Introduction

The food system is a major contributor to global greenhouse-gas emissions. Greenhouse gases are produced at all stages in the system, from farming and its inputs through to food distribution, consumption, and the disposal of waste. The latest Intergovernmental Panel on Climate Change report estimated that agriculture alone accounts for about 10–12% of global greenhouse-gas emissions, and emissions from this sector are expected to rise by up to half again by 2030. Agriculturally-induced change in land use—such as deforestation, overgrazing, and conversion of pasture to arable land—presently accounts for a further 6–17% of global greenhouse-gas emissions.

About half of all food-related greenhouse-gas emissions are generated during farming. Farm-stage emissions include nitrous oxide and methane from livestock, and carbon dioxide from agriculturally-induced change in land use, especially deforestation. Nitrous oxide (from pasture land and arable land used to grow feed crops) and methane (from the digestive processes of ruminant animals such as cows and sheep) account for 80% of all agricultural greenhouse-gas emissions. The emissions per unit of livestock product vary by animal type and seem to be higher in beef, sheep, and dairy farming than in pig and poultry farming (figure 1). However, the ability of cattle and sheep to graze on land unsuited to other forms of farming, and the emissions associated with the production of feeds for pigs and poultry complicate the interpretation of this difference (panel 1). By 2030, rising demand for meat, especially in countries with transition economies, is expected to drive up livestock production by 85% from that in 2000, which will substantially affect emissions. Once foodstuffs leave the farm, the bulk of food-related emissions arise from use of fossil fuels.

The food system contributes to health benefits and harms through the availability, quality, and affordability of food. Animal foods are important sources of protein,
energy, and nutrients—such as iron, calcium, vitamin B12, and zinc12—especially for children and for undernourished populations in low-income countries,13 but are also major sources of saturated fats in the human diet.13 In all but the poorest countries, diets are becoming high in saturated fat and sugar, and low in fruit and vegetables.15 In addition to other behaviours such as physical inactivity and tobacco use, such diets are a leading cause of non-communicable diseases, including cardiovascular disease, some cancers, and type 2 diabetes.16

We aim to describe strategies that could substantially reduce farm-stage greenhouse-gas emissions in the food and agriculture sector by 2030, to meet targets recommended by the UK Committee on Climate Change, and to show and quantify the major effects on public health.

**Potential strategies to reduce emissions**

From expert reports we identified four strategies to reduce greenhouse-gas emissions in the food and agriculture sector, with a focus on the livestock sector in view of the dominant contribution of processes in livestock production to agricultural emissions:1 improved efficiency of livestock farming; increased carbon capture through management of land use; improved manure management; and decreased dependence on fossil-fuel inputs.17,18 Reduced production and consumption of foods from animal sources in high-consumption populations19–22 has also been proposed as a strategy. We did not consider other potentially important strategies including reduction of emissions from food transport, processing, and retailing since these are tackled best through measures to lower the carbon emissions from energy supplies and improve efficiencies. Nor did we assess the potential effect of decreasing food waste,19 although we acknowledge that this strategy could contribute to reduced emissions.

**Panel 1: Greenhouse-gas emissions from ruminant and monogastric animal production**

A shift from the production and consumption of livestock products of ruminant origin (beef, lamb, mutton, milk) to those of monogastric origin (pork, chicken, eggs) has been suggested as a measure to reduce greenhouse-gas emissions.2 Indeed, emissions per kilogram of livestock product seem to be lower for monogastric than for ruminant animals (figure 1), at least partly because pigs and poultry have better feed-conversion efficiency than do ruminants, and because they do not emit enteric methane while digesting their feed. However, production of monogastric animals is inherently dependent on cereals and soy which could be more efficiently consumed by human beings directly, whereas cattle and sheep can subsist on marginal land that could not be used for arable production (often supplemented with food and agricultural byproducts). In so doing, cattle and sheep can make use of land that is unsuited to other forms of food production, thereby helping to avoid change in land use and reducing the competition between animals and human beings for cereals. Cattle and sheep grazing at the right stocking density on unploughed pasture can also help to maintain and even sequester carbon in the soil. Such resource efficiency by ruminants is not shared by pigs and poultry, except for cottage-scale pigs and poultry which are fed on kitchen scraps.

