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Healthier diets: a global economic modelling study of income and employment impacts across regions

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ABSTRACT

Interest has grown in how to achieve healthy, sustainable, and affordable human diets. The potential income and employment effects of a transition towards healthier diets have received much less attention. We simulate aggregate and sectoral income and employment for business-as-usual and healthier diets for all geographic regions up to 2050 using scenario-based modelling. These healthier diets can increase food's share of household expenditure in some regions, for example from 18% to 25% in East and Central Africa in 2050. Our results suggest that a global shift towards healthier diets leads to a reallocation of primary factors of production, especially low-skilled labour and capital, from non-agricultural sectors to crop agriculture in parts of sub-Saharan Africa and South Asia. Notably, in 2050, with healthier diets, agriculture's share of low-skilled labour increases by 3.2 percentage points in East and Central Africa and 1.5 percentage points in South Asia excluding India. Although Gross Domestic Product increases in these regions relative to business-as-usual, this reallocation raises agriculture's share of Gross Domestic Product, consistent with a slower pace of long-run structural transformation. The reallocation leads to a mild increase in wages for low-skilled workers relative to high-skilled workers in most of these regions, compared to business-as-usual. However, in parts of sub-Saharan Africa, food price increases outweigh wage gains for low-skilled labour, reducing real purchasing power. Policies that encourage healthier diets may also alter income and employment and reduce economic welfare of poor populations in some regions, so care is needed in policy design to avoid adverse unintended consequences.

1. Introduction

Food system policies aim to encourage healthier food consumption that benefits human health and the natural environment. Yet an important question is whether transitions towards these healthier diets would have negative impacts on aggregate and sectoral income and employment. Understanding and mitigating these negative impacts is important for food system policy (Ambikapathi et al., 2022; Rockström et al., 2025). Some of the policy interventions to support these transitions include food environment interventions, fiscal measures such as taxes or subsidies, changes in agricultural priorities towards nutritious foods, and broader food system governance reforms (Fanzo et al., 2021b; Rockström et al., 2025; Zhang et al., 2025). Because these policies influence both food demand and food production, they could also have economywide implications.

The objective of our study is to quantify the aggregate and sectoral income and employment effects of a transition towards healthier diets using a scenario-based simulation modelling approach. We ask: How would a shift towards healthier diets affect income and employment across the sectors of the economy globally and across the world's regions by the year 2050? To answer this question, we use a dynamic global multi-region, full-employment, computable general equilibrium model (GLOBE) that uses selected outputs from a partial equilibrium multi-market model of the agricultural sector (IMPACT) (McDonald et al.,

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2007; Willenbockel et al., 2018; Robinson et al., 2024).

Existing studies on healthier diets have typically focused on how shifts in dietary preferences alter food demand and its associated consequences. An analysis of business-as-usual trends, and not specifically healthier diets, based on 57 studies (with 39 studies assuming some dietary change over time) concluded that global food demand would increase by 35% to 56% between the years 2010 and 2050, though with considerable variation among regions (van Dijk et al., 2021). There was less certainty about changes in the percentage of the population at risk of hunger, which varied from a 91% decrease to an 8% increase between the years 2010 and 2050 (van Dijk et al., 2021). Diet changes can create additional costs to consumers. These include higher food expenditures, with the affordability of healthy diets varying by region (Hirvonen et al., 2020; Bai et al., 2021; Springmann et al., 2021). Global estimates suggest that, for about 1.6 billion people, the cost of the EAT-Lancet reference diet exceeds their household per person income using 2011 price data (Hirvonen et al., 2020). Nutrient-adequate diets cost, on average, 2.7 times more than energy-adequate diets (Bai et al., 2021). In addition, the cost of a healthy diet was unaffordable for about 2.8 billion people globally in 2022, with affordability based on allowing up to 52% of household income to be spent on food (FAO et al., 2024).

Healthier diets can generate direct benefits for consumers and society by reducing the burden of non-communicable diseases (Cordain et al., 2005; Sinha et al., 2009; Chen et al., 2013; Feskens et al., 2013; Bouvard et al., 2015; Stanhope, 2016; Yang et al., 2016; Satija et al., 2018). They can also drive structural changes in the food system. For example, decreased demand for processed foods, a major source of value addition, could reduce earnings for businesses and workers employed in that activity (White et al., 2020). Food demand is a function of prices, income, and preferences (Unnevehr et al., 2010), and changes in consumer demand towards healthier diets could contribute to increased prices for fruits and vegetables and decreased prices of red meat and sugar in some modelling studies (Rieger et al., 2023). However, using prices alone to assess the consequences of diet change underplays the role of income (Sen, 1983) as both a driver of demand and as a food system outcome (Hertel, 2015). Modelling studies have also shown how healthier diets can affect both food prices and income; for example, a transition towards healthier diets contributed to higher wages (a major source of income for poorer households) for low-skilled workers in sub-Saharan Africa (Gatto et al., 2023).

Economic analyses of healthier diets have shown that these diets can affect food expenditures, labour markets, and food affordability. Several studies find that healthier diets can increase food expenditures (Hirvonen et al., 2020; Bai et al., 2021; Springmann et al., 2021; Ambikapathi et al., 2022; Bai et al., 2022), including in partial-equilibrium modelling (Mishra et al., 2025). Gatto et al. (2023) show that healthier diets can increase wages for low-skilled workers by reallocating primary factors of production (land, labour, and capital) from the non-agricultural sectors to the agricultural sector in some regions. Multi-model evidence from the 2025 EAT-Lancet Commission (Rockström et al., 2025), using partial and general equilibrium modelling, similarly suggests that healthier diets may lead to modest changes in aggregate agricultural labour demand by 2050, alongside substantial regional heterogeneity in affordability outcomes. These results were reported at regional averages and can mask affordability constraints for lower-income groups within countries and regions (Kuiper et al., 2025). Moreover, the Commission results suggested that food affordability under healthier diets would improve by 2050 compared with 2020, mainly because the models assume rising per person income over time. However, food price changes partly offset this improvement at the global average, and some regions face higher diet costs than under business-as-usual.

Our study provides complementary modelling evidence on the income and employment effects of diet transitions, together with associated changes in food prices and expenditures. Understanding the multiple demand- and supply-side economic consequences of diet change may inform the design of more effective interventions in an already complex policy setting (Mozaffarian et al., 2018; Willett et al., 2019), and address some of the concerns about the cost of healthier diets and their effects on aggregate and sectoral income and employment. Our modelling approach acknowledges the uncertainties in representing a healthier diet (Cena et al., 2020). Compared with Gatto et al. (2023), whose healthier diet scenarios implied lower total calorie intake than in their business-as-usual projections, our modelling approach allows the shares of different food groups in total household food demand to change over time while keeping total calorie demand in 2050 broadly similar, at the global level, across scenarios. Given the substantial challenge of achieving healthier diets, we quantify the economic consequences of dietary change under two scenarios: a global diet shift and a diet shift confined to high-income countries. We include a separate simulation of a shift towards healthier diets in high-income countries only because existing diets in high-income countries differ from those in low- and middle-income countries, and reflect a later stage of the nutrition transition (Popkin, 2002). These differences imply different directions and magnitudes of dietary adjustment to reach healthier diets.

2. Methods

2.1. Modelling approach

We simulated the transition towards healthier diets as a linear transition starting in the year 2017 and ending in 2050. We studied this transition using two sequentially linked economic models to examine changes in food demand, agricultural production, and prices, and then to assess aggregate and sectoral shifts in income and employment. First, IMPACT version 3 simulated annual food demand under a range of dietary scenarios until 2050. This food demand differs from dietary intake, which refers to the quantity of food consumed. Our simulations therefore represent changes in household food demand rather than dietary intake. Second, we used results from IMPACT as inputs into a dynamic version of GLOBE (McDonald et al., 2007) modified to link with IMPACT (Willenbockel et al., 2018; Delzeit et al., 2020).

