needs of its population and achieving a planetary health diet,[13] are likely going to be the case for most developing countries. The global implication may mean a trade-off with a higher environmental cost to meet nutrient needs in certain contexts and an acceleration of a more 'plant-forward' diet in high-income countries (Mason-D'Croz et al. 2019). This would entail a moderate, albeit an increased intake of animal source foods in lower/middle-income countries and a substantial decrease in many high-income countries. A "healthy diet" may not look too different across countries but optimizing may mean different shifts across different countries through the spectrum of development.

Currently, the global production levels would preclude the provision of the EAT-Lancet diet, particularly due to the low production of non-staple plant-based foods (pulses, nuts, vegetables, fruit). In addition, supply chain issues related to the cold chain and transport of perishable foods also presents challenges in many contexts and needs to be addressed as part of a food systems transformation.

The policy level implications related to the production, or the supply side provides an opportunity to prioritize actions and investments in certain food sectors for Bangladesh. Food and agricultural policies and regulation affect what is grown and its impact on the environment, overall global food prices, and practices related to processing, marketing, distribution, trade and retailing of foods and ingredients. Implications and options related to domestic production and potential for import have been outlined in the results. However, without a complete analysis of the logistics costs and impacts of all countries taking such an approach, it would be difficult to ascertain the true level of trade-offs.

Institutional demand, in the form of social assistance transfers that include provision of food (in-kind or vouchers) and school feeding can be leveraged to direct food system change towards desirable outcomes and to manage trade-offs, including among specific target groups. Schools can serve as a good platform to ensure access to safe and nutritious school meals which along with education and social and behavior change communication can support the establishment of healthy habits from early in life.

4.4 Demand-side considerations

The diet in Bangladesh is increasingly reflecting an urban lifestyle of convenient foods and an over consumption of rice and foods rich in salt, sugar, and oil (Cabinet Division of the People's Republic of Bangladesh and WFP 2019). The Fill the Nutrient Gap analysis in Bangladesh (Cabinet Division of the People's Republic of Bangladesh and WFP 2019) showed low consumption of fruit, vegetables, and animal source foods due to additional time and labor required to source and prepare the foods, higher consumer trust in packaged foods and concerns related to food safety of fresh fruits and vegetables. Nutritious foods, especially green leafy and other

[13] The discussion is further elaborated by two of the authors of this document in Mehra et al. 2021. "Greening Food Demand in Less-Advanced Economies" in *The Economics of Sustainable Food,* edited by Batini, N, 140-154. Washington, DC: Island Press.

vegetables have a low social status and are considered to be food of the poor. A nutritious diet is more than twice as expensive as a diet meeting only energy requirements.

Policies and programs that stimulate the demand for healthy diets are critical in the context of Bangladesh and could spur greater production and consumption of healthier and nutritious foods. One of the main bottlenecks is the food environment; at least 12 percent of households could not afford even the lowest cost nutritious diet prior to the COVID-19 pandemic (Cabinet Division of the People's Republic of Bangladesh and WFP 2019). The cost of the nutritious diet increases substantially in pre-adolescence and is highest during adolescence for both girls and boys (Cabinet Division of the People's Republic of Bangladesh and WFP 2019). Creating demand for healthy diets and lifestyles requires a comprehensive life-cycle approach, targeting different age/gender groups with tailored messages and strategies by different stakeholders and platforms (private sector, public sector, media, messaging in schools). For instance, for the consumption of rice to decrease, behavioral change is required for the society, beyond consumers. This includes food producers, retailers, and the private sector (by producing alternatives and through media messaging). A national campaign for healthy diets would prompt behavior change. Social protection programs and schools are also important vehicles for delivery of nutritious food to vulnerable populations. The public sector can also influence both supply chains and dietary practices and preferences, for example through social safety nets and lower cost nutrient dense commodities such as fortified rice. Integration of social and behavior change communication as well as the use of incentives in social protection programs to nudge change towards healthy purchase and consumption behaviors have the potential to increase consumer demand and consumption of healthy foods.

