Supplementary Information for

Socio-economic, environmental and health trade-offs in Bangladesh's food system transformation

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2024-05-08

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1 The MAGNET model

Key characteristics of MAGNET relevant for this study are endogenous land markets, capturing the dynamics between agricultural land supplied and real land prices including the total potential suitable land available for agriculture (Dixon et al., 2013; H. van Meijl et al., 2006) and segmented factors markets in agricultural and non-agricultural labor and capital, given the empirical evidence that the mobility of labor is imperfect reflected by structurally lower wages in agricultural sectors (Herrendorf et al., 2018).

Given the focus of this study, the MAGNET model version we use details primary agriculture, food processing, fisheries and industry sectors related to the food system, while sectors not directly related to the food system sectors are aggregated (see Table S1). In addition, information on the chosen region aggregation can be found in Table S2. We conducted a pre-simulation for the period 2014 and 2022 to calibrate per capita food consumption and the income elasticities of the food commodities for Bangladesh based on the historical consumption pattern (Bangladesh Bureau of Statistics, 1997, 2023).

Table S1: Sectoral model aggreagtion

Model aggregation	Description	Disaggregated MAGNET sets	GTAP sectors	Diet target - primary sectors agriculture	Aggregation used for analysis
pdr	Paddy rice	pdr, r__pdr	pdr	Cereals	Rice
wht	Wheat	wht, r__wht	wht	Cereals	Wheat
gro	Cereal grains nec	gro, r__gro	gro	Cereals	Other grains
veg	Vegetables	v__f, veg, r__v__f, r__veg	v__f	Vegetables	Vegetables
fruit	Fruit	fruit, r__frt	v__f	Fruits	Fruits
nuts	Nuts	nuts, r__nuts	v__f	Nuts	Nuts
roots	Roots and tubers	roots, r__root	v__f	Roots and tubers	Roots and tubers
pulses	Pulses	pulses, r__puls	v__f	Legumes	Legumes
osd	Oil seeds	osd, r__osd	osd	Oil seeds	Oil seeds
c__b	Sugar cane, sugar beet	c__b	c__b	Sugar	Sugar
fsh	Fishing	fsh, Swd	fsh	Fish	Fish
aqcltr	Aquaculture	Diad, Fresh, Crust, Marin, Molus	fsh	Fish	Fish
pltry	Poultry	pltry	oap	Poultry	Poultry
pig	Pigs, animal products nec	oap	oap	Red meat	Red meat
bfctl	Beef cattle	bfctl	ctl	Red meat	Red meat
ctl	Sheep, goats, other ruminant cattle	ctl	ctl	Red meat	Red meat
rmk	Raw milk	rmk	rmk	Dairy	Dairy
pcr	Processed rice	pcr	pcr	-	Rice
vegoil	Vegetable oils and fats	vol	vol	-	Oil seeds
sgr	Sugar	sgr, lsug, SugSc, mola	sgr, ofd	-	Sugar
fishp	Processed fish	Fishp	ofd	-	Fish
pltrymt	Poultry meat	poum	omt	-	Poultry
pork	Pork meat	omt	omt	-	Red meat
beef	Beef meat	BFCMT	cmt	-	Red meat
rummt	Other ruminant meat	cmt	cmt	-	Red meat
dairy	Dairy products	mil	mil	-	Diary

Table S1: Sectoral model aggreagtion *(continued)*

Model aggregation	Description	Disaggregated MAGNET sets	GTAP sectors	Diet target - primary sectors agriculture	Aggregation used for analysis
ofd	Processed food	ofd, b_t	ofd, b_t	-	Processed food
fsvces	Food services	afs, ros	afs, ros	-	Processed food
gsvces	Government services	osg, edu, hht	osg, edu, hht	-	Non-food
fert	Fertilisers	fert_n, fert_p, fert_k	chm	-	Non-food
oilcake	Oilcake	oilcake	vol	-	Non-food
fishm	Fishmeal	fishm	ofd	-	Non-food
feed	Animal feed	feed	ofd	-	Non-food
cvol	Crude vegetable oil	cvol	vol	-	Non-food
ocrop	Other non-food crops	pfb, ocr, r_ocr	pfb, ocr	-	Non-food
wol	Wool, silk-worm cocoons	wol	wol	-	Non-food
frs	Forestry	frs, plan, r_frs	frs	-	Non-food
coa	Coal	coa	coa	-	Non-food
c_oil	Crude oil	oil	oil	-	Non-food
gas	Gas & gas distribution	gas, gdt, Bgas	gas, gdt	-	Non-food
petro	Petroleum & coal products	p_c, biog, biod, bf_g, bf_s, bf_m, bf_o, ftfuel, eth, res, aviaf, ftavia, ddgs	p_c	-	Non-food
ely	Electricity	ely, ely_c, ely_g, ely_n, ely_h, ely_w, bioe, edt, heat, bioh	ely	-	Non-food
manuf	Manufacturing	oxt, tex, wap, lea, lum, ppp, chm, bph, rpp, nmm, i_s, nfm, fmp, ele, eeq, ome, mvh, otn, omf, cns, pe, pla, pel, bfchem, bioch, bioph, biopl	oxt, tex, wap, lea, lum, ppp, chm, bph, rpp, nmm, i_s, nfm, fmp, ele, eeq, ome, mvh, otn, omf, cns	-	Non-food
svces	Services	wtr, trd, cmn, ofi, ins, rsa, obs, dwe	wtr, trd, cmn, ofi, ins, rsa, obs, dwe	-	Non-food
trans	Transport services	otp, wtp, atp, whs	otp, wtp, atp, whs	-	Non-food