IMPACT is a global partial equilibrium multimarket economic model linked to a network of climate, water, and crop models that simulates national and international agricultural demand, production, and markets for approximately 60 commodities in 160 countries under a range of biophysical and socioeconomic assumptions. IMPACT is solved to ensure that in each year global supply for a commodity equals its global demand. It is a recursive dynamic model that uses structural equations to simulate demand, supply, international trade, and prices for agricultural commodities. Commodity prices are endogenous. Total household demand for a food commodity in a country is a function of total population, per person income, the price of the commodity, prices of competing commodities, income elasticities of demand, and price elasticities of demand. Total domestic demand for a commodity is the sum of household food demand, agricultural intermediate demand (feed and processed goods), and intermediate demand from other sectors (including for biofuels and industrial uses) (Robinson et al., 2024). In the IMPACT model's base year (2020 in version 3.6), food demand quantities are initialised using FAOSTAT commodity balance sheets.

GLOBE is a computable general equilibrium model that distinguishes 15 geographic regions that together provide full coverage of the global economy under conditions of full employment. Assuming full employment means that total employment is fixed in our simulation scenarios, but the sectoral allocation changes. The 15 regions consist of either an individual country, such as China or India, or multiple countries (Supplementary Information Section 1, Table SI.1). The model distinguishes 22 production sectors and corresponding commodity groups (Supplementary Information Section 1, Table SI.2). GLOBE is calibrated to a Social Accounting Matrix representation of the Global Trade Analysis Project (GTAP) Data Base Version 11 (GTAP11 database) (Aguiar et al., 2023).

As in Gatto et al. (2023) and Kuiper et al. (2025), our global computable general equilibrium model uses one representative household per modelled region. We therefore complement region-average results of food affordability with simulation changes in real wages for low-skilled and high-skilled workers.

In our Business-as-usual scenario, GLOBE adopts the same assumptions of growth in population and GDP as used in IMPACT. The GLOBE Business-as-usual scenario also replicates the growth rates of household demand and total demand for food commodities by region as well as the agricultural supply price projections and agricultural land use projections by region of the IMPACT baseline. The Shared Socioeconomic Pathway 2 (SSP2) provides the assumed growth rates for population and GDP (Riahi et al., 2017). Supplementary Information Section 1 provides additional details on the assumptions of the simulation models relevant to our current study, including the linked IMPACT-GLOBE baseline calibration process. Fig. 1 illustrates the one-way linkage between the IMPACT and GLOBE models.

GLOBE distinguishes six primary factors of production: low-skilled labour, high-skilled labour, capital, agricultural land, fossil fuel resources, and other natural resources. Income refers to the annual gross value added generated by these factors of production, where gross value added is defined as value of output minus the cost of intermediate inputs used in the production of this output. The sum of value added across production sectors in a region equals that region's GDP at basic prices or aggregate income. We measure commodity prices, wages and other factor prices as well as aggregate income flows in real purchasing power terms. We define purchasing power with a baseline consumption basket for each region.

2.2. Simulation scenarios

We simulated three scenarios (Table 1 and Supplementary Information Section 2) across 15 regions: business-as-usual (BAU), a global transition to healthier diets (GBL), and a transition to healthier diets in high-income countries only (HIC).

Our global healthier diet assumptions are based on recommendations by the World Health Organization (WHO, 2004a, b), the 2019 EAT-Lancet Commission report (Willett et al., 2019), other scenario studies (Springmann et al., 2018), and other food-based dietary guidelines (Camara et al., 2021) (Table 2). These sources were used to define a single set of global dietary targets, but the implied changes in food demand varied across countries because countries started from different baseline food demand patterns. Supplementary Information Section 2 provides additional details on our diet assumptions. We compared the Global healthier diets scenario with a Business-as-usual scenario that reflects a projected continuation of current food commodity demand. Compared with the BAU scenario, the two diet-shift scenarios (GBL and

Table 1
Scenario definitions.

Name	Acronym	Description
Business-as-usual	BAU	Reference case
Global healthier diets	GBL	Diet shift in all countries
Healthier diets in high-income countries only	HIC	Diet shift in high-income countries only with all other countries following business-as-usual

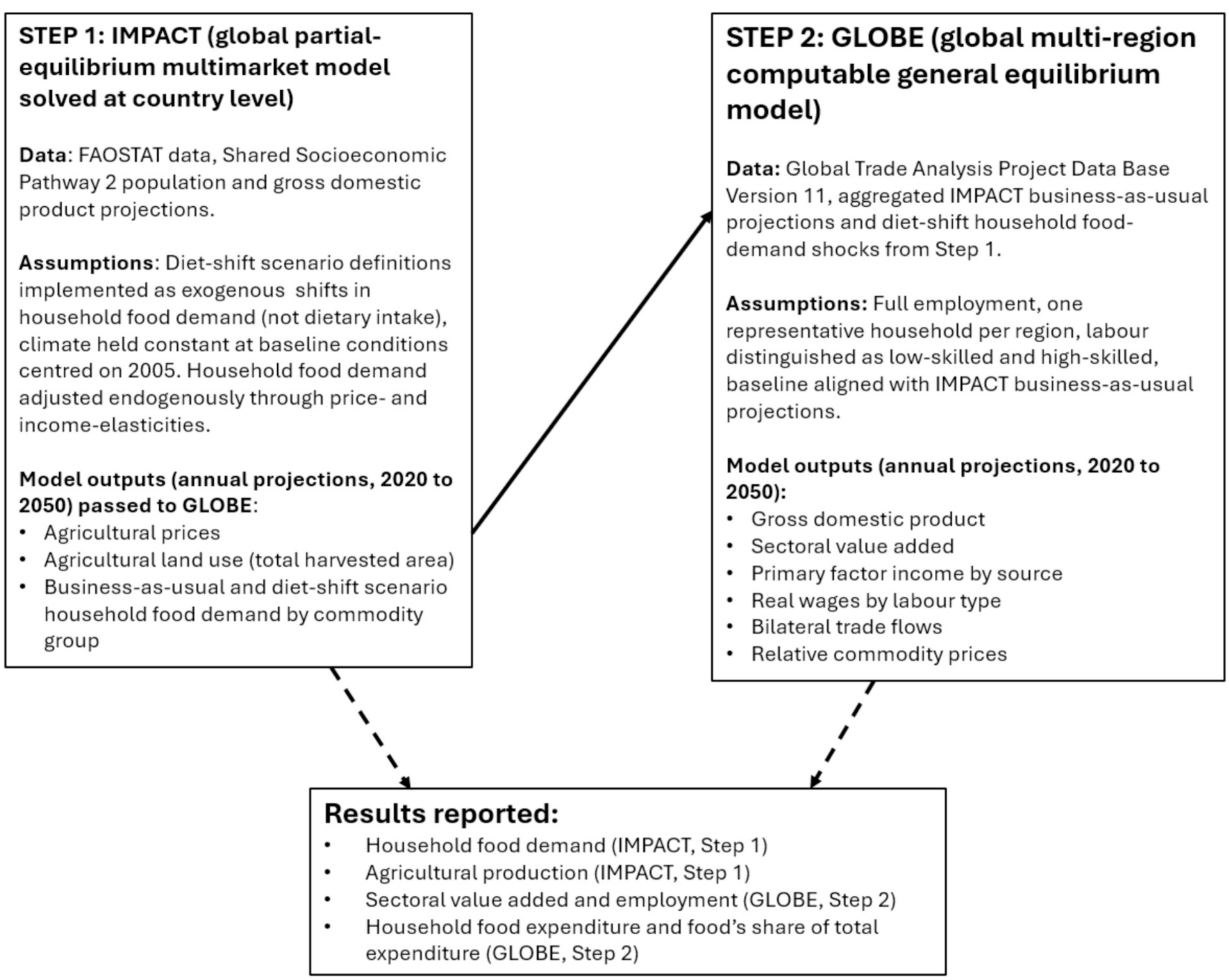

Fig. 1. One-way linkage between the IMPACT and GLOBE models in the current study.

Table 2
Assumptions for simulated food demand in 2050 in the two diet-shift scenarios.

Item	Units	Global average (per person per day)
Energy	Kilocalories	$\approx 3{,}000$
Refined sugar	Grams	< 68
Beef (from bovine cattle)	Grams	< 82
Dairy milk	Grams	< 658
Pork, poultry, lamb	Grams	< 151
Vegetable oils	Grams	< 41
Fruits and vegetables	Grams	> 507

Notes: Data are for food demand, not food production or dietary intake. Supplementary Information Section 1 Table SI.4 lists the food commodities within each item listed in column 1.