Consumers, including the poorest, need to be empowered to demand and access nutritious foods, taking into consideration the sociocultural and community-related dynamics that influence consumption, in addition to the obvious driver, affordability. The private sector is often an underused resource but can be effectively leveraged to provide insights on how to design behavior change strategies and support national efforts to increase demand for healthy foods and trigger healthier food choices by consumers.

It is important to note that the affordability of the FBDG and EAT Lancet diets is most likely lower than that of current consumption since the modeled diets are more diverse and a more diverse diet is more costly than a diet with a relatively high amount of staples (Herforth et al. 2020, Bose et al. 2019, de Pee et al. 2021).

4.5 Limitations

The comparison of nutrient intake has been made with adult men and this may underestimate the actual nutrient needs for some groups such as pregnant and breastfeeding women and women of reproductive age in general, who may have higher needs, in which case the gap compared to the recommended amount will be larger.

Using expenditure as a proxy for consumption may lead to underestimation or overestimation of actual consumption during the reference period. Households might consume stored foods like grains or foods they produced themselves. In the same vein, households might obtain foods through purchase but store the foods without consumption during the reference period. In these cases, expenditure data fails to reflect the actual amount of consumption.

The EAT Lancet planetary health diet's composition as used for this paper is one specific selection that has been made based on the quantified contribution from each food group as proposed by the EAT Lancet publication, with the contribution from different foods within each food group as observed in the Bangladesh HIES. Another contribution from different food groups, so as to select a vegetarian or vegan diet or to adapt to specific dietary patterns in different countries is also possible, but as no quantification for those options was provided, we used the quantified option.

5 Conclusion

Many developing countries (48 lower middle-income countries) have a severe double burden[14] (Popkin et al. 2020) where both undernutrition and poor diets are equally important to consider. For ensuring access, links need to be drawn between social protection programs and food systems to ensure that sustainable approaches are taken to reduce undernutrition and poverty, which at the same time do not harm these populations (i.e., by resulting in overweight/obesity and not resolving micronutrient deficiencies) and the impact on the environment is appropriately balanced with the right food production policies and approaches.

[14] Defined as a prevalence of wasting of >15%, stunting of >30%, and thinness in women of >20%, and an adult or child overweight prevalence >20%.

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ANNEX

Annex 1. Items excluded from HIES 2000 and their shares of consumptions (by weight).

Food Name	Food Code	% of excluded consumption	% of total consumption
Salt	206	47.8%	1.8%
Betel leaf	221	9.1%	0.3%
Dried chili	201	8.5%	0.3%
Turmeric	205	7.6%	0.3%
Betel nut	222	4.8%	0.2%
Ginger	207	4.6%	0.2%
Biri	193	4.2%	0.2%
Coriander-seed	209	3.8%	0.1%
Cummins	208	2.2%	0.1%
Lime	224	1.4%	0.1%
Tea/ Coffee leaf (drinks)	153	1.4%	0.1%
Clove/ Black pepper/ Cassia-leaf	212	0.9%	0.0%
Cigarette	191	0.9%	0.0%
Zorda/ tobacco leaf	223	0.7%	0.0%
Tea/ Coffee (food outside)	182	0.5%	0.0%
Pickles	171	0.5%	0.0%
Aromatic-seed	211	0.4%	0.0%
Prepared Betel-leaf	185	0.2%	0.0%
Khoer	225	0.2%	0.0%
Other chewgoods	227	0.0%	0.0%
Other spices	213	0.0%	0.0%
Tobacco leaf	192	0.0%	0.0%
Jelly/ Jam	172	0.0%	0.0%
Amshatta	173	0.0%	0.0%
Sauce	174	0.0%	0.0%
Other tobacco & tobacco products	194	0.0%	0.0%
Snacks	184	0.0%	0.0%
Soft drinks	183	0.0%	0.0%
Other drinks	156	0.0%	0.0%
Other miscellaneous food	175	0.0%	0.0%
TOTAL		**100.0%**	**3.8%**

Annex 2. Items excluded from HIES 2016 and their shares of consumptions (by weight).

