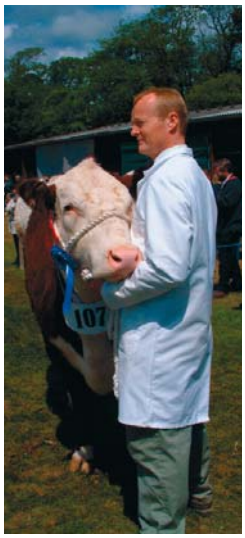
The Potential of the High Weald to Supply the Food Needs of its Population under Conventional and Organic Agriculture

Furthering understanding of one of England's Finest Landscapes




A report to the High Weald Joint Advisory Committee

By the Centre for Agricultural Strategy and the School of Agriculture, Policy and Development, the University of Reading

July 2009

The High Weald AONB Joint Advisory Committee provides guidance to local authorities and other bodies on implementing the statutory AONB Management Plan and on how local and government policy objectives can be accommodated without damaging the outstanding character of the nationally important landscape.

The High Weald Joint Advisory Committee's Research Programme

Furthering understanding of one of England's Finest Landscapes

The High Weald Joint Advisory Committee's management aims and priorities for the AONB are firmly based on an understanding of the fundamental and defining character of the whole area – that is, those components of natural beauty that have made the High Weald a recognizably distinct and homogenous area for at least the last 700 years and that will continue to define it in the future. It develops its understanding through undertaking work itself, through its specialist team, the AONB Unit, or by commissioning independent reports from others.

The primary purpose of its research programme is to better understand the components of natural beauty. The key components are:

- Geology, landform, water systems and climate: deeply incised, ridged and faulted landform of clays and sandstone. The ridges tend east-west and from them spring numerous gill streams that form the headwaters of rivers. Wide river valleys dominate the eastern part of the AONB. The landform and water systems are subject to and influence, a local variant f the British sub-oceanic climate.
- Settlement: dispersed historic settlements of farmsteads, hamlets and late medieval villages founded on trade and non-agricultural rural industries.
- Routeways: ancient routeways (now roads and Rights of Way) in the form of ridge-top roads and a dense system of radiating droveways. The droveways are often narrow, deeply sunken and edged with trees, hedges, wildflower-rich verges and boundary banks.
- Woodland: a great extent of ancient woods, gills and shaws in small holdings, the value of which is inextricably linked to long-term management.
- Field and heath: small, irregularly shaped and productive fields, often bounded by (and forming a mosaic with) hedgerows and small woodlands and typically used for livestock grazing. Small holdings and a non-dominant agriculture. Distinctive zones of heaths and inner river valleys.

By researching the key components – their history, development, distribution, special qualities, deterioration, damage and loss – we can develop an evidence base for the AONB Management Plan and other AONB policy and guidance.

The JAC's secondary purpose is to better understand how the High Weald landscape can contribute to society – food, energy, water provision, flood protection, recreation, biodiversity and fisheries – without damage to its natural beauty.

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Executive Summary

Introduction

The High Weald AONB Joint Advisory Committee has set an objective to understand the capacity of the High Weald AONB to meet the food, fuel, water and energy needs of its resident population, within the limits imposed by the physical environment, farming structure, historical and cultural constraints, and economic and environmental policy. Because these drivers and constraints form a complex matrix, estimating an 'optimal' mix of land uses to achieve all objectives is difficult. Therefore, as a first step, a simplified approach is preferable, focusing solely on the food production capacity of the High Weald AONB. The Centre for Agricultural Strategy, University of Reading, was commissioned to scope the limits to this potential, using a scenario-based approach reflecting possible future dietary habits and production practices (organic and conventional).

Research objectives

(i) estimate current notional food self-sufficiency in the AONB;

(ii) assess how self-sufficient the AONB could be through changes to land use and farming practice;

(iii) estimate how self-sufficient the AONB would be if the population adopted a healthy diet;

(iv) estimate how self-sufficient the AONB could be, with a healthy diet, through changes to land use and farming practice;

(v) estimate how organic conversion would affect self-sufficiency now and under a healthy diet.

Results

Agricultural commodity	Total volume of food output (marketed) (t, M eggs, M litres)	Current food demand (t, M eggs, M litres)	Revised food demand – healthy diet (t, M eggs, M litres)	**Self sufficiency (%)**		
				Current demand/ Current supply	'Healthy diet' demand/ Current Supply	Current demand/ Organic supply
Cereals	121730	15521	19516	784	624	618
Other arable crops	26049	33986	39023	77	67	53
Field-scale veg.	2914	11855	19664	25	15	15
Horticulture crops	5750	4332	6823	133	84	92
Top fruit	56726	4810	7374	1179	769	556
Soft fruit	8419	500	1007	1684	836	825
Milk	81	64	37	127	221	88
Beef & Veal	2047	3502	2961	59	69	45
Mutton & Lamb	2293	1023	735	224	312	173

