

Environmental impact



of vegan versus conventional diets in the UK

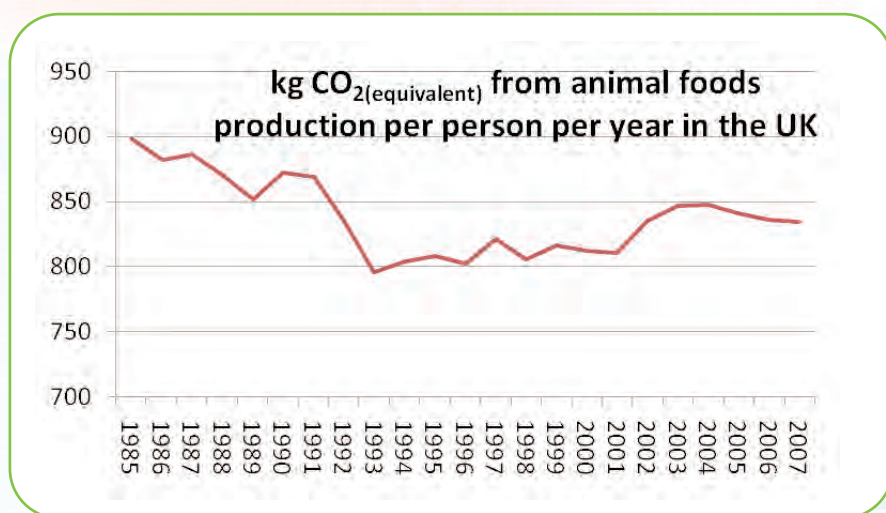
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It has long been recognised that vegans need less land, water and energy to meet their dietary needs. It is also increasingly recognised that vegan diets cause less global warming impact. However, quantifying how much less is not straightforward as it requires a lot of information on the impact of different foods.

In 2006, a £400,000 study sponsored by DEFRA reported on the environmental impact of agricultural and horticultural commodities produced in the UK¹. The results have since been slightly updated and the latest spreadsheets (last updated in 2007) are available from the authors. The analysis that follows is based on these updated figures.

This DEFRA study provides a solid reference point for examining the environmental impact of different diets in the UK. The strengths of the study include: the breadth of products considered using a consistent approach; the focus on the UK; and the wide range of environmental impacts considered.

The DEFRA study calculated the impacts associated with a given quantity of selected products at the farm gate. DEFRA also publish figures for the annual supply of the same products (including imports) going back to 1985.² I combined these two sources of information with figures for UK population to get an estimate of the total greenhouse gas impact of livestock consumption per person in the UK from 1985 to 2007, measured in kilograms of carbon dioxide equivalents per year (on a 100 year horizon).



The modest dip in the early 1990s was due to a drop in consumption of beef.

To get to a realistic comparison of the impact of various diets, we need to express the consumption of each food in terms of calories as when substituting one food for another we should keep the total number of calories the same.

There is good data available from the United Nations Food and Agriculture Organization (FAO) on the mix of foods available in the UK up to 2003³. The FAO data is for supplied calories rather than consumed calories which are much lower due to food wastage. Total food calories per person per day in the UK for 2003 were 3450 kCal.

The DEFRA reports^{1,2} consider each major type of meat (pig, cow, sheep and chicken) separately, allowing the impact of variations in the type of meat consumed to be considered. I matched the percentage of calories from each animal food to the FAO supply figures as closely as possible.

Some adjustment was needed to attribute calories reported as non-dairy animal fats to specific meat products.

The main plant foods for human consumption considered in the Williams et al report¹ were potatoes, bread wheat and British grown tomatoes (a very untypical high-impact plant food due to the use of heated greenhouses). Fortunately, soya and rapeseed were included as animal feeds as part of their analysis of animal products.

As rapeseed is produced mainly as an oil crop, all the impact of the rapeseed is attributed to the oil in my analysis. Overall plant food consumption was represented by a mix of soya, rapeseed, wheat and potatoes rather than following the more detailed breakdown in the FAO statistics. Wheat use directly matched the FAO figures; rapeseed oil matched total vegetable oil and nut use; 10% of calories in the vegan diet were attributed to soya; and the balance of calories was attributed to potatoes.

