APPENDICES

Appendix 1- Data sources used for the thesis

Title	Source
Data on primary school meals	Primary School Food Survey 2009. School Food Trust. Data available from the (http://discover.ukdataservice.ac.uk/catalogue?sn=7144)
Data on primary school packed lunches	Primary School Food Survey 2006. School Food Trust. Data available from the (http://discover.ukdataservice.ac.uk/catalogue?sn=7144
Nutrient based standards for primary school meals	Primary School Food Survey 2009- full technical report. School Food Trust (Revised 2012)
Food based guidelines for primary school meals.	SFP (2014). School food standards. London, School Food Plan.
Search terms – list of food items for the systematic review	Food Frequency Questionnaire used by the EPIC Oxford study 2010. http://www.epic-oxford.org/files/epic-baseline-PQ.pdf
Quality assessment tool for the systematic review	Joint Research Centre of the European Commission. ILCD handbook – international reference life cycle data system. Annex A (page 323-336) http://eplca.jrc.ec.europa.eu/uploads/ILCD-Handbook-General-guide-for-LCA-DETAILED-GUIDANCE-12March2010-ISBN-fin-v1.0-EN.pdf

Appendix 2- Publication plan from the thesis

Number	Chapter	Publication title	Current status
1	4	Comparing greenhouse gas emissions from different food groups: a systematic review	Conference abstract published. UK Public Health conference 2013. Search needs to be updated for 2013 and 2014 before submitting to a journal
2	5	Contribution of primary school meals to greenhouse gas emissions in England	Draft available and received comments from co-authors. Will be submitted in August 2015
3	6	Impact on greenhouse gas emission and nutrition by adopting new School Foo Plan Standards by primary schools in England	Draft written. Paper will be submitted after circulating to co-authors and addressing comments. Will be submitted in October 2015
4	6	Impact on greenhouse gas emission and nutrition by adopting a meat free Monday policy in primary schools in England	Will be submitted in 2015 or early 2016
5	7	Sustainable healthy diets: Using a linear programming model to quantify the nutritional and environmental outcomes of school food policies	Will be submitted in 2015 or early 2016

Appendix 3- Food Frequency Questionnaire used to identify search terms for the systematic review in Chapter 4

2010 +

epic
Study of Nutrition and Health

Please see our letter inside

Please write as clearly as possible with a black pen and complete the questionnaire by putting a cross in the appropriate box(es).

e.g. Yes [X] No [ ]

OR putting numbers in the appropriate box(es)

e.g. 0 5 | 2 0 1 0

All information will be treated confidentially and will only be used for medical research. If you have any queries, you can ring us at (01865)289611 or email us at queries@epic-oxford.org

We know it may be difficult to answer some of the questions, but an approximate answer is better than none.

PLEASE COMPLETE USING A BLACK PEN IF POSSIBLE

If your name and/or address has changed or is incorrect, please give the correct details below:

Surname: **Forename(s):**

Address:

Postcode:

Please print your email address below if you would be prepared for us to contact you about this study by email

For office use only

1. What is your date of birth? __ __ / __ __ / 1 9 __ __

2. What is today's date? __ __ / __ __ / 2 0 __ __

DIET

3. Do you eat any meat? Yes [ ] No [ ]
including bacon, poultry, game, meat pies, sausages

If YES, how often did you eat the following in the last 12 months?
Please cross one box for each item

MEAT (medium serving)* *Remember stews, pies, stir fries, sandwiches	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Sausages	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Bacon, ham, salami, luncheon meat	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Beef	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Pork	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Lamb	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Chicken, turkey	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Liver, liver paté, liver sausage	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

If NO, how old were you when you last ate meat? __ __ years old

4. Do you eat dairy products? Yes [ ] No [ ]
including milk, cheese, butter, yogurt

If NO, how old were you when you last ate dairy products? __ __ years old

5. Which type of milk do you use most often?

full cream	[ ]	soya milk fortified with calcium	[ ]
semi-skimmed	[ ]	soya milk not fortified with calcium	[ ]
skimmed/fat-free	[ ]	other	[ ]
goat/sheep's milk	[ ]	none	[ ]

How much milk do you drink each day, including milk with tea, coffee, cereals etc?

less than 1/4 pint (< 150ml)	[ ]	3/4 of a pint (450ml)	[ ]
quarter of a pint (150ml)	[ ]	one pint or more (> 600ml)	[ ]
half a pint (300ml)	[ ]	none	[ ]

6. How often did you eat the following in the last 12 months?
Please cross one box for each item

CHEESE, YOGURT, CREAM (medium serving)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Dairy cheese, including in cooking	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Vegan cheese	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Soya yogurt	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Low fat yogurt, fromage frais	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Full fat or Greek yogurt	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Single/double cream	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

Supported by Cancer Research UK, the Health & Safety Executive UK, the World Health Organization and the European Union

7. Do you eat any eggs? Yes ☐ No ☐
including eggs in cakes and other baked foods

If YES, how many eggs did you eat each week in the last 12 months? ☐☐ eggs per week

If NO, how old were you when you last ate eggs? ☐☐ years old

8. Do you eat any fish? Yes ☐ No ☐
including seafood

If YES, how often did you eat the following in the last 12 months?
Please cross one box for each item

FISH (medium serving)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Canned tuna									
Fish fried in batter/crumbs									
Other white fish									
Oily fish e.g. salmon, sardines									
Shellfish, prawns									

If NO, how old were you when you last ate fish? ☐☐ years old

9. How often did you eat the following in the last 12 months?
Please cross one box for each item

BREAD, ROLLS, CRACKERS (one slice, roll or cracker)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
White bread and rolls including baguette, pitta, naan									
Brown bread and rolls									
Wholemeal bread and rolls									
Other bread type products e.g. crumpet, tortilla wraps									
Oatcakes, crackers									
Crispbread e.g. Ryvita									

SPREADS The following on bread or vegetables (teaspoon)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Butter									
Vegan margarine									
Polyunsaturated margarine									
Cholesterol-lowering margarine									
Low fat spread									
Other margarine, dairy spreads									
Marmite, yeast extract									
Jam, marmalade, honey									
Peanut/other nut butters									

CEREALS (one bowl)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Porridge, Ready brek									
All-bran									
Bran flakes, Weetabix, muesli									
Other breakfast cereal e.g. cornflakes, Special K									

Beverages/

DRINKS (mug/glass)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Water									
Tea, all types									
Coffee, all types									
Hot chocolate, milkshake									
Milk-based smoothie									
Pure fruit juice or smoothie									
Fruit squash or cordial									
Low calorie/diet soft drinks									
Fizzy soft drinks e.g. coke									
Wine, Champagne, Sherry, etc.									
Beer, lager or cider (half pint)									
Spirits e.g. gin, whisky (single)									