However, the global situation is complicated. Although ruminants can subsist on grassland, industrialised beef and dairy production relies on large inputs of cereals and oilseeds with accompanying methane emissions, thereby combining the disadvantages of monogastric and ruminant livestock production. Increasing demand for beef has led to the growth of cattle ranching and consequent deforestation in the Amazonian region and elsewhere. Furthermore, in developing countries, extensive grazing systems can lead to land degradation and the loss of soil carbon in regions where population pressures are high for human beings and livestock. Therefore, the merits of different livestock types to reduce emissions largely depend on the scale of demand and the system in which the animals are reared.

**Pathways to health**

We mapped the pathways from our selected strategies to reduce emissions to the most plausible nutrition-related health outcomes (figure 2). Technological strategies are necessary components of efforts to reduce emissions, but they will have little effect on health. By contrast, change in dietary intake of saturated fat from animal sources is a major pathway to population health. Consistent experimental and epidemiological evidence has linked intake of saturated fat with cardiovascular disease, largely because of the effect on serum cholesterol concentrations.23–25 Cardiovascular disease is the world’s leading cause of death, with the largest burden in countries of middle and low income.29 Moreover, consumption of high-fat energy-dense diets is associated with increased risk of obesity.26
and, in the case of red meat, increased risk of colorectal cancer and total mortality.27

**Estimation of the effect on population health**

To analyse the effect of reduced consumption of foods from animal sources on population health, we focused on changes in livestock production, the estimated shifts in intake of saturated fat and cholesterol at a population level, and the burden of cardiovascular disease, specifically ischaemic heart disease and stroke. We used Comparative Risk Assessment for modelling, as described in the first paper in this Series,28 and briefly outlined in webappendix pp 1–2. We used case studies from the UK and São Paulo city, Brazil, to quantify the relation between the strategy to reduce emissions and the burden of ischaemic heart disease and stroke. We used Comparative Risk Assessment for modelling, as described in the first paper in this Series,28 and briefly outlined in webappendix pp 1–2.

The UK has good data available for both dietary intake and greenhouse-gas emissions. Estimates of average consumption of saturated fat and cholesterol in the UK, stratified by age and sex, are available from published data gathered for the nationally representative National Diet and Nutrition Surveys.29–31 The surveys used 4-day29 or 7-day30,31 weighed dietary intake methods, and the data are separated into the source of dietary saturated fats by broad food category, enabling estimates of the proportion of total intake of saturated fat of animal origin. The source of saturated fat for some food categories (eg, cereal products such as cakes that might contain saturated fats from both animal and vegetable sources) was not known and was assumed to be of vegetable origin. Our estimates of intake of saturated fat from animal sources in the UK are therefore probably conservative.

Brazil, a country with a rapidly growing economy, is a mass producer and exporter of livestock products. The Brazilian population consumes substantial quantities of foods from animal sources and is undergoing a transition in its overall pattern of dietary intake.32 Few data about greenhouse-gas emissions are available from the Brazilian agricultural sector, which restricted the scope of our modelling. Cattle ranching in combination with soy cultivation (at least partly for animal feed) are key causes of Amazonian deforestation, which substantially contributes to global emissions of greenhouse gases.33

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See Online for webappendix
Panel 2: Strategies to reduce greenhouse-gas emissions from the UK food and agriculture sector

The supply of food to UK consumers produces about 160 megatonnes of carbon dioxide equivalents (MtCO₂e), or 19% of the UK's total greenhouse-gas emissions. Estimates include the embedded emissions from imported foods for human consumption and feedstuffs for UK livestock production, and exclude emissions from exported foods. In 1990, total emissions from the UK domestic agriculture sector were 55 MtCO₂e, a figure which by 2007 had reduced to 44 MtCO₂e, of which 36 MtCO₂e—about 80%—were due to the rearing of livestock. About two-thirds of nitrous oxide emissions are attributable to livestock because of high nitrous oxide emissions from grasslands, which account for a high proportion of the UK’s total agricultural land area.

In 2008, the UK Government agreed that by 2050, it would achieve an 80% reduction in total UK greenhouse-gas emissions from concentrations recorded in 1990, and has further committed to achievement of a 34% reduction by 2020. These targets relate to emissions generated within UK borders only, and do not apply to the embedded emissions in the totality of goods and services consumed. To achieve the target for 2050, emissions from food and agriculture will need to decrease from concentrations recorded in 1990 by 50% by 2030, based on a proportionate decline in emissions between 2020 and 2050.

We have calculated the reductions in emissions that could be achieved by technological changes in livestock farming, and estimated the additional reductions in livestock production that would be needed to bridge the gap with the emissions target. We have assumed that agriculture contributes a proportional share to emissions reductions that is the same as for all other sectors. The potential reduction in emissions from the strategies is summarised in table 1.