Food	typical UK diet (animals 30% of calories)	replace cow and sheep meat with poultry and pig meat	replace all animal products with dairy	halve the amount of dairy	vegan
Pig meat	0.070	0.110	0.000	0.000	0.000
Poultry	0.040	0.052	0.000	0.000	0.000
Beef	0.038	0.000	0.000	0.000	0.000
Sheep meat	0.014	0.000	0.000	0.000	0.000
Milk	0.120	0.120	0.295	0.150	0.000
Eggs	0.013	0.013	0.000	0.000	0.000
Soya	0.000	0.000	0.000	0.000	0.100
Bread wheat	0.250	0.250	0.250	0.325	0.340
Rapeseed	0.125	0.125	0.125	0.125	0.150
Potatoes	0.330	0.330	0.330	0.400	0.410

This simplification of the plant part of the diet is unlikely to have distorted the results as there is relatively little variation in the impacts of different field-grown unprocessed plant foods per calorie: sugar appears to have a lower impact than potatoes while fruit and vegetables have a higher impact.

Conventionally grown foods are used in the analysis that follows as these are much more common than organically grown foods. The main difference for organic food in the DEFRA report is a higher arable land requirement due to lower crop yields.

The fraction of calories contributed by each food to each of the diets that I analysed is shown in the table above.

The key results are shown in the table right. Impacts are measured in terms of land and water requirements and in terms of the global warming effect measured in kg of CO₂ equivalents. It should be noted that the figures in the second table are based on the *production* of food and do not include food transport, abattoirs, bakeries, packaging, shops or refrigeration and cooking at home. Production and transport of animal feeds is included.

Greenhouse gas impacts are usually calculated in terms of CO₂ equivalents over a 100 year horizon but if we are more concerned with the immediate future then a 20 year horizon is more appropriate.

Replacing cow and sheep meat with poultry and pig meat leads to significant reductions in land requirements and in greenhouse gas impacts. Replacing all meats with dairy products also leads to a significant decrease, though dairy has limited advantage over poultry and pig meat and indeed is worse in terms of short-term global warming effect. A more typical lacto-vegetarian diet with about 15% of calories from dairy products shows more advantage over a conventional UK diet, while a vegan diet has the lowest environmental demands of all.

	typical UK diet (animals 30% of calories)	replace cow and sheep meat with poultry and pig meat	replace all animal products with dairy	halve the amount of dairy	vegan	ratio of impact of typical diet vs basic vegan diet
land (ha)	0.195	0.118	0.101	0.079	0.065	3.0
arable land (ha)	0.143	0.121	0.110	0.083	0.065	2.2
water (litres per year)	535,000	530,000	347,000	250,000	140,000	3.8
kg CO ₂ equiv per year (100 year horizon)	1,088	873	844	591	332	3.3
kg CO ₂ equiv per year (20 year horizon)	1,588	1,138	1,334	836	322	4.9

The figures may slightly *underestimate* the benefits of a vegan diet as the DEFRA data² may miss some imported processed meats and the Williams et al report¹ does not quantify the impact of fish, which provides about 1% of UK calories. Also the impact of animal use on deforestation and other land use change was not considered. Meat processing and storage may be more energy intensive than plant food processing and storage. On the other hand, a less basic vegan diet including foods grown in heated greenhouses or transported by air would offer much less benefit in terms of global warming, though it should still have advantages in terms of land use.

Based on the DEFRA report¹, a vegan diet based entirely on organic foods would have little or no advantage in land use over a conventional UK diet but would in other respects have similar advantages to a conventionally grown vegan diet. Some other reports give more favourable results for organic farming and vegan-organic methods may give different results to conventional organic methods.

Overall, producing a basic vegan diet has about a third of the resource demands and global warming impact of a conventional diet – a substantial advantage, particularly in terms of land requirements as human food production dominates land use.

1 Williams A.G. et al. Determining the environmental burdens and resource use in the production of agricultural and horticultural commodities. Main Report. Defra Research Project IS0205. Bedford: Cranfield University and Defra; 2006. http://randd.defra.gov.uk/Document.aspx?Document=IS0205_3959_FRP.doc (accessed 28 September 2009).

2 Agriculture in the UK 2008 – Tables and Charts: Tables 5.13-5.17 and table 5.19) <https://statistics.defra.gov.uk/esg/publications/auk/2008/excel.asp> (accessed 28 September 2009)

3 FAOSTAT Food Balance Sheets (UK, 2003 selected) <http://faostat.fao.org/site/368/DesktopDefault.aspx?PageID=368> (accessed 28 September 2009)

Note: Stephen's figures have already been used by *The Times* on 27 October.