POTATOES, RICE, PASTA, PIZZA (medium serving)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Boiled, mashed, or jacket potatoes									
Chips, roast potatoes									
White rice									
Brown rice									
Couscous, bulgur wheat, etc.									
White pasta/noodles									
Wholemeal pasta									
Pizza									

SWEETS AND SNACKS (medium serving)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Biscuits e.g. digestive, chocolate-chip, Hobnob									
Cakes, pastries									
Cereal bar									
Fruit pie, fruit tart, crumble									
Rice pudding, custard, crème caramel									
Ice cream, choc ices									
Chocolate or sweets, all types									
Sugar added to tea, coffee, cereal (teaspoon)									
Crisps									
Peanuts, other nuts, seeds									

DIPS and DRESSINGS (tablespoon)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Hummus									
Mayonnaise (full-fat)									
Salad cream, dressing, dips, low-fat mayo									

7. Do you eat any eggs?

including eggs in cakes and other baked foods

Yes ☐ No ☐

If YES, how many eggs did you eat each week in the last 12 months? ☐☐ eggs per week

If NO, how old were you when you last ate eggs? ☐☐ years old

8. Do you eat any fish?

including seafood

Yes ☐ No ☐

If YES, how often did you eat the following in the last 12 months?

Please cross one box for each item

FISH (medium serving)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Canned tuna									
Fish fried in batter/crumbs									
Other white fish									
Oily fish e.g. salmon, sardines									
Shellfish, prawns									

If NO, how old were you when you last ate fish? ☐☐ years old

9. How often did you eat the following in the last 12 months?

Please cross one box for each item

BREAD, ROLLS, CRACKERS (one slice, roll or cracker)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
White bread and rolls including baguette, pitta, naan									
Brown bread and rolls									
Wholemeal bread and rolls									
Other bread type products e.g. crumpet, tortilla wraps									
Oatcakes, crackers									
Crispbread e.g. Ryvita									

***SPREADS* The following on bread or vegetables (teaspoon)**	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Butter									
Vegan margarine									
Polyunsaturated margarine									
Cholesterol-lowering margarine									
Low fat spread									
Other margarine, dairy spreads									
Marmite, yeast extract									
Jam, marmalade, honey									
Peanut/other nut butters									

CEREALS (one bowl)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Porridge, Ready brek									
All-bran									
Bran flakes, Weetabix, muesli									
Other breakfast cereal e.g. cornflakes, Special K									

Beverages/

DRINKS (mug/glass)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Water									
Tea, all types									
Coffee, all types									
Hot chocolate, milkshake									
Milk-based smoothie									
Pure fruit juice or smoothie									
Fruit squash or cordial									
Low calorie/diet soft drinks									
Fizzy soft drinks e.g. coke									
Wine, Champagne, Sherry, etc.									
Beer, lager or cider (half pint)									
Spirits e.g. gin, whisky (single)									

POTATOES, RICE, PASTA, PIZZA (medium serving)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Boiled, mashed, or jacket potatoes									
Chips, roast potatoes									
White rice									
Brown rice									
Couscous, bulgur wheat, etc.									
White pasta/noodles									
Wholemeal pasta									
Pizza									

SWEETS AND SNACKS (medium serving)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Biscuits e.g. digestive, chocolate-chip, Hobnob									
Cakes, pastries									
Cereal bar									
Fruit pie, fruit tart, crumble									
Rice pudding, custard, crème caramel									
Ice cream, choc ices									
Chocolate or sweets, all types									
Sugar added to tea, coffee, cereal (teaspoon)									
Crisps									
Peanuts, other nuts, seeds									

DIPS and DRESSINGS (tablespoon)	Never	Less than once a week	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Hummus									
Mayonnaise (full-fat)									
Salad cream, dressing, dips, low-fat mayo									

18. How often do you usually nap? [|] naps per week (0 if less than one)

- about how long is a nap usually? [| |] minutes

19. When you sleep at night, is the room usually:

very dark ☐ dark ☐ dimly lit ☐ lit ☐

20. One hears about "morning" and "evening" types of people. Which ONE of these types do you consider yourself to be?

a morning type ☐ an evening type ☐

more morning than evening ☐ none of the above ☐

more evening than morning ☐

NIGHT WORK

21. Have you ever regularly worked at night, on night shifts or on call at night?

Please only consider any job lasting for at least ONE YEAR - AND occurring on a regular basis for at least one night per month or 12 nights per year

Yes ☐ - go to question 22 No ☐ - go to question 24

22. Please tell us more about your night work

- over how many years in total? [|] total years
- when did you last work nights? [|] years ago (0 if you still work at night)
- how many different jobs involving night work have you had over these years? [|] jobs eg five different jobs put [0|5]

23. Please tell us more about the jobs you have done involving night work

	Which year did you start?	Which year did your finish?	How many nights per month usually?	How many hours per night usually?	fixed/ permanent	rotating	irregular/ flexible	Please write down the occupation
1st night work job:	[| | |]	[| | |]	[|]	[|]	☐	☐	☐	
2nd night work job:	[| | |]	[| | |]	[|]	[|]	☐	☐	☐	
3rd night work job:	[| | |]	[| | |]	[|]	[|]	☐	☐	☐	
4th night work job:	[| | |]	[| | |]	[|]	[|]	☐	☐	☐	
5th night work job:	[| | |]	[| | |]	[|]	[|]	☐	☐	☐	
6th night work job:	[| | |]	[| | |]	[|]	[|]	☐	☐	☐	

SHIFT WORK

24. Have you ever regularly done any shift work (at least two days per week) which does/did NOT involve night work?

Any work schedule that involves working outside a standard working day (e.g., 8am-6pm) is called a shift work schedule

Yes ☐ No ☐ - You have finished - thank you

If YES,

- over how many years in total? [|] total years (0 if less than 1)

Please tell us more about which shifts you have worked and over how many years in total you have worked them:

- mornings
Yes ☐ No ☐ If YES, [|] total years (0 if less than 1)
- afternoons
Yes ☐ No ☐ If YES, [|] total years (0 if less than 1)
- evenings
Yes ☐ No ☐ If YES, [|] total years (0 if less than 1)

- continued on the right

About the job involving shift work you have had for the LONGEST period of time

- what is/was the occupation of this job?

[ ]

- over how many years? [|] total years (0 if less than 1)
- how many hours per week usually? [|] hours (0 if less than 1)
- what is/was your overall work pattern for this job?

fixed/permanent ☐ rotating ☐ irregular/flexible ☐

If ROTATING,

- how are/were these rotating shifts arranged?

mainly forwards rotation (e.g. morning > afternoon > late) ☐ mixed ☐

mainly backwards rotation (e.g. late > afternoon > morning) ☐ flexibly (e.g. with the roster being drawn up after consultation about preferred hours) ☐

THANK YOU VERY MUCH. Please return the questionnaire in the pre-paid envelope.