(Continues in next column)

Strategy one: technological change

Technological change to reduce emissions in the UK agricultural sector includes increased efficiency, new technologies, and improved farm management, but estimates of its contribution to achievement of the target for 2020 vary widely: 3–13 MtCO₂e. The mid-range ADAS estimate of 5 MtCO₂e is used as the basis for our analyses. In the absence of robust estimates of the UK potential to reduce emissions from agriculture by 2030, we made several assumptions. The potential to reduce emissions from technological means was taken at a starting point of 5 MtCO₂e for agriculture in 2020, with 80% attributed to livestock (4 MtCO₂e). We assumed that the greenhouse-gas mitigation achievable for 2020–30 would be equal to the estimated percentage improvement for 2007–20. For the livestock sector, the reduction for 2007–20 is expected to be 11.1% in MtCO₂e (reduction of 4 MtCO₂e from 36 MtCO₂e). A further 11.1% reduction for 2020–30 lowers livestock emissions to about 28 MtCO₂e. However, to reach the target of reduction from concentrations in 1990 by 50% by 2030, emissions from the livestock sector would need to be 22 MtCO₂e.

Strategy two: technological change and reduced livestock production

There is a gap of 6 MtCO₂e between the reduction in emissions that can be achieved via technological strategies and the UK’s target for 2030. To accommodate the projected UK population increase of 10% for 2010–30, we have added 10% onto projected emissions in 2030 (assuming a proportionate increase in the amount of livestock products needed as projected from present UK consumption), resulting in emissions of 31 MtCO₂e and an increase in the emissions gap to 9 MtCO₂e (table 1). With the assumption that the emissions gap can be met by reduction of livestock production above that achieved by technological improvements in productivity, a reduction in livestock production of about 30% is needed by 2030. These reductions would be additional to technological changes. The lower the feasibility of technological and managerial changes, the greater the additional reductions in production that will be needed. Our burden of disease analysis assumes that this 30% reduction in livestock production will be matched by an equal reduction in the consumption of foods from animal sources.
conservative. We acknowledge that Brazil is not committed to the same reductions in emissions as Annex 1 (industrialised) countries. There are uncertainties in estimation of the potential to reduce emissions in a complex living system, and in separation of livestock emissions from those generated by the agriculture sector as a whole.

We estimated the effect of a 30% decrease in livestock production on dietary intake of saturated fat and cholesterol from animal sources and on serum cholesterol concentration (webappendix p 3). We assumed that reductions in livestock production would result in declines of equal size in consumption of foods from animal sources, and specifically in dietary intake of saturated fat and cholesterol. This assumption is necessarily simplistic since various interconnected factors affect dietary intake, including international trade, waste, food prices, and sociocultural practices.

Hazard ratios from published meta-analyses enabled quantification of the relation of intake of saturated fat and cholesterol with death or disability from ischaemic heart disease (table 2). We assumed isocaloric replacement of saturated fats with polyunsaturated fats. The Keys equation was used to quantify the effect of changes in dietary intake of saturated fat and cholesterol on serum cholesterol concentration; consequently, we were also able to model the relation between the change in serum cholesterol concentration and death from ischaemic heart disease and stroke. In both case studies, the analyses were based on average dietary intakes, and did not allow for individual, socioeconomic, or geographical variations that are known to exist in diets, or for underlying temporal changes in consumption that might take place by 2030.

We modelled the effect of a 30% reduction in intake of saturated fat and cholesterol from animal sources on the burden of ischaemic heart disease in the UK and São Paulo city (table 3). For the UK population, a 30% decrease in intake of saturated fats from animal sources could reduce the total burden from ischaemic heart disease by 15% in disability-adjusted life-years (DALYs), by 16% in years of life lost, and by 17% in number of premature deaths. From the model of disease burden associated with change in serum cholesterol concentration, reductions in ischaemic heart disease in the UK seemed to be lower than with the model of intake of saturated fats (5% in years of life lost, 4% in number of premature deaths).

In São Paulo city, a 30% reduction in intake of saturated fat from animal sources could reduce the total burden from ischaemic heart disease by 16% in DALYs, by 17% in years of life lost, and by 17% in number of premature deaths. Similar to results for the UK, reductions in the burden of disease in São Paulo city were lower with the model of change in serum cholesterol concentration than with the model of intake of saturated fat (7% in years of life lost, 6% in number of premature deaths).