Table S2: Regional model aggregation

Regional Aggregation	Description	Mapped GTAP region
HICC	High income countries	aus, nzl, hkg, jpn, kor, twn, xea, brn, sgp, can, usa, xna, chl, ury, pan, pri, tto, aut, bel, hrv, cyp, cze, dnk, est, fin, fra, deu, grc, hun, irl, ita, lva, ltu, lux, mlt, nld, pol, prt, svk, svn, esp, swe, gbr, che, nor, xef, bhr, isr, kwt, omn, qat, sau, are, xtw
ASPA	Asia & the Pacific	xoc, chn, mng, khm, lao, mys, phl, tha, xse, npl, lka, xsa, irn
Idn	Indonesia	idn
Vnm	Vietnam	vnm
Bgd	Bangladesh	bgd
Ind	India	ind
Pak	Pakistan	pak
LACB	Latin America & the Caribbean	mex, arg, bol, col, ecu, pry, per, ven, xsm, cri, gtm, hnd, nic, slv, xca, dom, jam, xcb
Bra	Brazil	bra
NNEC	Near East, North Africa, Europe & Central Asia	bgr, rou, alb, blr, rus, ukr, xee, xer, kaz, kgz, tjk, xsu, arm, aze, geo, jor, tur, xws, egy, mar, tun, xnf
SSA	Sub-Sharan Africa	ben, bfa, cmr, civ, gin, sen, tgo, xwf, xcf, xac, mdg, mwi, mus, moz, rwa, tza, zmb, zwe, xec, bwa, nam, zaf, xsc
Gha	Ghana	gha
Nga	Nigeria	nga
Eth	Ethiopia	eth
Ken	Kenya	ken
Uga	Uganda	uga

2 Diet scenarios

The BAU scenario is based on the food demand projection for the Shared Socioeconomic Pathway (SSP) 2 by Bodirsky et al. (2020), who made SSP projections for food demand until 2100 for the aggregated food groups staples; vegetables, fruits and nuts; empty calories; and animal source food, expressed in calories at country-level, based on calorie availability data from FAOSTAT. We converted the food demand projection to food intake levels by adjusting for household waste and edible fraction using the waste shares for South Asia and Southeast Asia from Alexandratos and Bruinsma (2012, as cited in Springmann et al., 2018) and edible fraction data (Smith et al., 2016). In addition, we converted the food demand expressed in calories to grams using conversion factors from the Bangladesh Food Composition Table (Shaheen et al., 2013). Finally, we split the empty calories projection into two projections for oil seeds and sugar by extrapolating the historical trend of these two food groups until 2050 based on HIES data (Bangladesh Bureau of Statistics, 1997, 2023).

For the EAT-Lancet diet, we used the dietary intake recommendations presented by Willett et al. (2019) and derived the diet target based on the consumption pattern in the BAU diet scenario in 2050. We derived the EAT-Lancet diet scenario by correcting the consumption pattern in the BAU diet scenario in 2050 for the EAT-Lancet dietary intake recommendations presented in Willett et al. (2019). The non-staple food groups exceeding the maximum EAT-Lancet targets were scaled down to the maximum target. The food groups with lower consumption levels in 2050 than the minimum diet requirements were set to the minimum EAT-Lancet targets. The values of the staple food groups were based on the total calorie consumption of the diet was equal to the recommended daily calorie target of 2503 kcal Willett et al. (2019).

For the third diet scenario, we translated the recently published National Food-Based Dietary Guidelines (FBDG) for Bangladesh (2020) (Ministry of Food, 2021), which serves as a national policy reference for a healthy diet, into quantitative diet intake recommendations expressed in grams on a food group level by following the structured approach by Springmann et al. (2020) (see next section for more information). After translating the diet intake recommendations, we used the same approach to derive the targets for staple food groups as for the EAT-Lancet diet. The recommended daily calorie intake target in the FBDG is 2430 kcal.

3 Quantification of Food-Based Dietary Guidelines of Bangladesh (2020)

To ensure the precision and applicability of the Food-Based Dietary Guidelines of Bangladesh 2020 (FBDG) (Ministry of Food, 2021) within the context of health and environmental impact models, our methodology closely followed the structured approach outlined by Springmann et al. (2020). We adjusted the coding scheme to include food groups specific to the Bangladeshi diet. This section describes the modified process of collection, translation, and coding of the dietary guidelines.

The Food-Based Dietary Guidelines of Bangladesh for the year 2020 were obtained from the Ministry of Food's official website. Since the original document was in Bangla (Bengali), a team of bilingual dietary experts was assembled to ensure an accurate and faithful translation. This was essential to avoid the inaccuracies found in the 2013 guidelines analysis by Springmann et al. (2020), which relied on machine translation. We employed a consensus-based approach to resolve ambiguity, ensuring the final translation accurately reflected both the guidelines' intent and cultural nuances.

We modified the food group aggregation used Springmann et al. (2020) to the model aggregation used in this study. We split the food group "Fruits & Vegetables" to two seperate groups and included roots and tubers as additional food group. In addition, we merged the fish, meat, and egg consumption dietary guidelines because the FBDG does not provide separate dietary recommendations for red meat, poultry, and fish, while MAGNET does not differentiate for poultry meat and eggs. The original analysis of Springmann et al. (2020) for the 2013 guidelines was also reanalyzed with the modified food groups.

During the translation and coding of the Bangladeshi guidelines, several challenges emerged, particularly with the mismatch between portion size/serving size definitions in the local context versus those used by Springmann et al. (2020). For instance, what constitutes a 'serving' in Bangladesh often differs in size and caloric content from the standard definitions of 'portions' applied in global guidelines. Additionally, the conversion from grams to kilo calories presented inconsistencies due to variations in food composition-specifically, the nutrient density of local food varieties. To address these issues, we consulted a combination of regional dietary studies and frameworks used in the Dietary Guidelines to establish a conversion framework that accurately reflected the caloric and nutritional content of the local food supply.

3.1 Coding scheme for dietary recommendations

The translation of dietary recommendations into a quantifiable framework was governed by a detailed coding scheme provided by Springmann et al. (2020). Each recommendation was scrutinized and assigned an uncertainty score that reflected the clarity and specificity of the guidance provided. This scoring system allowed for the categorization of recommendations into discrete, actionable nutritional advice. For instance, explicit quantitative recommendations were scored as '1', indicating low uncertainty and high precision. Conversely, recommendations with vague qualitative instructions were assigned a '5', indicating a high degree of uncertainty. This systematic scoring approach was pivotal in constructing a consistent framework for analyzing the dietary guidelines.