PROF T KEY, EPIC STUDY, CANCER EPIDEMIOLOGY UNIT, UNIVERSITY OF OXFORD, RICHARD DOLL BUILDING, ROOSEVELT DRIVE, OXFORD OX3 7LF

Appendix 4 – Reasons and proportion of papers excluded from the systematic review

Reason for the exclusion		**Percentage of excluded studies (n=76)**
Didn't meet following inclusion criteria:		
	Study must be a LCA estimating GHGEs associated with production or consumption of at least one food type included in the search terms	15.7 % (12)
	The GHGE value should be reported in carbon dioxide equivalent (CO2e)or individually for three main gases- CO2, N2O and CH4	11.8 (9)
	The study must report on for essential components of an LCA as set out by the International Organization for Standardization (ISO) which has standardized the methodology to conduct LCAs.	14.4% (11)
Met following exclusion criteria:		
	Greenhouse gas emission data are not presented in CO2es or it was not possible to estimate GHGEs as values for all three main individual gases (CO2, N2O and CH4) are not presented	9.25 (7)
	Details are not provided about the method of calculation	25% (19)
	Study presents results for farms or areas as opposed to an amount of a food type	21% (16)

Appendix 5- Summary data sheets of the systematic review (chapter 4) by food group

Table A1 Greenhouse gas emissions per Kg of beef

Study ID	Author	Setting	Production / farming method	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
				Total	
1	Williams 2006	England/ Wales	Non organic	15.8	2,3,4,5
			Organic	18.2	2,3,4,5
2	Williams 2008	UK		23.97	2,3,4,5
		Brazil to UK		32.15	2,3,4,5
4	Cederberg 2009	Sweden		20	2,3,4,5
6	Nielsen 2003	Denmark	Conventional	11.6	2,3,4,5
7	Nguyen	EU	Suckler cow calf	27.3	1,2,3,4
			Dairy bull calf	16	1,2,3,4
			Suckler cow calf	84.1	1,2,3,4
			Dairy bull calf	62.4	1,2,3,4
17	Ogino 2007	Japan		36.4	3,4
18	Johnson 2003	USA	Traditional	13	2,3,4

26	Cederberg 2011	Brazil		156	1,2,3,4
36	FAO 2010	Global	Salughtered dariy animals	15.6	1,2,3,4,5
			Fattened surplus calves	20.2	1,2,3,4,5
44	Peters 2010	Australia	Grain finish	9.9	2,3,4,5
			Grass finish	12	2,3,4,5
45	Nemry 2001	Belgium		14.8	2,3,4,5,6
46	Casey 2006	Ireland	Suckler beef- conventional	19.6*	2,3,4
			Suckler beef- organic	16.6*	2,3,4
57	Subak 1999	USA	Feedlot	14.8	2,3,4
		Sohelian	Pastoral	8.1	2,3,4
61	Zehetmeier 2012	Germany		5.55- 14.63	2,3,4
64	Verge 2008	Canada		15.55*	2,3,4
66	Vintila 2010	Romania	Organic	20	2,3,4,5
			Conventional	28.5	2,3,4,5

	Range	**Mean per study**

TOTAL	**8.1- 156**	**28**
Conventional	13.07 - 28.5	21.3
Organic	16.6 - 20	18.2

Notes:

* Live weight value was used to estimate the GHGE of edible meat with 50% conversion rate

When results were presented as a range, median value was taken for analysis

Organic Vs conventional estimates are based on individual studies which included both categories

Rain forest loss or Land use change	1
Land use	2
Pre-farm activities Fertililisers, fuel etc./primary resources	3
On farm activites	4
Any post farm gate/ post production activites up to retail	5
Household/consumption related activites	6

GHGE associated with transport to the UK was negligible.

On average we estimate that one Kg of food transported by sea would add following values to the total GWP

Country	**GWP Kg CO2e**
From EU	0.01
From South America	0.035
From USA	0.34
From Africa	0.035
From New Zeland	0.1

Table A2 Greenhouse gas emissions per Kg of pork

Study ID	Author	Setting	Functional unit	Production / farming method	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
					Total	
1	Williams 2006	England/ Wales	Kg	Non organic	6.3	2,3,4,5
			Kg	Organic	5.6	2,3,4,5
4	Cederberg 2009	Sweden	Kg		3.54	2,3,4,5
5	Dalgaard 2007	Denmark to UK	Kg		3.77	2,3,4,5
11	Basset-Mens 2004	France	Kg	Good agriculture practice	3.45*	2,3,4
			Kg	Red Label (RL)	5.19*	2,3,4
			Kg	Organic agriculture	5.95*	2,3,4
25	Carlsson-Kanyama 1998	Sweden	Kg		6.1	2,3,4,5
45	Nemry 2001	Belgium	Kg		3.6	2,3,4,5,6
47	Phong 2011	Vietnam	Kg		8.26	2,3,4
52	Eriksson 2005	Sweden	Kg		4.3	2,3,4

56	Davis 2010	Sweden	One meal		1.19#	2,3,4,5,6
		Spain	One meal		1.77#	2,3,4,5,6
66	Vintila 2010	Romania	Kg	Organic	3.5	2,3,4,5
			Kg	Conventional	4.5	2,3,4,5

	Range	**Mean per study**
TOTAL	**3.54 - 8.26**	**4.93**
Conventional	3.45 - 6.3	4.75
Organic	3.5 - 6.0	5

Notes:

excluded from analysis

* Live weight value was used to estimate the GHGE of edible meat with 50% conversion rate

When results were presented as a range, median value was taken for analysis

Organic Vs conventional estimates are based on individual studies which included both categories

Rain forest loss or Land use change
Land use
Pre-farm activities Fertililisers, fuel etc./primary resources
On farm activites
Any post farm gate/ post production activites up to retail
Household/consumption related activites

GHGE associated with transport to the UK was neglegable.