HIC) contain lower demand for refined sugar, lower demand for meat (beef, pork, lamb, and poultry), lower demand for vegetable oils, higher demand for fruits and vegetables, and higher demand for pulses. Fig. 2 summarises the assumed total household food demand in IMPACT. Table 3 reports the magnitude of the exogenous shifts in household food demand implemented in GLOBE, which were derived from the IMPACT simulations after removing endogenous own-price effects. Specifically, the exogenous demand shift was calculated as:

$$\left(\frac{X_{HDS} - X_{BAU}}{X_{BAU}} \times 100\right) - \varepsilon\left(\frac{P_{HDS} - P_{BAU}}{P_{BAU}} \times 100\right)$$

where X is aggregated volume of household demand in 2050 for a GLOBE region and GLOBE food commodity group, derived from the corresponding quantities of the IMPACT scenario; P is the corresponding aggregated IMPACT consumer price in 2050; ε is the corresponding aggregate IMPACT own-price elasticity; HDS is one of the two diet-shift scenarios; and BAU is the Business-as-usual scenario.

To model the two diet-shift scenarios in IMPACT, we implemented exogenous shifts in household food demand by adjusting the model's income elasticity parameters for commodity demand, which vary by commodity, country, and year. For livestock-related commodities, these elasticities were informed by Komarek et al. (2021). In SSP2, global GDP and global population increase between the years 2020 and 2050 following middle-of-the-road trajectories. To isolate the economic effect of the change in food demand, all scenarios hold climate at the IMPACT baseline climate, defined using historical average conditions over 1995 to 2015 (centred on 2005). All projections used mid-range country-specific estimates of growth in Gross Domestic Product (GDP) and population combined with existing country-specific relationships between GDP and demand for specific foods.

The EAT-Lancet Commission's healthy reference diet specified an illustrative energy intake of 2,500 kcal per person per day (Willett et al., 2019) and the planetary health diet specified 2,400 kcal per person per day (Rockström et al., 2025). These values refer to dietary intake levels rather than estimates of food demand. In contrast, we model food demand rather than dietary intake, with each food group's share of total food demand changing over time while keeping total calorie demand in 2050 broadly similar in our Business-as-usual scenario and two diet-shift scenarios.

3. Results

3.1. Agricultural production

The simulated shifts in food demand associated with healthier diets lead to changes in agricultural production (Fig. 3). In high-income regions in the HIC diet-shift scenario, production typically increases for Fruits, Vegetables, Pulses, Roots, and Tubers and decreases for Cattle, Other Livestock Products, Oilseeds, and Sugar Crops (sugar cane and sugar beet combined). In the GBL diet-shift scenario, low- and middle-income regions see similar production changes to those in the high-income regions, including declines in Wheat production (apart from India and South America, where Wheat production increased). These production changes mainly reflect agricultural production responding to the exogenous shifts in household food demand in the diet-shift scenarios. Production tends to increase where demand rises and decrease where demand falls. The magnitude and regional distribution of these production changes also reflect modelled changes in commodity prices (Table SI.8 and Table SI.9), land use (Fig. SI.1), crop yields (Fig. SI.2), and trade (Fig. SI.5, Fig. SI.6, and Fig. SI.7). For example, in East and Central Africa under the GBL diet-shift scenario in 2050, household demand for Fruits, Vegetables, Pulses, Roots, and Tubers is 92.6% higher than in the Business-as-usual scenario, while demand for Cattle is 23.7% lower (Table 3). Production changes are consistent with the direction of demand changes in Table 3: production of Fruits, Vegetables, Pulses, Roots, and Tubers increases by 79.8%, while Cattle production decreases by 17.6% and Wheat production decreases by 4.8% (Table SI.7). Consumer prices also change in the same direction: 21.8% higher for Fruits, Vegetables, Pulses, Roots, and Tubers, 9.0% lower for Cattle, and 1.3% lower for Wheat (Table SI.9). Crop agriculture producer prices increase by 16.6%, while livestock agriculture producer prices decrease by 2.0% (Table SI.8).

In the GBL scenario, China and India see a decrease in the production of Cattle, Other Livestock Products, and Sugar Crops and an increase in production of Fruits, Vegetables, Pulses, Roots, and Tubers. China also sees a decline in Wheat production in the GBL scenario. In contrast, South Asia excluding India and West Africa experience a substantial increase in the production of Fruits, Vegetables, Pulses, Roots, and Tubers, a decline in Wheat production, and a moderate reduction in the production of Other Livestock Products. Regional variation in the changes in crop land use (Supplementary Information Section 3, Fig. SI.1) and crop yields (Supplementary Information Section 3, Fig. SI.2) contribute to variation in the change in agricultural production. Changing food demand drives changes in agricultural production globally, which contributes to changes in international trade through bilateral trade flows, where demand shifts in one region affect production responses in other regions (Supplementary Information Section 3, Fig. SI.5, Fig. SI.6, and Fig. SI.7 show all non-negligible trade flow responses).

3.2. Food expenditure

To understand how healthier diets affect GDP and agriculture's share of GDP and employment, we assessed how healthier diets affect household expenditure on food. In 2050, household expenditure on food is higher in the GBL scenario than in the BAU scenario in 8 of the 15 regions (Fig. 4). The increase in food expenditure is particularly pronounced in parts of sub-Saharan Africa and South Asia, with increases of 35% in West Africa, 41% in East and Central Africa, and 19% in South Asia excluding India (Fig. 4). Changes in the quantity of food demanded (Table 3) contribute to explaining why household expenditure on food differs between the GBL scenario and the BAU scenario (Fig. 4), with endogenous price changes a secondary reason (Supplementary Information Section 3, Table SI.8 and Table SI.9).

Fig. 5 displays food's share of total household expenditure by region and scenario. Over time, in the BAU scenario all regions see an increase in GDP (Supplementary Information Section 3, Fig. SI.3) and a decrease in food's share of total household expenditure (Fig. 5), which is consistent with Engel's Law (Engel, 1857). In the GBL scenario compared to the BAU scenario, food's share of total household expenditure in 2050 is 5.2 percentage points higher in West Africa, 6.7 percentage points higher in East and Central Africa, and 2.5 percentage points higher in South Asia excluding India. In 2050, the GBL scenario shifts household expenditure toward food relative to non-food items, compared to the BAU scenario. In the model, in regions where food's share of total household expenditure increases (Fig. 5), crop agriculture's share of GDP often rises (Supplementary Information Section 3, Table SI.13), and