3.2 Analysis of the quantified national dietary guidelines (2020)

Our comparison of the 2013 and 2020 Bangladesh National Dietary Guidelines shows a major improvement in the specificity and clarity of dietary recommendations. Notably, the 'nuts & seeds' category saw an improvement in its uncertainty score, moving from a highly uncertain '5' in 2013 to a '2' in 2020, indicating more explicit serving size guidance in the latter. Similarly, 'whole grains' and 'grains' went from a '4' to a '1', a shift to precise quantitative recommendations. The inclusion of specific recommendations for 'tubers' in the 2020 guidelines with an uncertainty score of '1' is a significant introduction of specific guidance for this food group. These improvements underscore a deliberate move towards more detailed and actionable dietary guidelines, presumably aimed at better informing public health initiatives and enabling more accurate assessment of diet-related health outcomes. Furthermore, the comparative analysis of the 2013 to 2020 guidelines shows a shift towards quantifiable and actionable dietary advice across various food groups. In 2020, the guidelines for legumes specify “1-2 cups (1 cup = 30 grams; dry weight) of pulses,” a clearer and more specific instruction compared to the 2013 recommendation of “1/3 to 1/2 cup of pulses daily.” This is reflected in the consistent coding score of ‘1.0’ across both years, suggesting that while both years had quantified recommendations, the quantity advised has become more precise. Similarly, nuts and seeds saw a significant improvement in their coding score, from ‘5.0’ in 2013, indicating no specific recommendation, to ‘2.0’ in 2020, which provides a clear guideline to “Eat a small handful of raw or dry roasted varieties.” Such advancements in the guidelines demonstrate a clear intention to offer well-defined dietary goals, likely to facilitate easier understanding and implementation by the general population. For other food groups, some nuanced changes to dietary recommendations in the updated guideline are noticed. The meat category, for instance, retains a coding score of ‘4’ from 2013 to 2020, despite a more detailed recommendation to “Eat 1 to 4 medium-size pieces,” suggesting that while the amount is quantified, the frequency or total intake might not be sufficiently detailed. This lack of change in the coding score may point to an area where future guidelines could be improved for greater impact. The eggs category underwent a notable revision; the recommendation changed from “2 to 3 eggs per week” in 2013 to “1 egg daily” in 2020, changing from a weekly to a daily consumption guideline. This change likely reflects updated nutritional research or a response to public health objectives. Such updates in the guidelines underscore the dynamic nature of nutritional science and public health policy, adapting to emerging evidence and health trends to optimize dietary recommendations. Table S3 summarizes the major changes in the dietary recommendations between 2013 and 2020, highlighting the food groups with significant shifts in coding scores and recommendations.

Table S3: Comparison of major changes in recommendations between the Food-Based Dietary Guidelines of Bangladesh 2013 (information obtained from the Supplementary Information of Springmann et al. (2020)) and the Food-Based Dietary Guidelines of Bangladesh 2020 (Ministry of Food, 2021).

Food Group	Recommendation 2013	Recommendation 2020	Coding Score 2013	Coding Score 2020
Legumes	"1/3 to 1/2 cup of pulses daily"	"1-2 cups (1 cup = 30 grams; dry weight) of pulses"	1	1
Nuts & Seeds	No specific recommendation	"Eat a small handful of raw or dry roasted varieties"	5	2
Meat	General recommendation	"Eat 1 to 4 medium-size pieces"	4	4
Eggs	"2 to 3 eggs per week"	"1 egg daily"	1	1
Tubers	No recommendations	"For Starch-based roots, tubers, and bulbs, 1 serving"	5	1

4 Indicators used in this study

We defined a set of indicators for each of the three trade-off domains. For the socio-economic domain, we used the average wage of low-skilled workers employed in agriculture, cereal affordability and diet affordability, and the self-sufficiency ratio as proxies for the change in income and food security between 2022 and 2050 in the different diet scenarios. For the first three mentioned indicators we focus on low-skilled workers employed in agriculture which is one of the largest and poorest groups in Bangladesh. The food and diet affordability indicators are measured as the relative change between the average food price of a given food basket and the wage. Cereal affordability only looks at the change in the price of cereals (rice and grains), which can be considered as a proxy of the affordability of minimum energy requirement (e.g. an indicator of hunger) (Hans van Meijl et al., 2020). Diet affordability includes all food groups that make up the specific diet scenario. For the self-sufficiency ratio (SSR), we used the definition by Beltran-Peña et al. (2020), who expressed self-sufficiency as the country's ability to produce enough food domestically to meet the caloric demand of its population in a particular year. The SSR is derived by dividing the total kcal domestic production by the total kcal domestic demand.

For the environmental domain, we used additional data on GHG emissions and land use (Chepeliev, 2020), freshwater use (Haqiqi et al., 2016), and nitrogen and phosphorus application (https://www.ifastat.org/databases) to derive environmental footprints. The data are region-specific, meaning that the footprint of a produced unit of a given commodity has a different value between regions depending on the production techniques used. The GHG emissions include the GHG gasses CO_2, CH_4 and N_2O in Mton CO_2eq and take into account emitted GHG from land use change and CH_4 emissions during livestock production.

For the health domain, we used the Sustainable and Healthy Diet Index (SHDI) (Ali et al., 2022). The Sustainable and Healthy Diet Index (SHDI) (Ali et al., 2022) is a modification of the EAT-Lancet index developed by Stubbendorff et al. (2022) and reflects the positive impact of adherence to the EAT-Lancet diet on a lower risk of mortality. The food groups with a positive effect on health, such as vegetables, fruit, unsaturated oils, legumes, whole grains, nuts and fish, will lead to a higher score when consumption increases. Food groups (beef and lamb, pork, poultry, eggs, dairy, potatoes and added sugars) that have a negative effect on health when consumed in high quantities will lead to a lower score. As not consuming these nutrient-rich foods gives the highest score, the index might not reflect micronutrient inadequacy. In contrast, the SHDI corrects for this and avoids giving positive scores for non-consumption, which is important in the context of a country where part of the population is undernourished (Ali et al., 2022). In the context of this study, the SHDI is the preferred index over the EAT-Lancet index of Stubbendorff et al. (2022). The use of an index based on the EAT-Lancet score is a reliable proxy for the impact of consumed diets on health outcomes. Several studies have demonstrated that higher adherence to the EAT-Lancet diet is associated with a lower risk of several diseases, including type 2 diabetes (Knuppel et al., 2019; Langmann et al., 2023; Zhang, Stubbendorff, et al., 2023), cardiovascular diseases (Colizzi et al., 2023; Knuppel et al., 2019; Zhang, Dukuzimana, et al., 2023) and cancer (Stubbendorff et al., 2022).