Table 2: Risk of health outcomes from exposure to dietary saturated fat or from serum cholesterol concentration for use in burden of disease models for the food and agriculture sector

<table>
<thead>
<tr>
<th>Dietary intake of saturated fatty acids or change in serum cholesterol concentration</th>
<th>Hazard ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disability from ischaemic heart disease at &gt;35 years</td>
<td>0.87 (0.77–0.97)</td>
</tr>
<tr>
<td>Death from ischaemic heart disease at &gt;35 years</td>
<td>0.74 (0.61–0.89)</td>
</tr>
<tr>
<td>Serum cholesterol concentration</td>
<td></td>
</tr>
<tr>
<td>Death from ischaemic heart disease</td>
<td></td>
</tr>
<tr>
<td>40–49 years</td>
<td>0.45 (0.42–0.47)</td>
</tr>
<tr>
<td>50–59 years</td>
<td>0.57 (0.55–0.58)</td>
</tr>
<tr>
<td>60–69 years</td>
<td>0.68 (0.66–0.69)</td>
</tr>
<tr>
<td>70–79 years</td>
<td>0.79 (0.78–0.81)</td>
</tr>
<tr>
<td>80–89 years</td>
<td>0.85 (0.82–0.89)</td>
</tr>
</tbody>
</table>

*Per 5% reduced energy intake from saturated fatty acids and a concomitant increased intake of polyunsaturated fatty acids. †Per 1 mmol/L reduction in total serum cholesterol.
Discussion
Urgent and substantial actions are needed to reduce greenhouse-gas emissions and thus stabilise the world’s climate before the extent of climate change becomes obviously dangerous. Our combined strategy of agricultural technological change and decreased livestock production would reduce emissions in the agriculture sector. Moreover, our model indicated that the commensurate reductions in consumption of saturated fat and cholesterol from animal sources would substantially decrease deaths and disability caused by ischaemic heart disease. Association of exposure—saturated-fat intake and change in serum cholesterol concentration—with health outcome could have been responsible for the uncertainty in our estimates of the effect of the strategy to reduce emissions on disease burden. The estimated health benefits from decreased serum cholesterol concentration were smaller than those from saturated-fat intake, and use of more nuanced data from cholesterol subclasses might have increased the estimated benefits. Whichever approach was used, overall the strategy improved public health.

We acknowledge that our analyses contain several limitations and assumptions, some of which could have resulted in underestimation of the effect of reduced emissions on public health. For example, health modelling was limited to pathways leading from consumption of livestock products to ischaemic heart disease, and we did not model the possible implications for other health outcomes, such as obesity and diet-related cancers.26,44 Since we selected this specific health outcome, our modelling was undertaken for adults only. The case studies on which we based our model were set in countries where consumption of foods from animal sources is quite high; consequently, our results are not generalisable to countries with lower consumption of animal products. Our estimate of the potential reductions in emissions is subject to uncertainties and is likely to be an underestimate, since it is based on data from the UK only, and we did not include the potential savings in greenhouse-gas emissions that would accrue from livestock produced overseas for UK consumption. In other countries, especially developing countries, we expect that the potential for managerial approaches to reduce emissions might be greater than that recorded in our case studies.

Other limitations might have resulted in overestimation of health effects. First, we assumed that the reduction in national production of livestock would directly result in commensurate reductions in the intake of saturated fat and cholesterol from animal sources. This assumption is an oversimplification since livestock products are globally traded commodities, and reduced production in the UK and Brazil could only reduce national demand for consumption if such a change was not undermined by increased consumption of cheaply imported livestock products. Global actions are needed to achieve maximum benefits to public health in high-consumption populations. Second, we made no allowance for the different dietary proportions or total saturated-fat content of foods from animal sources, or for the contribution of different livestock to emissions. For example, since ruminant animals are an important source of methane, which has highly potent near-term warming potential (up to two orders of magnitude more potent than carbon dioxide in the first decade after release), reduction of products from such animals could be argued to be especially necessary.745

Third, we used data from two meta-analyses but in their investigation of the relation between saturated-fat consumption and ischaemic heart disease, Jakobsen and colleagues41 recorded no modifying effect of age, probably because the statistical power was low, whereas the Prospective Studies Collaboration46 reported age to be a strong modifier in their study of serum cholesterol concentration and ischaemic heart disease. Fourth, we modelled the effect of immediate and full implementation of our strategies, but in reality, the effects on public health will only become evident over time (ie, these are committed reductions that could take many years to be realised). Furthermore, the size of these effects might be modified in subsequent years because of changes in