Food Name	Food Code	% of excluded consumption	% of total consumption
Salt	216	41.3%	1.8%
Betel leaf	231	9.6%	0.4%
Dried chili	211	7.9%	0.4%
Turmeric	215	7.5%	0.3%
Ginger	217	6.3%	0.3%
Betel nut	232	5.1%	0.2%
Cummin	218	3.5%	0.2%
Coriander-seed	219	2.2%	0.1%
Biries	203	2.0%	0.1%
Tea/ Coffee leaf	153	1.6%	0.1%
Samucha/Singara/Puri	191	1.6%	0.1%
Aromatic-seed	221	1.3%	0.1%
Cigarette	201	1.2%	0.1%
Other Dining out (specify)	195	1.2%	0.1%
Lime	234	1.0%	0.0%
Clove/ Black pepper/ Cassia-leaf	222	0.8%	0.0%
Pickles	171	0.8%	0.0%
Zorda/ tobacco leaf	233	0.7%	0.0%
Other spices (specify)	223	0.7%	0.0%
Gul and Other (specify)	204	0.7%	0.0%
Tea	192	0.6%	0.0%
Soft drinks/bottle water	194	0.5%	0.0%
Tobacco leaf	202	0.4%	0.0%
Meat (food outside)	184	0.3%	0.0%
Rolled betel leaf	236	0.3%	0.0%
Other Drinks (specify)	156	0.2%	0.0%
Other Miscellaneous Food (specify)	175	0.1%	0.0%
Khoer	235	0.1%	0.0%
Pizza	189	0.1%	0.0%
Burger	187	0.1%	0.0%
Sandwich	186	0.1%	0.0%
Jelly/ Jam	172	0.1%	0.0%
Amshatta	173	0.1%	0.0%
Other chewgoods (specify)	237	0.0%	0.0%
Sauce/Sirka	174	0.0%	0.0%
Hotdog	188	0.0%	0.0%
Coffee	193	0.0%	0.0%
TOTAL		**100.0%**	**4.5%**

Annex 3. "Other (specify)" items matching list, 2000 and 2016.

Code	Food Name	TM Code	TM Item	FBS Code	FBS Item
YEAR 2000					
25	Other food grains (specify)	27	Rice, paddy	2805	Rice (Milled Equivalent)
36	Other pulses (specify)	201	Lentils	2549	Pulses, Other and products
56	Other fish (specify)	-	-	2761	Freshwater Fish
63	Other egg (specify)	1062	Eggs, hen, in shell	2744	Eggs
77	Other meat (specify)	867	Meat, cattle	2731	Bovine Meat
96	Other vegetable (specify)	388	Tomatoes	2605	Vegetables, Other
106	Other milk and milk products (specify)	893	Buttermilk, curdled, acidified milk	2848	Milk - Excluding Butter
114	Other sugar (specify)	168	Sugar confectionery,	2542	Sugar (Raw Equivalent)
125	Other fats and oils (specify)	237	Oil, soybean	2571	Soyabean Oil
148	Other fruit (specify)	603	Fruit, tropical fresh nes	2625	Fruits, Other
166	Other sugar & molasses (specify)	910	Ice cream and edible ice,	2848	Milk - Excluding Butter
YEAR 2016					
23	Other food grains (specify)	27	Rice, paddy	2805	Rice (Milled Equivalent)
36	Other pulses (specify)	201	Lentils	2549	Pulses, Other and products
58	Other fish (specify)	-	-	2761	Freshwater Fish
63	Other egg (specify)	1062	Eggs, hen, in shell	2744	Eggs
77	Other meat (specify)	867	Meat, cattle	2731	Bovine Meat
97	Other vegetable (specify)	388	Tomatoes	2605	Vegetables, Other
106	Other milk and milk products (specify)	893	Buttermilk, curdled, acidified milk	2848	Milk - Excluding Butter
114	Other sugar (specify)	168	Sugar confectionery,	2542	Sugar (Raw Equivalent)
126	Other fats and oils (specify)	237	Oil, soybean	2571	Soyabean Oil
148	Other fruit (specify)	568	Melons, other (inc.cantaloupes),	2625	Fruits, Other
166	Other sugar & molasses (specify)	910	Ice cream and edible ice,	2848	Milk - Excluding Butter