On average we estimate that one Kg of food tranported by sea would add following values to the total GWP

Country	**GWP Kg CO2e**
From EU	0.01
From South America	0.035
From USA	0.34
From Africa	0.035

From New Zeland	0.1

Table A3 Greenhouse gas emissions per Kg of lamb

Study ID	Author	Setting	Production / farming method	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
				Total	
1	Williams 2006	England/ Wales	Non organic	17.5	2,3,4,5
			Organic	10.1	2,3,4,5
2	Williams 2008	UK		14.14	2,3,4,5
		NZ lamb in UK		11.56	2,3,4,5
21	Biswas 2010	Australia	Sub-clover	5.56	2,3,4
			Mixed pasture	5.09	2,3,4
45	Nemry 2001	Belgium		18.8	2,3,4,5,6
44	Peters 2010	Australia	Mixed	10.2	2,3,4,5
			Grain finished	9.9	2,3,4,5
			Grass finished	12	2,3,4,5
48	Ripoll-Bosch 2011	Spain	Grazing	56.7	2,3,4
			Mixed	48.5	2,3,4
			No gazing	38.9	2,3,4

51	Saunders 2008	UK		2.8	2,3,4,5
		NZ to UK		0.668	2,3,4,5
66	Vintila 2010	Romania	Organic	8	2,3,4,5
			Conventional	18	2,3,4,5

	Range	**Mean per study**
TOTAL	**0.668 - 56.7**	**15.52**
Conventional	17.5 - 18	17.75
Organic	8 -10.1	9

Table A4 Greenhouse gas emissions per Kg of chicken

Study ID	Author	Setting	Production / farming method	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
				Total	
1	Williams 2006	England/ Wales	Non organic	4.57	2,3,4,5
			Organic	6.68	2,3,4,5
2	Williams 2008	UK		2.82	2,3,4,5
		Brazil to UK		2.57	2,3,4,5
4	Cederberg 2009	Sweden		2.15	2,3,4,5
6	Nielsen 2003	Denmark	Fresh	3.16	2,3,4,5
			Frozen	3.65	2,3,4,5
43	Pathak 2010	India		0.801	2,3,4,5,6
45	Nemry 2001	Belgium		2.1	2,3,4,5,6
47	Phong 2011	Vietnam	Fish feed	6.07	2,3,4
53	Tynelius 2008	Sweden		1.64	2,3,4,5

54	Pelletier 2008	USA	Chicken - live weight	2.09*	2,3,4
58	Usva 2009	Finland	Broiler chicken	3.63	2,3,4,5,6
66	Vintila 2010	Romania	Organic	3.8	2,3,4,5
			Conventional	4	2,3,4,5
				6.68	

	Range	**Mean per study**
TOTAL	**0.80 - 6.68**	**3.1**
Conventional	4 - 4.57	4.28
Organic	3.8 - 6.68	5.3

Table A5 Greenhouse gas emissions per Kg of cultured meat

Study ID	Author	Setting	Meat type	Production / farming method	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
					Total	
63	Tuomisto 2010	Thailand	Cultured meat	Cultured meat	1.9	2,3,4
		California			2.24	2,3,4
		Spain			1.9	2,3,4

	Range	Mean per study
TOTAL	1.9 -2.4	**2.01**

Table A6 Greenhouse gas emissions per Kg of other meat

Study ID	Author	Setting	Meat type	Production / farming method	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
					Total	
43	Pathak 2010	India	**Mutton**		9.14	2,3,4,5,6
66	Vintila 2010	Romania	Turkey	Organic	8	2,3,4,5
				Conventional	10.3	2,3,4,5

	Range	Mean per study
TOTAL	**8 -10.3**	**9.12**

Table A7 Greenhouse gas emissions per Kg of milk

Study ID	Author	Setting	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg) Total	Included stages
1	Williams 2006	UK	Non-organic	Kg	1.19	2,3,4,5
			Organic	Kg	1.98	
4	Cederberg 2009	Sweden		Kg	1.08	2,3,4,5
16	Casey 2004	Ireland		1 Kg	1.5	3,4
22	Boer 2003	Sweden	Conventional	Kg	0.999	2,3,4
			Organic	Kg	0.942	2,3,4
		Netherland	Conventional	Kg	0.888	2,3,4
			Environmental friendly milk	Kg	0.689	2,3,4
			Organic milk	Kg	0.922	2,3,4
		Germany	Conventional intensive	Kg	1.3	2,3,4
			Conventional extensified	Kg	1	2,3,4

			Organic milk	Kg	1.3	2,3,4
27	Dalgaard 2004	Denmark		1KG	0.75	2,3,4
33	Basset-Mens 2008	New Zealand	Average	1KG	0.933	2,3,4
34	Capper 2009	USA		1Kg	1.35	2,3,4
35	Eide 200	Norway	Small dairy	1L	0.54	3,4,5,6
			Middle size dairy	1L	0.56	3,4,5,6
			Large dairy	1L	0.64	3,4,5,6
36	FAO 2010	Global		1Kg	2.4	1,2,3,4,5
		Western EU		1Kg	1.5	1,2,3,4,5
37	Haas 2001	Germany	Intensive	1Kg	1.3	2,3,4
			Estensified	1Kg	1	2,3,4
			Organic	1Kg	1.3	2,3,4
38	Thoma 2010	USA		1KG	1.2	2,3,4
39	Thomssen 2008	Netherland	Conventional	1Kg	1.4	2,3,4
			Organic	1Kg	1.5	2,3,4
40	O'Brien 2012	Ireland	Grass	1KG	0.87	1,2,3,4
			Confinement	1KG	1.02	1,2,3,4

42	Muller-Lindenlauf 2010	Germany	Grassland low intensity	1KG	1.17	2,3,4
			Grassland high intensity	1KG	1.04	2,3,4
			Mixed low intensity	1KG	1.08	2,3,4
			Mixed high intensity	1KG	0.91	2,3,4
43	Pathak 2010	India		1KG	0.766	2,3,4,5,6
51	Saunders 2008	UK		1Kg	2.92	2,3,4,5
		NZ to UK		1Kg	1.42	2,3,4,5
59	Hospido 2003	Spain		1L	1.05	2,3,4,5
61	Zehetmeier 2011	Germany		1Kg	0.98 - 1.35	2,3,4
68	Sheane 2011	Scotland		1Kg	1.1	1,2,3,4,5,6

	Range	**Mean per study**
TOTAL	**0.54 - 2.92**	**1.14**
Conventional	0.8 -1.4	1.17

Organic	0.92 -1.5	1.32

Table A8 Greenhouse gas emissions per Kg of cheese

Study ID	Author	Setting	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
				Total	
4	Cederberg 2009	Sweden	1KG	10.8	2,3,4,5
58	Usva 2009	Finland	1Kg	12.972	2,3,4,5,6
68	Sheane 2011	Scotland	1Kg	11.1	1,2,3,4,5,6

	Range	Mean per study
TOTAL	**10.8 - 12.97**	**11.6**

Table A9 Greenhouse gas emissions per Kg of yoghurt

Study ID	Author	Setting	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
			Total	
4	Cederberg 2009	Sweden	1.08	2,3,4,5
68	Sheane 2011	Scotland	2.4	1,2,3,4,5,6