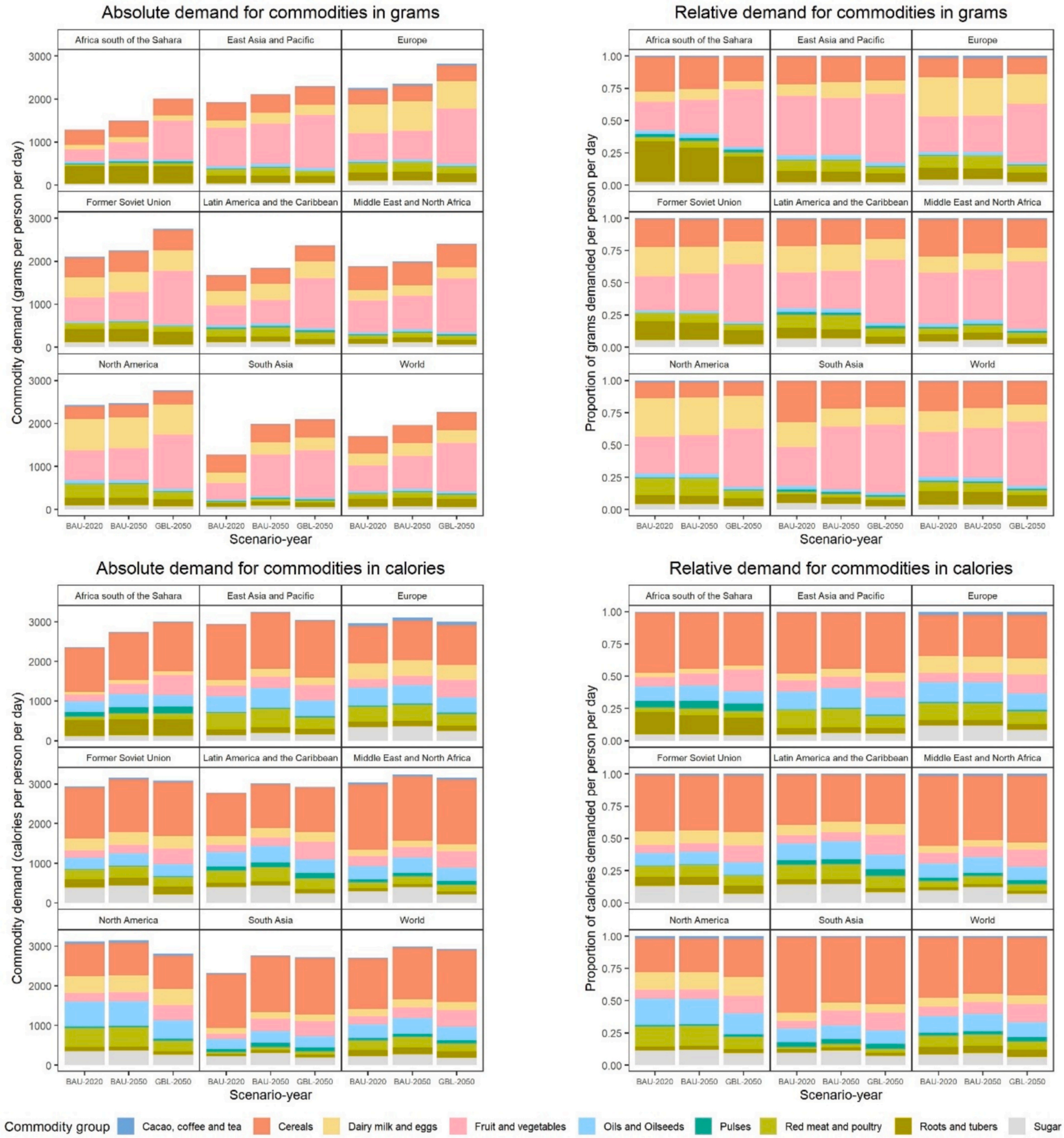

Fig. 2. Household food demand in the Business-as-usual (BAU) scenario in 2020 and 2050 and in the Global healthier diets (GBL) scenario in 2050, simulated in IMPACT. Supplementary Information Section 1, Table SI.1 lists the countries in each GLOBE region. Supplementary Information Section 1, Table SI.5 lists the concordance between IMPACT, GLOBE and GTAP commodity names. Supplementary Information Section 1, Table SI.6 reports the numerical data underpinning Fig. 2.

low-skilled labour shifts towards the agricultural sector (Supplementary Information Section 3, Table SI.12). The magnitude of the expenditure switch explains why these factor reallocation effects are negligible in most regions but quite large in others, such as in parts of sub-Saharan Africa and South Asia. The transition to healthier diets thus drives a structural change in both food demand and supply, which leads to changes in food prices (Supplementary Information Section 3, Table SI.8 and Table SI.9) and subsequently a reallocation of primary factors of production.

Supplementary Information Section 3, Table SI.10 reports the scenario in which healthier diets are adopted only in high-income countries (HIC). Compared with the Global healthier diets scenario (GBL), the resulting changes relative to the Business-as-usual scenario are generally small. For example, in 2050 the share of household expenditure spent on

Table 3
Assumed exogenous shifts in food demand in 2050 in the two diet-shift scenarios relative to the Business-as-usual scenario (%), derived from IMPACT simulations, by GLOBE region and commodity, net of endogenous own-price effects.

GLOBE Region	Income classification of countries	Select food commodity groups					
		Cattle (Bovine cattle, sheep and goats, horses)	Other Livestock Products (Pigs, poultry, eggs, dairy milk)	Fruits, Vegetables, Pulses, Roots, and Tubers	Sugar	Vegetable Oils and Fats	Processed Livestock Products
North America	High-income	−39.8	−31.4	74.1	−34.6	−30.7	−34.1
High-income Asia		−5.5	−33.5	94.9	−4.8	−5.5	−27.5
Europe		−10.9	−27.5	88.9	−33.9	−20.7	−24.0
Australia, New Zealand and Other Oceania		−46.6	−35.4	120.6	−44.5	−32.2	−40.2
Middle East and North Africa (in HIC scenario)	High-, middle-, and low-income	−5.4	−8.4	8.4	−1.8	−1.4	−7.2
Middle East and North Africa (in GBL scenario)		−16.7	−16.1	60.5	−60.5	−19.0	−16.3
Former Soviet Union	Low- and middle-income	−13.2	−12.9	81.6	−61.4	−9.0	−13.0
West Africa		−25.3	−3.2	82.9	−15.5	−27.7	−15.5
Southern Africa		−20.6	−31.0	278.2	−25.4	−0.8	−26.6
East and Central Africa		−23.7	−1.8	92.6	−16.0	−8.9	−14.6
South America		−38.5	−20.9	108.5	−56.5	−31.2	−27.9
Central America and Caribbean		−9.2	−18.5	107.7	−69.6	−10.5	−15.9
South Asia excluding India		−15.2	−3.5	147.3	−54.0	−6.1	−9.1
Other East Asia		−20.2	−32.6	107.7	−39.1	−34.8	−29.8
China		−32.1	−48.5	8.9	−5.5	−34.6	−45.3
India		−11.1	−8.5	8.5	−41.0	−3.7	−9.0

Notes: Data show the percentage change in demand quantity that would have occurred after removing endogenous own-price effects. For high-income regions the reported changes in demand are the same in the GBL and HIC scenarios. For low- and middle-income regions the reported changes in demand are zero in the HIC scenario, except for Middle East and North Africa, which includes both high-income and low- and middle-income countries, so its HIC scenario shifts are smaller than in the GBL scenario. Food commodity group names use the GLOBE activity and commodity aggregation listed in Supplementary Information Section 1, Table SI.2. Supplementary Information Section 1, Table SI.5 lists the concordance between IMPACT, GLOBE, and GTAP commodity names. For example, processed dairy products are included in Processed Livestock Products. Supplementary Information Section 1, Table SI.1 lists the countries in each of the GLOBE regions.