We made minor modifications to the SHDI indicators to match the food groups used in our model to score the healthiness of the diet in this study (Table S4). We merged the scoring of poultry and eggs into one indicator, given eggs are aggregated with poultry meat in our used data. We did the same for beef and lamb, and pork and merged it to red meat. Palm oil was excluded because our model aggregation does not include this food group. Although we did not distinguish between whole and refined grains in our model aggregation, we have a proxy for whole grain consumption per scenario, which is used in the Sustainable and Healthy Diet Index (SHDI) (see next section). We assumed that whole grain consumption in the base year is less than 15 grams per day (Micha et al., 2015) and does not increase in the BAU diet scenario. In the FBDG, the whole grain target is set at 50% of total cereal consumption, and in the EAT-Lancet scenario, 100% of cereal consumption is whole grain.

Table S4: Modified scoring of diet consumption on food group level to generate the SHDI based on Ali et al. (2022).

Food groups	EAT-Lancet target intake (grams d-1)	Score			
		3	2	1	0
Vegetables	300	>300	200-300	100-200	<100
Fruits	200	>200	100-200	50-100	<50
Oil seeds	40	>40	20-40	10-20	<10
Legumes	100	>100	50-100	25-50	<25
Nuts	25	>25	12.5-25	6.25-12.5	<6.25
Wholegrains	116	>116	58-116	29-58	<29
Roots and tubers	50	>50	25-50	12.5-25	<12.5
Fish	28	>28	14-28	7-14	<7
Sugar	31	<7.75	7.75-15.5	15.5-31	>31
Refined grains	116	<58	58-116	116-232	>232
Red meat	14	14-28	7-14	3.5-7	<3.5 or >28
Poultry	42	42-83	21-42	10.5-21	<10.5 or >83
Dairy	250	250-500	125-250	62.5-125	<62.5 or >500

4.1 Sensitivity analysis

The sensitivity analysis included a comparison with two alternative shared socioeconomic pathways (SSP) (O'Neill et al., 2017). We simulated dietary shocks using SSP1 and SSP3, in addition to the dietary scenarios presented in the main text using SSP2. The differences between SSP3 and SSP1 in relative to SSP2 are due to their respective increases in GDP per capita, with SSP1 having the highest and SSP3 having the lowest (Figure S1). This results in a higher level of technological change in SSP1 and the lowest level in SSP3. In addition, population growth is highest in SSP3 and lowest in SSP1 (Figure S1), which affects total food demand in different ways.

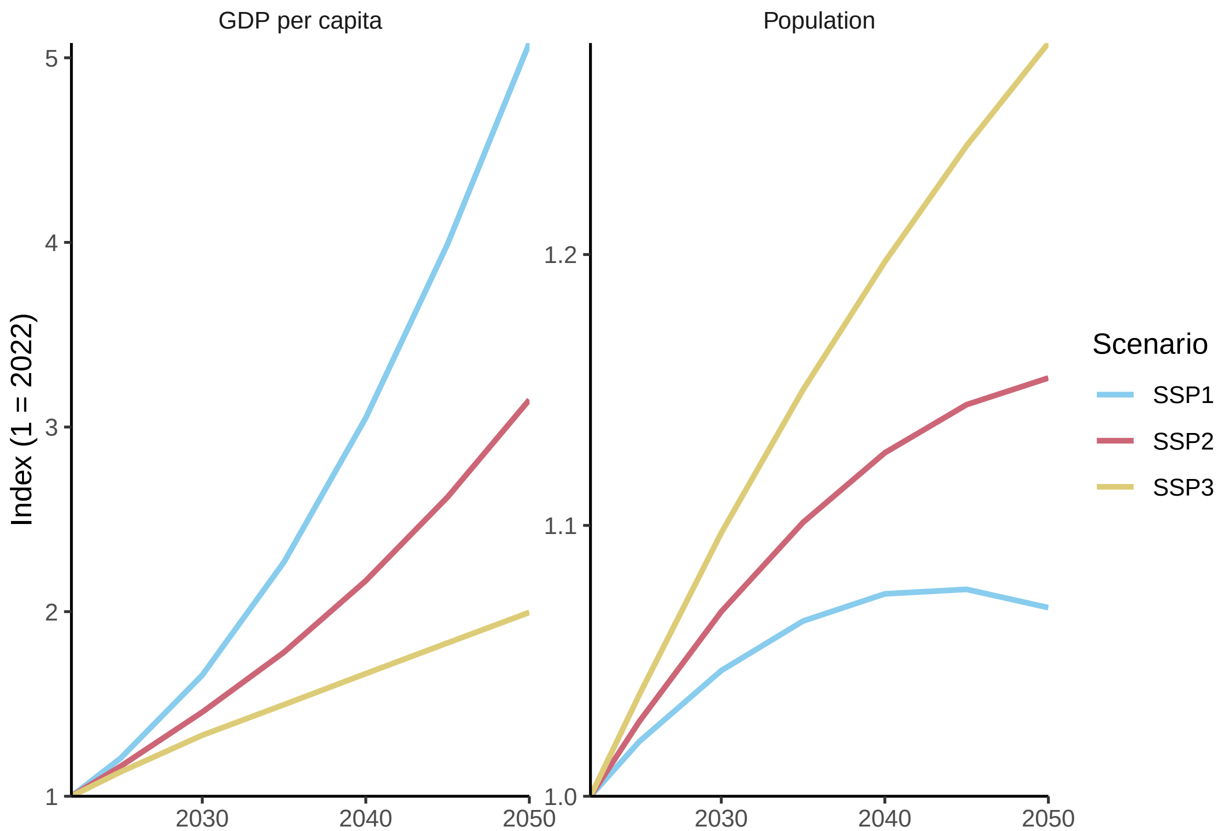

Figure S1: GDP per capita and population projections of Bangladesh for SSP1-SSP3

This analysis demonstrates that the diet scenarios have only a minor impact on the wages of low-skilled workers and cereal and diet affordability (Figure S2.a), and is primarily a result of the differences in projected GDP growth between the SSPs. A comparison of the differential impact of the various diet scenarios on the environment between SSP1 and SSP3 reveals that the change in diet exerts the most pronounced effect on the environment in SSP3 while exerting the least effect in SSP1 (Figure S2.b).