	Range	Mean per study
TOTAL	**1.08 - 2.4**	**1.74**

Table A10 Greenhouse gas emissions per Kg of egg

Study ID	Author	Setting	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
					Total	
1	Williams 2006	England/ Wales	Non organic	Kg	5.53	2,3,4,5
			Organic	Kg	7.00	2,3,4,5
4	Cederberg 2009	Sweden		KG	1.47	
43	Pathak 2010	India		Kg	0.66	2,3,4,5
60	Mollenhorst 2006	Netherland	Battery cage	Kg	3.90	2,3,4
			Deep litter	Kg	4.30	2,3,4
			Deep litter with out door run	Kg	4.60	2,3,4
			Aviary with out door run	Kg	4.20	2,3,4

	Range	Mean per study
TOTAL	0.66 - 7.00	4.72

Table A11 Greenhouse gas emissions per Kg of fish

Study ID	Author	Setting	Fish	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
						Total	
3	Winther, U 2009	Oslo to Paris	Salmon	Aquaculture	Kg	3.6	3,4,5
		Oslo to Tokyo by air	Salmon	Aquaculture	Kg	13.86#	3,4,5
		Oslo Shanghai by boat	Salmon	Aquaculture	Kg	4.2#	3,4,5
55	Pelletier 2007	Canada	Salmon	Farmed	Kg	1.2 - 1.7	3,4
8	Silvenius 2003	Finaland	Salmon	Cultivated	Kg	0.89	3,4,5
				Range	**Mean per study**		
			Salmon	**0.89 - 3.6**	**1.98**		
3	Winther, U 2009	Oslo to Paris	Cod	Capture	Kg	3.62	3,4,5
		Oslo to Paris via China	Cod	Capture	Kg	3.78#	3,4,5

		Oslo to Paris via China	Cod	Capture	Kg	2.51#	3,4,5
6	Nielsen 2003	Denmark	Cod	Wild	Kg	3.2	2,3,4,5
62	Ziegler 2003	Sweden	Cod	Trawl	Kg	10	3,4,5,6
			Cod	Gilnet	Kg	2.5	3,4,5,6
			Cod	Mixed	Kg	6.7	3,4,5,6
				Range	**Mean per study**		
			Cod	**2.5 - 10**	**4.4**		
3	Winther, U 2009	Oslo to Paris	Haddock	Capture	Kg	3.72	3,4,5
3	Winther, U 2009	Oslo to Paris	Blue mussels	Aquaculture	Kg	2.54	3,4,5
6	Nielsen 2003	Denmark	Mussels		Kg	0.09	2,3,4,5
				Range	**Mean per study**		

			Mussels	0.09 - 2.54	1.31		
6	Nielsen 2003	Denmark	Trout	Farmed	Kg	4.47	2,3,4,5
14	Aubin 2008	France	Trout	Flow throw traditional system	Kg	2.7	3,4
		France	Trout	Land based Re circulating system	Kg	6	3,4
8	Silvenius 2003	Finaland	Rainbow trout	Cultivated	Kg	0.847	3,4,5
				Range	**Mean per study**		
			Trout	**0.84 - 6**	**3.22**		
3	Winther, U 2009	Norway to Tokyo	Mackerel	Cature	Kg	1.92	3,4,5
6	Nielsen 2003	Denmark	Mackerel	Wild	Kg	0.22	2,3,4,5
65	Vazquez-Rowe 2010	Spain	Mackerel	Purse seiners	Kg	0.8	2,3,4
			Mackerel	Bottom trawlers	Kg	2.3	2,3,4

				Range	**Mean per study**		
			Mackerel	0.2 - 2.3	1.31		
14	Aubin 2008	Greece	Sea-bass	Marine based farm	Kg	3.6	3,4
19	Schau 2012	Europe	Atlantic herring		Kg	2.14	3,4,5,6
3	Winther, U 2009	Norway to Russia	Herring	Capture	Kg	1.39	3,4,5
8	Silvenius 2003	Finaland	Herring	Cultivated	Kg	0.424	3,4,5
				Range	**Mean per study**		
			Herring	0.424 - 2.14	1.31		
28	Hospido 2005	Spain	Tuna	Tuna from Atlantic	Kg	1.6	3,4,5
				Tuna from Indian ocean	Kg	1.7	3,4,5
				Tuna from Pacific	Kg	2.2	3,4,5

				Tuna- weighted average	**Kg**	**1.8**	3,4,5
43	Pathak 2010	India	Fish		Kg	0.75	2,3,4,5
47	Phong 2011	Vietnam	Fish		Kg	6.07	2,3,4
49	Pelletier and Tyedmers 2009	Indonesia to Europe	Tilapia		Kg	2.22	3,4,5
3	Winther, U 2009	Norway to Berlin	Saithe	Capture	Kg	2.56	3,4,5
				Fish (not including lobster and shrimp)			
				Range	**Mean per study**		
				0.09 - 6.4	2.72		

6	Nielsen 2003	Denmark	Lobster		Kg	20.2	2,3,4,5
9	Ziegler 2007	Sweden	Lobster	Trawled lobster	Kg	31.7	3,4,5,6
			Lobster	Creeled lobster	Kg	11.1	3,4,5,6
					Range	**Mean per study**	
				Lobster	**11.1 - 31.7**	**20.8**	
6	Nielsen 2003	Denmark	Shrimp		Kg	3	2,3,4,5
13	Ziegler 2011	Senegal to Europe	Pink Shrimp	Trawled	Kg	38	3,4,5
				Artisanal	Kg	7.8	3,4,5

				Range	**Mean per study**		
			Shrimp	**3 - 38**	**12.95**		
				Lobster and shrimp			
				Range	**Mean per study**		
				3 - 67.5	18.6		

Table A12 Green house gas emissions per Kg of bread, crackers

Study ID	Author	Setting	Food	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg)		Included stages
						Total		
1	Williams 2006	England/ Wales	Bread wheat	Non-organic	Kg	0.8		2,3,4,5
			Bread wheat	Organic	Kg	0.786	0.793	2,3,4,5
6	Nielsen 2003	Denmark	Wheat	Conventional	Kg	0.71		2,3,4,5
				Organic		0.28	0.495	2,3,4,5

12	Williams 2010	England/ Wales	Bread wheat	Non organic	Kg	0.7		2,3,4,5
			Bread wheat	Organic	Kg	0.8	0.75	2,3,4,5
21	Biswas 2010	Australia	Wheat		Kg	0.4	0.4	2,3,4
29	Kramer 1998	Netherlands	Spring Wheat		Kg	0.307		2,3,4
			Winter Wheat		Kg	0.399	0.353	2,3,4
31	Meisterling 2009	USA	Wheat	Conventional	Kg	0.73		2,3,4
			Wheat	Organic	Kg	0.73	0.73	2,3,4
					Range	**Mean per study**		
				Wheat	0.28 - 0.8	0.58		
6	Nielsen 2003	Denmark	Wheat bread		Kg	0.84		2,3,4,5
43	Pathak 2010	India	Bread		Kg	0.257		2,3,4,5,6