<table>
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<tr>
<th>UK</th>
<th>São Paulo city, Brazil</th>
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- **Populations**
  - Total in thousands*: 61367, NA = 10435, NA
  - Dietary intake of saturated fat46
    - DALYs
      - Total in thousands*: 1183, -175, 147, -23
      - Per million population*: 19270, -2850, 14090, -2180
    - Years of life lost
      - Total in thousands*: 1052, -165, 127, -21
      - Per million population*: 17140, -2690, 12130, -2030
    - Premature deaths
      - Total in thousands*: 107, -18, 8, -1
      - Per million population*: 1750, -290, 750, -130
  - Serum cholesterol concentration47
    - Years of life lost
      - Total in thousands*: 1052, -55, 127, -9
      - Per million population*: 17140, -900, 12130, -870
    - Premature deaths
      - Total in thousands*: 107, -4, 8, -0.4
      - Per million population*: 1750, -70, 750, -40

*Rounded to the nearest thousand; percentage reductions cannot be calculated accurately from rounded figures.†Rounded to the nearest ten; percentage reductions cannot be calculated accurately from rounded figures.‡DALYs = disability-adjusted life-years.
Panel 3: Uncertainty in burden of disease estimates

We recognise the substantial uncertainty in our estimates of the health effects of strategies to reduce greenhouse-gas emissions. Therefore, we have attempted to quantify one aspect of this uncertainty: assessment of health outcome from exposure to intake of saturated fat or change in serum cholesterol concentration. The two models gave substantially differing results. To assess the relative contribution of structural uncertainty (ie, whether the pathway to health effects from direct intake of saturated fat is different from the effect of change in serum cholesterol concentration) and parameter uncertainty (ie, the accuracy of the mean estimate of exposure to health outcome compared with the true value) to these recorded differences, we repeated calculations with our models using the upper and lower 95% CIs of the published hazard ratios (table 2).

The upper and lower uncertainty bounds (table 4) suggest that although the mean reductions in years of life lost and number of premature deaths differed between the two models, the lower uncertainty bound from the model of saturated-fat intake was similar to the upper uncertainty bound of the model of change in serum cholesterol concentration for the UK. Furthermore, in São Paulo city the lower and upper uncertainty bounds of the two models overlapped. We conclude that the difference between the estimates provided by the two models is largely compatible with parameter uncertainty in the hazard ratios, but does not exclude structural uncertainty. The wide 95% CI for the model of dietary saturated-fat intake probably indicates the difficulty in accurate estimation of fat consumption in free living populations.

Population structure and the background frequency of cardiovascular disease, which is declining in the UK56 and Brazil57 because of several factors including other public health and health-care interventions. However, for much of the world, occurrence of cardiovascular disease is rising,58 and so strategies to reduce emissions might have even greater benefit for population health in such countries. Last, we did not account for the emissions of substitute foods in our calculation of reduced consumption of livestock products. Our model is based on replacement of saturated fat with polyunsaturated fats. Generally, plant-based diets are high in polyunsaturated fats and have a lower greenhouse-gas burden than do foods from animal sources,59 but some plants are also important sources of saturated fats (eg, palmitic acid in palm oil). Our analysis also made no allowance for the varying amounts of different saturated fatty acids in meat and dairy products. Whereas saturated fats raise overall serum cholesterol concentration, individual saturated fatty acids have contrasting effects.59

Despite these limitations, we have shown that a strategy to reduce production and consumption of foods from animal sources would help to prevent dangerous climate change from greenhouse-gas emissions and benefit the health of adults in countries consuming high amounts of animal products. This strategy has several policy implications for trade, agriculture, and health. An important challenge in public health is to balance the need for adequate population intake of animal-source protein and essential nutrients with reduced consumption of saturated fat. Almost a billion people have protein-energy undernutrition, most of whom are also undernourished in micronutrients, especially iron and zinc. Adequate protein, energy, iron, and zinc can be obtained from a plant-based diet.31,32 However, the consumption of a small amount of animal-source foods per day in low-consumption populations could help to alleviate the burden of undernutrition.31 At present, agricultural production is mismatched with the provision of a diet that is balanced in terms of foods from plant and animal sources. Globally, production per head of energy, fats, proteins, and micronutrients has increased and is sufficient to meet global population needs,31 but the benefits have not been distributed evenly across countries and regions.31 A wide range of factors affect the supply and demand for animal-source foods; some policy levers offer potential approaches to change consumption patterns in populations (panel 4).