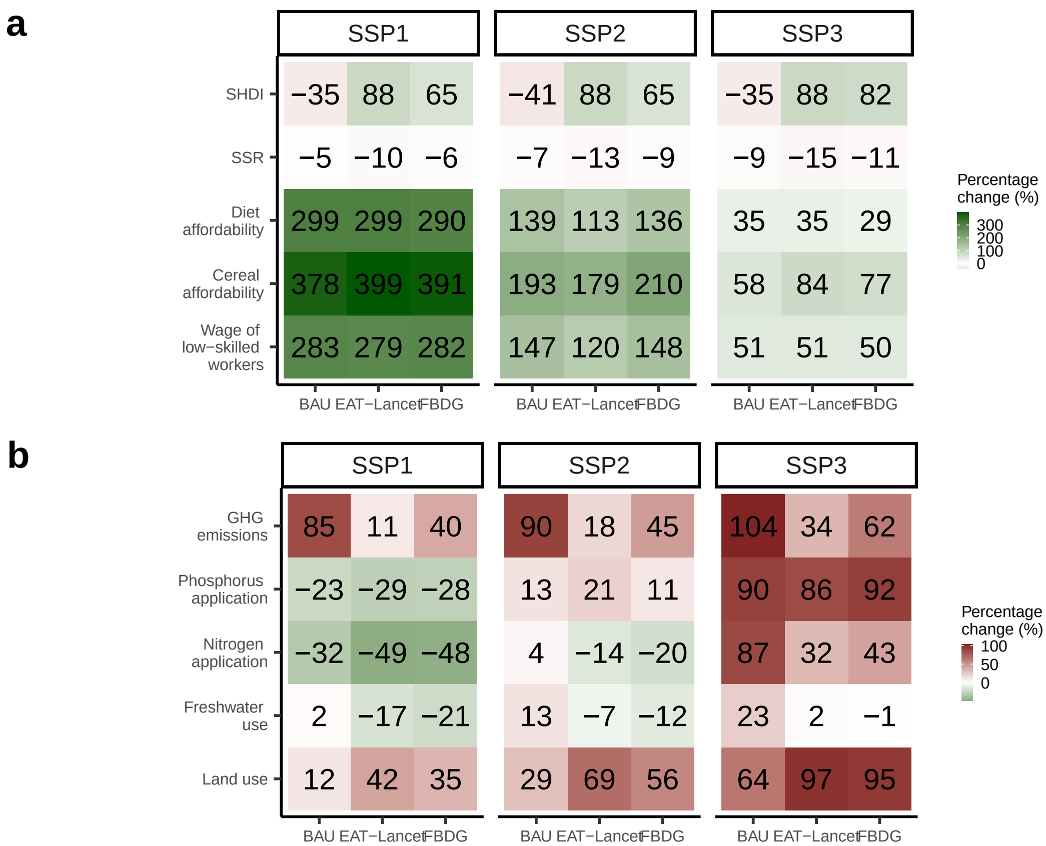

Figure S2: Environmental and socio-economic trade-offs for the BAU, EAT-Lancet and FBDG diet scenarios for SSP1 - SSP3. The environmental footprint is the total footprint of food consumption from commodities produced in Bangladesh and abroad.