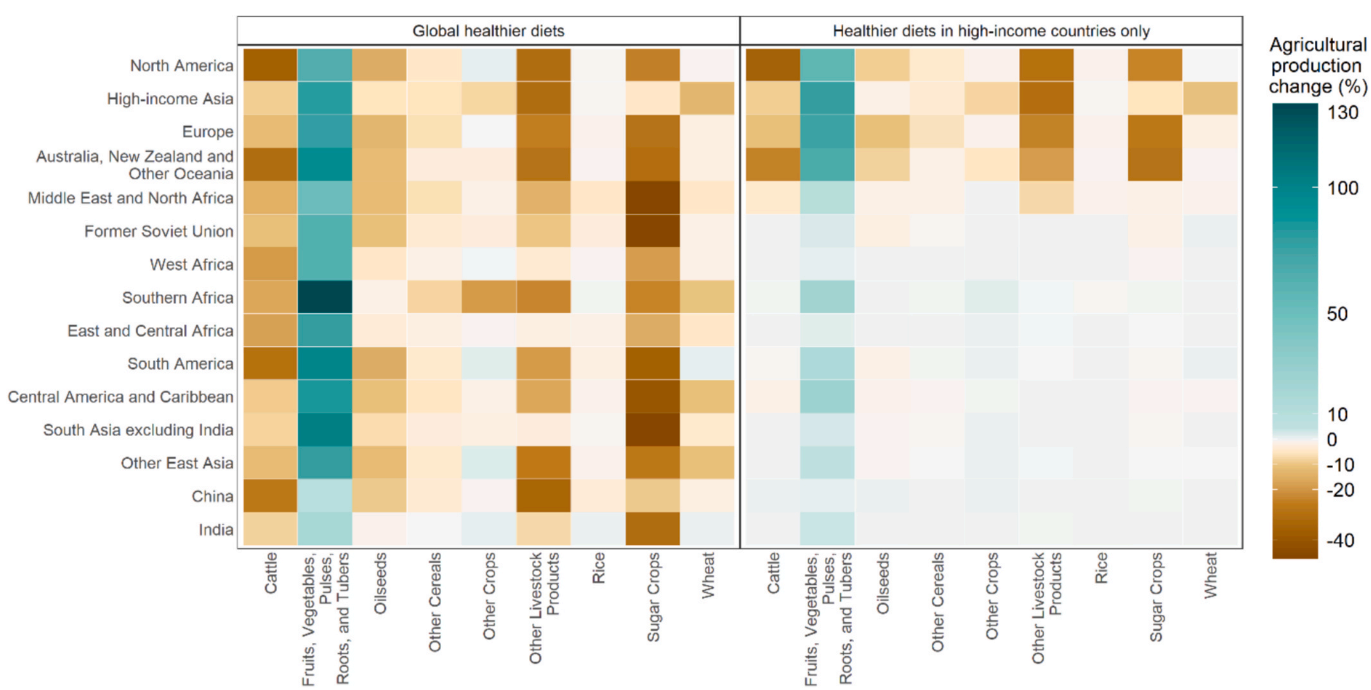

Fig. 3. Change in agricultural production in the two diet-shift scenarios compared to the Business-as-usual scenario in 2050 (%), simulated in IMPACT. Percentage changes are calculated relative to production in the Business-as-usual scenario in 2050 for each region and commodity. Supplementary Information Section 1, Table SI.1 lists the countries in each of the GLOBE regions. Column headings use the GLOBE commodity group names and reporting labels listed in Supplementary Information Section 1, Table SI.2. Supplementary Information Section 1, Table SI.5 provides the concordance between IMPACT, GLOBE, and GTAP commodity names. Cattle corresponds to the GTAP11 database sector “Bovine cattle, sheep and goats, horses”, covering bovine animals, sheep and goats, and horses. Dairy milk is represented as raw milk within Other Livestock Products. Sugar Crops include both sugar cane and sugar beet. Supplementary Information Section 3, Table SI.7 reports the numerical data underpinning Fig. 3.

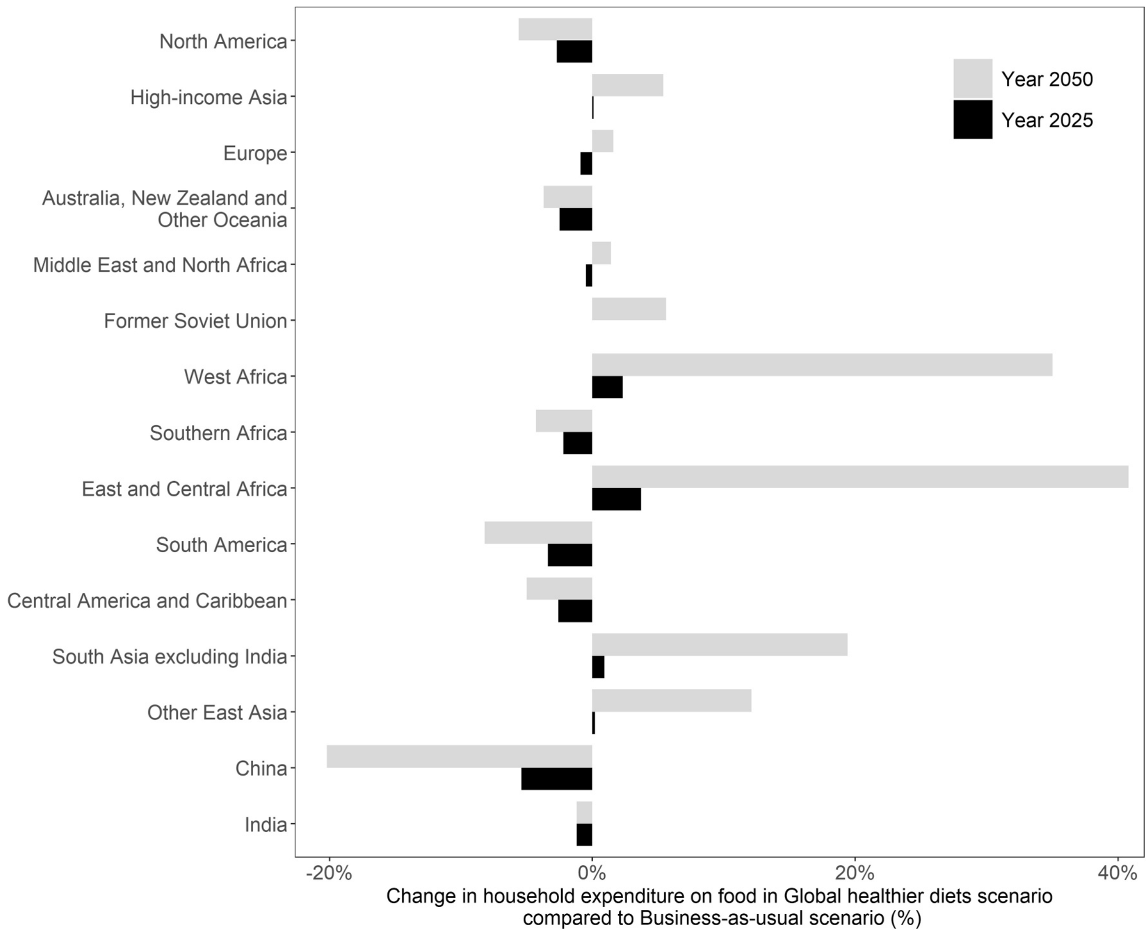

Fig. 4. Changes in household expenditure on food in the Global healthier diets scenario (GBL) compared to the Business-as-usual scenario in the years 2025 and 2050 (%), simulated in GLOBE.

food in India is 13.6% under the HIC scenario and 13.4% under the GBL scenario. In China, the corresponding shares are 4.6% under the HIC scenario and 3.7% under the GBL scenario.

In both the BAU and GBL scenarios food accounts for less than 25% of total household expenditure in 2050 (Fig. 5), but trade-offs exist between food and non-food items in household expenditure decisions. Over time affordability typically increases as incomes rise, but in some regions of sub-Saharan Africa and South Asia food affordability decreases in the GBL scenario as households spend a higher share of their total household expenditure on food than in the BAU scenario (Fig. 5). This decreased food affordability would reduce the amount households can spend on non-food items.

3.3. *Aggregate and sectoral income and employment*

The shift towards healthier diets occurs gradually and so involves marginal rather than dramatic reallocations of primary factors of production (land, labour, and capital) between sectors of the economy. But over time these reallocations affect sectoral economic activity as well as employment.

The direct implications of the expenditure shifts, induced by the exogenous change in food demand, include changes in agriculture's share of GDP (Table 4) and sectoral allocations of low-skilled labour (Table 5). In the GBL scenario compared to the BAU scenario, agriculture's share of GDP in 2050 is 5.8 percentage points higher in West Africa, 5.3 percentage points higher in East and Central Africa, and 1.9 percentage points higher in South Asia excluding India. Low-skilled labour in the agricultural sector increases in 10 of the 15 regions (Table 5) compared to the BAU scenario. This is primarily driven by increases in low-skilled labour in the crop subsector, despite decreases in the livestock subsector. Table 5 reports the GBL and HIC scenarios for agricultural subsectors and Supplementary Information Section 3, Table SI.11 reports the non-agricultural decomposition. The additional labour required for producing Fruits, Vegetables, Pulses, Roots, and Tubers more than offsets the reduction in labour requirements for crops linked to livestock feed demand, Sugar Crops and Oilseeds, leading to a larger share of labour allocated to crop production in all regions except China in the GBL scenario compared to the BAU scenario. The net increase in low-skilled employment in crop agriculture, relative to the decrease in low-skilled employment in livestock agriculture in most regions, is consistent with crop agriculture generally having a higher share of low-skilled labour costs than livestock agriculture and, in most regions, than non-agricultural sectors (Supplementary Information Section 3, Fig. SI.4). The decrease in labour demand in the livestock subsector would affect producers, including nomadic pastoralists, who are often geographically and socially distant from alternative employment opportunities. Many of these producers may have no links or only partial links with global food markets.