A 30% reduction in adult consumption of livestock products in high-consumption countries results in intake of saturated fat that falls well within existing distributions of population intake73 and is therefore realistic from a dietary perspective. Our findings have important implications for agriculture. Although reduced livestock production and consumption will have social, health, and environmental advantages, these benefits are affected by geographical, social, and economic contexts. For example, ruminant livestock in upland and marginal areas can help to maintain and build the carbon-sequestering properties of soil. Where grazing cattle are reared without use of feed inputs or additional fertiliser, and at low stocking densities, carbon sequestration can outweigh methane and nitrous oxide emissions.74 Intensive agricultural methods have
The food production system is a complex interaction of global, national, and local factors that can affect supply and demand with respect to foods from animal sources. Various policy levers can affect food supply: direct investment by transnational food corporations; trade arrangements affecting food imports, exports, and domestic production; agricultural policy; food processing and procurement; and retail systems.

Food pricing, food marketing and labelling, and community-level interventions affect dietary demands of consumers. Evidence from several countries suggests that a comprehensive range of intersectoral policies that combine such interventions with nutritional education can change the type of dietary fats consumed. In Finland, such an approach may have changed patterns of consumption, including the type of dietary fats, and reduced mortality due to ischaemic heart disease by 65%. Regulatory policies in Canada, Denmark, and Mauritius, including those on food labelling and composition, have improved the fat content of foods, with benefits to health.

New policy initiatives are emerging with a focus on the environmental benefits of dietary change. Sweden produced dietary guidelines in 2009 recommending that citizens eat meat less often and in reduced quantities, to decrease greenhouse-gas emissions, and the city council of Ghent in Belgium has proclaimed a meat-free day each week. Although inclusion of environmental concerns in dietary guidelines and social marketing will probably have little effect on behavioural change, as part of a comprehensive policy approach to sustainable and healthy dietary behaviours, they could be a useful advance to link health and climate-change agendas.

By contrast, excessive livestock production to meet growing demand has created problems of soil degradation, biological impoverishment, and, through overgrazing and intensive feed production, a loss in the soil’s ability to sequester carbon. The cultivation of crops for biofuel production is an emerging issue of relevance to livestock production. Biofuel production places additional pressure on land, but conversely, the refining of oil or starch grains to produce biodiesel or ethanol can generate protein rich byproducts that can be used to feed animals. Furthermore, climate change generally affects livestock production and agriculture via water and heat stress, and change in the spread of pests, disease, and infections.

Reduction of greenhouse-gas emissions in the food and agricultural sector could help to prevent climate change and reduce the burden of ischaemic heart disease. Formulation of appropriate national and international policies that recognise both the benefits of reduced livestock production in high-consumption countries and the need for more equitable distribution of these products remains an important global challenge. Such policies will need intersectoral actions and good global governance to succeed.

Contributors
ADD, SF, TG, AH, IR, and JW led, and CDB and AJM contributed to, the conceptual development of the report. TG developed the greenhouse-gas mitigation scenarios. ADD led, and KL contributed to, the nutrition and health analysis. ZC did the modelling. SF wrote the first draft of the report. All authors contributed to the intellectual guidance, analysis, and subsequent drafts of the report.

Conflicts of interest
We declare that we have no conflicts of interest.

Acknowledgments
The project that led to this Series was funded by the Wellcome Trust (coordinating funder); Department of Health, National Institute for Health Research; the Royal College of Physicians; the Academy of Medical Sciences; the Economic and Social Research Council; the US National Institute of Environmental Health Sciences; and WHO. The Royal College of Physicians was supported by an unrestricted educational grant from Pfizer. The funders had no role in the design, analysis, or interpretation of the study. The views expressed are those of the authors and do not necessarily reflect the position of the funding bodies. For their expert advice, we thank A Aikenhead (International Association for the Study of Obesity, London, UK), R Beaglehole (University of Auckland, Auckland, New Zealand), M A de Castro (University of São Paulo, São Paulo city, Brazil), G Edwards-Jones (Bangor University, Bangor, UK), R M Fisberg (University of São Paulo, São Paulo city, Brazil), R Jackson (University of Auckland, Auckland, New Zealand), P C Jaime (University of São Paulo, São Paulo city, Brazil), G Jones (ADAS, Wolverhampton, UK), M Lawrence (Deakin University, Burwood, VIC, Australia), C Mathers (WHO, Geneva, Switzerland), and R Uauy (London School of Hygiene and Tropical Medicine, London, UK).

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