6	Nielsen 2003	Denmark	Bread rolls		Kg	0.93		2,3,4,5

	Range	**Mean per study**
Bread	0.25 -0.93	0.56

Table A13 Greenhouse gas emissions per Kg of spreads

Study ID	Author	Setting	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg) Total	Included stages
43	Pathak 2010	India	Butter	Kg	0.997	1,2,3,4,5,6
68	Sheane 2011	Scotland	Butter	1Kg	8.9	1,2,3,4,5,6
				Range	**Mean per study**	
			Butter	0.9 - 8.9	4.9	

Table A14 Greenhouse gas emissions per Kg of cereals

Study ID	Author	Setting	Food	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg) Total	Included stages
66	Vintila 2010	Romania	Cereal-Wheat	Organic	Kg	0.19	2,3,4,5
			Cereal-Wheat	Conventional	Kg	0.45	2,3,4,5
			Cereal-Rye	Organic	Kg	0.65	2,3,4,5
			Cereal-Rye	Conventional	Kg	0.75	2,3,4,5
			Cereal - Rice	Conventional	Kg	4.6	2,3,4,5
				Range	**Mean per study**		
			Cereal	0.19 - 4.6	1.87		

Table A15 Greenhouse gas emissions per Kg of drinks

Study ID	Author	Setting	Drink	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg) Total	Included stages
15	Nilsson 2011	Denmark	Nygarda cola		33cl	0.11	3,4,5
					Ikg	0.33	
20	Beccali 2009	Italy	Orange natural juice		1Kg	1	2,3,4,5
			Lemon natural juice		1Kg	0.7	2,3,4,5
				Average	**0.85**	(1 -0.7)	
20	Beccali 2009	Italy	Organce concentrated juice		1Kg	6	2,3,4,5
			Lemon concentrated juice		1Kg	4	2,3,4,5
						2.925	

23	Brommer 2011	Germany	Coffee	Coffee machine	1 cup of 125ml	0.06	3,4,5,6
43	Pathak 2010	India	Lassi		1Kg	0.345	2,3,4,5,6

Table A16 Greenhouse gas emissions per Kg of potatoes, rice, pasta, pizza

Study ID	Author	Setting	Food	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
						Total	
2	Williams AG 2008	UK	Potatoes	Main crop	Kg	0.25	2,3,4,5
		Israel to UK	Potatoes	Main crop	Kg	0.48	2,3,4,5
6	Nielsen 2003	Denmark	Potatoes		Kg	0.22	2,3,4,5
12	Williams 2010	England/ Wales	Potatoes	Organic	Kg	0.2	2,3,4,5
		England/ Wales	Potatoes	Non-organic	Kg	0.19	2,3,4,5
		England/ Wales	Potatoes	Main crop	Kg	0.17	2,3,4,5
25	Carlsson-Kanyama 1998	Sweden	Potatoes		Kg	0.17	2,3,4,5
29	Kramer 1998	Netherlands	Potatoes		Kg	0.147	2,3,4
30	Maraseni 2010	Australia	Potatoes		Kg	0.27	2,3,4,5
43	Pathak 2010	India	Potato		Kg	0.132	2,3,4,5,6

				Range	**Mean per study**		
			TOTAL	**0.13 - 0.48**	**0.21**		
25	Carlsson-Kanyama 1998	Sweden	Rice		Kg	6.4	2,3,4,5
43	Pathak 2010	India	Rice		Kg	**0.78**	2,3,4,5,6
47	Phong 2011	Vietnam	Rice		Kg	0.94	2,3,4
50	Roy 2009	Japan	Rice	Cooked rice at home	Kg	0.2	2,3,4,5,6
67	Wang 2007	China	Rice		Kg	1.52	2,3,4
					Range	**Mean per study**	
				TOTAL	**0.2 - 6.4**	**1.96**	

Notes:

When results were presented as a range, median value was taken for analysis

Table A17 Greenhouse gas emissions per Kg of sweets and snacks

Study ID	Author	Setting	Food	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg) Total	Included stages
6	Nielsen 2003	Denmark	Sugar beet		Kg	0.16	2,3,4,5
29	Kramer 1998	Netherlands	Sugar beet		Kg	0.041	2,3,4
6	Nielsen 2003	Denmark	Sugar		Kg	0.96	2,3,4,5
15	Nilsson 2011	Denmark	Crisps- lightly salted		1Kg	2.2	3,4,5
15	Nilsson 2011	Denmark	Ahlgren's car sweets		1Kg	3.92	3,4,5
			Stora Zoo weets in plastic container		1Kg	2.45	3,4,5

						3.185	
				Range	**Mean per study**		
			Total	**2.45 - 3.92**	**3.1**		
68	Sheane 2011	Scotland	Ice cream		1Kg	4	1,2,3,4,5,6

Table A18 Greenhouse gas emissions per Kg of soup and sauces

Study ID	Author	Setting	Food	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg)	Included stages
						Total	
10	Andersson 1998	Sweden	Tomato Ketchup	Imported tomato paste	1Kg	0.68-0.98	2,3,4,5,6

32	Cannals 2011	Europe	Dehydrated soup - cookeup		1Kg	6.5	1,2,3,4,5,6
			Dehydrated soup- instant		1Kg	8	1,2,3,4,5,6
			Wet soup-Aseptic		1Kg	1.5	1,2,3,4,5,6
			Wet soup- Doy pack		1Kg	2	1,2,3,4,5,6
			Wet soup- can		1Kg	2.4	1,2,3,4,5,6
			Bouillon soup- pasty		1Kg	7	1,2,3,4,5,6
			Bouillon soup- Pressed		1Kg	7	1,2,3,4,5,6
			Bouillon soup - Jelly		1Kg	3	1,2,3,4,5,6
			Liquid bouillon - RTU Doy		1Kg	1.3	1,2,3,4,5,6
			Liquid bouillon - Conc glass		1Kg	3.5	1,2,3,4,5,6
					Range	**Mean**	
				Soup	**1.3 - 8**	**4.22**	

Table A19 Greenhouse gas emissions per Kg of vegetables

Study ID	Author	Setting	Food	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg)		Included stages			
						Total					
1	Williams 2006	England/ Wales	Tomatoes	Non organic	Kg	9.14		2,3,4,5			
				Organic	Kg	17.8	13.47	2,3,4,5			
2	Williams A.G 2008	UK	Classic loose tomatoes		Kg	2.24		2,3,4,5			
		Spain	Classic loose tomatoes		Kg	0.74	1.49	2,3,4,5			
		UK	Classic vine tomatoes		Kg	5.12		2,3,4,5			
		Spain	Classic vine tomatoes		Kg	1.04	3.08	2,3,4,5			