5 Supplementary figures

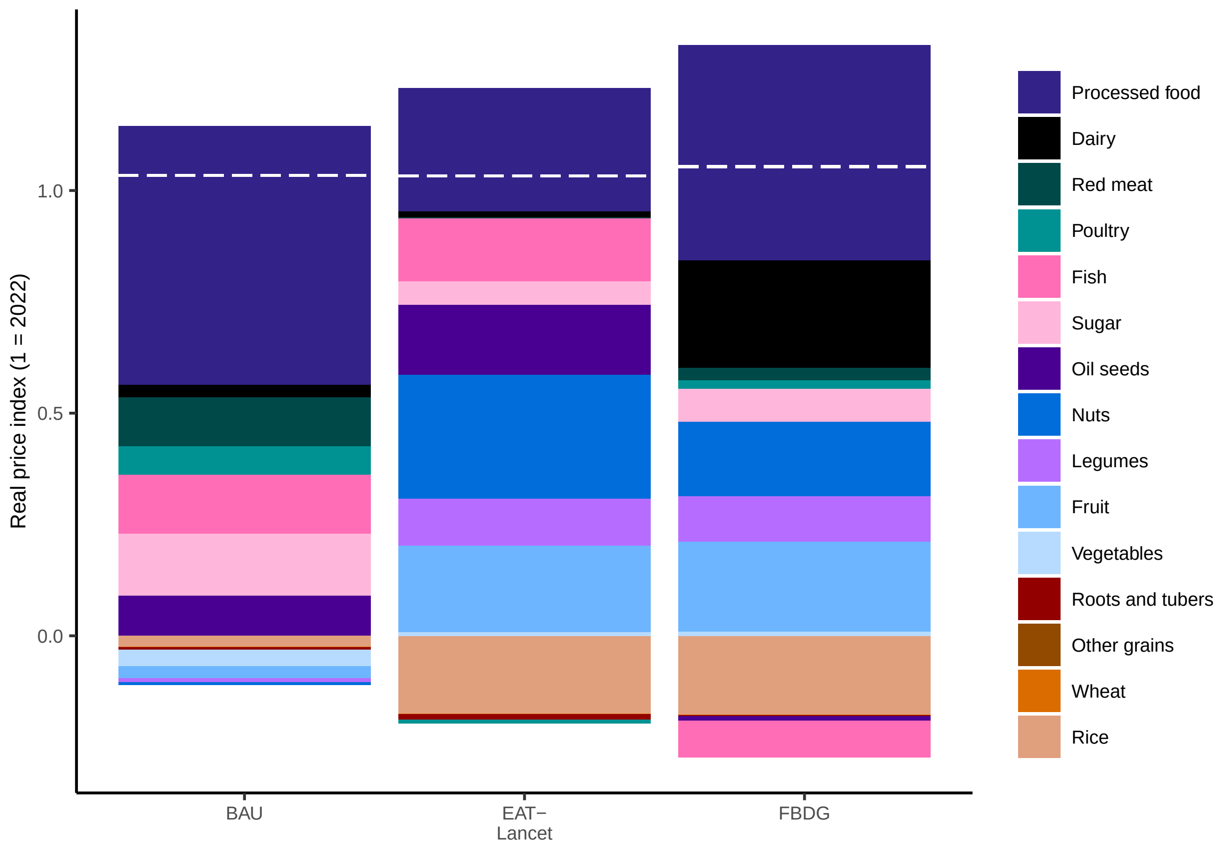

Figure S3: The real price index of the consumed diet subdivided per food group in 2050 for the BAU, FBDG and EAT-Lancet diet scenarios. The white dashed lines represent the real price index.

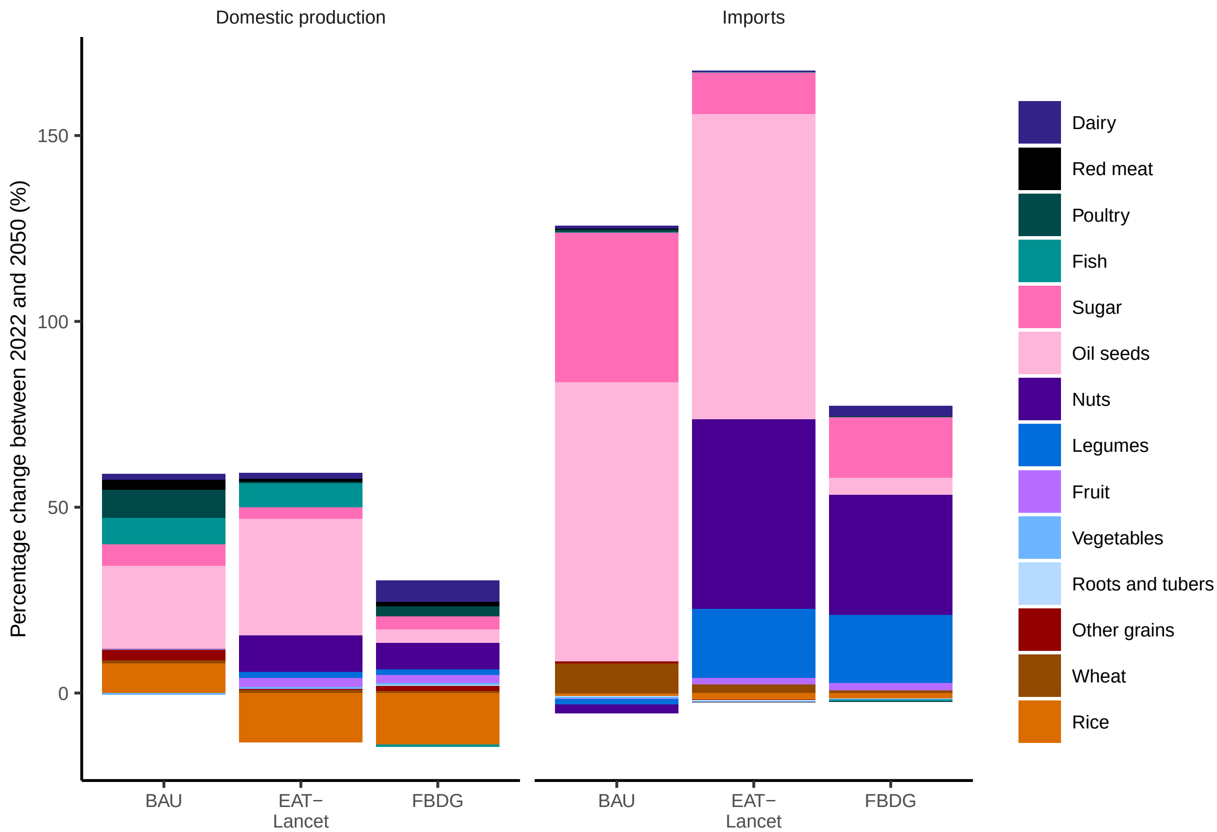

Figure S4: The percentage change in kcal domestic production and imports between 2022 and 2050 subdivided per food group for the BAU, FBDG and EAT-Lancet diet scenarios