Table 4 displays the deviations of aggregate real GDP by region from the BAU scenario in 2050, expressed in units of the current-period BAU scenario consumption basket. These GDP effects in the GBL scenario are mildly positive for all regions. These effects were primarily due to the price-induced yield responses for fruits and vegetables (Supplementary Information Section 3, Fig. SI.2) and the net increases in land allocated to crops and pasture in most regions. The magnitudes of GDP changes are negligible for the high-income regions and most middle-income

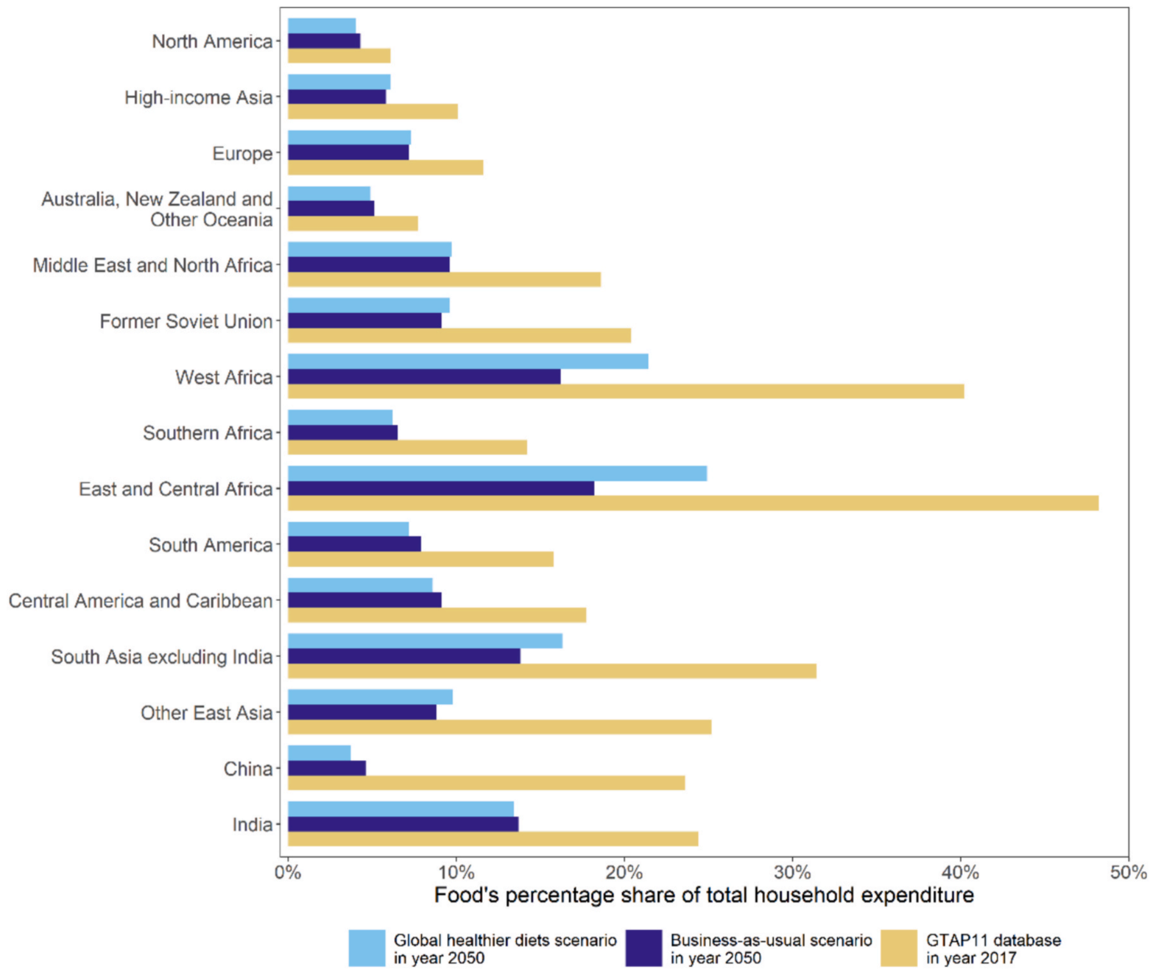

Fig. 5. Food's share of total household expenditure, simulated in GLOBE. Food's share of total household expenditure is defined as household expenditure on food divided by total household expenditure and is expressed as a percentage. Supplementary Information Section 1 Table SI.1 lists the countries in each of the GLOBE regions. Supplementary Information Section 3, Table SI.10 reports numerical data for shares in all scenarios.

regions but are slightly more pronounced in the low-income regions West Africa, East and Central Africa, and South Asia excluding India. In these low-income regions, crop agriculture's share of GDP (Supplementary Information Section 3, Table SI.13) is higher, and agricultural land accounts for a larger share of total factor income than in higher-income regions.

Under the HIC scenario, changes in GDP are smaller in absolute value than under the GBL scenario in 13 of the 15 regions. For example, GDP increases by 2.83% in East and Central Africa and 2.57% in West Africa under the GBL scenario, but by only 0.06% in East and Central Africa and 0.03% in West Africa under the HIC scenario (Table 4). In Europe and High-income Asia, GDP falls slightly under the Healthier diets in high-income countries only scenario, while agriculture's share of GDP increases slightly. This means that agriculture makes up a slightly larger share of GDP in those regions under this scenario than under the Business-as-usual scenario. Because GDP depends on changes in value added across all sectors, the higher share of agriculture in GDP in the Healthier diets in high-income countries only scenario can be associated with either a small fall in GDP, as in Europe and High-income Asia, or a small rise in GDP, as in North America. In India, GDP increases by 1.00% under the GBL scenario, while agriculture's share of GDP declines by 0.14 percentage points. One reason for this increase is that the diet-shift scenario slightly reduces food's share of total household expenditure relative to the Business-as-usual scenario in 2050 (Fig. 5), shifting a greater share of expenditure towards non-food items. The services share of GDP increases by 0.2 percentage points, while the industry share remains unchanged (Table SI.13). Within agriculture, the crop share of GDP increases by 0.1 percentage points, but the livestock share declines by 0.2 percentage points, so agriculture's overall share of GDP falls slightly (Table SI.13). In China, GDP increases by 0.41% under the GBL scenario, while agriculture's share of GDP declines by 0.40 percentage points. Like in India, the diet-shift scenario slightly reduces food's share of total household expenditure relative to the Business-as-usual scenario in 2050 in China (Fig. 5), shifting expenditure towards non-food items. The combined industry and services share of GDP increases by 0.4 percentage points (Table SI.13), while agriculture's share of GDP falls by 0.4 percentage points (Table SI.13).

Table 5 shows that the change in low-skilled labour in the industry and services sector is small in the two diet-shift scenarios (range − 3.6% to 0.4%), while within the agricultural sector low-skilled labour is generally reallocated towards crop agriculture and away from livestock agriculture. In the GBL scenario compared to the BAU scenario, agriculture's share of low-skilled labour in 2050 is 1.7 percentage points higher in West Africa, 3.2 percentage points higher in East and Central Africa, and 1.5 percentage points higher in South Asia excluding India, and the crop subsector's share increases in the two diet-shift scenarios (Supplementary Information Section 3, Table SI.12). Differences between the GBL and HIC scenarios in the change in agricultural low-skilled labour are especially large in parts of Africa. Notably, in East and Central Africa, low-skilled labour in agriculture is 32.7% higher in 2050 under the GBL scenario compared to the BAU scenario but is unchanged under the HIC scenario. In West Africa, low-skilled labour in

Table 4
Change in real Gross Domestic Product (GDP) and agriculture's share of GDP in the two diet-shift scenarios compared to the Business-as-usual scenario in 2050, simulated in GLOBE.