		UK	Baby plum tomatoes		Kg	5.86		2,3,4,5			
		Spain	Baby plum tomatoes		Kg	3.11	4.485	2,3,4,5			
25	Carlsson-Kanyama 1998	Sweden	Tomatoes		Kg	3.3	3.3	2,3,4,5			
30	Maraseni 2010	Australia	Tomatoes		Kg	0.22	0.22	2,3,4,5			
				Range	**Mean per study**				Tomatoes	0.22 - 17.8	5
			Tomatoes	**0.22 - 17.8**	**5**				Carrots	0.2 -0.5	0.35
									Peas	0.68 - 3.94	2.36
									Beans	0.1 - 10.5	2.33
									Spinach	0.12 - 0.19	0.163
25	Carlsson-Kanyama 1998	Sweden	Carrots		Kg	0.5		2,3,4,5	Cabbages	0.09 - 0.23	0.16

30	Maraseni 2010	Australia	Carrots		Kg	0.2		2,3,4,5	Broccoli	1.7	2.23
						0.35			Cauliflowers	0.13 - 0.59	0.25
									Lettuce	0.32 - 9.9	3.15
				Range	**Mean per study**				Onions	0.042 - 0.2	0.14
			Carrots	**0.2 -0.5**	**0.35**				Mushrooms	0.06	0.06
									Pumpkings	0.63	0.63
25	Carlsson-Kanyama 1998	Sweden	Dry peas		Kg	0.68		2,3,4,5	Sweet corn	1.38	1.38
30	Maraseni 2010	Australia	Green peas-fresh pod		Kg	3.94		2,3,4,5	Zucchini/ button squash	1.17	1.17
30	Maraseni 2010	Australia	Green peas-Shelled		Kg	2.46		2,3,4,5	Brinjal	0.141	0.141
				Range	**Mean per study**						
			Peas	**0.68 - 3.94**	**2.36**						

41	Canalas 2008	UK	Legumes - green beans		Kg	1.6		2,3,4,5,6			
41	Canalas 2008	Kenya to UK	Legumes - green beans		Kg	10.5		2,3,4,5,6			
41	Canalas 2008	Uganda to UK	Legumes - green beans		Kg	11		2,3,4,5,6			
29	Kramer 1998	Netherlands	French beans		Kg	0.1		2,3,4			
30	Maraseni 2010	Australia	Beans- french & runner		Kg	1.37		2,3,4,5			
29	Kramer 1998	Netherlands	Rench beans	(hand picked)	Kg	0.171		2,3,4			
				Range	**Mean per study**						
			Beans	**0.1 - 10.5**	**2.33**						

29	Kramer 1998	Netherlands	Spinach		Kg	0.198		2,3,4			
29	Kramer 1998	Netherlands	Spinach for industry		Kg	0.129		2,3,4			
				Range	**Mean per study**						
			Spinach	**0.12 - 0.19**	**0.163**						
29	Kramer 1998	Netherlands	Cabbages		Kg	0.094		2,3,4			
30	Maraseni 2010	Australia	Cabbages		Kg	0.23		2,3,4,5			
				Range	**Mean per study**						
			Cabbages	**0.09 - 0.23**	**0.16**						
30	Maraseni 2010	Australia	Asparagus		Kg	2.54		2,3,4,5			

30	Maraseni 2010	Australia	Beetroot		Kg	0.24		2,3,4,5			
30	Maraseni 2010	Australia	Broccoli		Kg	1.73		2,3,4,5			
41	Canalas 2008	UK	Broccoli		Kg	1.9		2,3,4,5,6			
41	Canalas 2008	Spain to UK	Broccoli		Kg	2.7		2,3,4,5,6			
41	Canalas 2008	UK	Broccoli-frozen		Kg	2.6		2,3,4,5,6			
						1.73					
				Range	**Mean per study**						
			Broccoli	1.7 - 2.7	2.23						
30	Maraseni 2010	Australia	Capsicums		Kg	0.59		2,3,4,5			

30	Maraseni 2010	Australia	Cauliflowers		Kg	0.38		2,3,4,5			
43	Pathak 2010	India	Cauliflowers		Kg	0.13		2,3,4,5,6			
				Range	**Mean per study**						
			Cauliflowers	**0.13 - 0.59**	**0.25**						
30	Maraseni 2010	Australia	Celery		Kg	0.18		2,3,4,5			
30	Maraseni 2010	Australia	Chillies		Kg	0.66		2,3,4,5			
30	Maraseni 2010	Australia	Cucumbers		Kg	0.13		2,3,4,5			
58	Usva 2009	Finland	Cucumbers		Kg	3.98		2,3,4,5,6			

30	Maraseni 2010	Australia	Lettuce		Kg	0.32		2,3,4,5	On plate		
41	Canalas 2008	UK	Lettuce	Under glass all year around	Kg	**1.4**		2,3,4,5,6			
41	Canalas 2008	Spain to UK	Lettuce		Kg	1		2,3,4,5,6			
41	Canalas 2008	Uganda to UK	Lettuce		Kg	9.9		2,3,4,5,6			
				Range	**Mean per study**						
			Lettuce	**0.32 - 9.9**	**3.15**						
30	Maraseni 2010	Australia	Mushrooms		Kg	0.06		2,3,4,5			

30	Maraseni 2010	Australia	Onions		Kg	0.21		2,3,4,5			
51	Saunders 2008	UK	Onions		Kg	0.042		2,3,4,5			
51	Saunders 2008	NZ to UK	Onions		Kg	0.18		2,3,4,5			
				Range	**Mean per study**						
			Onions	0.042 - 0.2	0.14						
30	Maraseni 2010	Australia	Pumpkings		Kg	0.63		2,3,4,5			
30	Maraseni 2010	Australia	Sweet corn		Kg	1.38		2,3,4,5			
30	Maraseni 2010	Australia	Zucchini/ button squash		Kg	1.17		2,3,4,5			

43	Pathak 2010	India	Brinjal		Kg	0.141		2,3,4,5,6			
47	Phong 2011	Vietnam	Vegetable		Kg	1.2		2,3,4			
					Range	**Mean per study**					
				Vegetables (excluding tomatoes)	0.042 - 11	**1.49**					
			Vegetables overall with tomatoes								

Table A20 Greenhouse gas emissions per Kg of fruits

Study ID	Author	Setting	Food	Production / farming method	Functional Unit	GHGE (GWP $_{100}$ CO_2 Kg)		Included stages
						Total		
2	Williams A.G 2008	UK	Strawberries		Kg	0.99		2,3,4,5
		Spain to UK			Kg	0.9	0.945	2,3,4,5
				Strawberries	**0.9-0.99**	**0.945**		
2	Williams A.G 2008	UK	Apples		Kg	0.35		2,3,4,5
		New Zeland to UK	Apples		Kg	0.87	0.61	2,3,4,5
24	Lmila I Canals, 2006	New Zeland	Apples		Kg	**0.065**	0.065	2,3,4