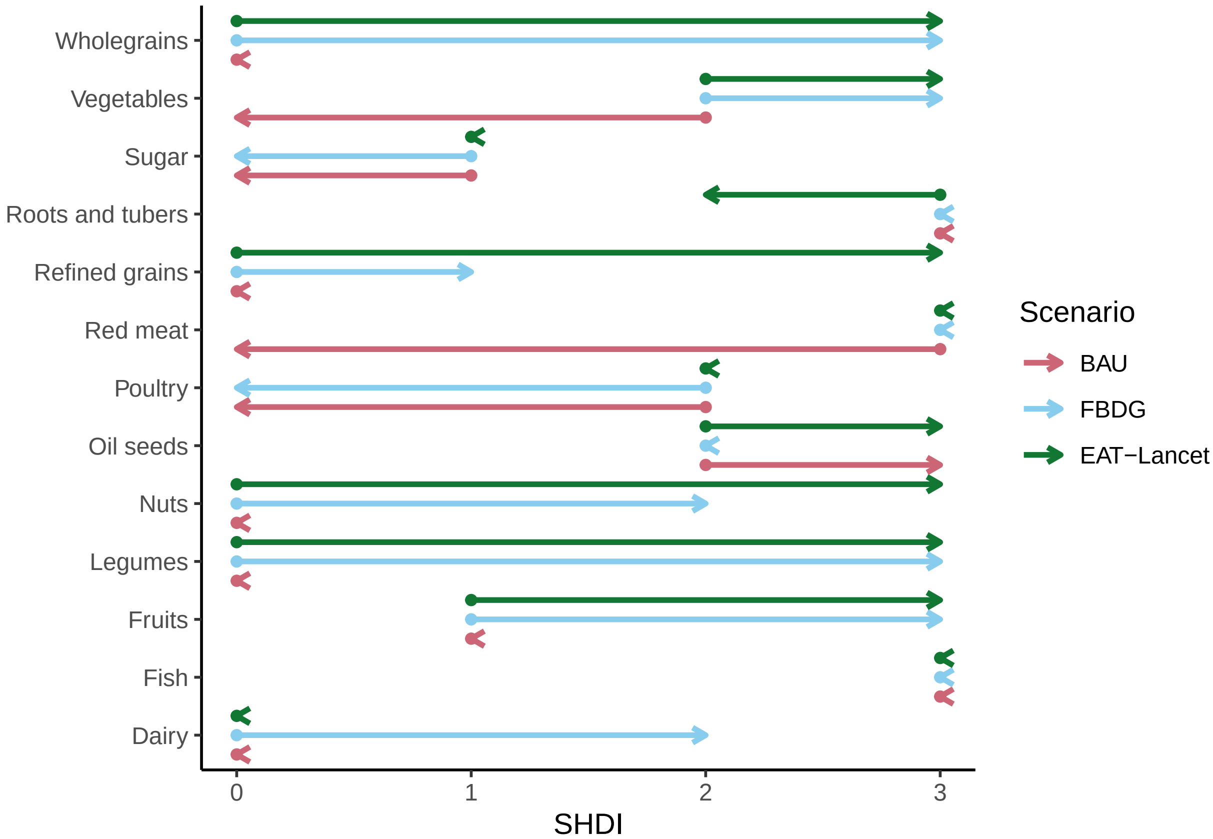

Figure S5: Diet scoring (SHDI) on food group level for the BAU, FBDG and EAT-Lancet diet scenarios

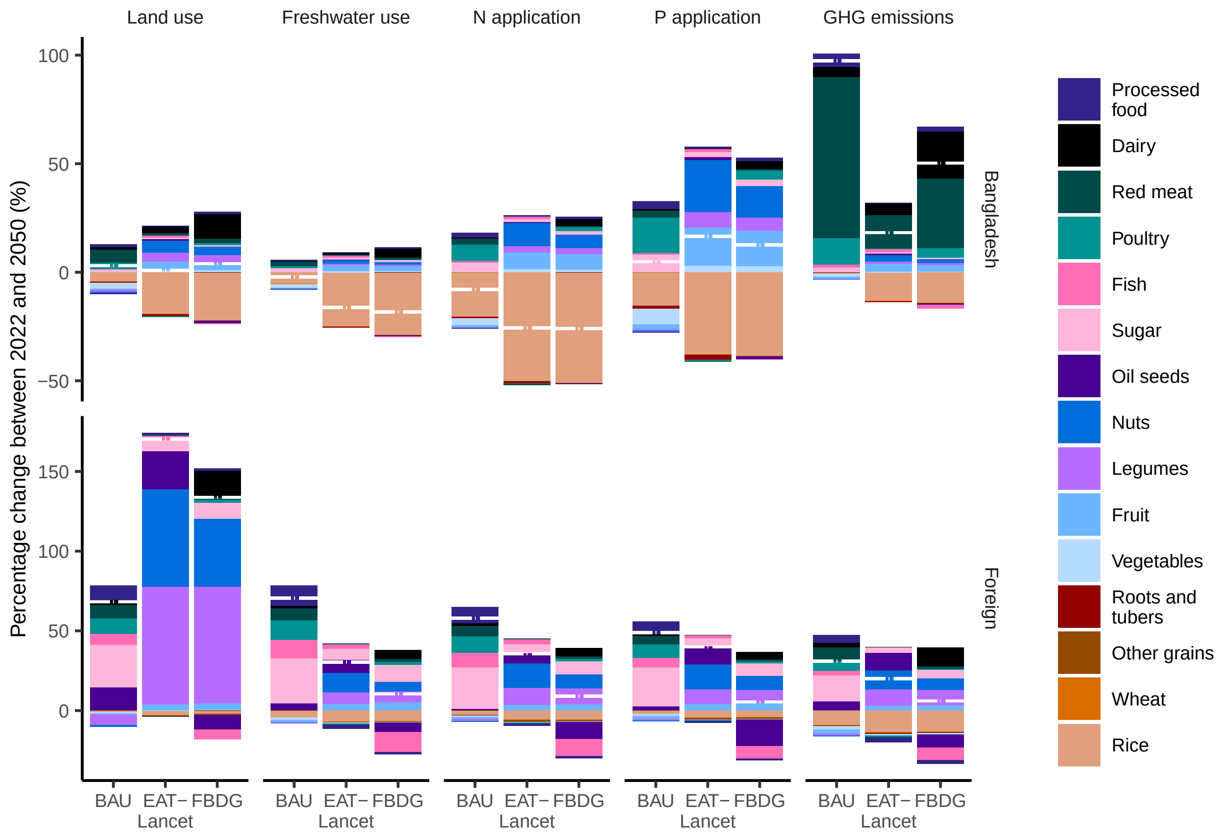

Figure S6: The change in environmental footprints between 2022 and 2050 of total food consumption subdivided by commodity in Bangladesh and abroad. The white dashed lines represent the total impact per footprint.

References

Ali, Z., Scheelbeek, P. F. D., Felix, J., Jallow, B., Palazzo, A., Segnon, A. C., ... Green, R. (2022). Adherence to EAT-Lancet dietary recommendations for health and sustainability in the Gambia. *Environmental Research Letters*, *17*(10), 104043. https://doi.org/10.1088/1748-9326/ac9326

Bangladesh Bureau of Statistics. (1997). *SUMMARY REPORT OF THE HOUSEHOLD EXPENDITURE SURVEY 1995-96*. Dhaka, Bangladesh.

Bangladesh Bureau of Statistics. (2023). *Household Income and Expenditure Survey 2022: Preliminary Report*. Dhaka, Bangladesh.