Annex 4. FBDG daily recommendation for an adult male (2430 kcal/AME/day) engaged in moderate activity.

Food group	Sub-group		Desirable intake (g)	Energy contribution	Serving (g) of the group
Starchy staples	Rice		350	49	500
	Wheat & other cereals		50	7	
	Potato		100	4	
Pulses	Pulses		50	6.5	50
Vegetables	Leafy vegetables		100	2	300
	Non-leafy vegetables		200	2	
Fruits	Fruits		100	3	100
Fish	Fish		60	3	60
Poultry & meat	Poultry & meat		40	2	40
Eggs	Eggs		30	2	30
Milk and milk products	Milk & milk products		130	3.5	130
Cooking oil	Cooking oil		30	11	30
Sugar/Gur/Molasses	Sugar/Gur/ Molasses		20	3	20
Spices (*Excluded*)	Spices (*Excluded*)		20	2	20
Total			**1280**		**1280**

Annex 5. EAT-Lancet reference diet for a 30-year-old woman weighing 60kg engaged in moderate to high activity.

Food group	**Sub-group**	**Serving (g)**	**Kcal per day**	**Serving (g) of the group**
Starchy staples	1. Rice, wheat, corn, and other	232	811	282
	2. Potatoes and cassava	50	39	
Fruits and vegetables	3. Dark green vegetables	100	23	500
	4. Red and orange vegetables	100	30	
	5.Other vegetables	100	25	
	6. All fruits	200	126	
Dairy	7.Whole milk or equivalents	250	153	250
Meat, eggs, and fish	8.Beef and lamb	7	15	84
	9.Pork	7	15	
	10.Chicken and other poultry	29	62	
	11.Eggs	13	19	
	12.Fish	28	40	
Legumes and nuts	13.Dry beans, lentils, and peas	50	172	125
	14.Soy foods	25	112	
	15.Peanuts	25	142	
	16.Tree nuts	25	149	
Oils and fats	17. Palm oil	6.8	60	51.8
	18.Unsaterated oils	40	354	
	19.Dairy fats	0	0	
	20. Lard or tallow	5	36	
All sweeteners	21. All sweeteners	31	120	31
Total			**2503**	**1323.8**

Annex 6a. Desirable macronutrient intake as per FBDG recommended daily energy per AME.

Macronutrients	% of energy provision (2430 kcal/AME/day)	Unit energy provision (Cal/gram)	RNI	Unit
Protein	12%	4	73	g/AME/day
Fat	15%	9	41	g/AME/day
	20%		54	
	35%		95	
Carbohydrate	55%	4	334	g/AME/day
	73%		443	
	75%		456	

Annex 6b. Desirable micronutrient intake as per FBDG recommended daily energy per AME.

Micronutrient	Bioavailability	RNI (FAO-2004)	Unit
Ca	-	1000	mg/AME/day
Fe	5%	27	mg/AME/day
Zn	Low[15]	14	mg/AME/day
Vit. A	-	600	mcg/AME/day
Vit. B_{12}	-	2	mcg/AME/day
Folate	-	400	mcg/AME/day

[15] Nahar et al, 2013 do not state the exact number of the low bioavailability level of Zn. They only use "high", "moderate", and "low" to describe each bioavailability level.