GLOBE Region	Change in GDP (%)		Change in agriculture's share of GDP (percentage point)	
	Global healthier diets	Healthier diets in high-income countries only	Global healthier diets	Healthier diets in high-income countries only
India	1.00	0.25	−0.14	−0.04
China	0.41	0.02	−0.40	−0.01
Other East Asia	0.37	0.05	0.94	0.07
South Asia excluding India	1.22	0.01	1.94	0.02
Central America and Caribbean	0.75	0.35	0.37	0.45
South America	0.21	0.06	0.08	0.13
East and Central Africa	2.83	0.06	5.32	0.02
Southern Africa	0.38	0.17	0.30	0.18
West Africa	2.57	0.03	5.78	0.04
Former Soviet Union	0.14	0.02	0.25	0.00
Middle East and North Africa	0.29	0.07	0.37	0.07
Australia, New Zealand and Other Oceania	0.29	0.31	0.04	0.06
Europe	0.05	−0.02	0.21	0.26
High-income Asia	0.01	−0.04	0.27	0.31
North America	0.16	0.11	0.00	0.04

Notes: Changes in GDP are percentage deviations from the Business-as-usual scenario in 2050. Changes in agriculture's share of GDP are differences in percentage points from the Business-as-usual scenario in 2050. Supplementary Information Section 1 Table SI.1 lists the countries in each of the GLOBE regions. Supplementary Information Section 3, Table SI.13 provides the changes in sectoral shares of GDP, including the crop and livestock subsectors within agriculture, as well as the industry and services sectors. Supplementary Information Section 3, Table SI.15 reports the changes in value added by sector. Supplementary Information Section 3, Table SI.17 reports agriculture's share of GDP by region and scenario.

agriculture is 35.3% higher in 2050 under the GBL scenario compared to the BAU scenario but only 0.3% higher under the HIC scenario (Table 5). In contrast, in North America total low-skilled labour in agriculture falls under the GBL scenario even though low-skilled labour in crop agriculture rises, because the 34.7% decline in livestock agriculture more than offsets the 9.3% increase in crop agriculture (Table 5).

In the HIC scenario, the effects on GDP and sectoral employment shares in the high-income regions are similar to those in the GBL scenario (Table 4 and Table 5). Repercussions on economic activity in the low- and middle-income regions arise from the impact of the demand shifts in the HIC regions on international trade. As further detailed in Supplementary Information Section 3, increases in imports of Fruits, Vegetables, Pulses, Roots, and Tubers to Europe, North America and High-income Asia, decreases in Processed Livestock Products imports to High-income Asia, Europe and North America, and decreases in Vegetable Oils and Fats imports to Europe are the most notable trade effects (Supplementary Information Section 3, Fig. SI.5). The Central America and Caribbean region experiences the largest export boost among the low- and middle-income regions (Supplementary Information Section 3, Fig. SI.6). Correspondingly, Central America and Caribbean is the low- and middle-income region with the strongest increase in the agricultural shares in GDP (0.45 percentage points, Table 4) and low-skilled employment (0.59 percentage points, Table 5). In this region the positive employment effect associated with the expansion of Fruits, Vegetables, Pulses, Roots, and Tubers exports dominates the negative employment effects associated with the contraction of exports of Processed Livestock Products, Sugar, Oilseeds, and Vegetable Oils and Fats. Due to the associated terms-of-trade gain, Central America and Caribbean is also the region with the strongest real GDP gain in the HIC scenario.

3.4. Wages for low-skilled workers

In all regions where agriculture's share of GDP noticeably increases in the GBL scenario, the real wages of low-skilled labour rise mildly relative to the wages of high-skilled labour. This relative wage effect occurs because the agricultural sector is generally more low-skill-intensive than the aggregate industry-services sector (Supplementary Information Section 3, Fig. SI.4). In most of these regions the low-skilled real wage also rises. However, in West Africa as well as in East and Central Africa, low-skilled wages drop slightly compared to the BAU scenario in real purchasing power terms because rising prices for Fruits, Vegetables, Pulses, Roots, and Tubers (Supplementary Information Section 3, Table SI.9) increase the cost of living, and food accounts for a relatively large share of household expenditure in these regions. The strong increases in prices for Fruits, Vegetables, Pulses, Roots, and Tubers are associated with pronounced increases in the corresponding returns to land in West Africa as well as in East and Central Africa. Supplementary Information Section 3, Table SI.14 displays the resulting factor decomposition of aggregate income effects for the GBL scenario.

4. Discussion

Our scenario-based modelling found that a shift to healthier diets might lead to a substantial reallocation of primary factors of production, especially labour, from non-agricultural sectors to crop agriculture, and an increase in wages for low-skilled workers in some regions. We also found an increase in food's share of total household expenditure in parts of sub-Saharan Africa and South Asia.

These results stem from the changes in food expenditure induced by the exogenous shift in the composition of food demand. A transition to healthier diets is modelled as an exogenous reallocation of demand for different food types, which changes the profile of agricultural production. The same exogenous demand shift affects food prices, quantities purchased and hence household expenditure on food and food's share of total household expenditure. In the regions that experience an increase in food's share of total household expenditure, the shift to a healthier diet slows long-run structural change associated with economic development, which is characterised by a falling share of agriculture in total economic activity. This is because the increase in food expenditure shifts relative demand towards agricultural goods, which leads to a reallocation of primary factors of production (such as land, labour, and capital).

Regional heterogeneity was evident across the 2025 EAT-Lancet Commission results (Rockström et al., 2025). Notably, although food's share of total household expenditure at the global level was slightly lower in the EAT-Lancet scenario compared to the 2025 EAT-Lancet Commission's Business-as-usual scenario, food affordability concerns were noted in parts of sub-Saharan Africa and South Asia. In our results, these concerns are consistent with the increase in food's share of total household expenditure in these regions in the Global healthier diets scenario. Affordability can be defined in several ways, such as deeming a diet unaffordable if it costs more than 52% of a household's income (Herforth et al., 2022) or a household being very vulnerable to food insecurity if a diet costs more than 75% of its income (Smith et al., 2007). Moreover, because our analysis is at the country-scale and region-scale, it masks the possibility of subnational variation in diet affordability.

Previous studies examined the effects of reducing the gap between

Table 5
Changes in low-skilled labour and agriculture's share of aggregate low-skilled labour in the two diet-shift scenarios compared to the Business-as-usual scenario in 2050, simulated in GLOBE.

GLOBE Region	Change in low-skilled labour by sector (%)								Change in agriculture's share of aggregate low-skilled labour (percentage point)	
	Global healthier diets				Healthier diets in high-income countries only				Global healthier diets	Healthier diets in high-income countries only
	Agriculture: total	Agriculture: crops	Agriculture: livestock	Industry and Services	Agriculture: total	Agriculture: crops	Agriculture: livestock	Industry and Services	Agriculture	
India	−0.8	1.9	−8.4	0.2	0.0	0.0	0.2	0.0	−0.1	0.0
China	−10.1	−1.4	−36.1	0.4	−0.2	−0.3	0.2	0.0	−0.4	0.0
Other East Asia	11.1	18.2	−25.2	−1.4	0.8	0.9	−0.2	−0.1	1.2	0.1
South Asia excluding India	12.4	22.9	−5.4	−1.6	0.1	0.0	0.3	0.0	1.5	0.0
Central America and Caribbean	7.5	15.6	−15.1	−0.5	9.1	12.7	−0.9	−0.6	0.5	0.6
South America	−1.1	10.8	−24.4	0.1	2.1	3.5	−0.4	−0.2	−0.1	0.2
East and Central Africa	32.7	45.1	−10.5	−3.6	0.0	0.0	0.1	0.0	3.2	0.0
Southern Africa	15.0	55.2	−22.4	−0.4	6.9	14.6	−0.3	−0.2	0.3	0.2
West Africa	35.3	44.5	−12.7	−1.8	0.3	0.3	0.0	0.0	1.7	0.0
Former Soviet Union	6.6	14.8	−11.1	−0.5	−0.1	−0.1	−0.1	0.0	0.4	0.0
Middle East and North Africa	13.5	24.8	−15.2	−1.1	2.4	5.9	−6.5	−0.2	1.0	0.2
Australia, New Zealand and Other Oceania	−2.7	25.0	−31.1	0.1	−0.6	20.4	−22.3	0.0	−0.1	0.0
Europe	17.6	39.8	−24.7	−0.6	19.1	41.4	−23.7	−0.6	0.6	0.6
High-income Asia	27.8	45.0	−29.0	−0.4	30.1	47.8	−28.6	−0.5	0.4	0.5
North America	−4.9	9.3	−34.7	0.0	−2.2	12.8	−33.6	0.0	0.0	0.0