Beltran-Peña, A., Rosa, L., & D'Odorico, P. (2020). Global food self-sufficiency in the 21st century under sustainable intensification of agriculture. *Environmental Research Letters*, *15*(9), 095004. https://doi.org/10.1088/1748-9326/ab9388

Bodirsky, B. L., Dietrich, J. P., Martinelli, E., Stenstad, A., Pradhan, P., Gabrysch, S., ... Popp, A. (2020). The ongoing nutrition transition thwarts long-term targets for food security, public health and environmental protection. *Scientific Reports*, *10*(1), 19778. https://doi.org/10.1038/s41598-020-75213-3

Chepeliev, M. (2020). *The GTAP 10A Data Base with Agricultural Production Targeting Based on the Food and Agricultural Organization (FAO) Data*.

Colizzi, C., Harbers, M. C., Vellinga, R. E., Verschuren, W. M. M., Boer, J. M. A., Biesbroek, S., ... Van Der Schouw, Y. T. (2023). Adherence to the EAT-Lancet Healthy Reference Diet in Relation to Risk of Cardiovascular Events and Environmental Impact: Results From the EPIC-NL Cohort. *Journal of the American Heart Association*, *12*(8), e026318. https://doi.org/10.1161/JAHA.122.026318

Dixon, P., van Meijl, H., Rimmer, M. T., Shutes, L., & Tabeau, A. (2013). RED vs. REDD: Biofuel Policy vs. Forest Conservation. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2275246

Haqiqi, I., Taheripour, F., Liu, J., & van der Mensbrugghe, D. (2016). *Introducing irrigation water into GTAP 9 data base*.

Herrendorf, B., & Schoellman, T. (2018). Wages, Human Capital, and Barriers to Structural Transformation. *American Economic Journal: Macroeconomics*, *10*(2), 1–23. https://doi.org/10.1257/mac.20160236

Knuppel, A., Papier, K., Key, T. J., & Travis, R. C. (2019). EAT-Lancet score and major health outcomes: The EPIC-Oxford study. *The Lancet*, *394*(10194), 213–214. https://doi.org/10.1016/S0140-6736(19)31236-X

Langmann, F., Ibsen, D. B., Tjønneland, A., Olsen, A., Overvad, K., & Dahm, C. C. (2023). Adherence to the EAT-Lancet diet is associated with a lower risk of type 2 diabetes: The Danish Diet, Cancer and Health cohort. *European Journal of Nutrition*, *62*(3), 1493–1502. https://doi.org/10.1007/s00394-023-03090-3

Micha, R., Khatibzadeh, S., Shi, P., Andrews, K. G., Engell, R. E., & Mozaffarian, D. (2015). Global, regional and national consumption of major food groups in 1990 and 2010: A systematic analysis including 266 country-specific nutrition surveys worldwide. *BMJ Open*, *5*(9), e008705. https://doi.org/10.1136/bmjopen-2015-008705

Ministry of Food, M. of H. and F. W. (2021). *National Food Prescription Guidelines 2020, Bangladesh*. Retrieved from https://mofood.gov.bd/site/page/744d00cb-5bab-497e-941b-0361c7260900/National-Food-Prescription-Guidelines,-2020

O'Neill, B. C., Kriegler, E., Ebi, K. L., Kemp-Benedict, E., Riahi, K., Rothman, D. S., ... Solecki, W. (2017). The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century. *Global Environmental Change*, *42*, 169–180. https://doi.org/10.1016/j.gloenvcha.2015.01.004

Shaheen, N., Rahim, A., Mohiduzzaman, M., Banue, C., Bari, L., Basak Tukun, A., ... Stadlmayr, B. (2013). *Food composition table for bangladesh*.

Smith, M. R., Micha, R., Golden, C. D., Mozaffarian, D., & Myers, S. S. (2016). Global Expanded Nutrient Supply (GENuS) Model: A New Method for Estimating the Global Dietary Supply of Nutrients. *PLOS ONE*, *11*(1), e0146976. https://doi.org/10.1371/journal.pone.0146976

Springmann, M., Spajic, L., Clark, M. A., Poore, J., Herforth, A., Webb, P., ... Scarborough, P. (2020). The healthiness and sustainability of national and global food based dietary guidelines: Modelling study. *BMJ*, m2322. https://doi.org/10.1136/bmj.m2322

Springmann, M., Wiebe, K., Mason-D'Croz, D., Sulser, T. B., Rayner, M., & Scarborough, P. (2018). Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: A global modelling analysis with country-level detail. *The Lancet Planetary Health*, *2*(10), e451–e461.

https://doi.org/10.1016/S2542-5196(18)30206-7

Stubbendorff, A., Sonestedt, E., Ramne, S., Drake, I., Hallström, E., & Ericson, U. (2022). Development of an EAT-Lancet index and its relation to mortality in a Swedish population. *The American Journal of Clinical Nutrition*, *115*(3), 705–716. https://doi.org/10.1093/ajcn/nqab369

van Meijl, Hans, Tabeau, A., Stehfest, E., Doelman, J., & Lucas, P. (2020). How food secure are the green, rocky and middle roads: Food security effects in different world development paths. *Environmental Research Communications*, *2*(3), 031002. https://doi.org/10.1088/2515-7620/ab7aba

van Meijl, H., van Rheenen, T., Tabeau, A., & Eickhout, B. (2006). The impact of different policy environments on agricultural land use in Europe. *Agriculture, Ecosystems & Environment*, *114*(1), 21–38. https://doi.org/10.1016/j.agee.2005.11.006

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., … Murray, C. J. L. (2019). Food in the Anthropocene: The EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, *393*(10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4

Zhang, S., Dukuzimana, J., Stubbendorff, A., Ericson, U., Borné, Y., & Sonestedt, E. (2023). Adherence to the EAT-Lancet diet and risk of coronary events in the Malmö Diet and Cancer cohort study. *The American Journal of Clinical Nutrition*, *117*(5), 903–909. https://doi.org/10.1016/j.ajcnut.2023.02.018

Zhang, S., Stubbendorff, A., Olsson, K., Ericson, U., Niu, K., Qi, L., … Sonestedt, E. (2023). Adherence to the EAT-Lancet diet, genetic susceptibility, and risk of type 2 diabetes in Swedish adults. *Metabolism*, *141*, 155401. https://doi.org/10.1016/j.metabol.2023.155401