43	Pathak 2010	India	Apples		Kg	0.357		2,3,4,5,6
51	Saunders 2008	UK	Apples		KG	0.186		2,3,4,5
		NZ to UK	Apples		KG	0.185	0.214	2,3,4,5
		UK	Apples		KG	0.271		2,3,4,5
				Apples	**0.06-0.87**	**0.296**		
30	Maraseni 2010	Australia	Melon- rock and cantaloupe		Kg	0.25		2,3,4,5
30	Maraseni 2010	Australia	Melon- water		Kg	0.38	0.315	2,3,4,5
				Melon	**0.25-0.38**	**0.315**		
43	Pathak 2010	India	Banana		Kg	0.097	0.227	2,3,4,5,6

47	Phong 2011	Vietnam	Fruit		Kg	1.371	1.371	2,3,4
							3.747	
					Range	**Mean per study**		
			Fruits		**0.065 - 1.37**	**0.53**		

Table A21 Greenhouse gas emissions per Kg of oilseed rape and others

Study ID	Author	Setting	Food	Production / farming method	Functional Unit	GHGE (GWP 100 CO_2 Kg)		Included stages
						Total		
1	Williams 2006	England/ Wales	Oil seed rape	Non organic	Kg	1.7		2,3,4,5
				Organic	Kg	1.6		2,3,4,5
6	Nielsen 2003	Denmark	Rape seed	Conventional	Kg	1.51		2,3,4,5
				Organic		0.95		2,3,4,5
12	Williams 2010	England/ Wales	Oil seed rape		Kg	1.4		2,3,4,5
				Range	**Mean per study**			
			Oil seed rape	**0.95 - 1.7**	**1.42**			
6	Nielsen 2003	Denmark	Winter barley	Conventional	Kg	0.62		2,3,4,5

6	Nielsen 2003	Denmark	Winter barley	Organic	Kg	0.32		2,3,4,5
29	Kramer 1998	Netherlands	Winter barley		Kg	0.326		2,3,4
6	Nielsen 2003	Denmark	Spring barley	Conventional	Kg	0.65		2,3,4,5
6	Nielsen 2003	Denmark	Spring barley	Organic	Kg	0.4		2,3,4,5
29	Kramer 1998	Netherlands	Spring barley		Kg	0.347		2,3,4
				Range	**Mean per study**			
			Barley	0.32 - 0.65	0.41			
6	Nielsen 2003	Denmark	Oat	Conventional	Kg	0.57		2,3,4,5
				Organic	Kg	0.39		
58	Usva 2009	Finland	Oat meal		Kg	0.834		
6	Nielsen 2003	Denmark	Soy beans		Kg	0.62		2,3,4,5

6	Nielsen 2003	Denmark	Soy oil		Kg	3.63		2,3,4,5
56	Davis 2010	Sweden	PEA pork chop		One meal	1.15		2,3,4,5,6
		Spain	PEA pork chop		One meal	1.76		2,3,4,5,6
		Sweden	Sausage partial PEA		One meal	1.22		2,3,4,5,6
		Spain	Sausage partial PEA		One meal	1.74		2,3,4,5,6
		Sweden	PEA burger		One meal	0.54		2,3,4,5,6
		Spain	PEA burger		One meal	1.16		2,3,4,5,6

Appendix 3- Abstract: Public Health UK conference 2013, abstract book published by The Lancet

Defining sustainable diets by comparing greenhouse gas emissions from different food groups: a systematic review

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Abstract

Background Many physical and biological systems are changing because of anthropogenic global warming, but many effects of climate change can be avoided, reduced, or delayed by mitigation. The UK Climate Change Act 2008 sets a target to cut the total annual greenhouse gas emissions (GHGE) by 80% by 2050, with an interim target of a reduction of 34% by 2020, compared with 1990 levels. UK food production and consumption is responsible for up to 18–30% of the total GHGE. Therefore, defining sustainable healthy diets is important to cut down GHGE from food. We have adequate information on nutrients in food, but we do not have robust data on GHGEs of individual food groups.

Methods This systematic review estimated GHGE values (mean and range) for all the food groups in a commonly used food frequency questionnaire (FFQ). Eight medical and geographical databases were searched from 1995 to 2012 to identify lifecycle assessment (LCA) studies of food. Full papers or reports of selected studies were obtained. If they estimated the GHGE (individual gases or the total global warming potential [GWP]) per functional unit (eg, kilogram or tonne of meat, litre of milk) of any food group by LCA they were included. If studies assessed only emissions per land area or per farm they were excluded. We selected studies that described these components and authors were contacted if these components were not explained in the full report. Studies were not excluded if authors did not respond or were not available in English language. GWP per kg of food, in kg of carbon dioxide equivalence over 100 years ($KgCO_2e$), was recorded from each study with details about farming methods, location, and the boundaries of lifecycle. The initial search identified 14 096 hits. 126 were selected after screening titles and abstracts and a further 42 papers were added by searching organisational websites and databases. Quality assessors were masked.

Findings Beef (mean 28·00, range 8·10–156·00) and lamb (15·52, 0·67–56·70) had the highest GWP values per kg and bread (–0·56, 0·25–0·93), fruits (–0·53, 0·06–1·37), and potatoes (–0·21, 0·13–0·48) were among the lowest values. The mean GWP for 1 kg of fruit juice was 2·92 $KgCO_2e$. Whether organically and locally produced foods always have less GWP than non-organic foods and imported foods, respectively, is unclear. The GHGE values for organic products such as pork, chicken, eggs, potatoes, and tomatoes were higher than those for these foods when non-organically produced. The boundary of the LCA considered by the authors contributed substantially to variance in the results. Variation in results is due to a wide range of production systems, locations, and different system boundaries used in LCA studies. Therefore, the final estimates are not directly comparable and ranges overlap between food groups. GHGE is not the only indicator to measure the sustainability of food. However, GHGE was used in this study because it is the most commonly used indicator and government targets are set to measure the reduction in GHGE.

Interpretation Organic foods and locally produced foods do not always produce fewer GHGEs. Little consistency in LCA methods makes direct comparisons of estimates difficult. Future LCA food studies should make efforts to follow a uniform approach, to include common definition of stages in the lifecycle and inclusion of similar activities always under each category of food. These GHGE estimates are for common food groups in a FFQ and could be combined with existing nutrition databases to address questions around sustainable healthy diets. These findings will be used to quantify the GHGE changes of different dietary scenarios in the UK to achieve GHGE reduction targets.

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Contributors

KW wrote the systematic review proposal and did the literature search, data extraction, and data analysis. PS did the study design, protocol development, and data extraction, analysis, and interpretation. MG and MR provided inputs to the protocol, results interpretation, and comments on the draft.