Notes: Changes in low-skilled labour by sector are percentage deviations from the Business-as-usual scenario in 2050. Changes in agriculture's share of aggregate low-skilled labour are differences in percentage points from the Business-as-usual scenario in 2050. Supplementary Information Section 1, Table SI.1 lists the countries in each of the GLOBE regions. Supplementary Information Section 3, Fig. SI.4 reports the percentage share of low-skilled labour cost in total production cost by sector, region, and year. Supplementary Information Section 3, Table SI.16 reports the factor shares for sectors at the start of the simulation period.

current diets and the EAT-Lancet diet, for example by a third on the global scale by the year 2030 (Gatto et al., 2023) or completely for all EU-27 countries in 2050 (Rieger et al., 2023). Our finding that healthier diets increase agriculture's share of GDP by 5.3 percentage points in East and Central Africa and by 5.8 percentage points in West Africa is similar to Gatto et al. (2023), who found that healthier diets increase agriculture's share of GDP in sub-Saharan Africa by 4 percentage points (15% to 19%). Like existing studies (Gatto et al., 2023; Rieger et al., 2023) we found that in parts of sub-Saharan Africa healthier diets increased consumer prices of Fruits, Vegetables, Pulses, Roots, and Tubers and reduced prices for Cattle. The 2025 EAT-Lancet Commission found an 8% decrease in average agricultural producer prices by the year 2050 in the EAT-Lancet scenario compared to the business-as-usual scenario.

We also found that healthier diets had mixed effects on agricultural sector value added, similar to Rieger et al. (2023), and we additionally assessed aggregate income. Differences between our results and previous studies likely reflect several factors, including the nature of assumed diet change and the time over which the transition occurs. For example, we assume a constant calorie demand for most regions and allow convergence in sub-Saharan Africa and South Asia towards the global average calorie demand rather than decreasing calorie demand, such as through reducing cereal demand. A difference in our results compared with Gatto et al. (2023) is that we did not find a substantial reduction in global cropland in response to a shift to diets with less meat. Gatto et al. (2023) modelled a transition towards the EAT-Lancet Commission's healthy reference diet using a 2,500 kcal per person per day target. Because their business-as-usual projections implied increasing per person calorie intake over time, their 'towards the EAT-Lancet diets' scenario reduced calorie intake relative to the business-as-usual projections. This reduction was mainly due to decreased demand for cereals and starchy vegetables.

Adjustments in sectoral employment are generally not quick or easy. Using a biophysical accounting (input–output) approach, Vittis et al. (2025) found that flexitarian diets reduce agricultural labour requirements overall, but increase them in some countries with increased horticultural production. This is consistent with our finding that healthier diets shift labour towards crop agriculture in some regions. Modelling from the 2025 EAT-Lancet Commission found average agricultural wages increased from 2020 to 2050 by 81% in the business-as-usual scenario and 74% in the EAT-Lancet scenario. Training and reskilling the agricultural labour force therefore seem important for increasing the benefits of the economic adjustments associated with a transition towards healthier diets.

Investments that increase total factor productivity (TFP) growth in agriculture could also ease adjustment pressures. Within our long-run general equilibrium framework, an acceleration of agricultural TFP growth would raise the growth rate of low-skilled wages and would thus reinforce the beneficial impacts on low-skilled wage growth in our GBL scenario. With an acceleration of agricultural TFP growth, within our long-run modelling framework that assumes full employment, less labour would be allocated to agriculture (as fewer workers are needed to produce the same output), while more labour would be allocated to the non-agricultural sectors. This implies that with an acceleration of agricultural TFP growth the slowdown of long-run structural change that occurs in some lower-income regions under the GBL scenario would be less severe or could be entirely avoided. Increases in agricultural investments (such as in capital and research and development) in specific regions that promote innovation and productivity in agriculture could stem the flow of labour from the non-agricultural sectors to the agricultural sector, therefore putting the region back on the path of long-run structural transformation. However, public investment in most fruits, vegetables, and pulses has been neglected (Pardey et al., 2018; Alston et al., 2021). Without sufficient, typically public, investment in research and development, TFP growth in agriculture slows (Pardey et al., 2016). Higher TFP growth rates in agriculture could also reduce the upward pressure on food prices (and the fraction of household income spent on food) by allowing production to increase. Policymakers should consider the broader economic consequences of a widespread, even if gradual, transition towards healthier diets when developing policies in public health, food, and agriculture. Sustained investment to accelerate TFP growth in agriculture, and employment opportunities more broadly, will be needed to facilitate a transition towards healthier diets on the global scale that limits adverse consequences.

Globally, at least 90 countries have food-based dietary guidelines (Herforth et al., 2019). Examples of these guidelines include Kenya's National Guidelines for Healthy Diets and Physical Activity, Nigeria's Food-based dietary guidelines for Nigeria – a guide to healthy eating, Dietary Guidelines for Indians (Singh et al., 2025), Chinese Dietary Guidelines (Zhang et al., 2025), the Eatwell Guide in the United Kingdom, and Dietary Guidelines for Americans. Although a range of policy interventions have been proposed and implemented to support shifts toward healthier diets (Hawkes et al., 2013; Drewnowski et al., 2020; Ameye et al., 2025), shifting population-level diets remains challenging, and diets in many countries remain far from recommended patterns (Rockström et al., 2025). Some of these policies include nutrition education, restrictions on food marketing, changes to food labelling (Fanzo et al., 2021a), and fiscal policies that tax or subsidise specific foods or beverages (Pineda et al., 2024; Springmann et al., 2025). Other policies address food affordability and access, such as school meal programs (Kovacs et al., 2020) and the Supplemental Nutrition Assistance Program (Gundersen, 2019).

Existing policies primarily target consumer-side factors such as food prices, affordability, and information, and are less directly linked to agricultural income and employment outcomes. As a result, these policies tend to give less attention to aggregate and sectoral income and employment effects, especially in agriculture. Dietary transitions alter both food demand and food production and can therefore have broader economywide implications, including for labour and income distribution (Mason-D'Croz et al., 2025; Rockström et al., 2025). Our scenario-based modelling shows that dietary transitions can have economywide implications for income and employment. These implications may be relevant when designing or assessing policies intended to encourage healthier diets, particularly if those policies succeed in shifting diets at the population level.

5. Conclusion

We found healthier diets may shift labour and capital towards crop agriculture in some regions and increase food expenditure shares in parts of sub-Saharan Africa and South Asia. These adjustments suggest that dietary transitions could slow structural transformation in some lower-income regions unless agricultural productivity growth accelerates.

We identified two opportunities for future research in the modelling of economywide effects of healthier diets. First, our modelling did not account for possible effects of healthier diets on labour productivity and, because full employment was assumed in our modelling, it did not capture unemployment or underemployment. Future research could extend the analysis to models with a more detailed representation of labour markets. This opportunity for future research is potentially important as healthier diets may improve labour productivity and increase the size of the workforce through fewer non-communicable diseases and lower mortality rates. Second, our study did not explore assumptions about investment patterns in agricultural research and development, but if wages increase in agriculture, this could encourage the private sector to increase investment in agricultural research and development.

A caveat of our approach is that our scenario-based modelling is at the country-scale and region-scale (i.e., we are modelling on population-wide averages), so while on average we found diets to be affordable at the region scale in 2050, these averages would mask subnational variation in diet affordability, especially based on income groups within countries and regions. Nevertheless, our scenario-based modelling investigates the economic implications of achieving healthier diets at the population level.

6. Data and code availability statement

The code and data used for the analysis are described in the Methods section and Supplementary Information.

CRediT authorship contribution statement

Adam M. Komarek: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Dirk Willenbockel:** Writing – review & editing, Methodology, Formal analysis, Data curation, Conceptualization. **Shahnila Dunston:** Writing – review & editing, Methodology, Formal analysis, Data curation. **Nicola Cenacchi:** Writing – review & editing, Conceptualization. **H. Charles J. Godfray:** Writing – review & editing, Conceptualization. **Daniel Mason-D'Croz:** Writing – review & editing, Conceptualization. **Timothy B. Sulser:** Writing – review & editing, Conceptualization. **Keith Wiebe:** Writing – review & editing, Conceptualization.

Declaration of competing interest

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

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Appendix A. Supplementary data

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