Current self sufficiency

The analysis revealed that, at present, some agricultural commodities are notionally over-supplied in the High Weald AONB, i.e. supply exceeds local demand, while others are under-supplied. There is a surfeit of cereals, oilseeds and indigenous fruit, but shortages of sugar beet, potatoes and fresh vegetables and salads. For livestock products, High Weald agriculture over-supplies milk and lamb, but under-supplies pork and beef. The term 'self sufficiency' in this context does not mean that High Weald agriculture actually satisfies local demand for particular commodities, as this is not the case even where local supply exceeds local demand, because existing food networks direct most of this production out of the region. In this sense self sufficiency merely implies that High Weald agriculture could meet local food demand should local food networks be developed to handle it.

To explore the potential of the AONB to improve current levels of self sufficiency a quadratic programming model of High Weald agriculture was constructed. The model was able to make sufficient adjustments to agriculture to fully meet current food demand. Potatoes, vegetables and salads are undersupplied at present, but the model was able to increase production to meet current levels of demand by taking land from wheat and top fruit production. The High Weald is currently a significant exporter of these products, with large areas grown. Because of this, if all available land were used to supply the local market, there would be more than sufficient to meet demand for indigenous foods in season.

Self sufficiency based on a healthy diet

This scenario explores whether a change to a healthier diet would make it more or less feasible for the High Weald AONB to be self-sufficient in food. The scenario assumes a positive change in average dietary patterns, i.e. the population becomes compliant with UK Department of Health guidelines on healthy eating. This would require a 25% increase in demand for cereals and 50%+ increases in demand for vegetables and fruit and significant declines in demand for dairy products and red meat.

Assuming that current food production remained unchanged, the adoption of a healthier diet has mixed impacts on self-sufficiency. Some products such as lamb and milk that are currently over-supplied become slightly more so under a healthier diet, while products such as fruit and cereals, which are over supplied, would be slightly less so due to increased demand. The under-supply of field-scale vegetables is exacerbated under a healthier diet, due to increased demand. If production remained at current levels, it would not be any easier to achieve food self-sufficiency should the resident population adopt a healthier diet, although the excessive over-supply of some commodities would be somewhat curtailed.

Modeling showed that agriculture in the High Weald could respond as much as necessary to meet this revised food demand. As is the case with the first scenario run, this adjustment is possible because that the High Weald produces a surplus of wheat and fruit and by scaling back supply of these commodities to match the revised local demand, large tracts of arable land are freed up for the

production of those commodities that would be undersupplied at current levels of production. Indeed, so much land is made available, there would be a surplus even after all food demand is met.

Self sufficiency based on organic agriculture

The final scenario explores the impact on food self-sufficiency of all agriculture in the High Weald converting to organic methods of production. This would inevitably impact on yields and the ability of High Weald agriculture to supply the food needs of the local population. Crop and livestock yields were adjusted downwards using data taken from sources including the organic sub-sample of the Farm Business Survey. Under organic agriculture output of cereals from the High Weald would fall by 21% and other arable crops by a little under 31%. However, even under these circumstances cereals would be many times over-supplied, based on current levels of demand. Also still over-supplied would be lamb, in spite of a 23% fall in supply. A 38% fall in field scale vegetables output would aggravate existing under supply of these products, with self sufficiency falling to 15% under organic agriculture.

Modelling reveals that, even under organic management practices, High Weald agriculture could supply the food requirements of the local population, both assuming current food demand and demand consistent with DoH guidelines. The model projects that High Weald agriculture could compensate for lower organic yields by expanding the area of production of various commodities, using some of the arable land currently producing cereals for export out of the region.

Discussion and conclusions

Because of the limited growing season in the UK, 100% self sufficiency for some commodities could never be achieved, even if the product was over-supplied in season. The impact of seasonality varies by commodity, according to the length of the growing season and storage potential. Based on the maximum levels of national self sufficiency in the main food commodities achieved over the last 20 years, notional best obtainable levels of self sufficiency have been estimated at: 100% for cereals, milk and lamb; 75% for fresh vegetables; and 25% for fresh fruit, including non-indigenous types.

Moves towards greater self sufficiency would require changes to consumer purchasing patterns and the creation of a more localized food network i.e. a move away from the global sourcing policies of the supermarkets and food service sector, which currently dominate the supply chain in the High Weald. Due to the geographic spread of production and processing for many every-day food products, particularly processed multi-ingredient products, few products that may be wholly sourced locally. The majority of existing local food sales are therefore of fruit and vegetables, dairy products, and meat, all of which, are currently under-supplied in the High Weald. In any policy initiative towards increasing food self-sufficiency, priority should therefore be given to developing local food markets for these products. This goal may be achieved by a number of means, i.e. expanding sales from existing businesses and developing new supplier businesses.

Due to low population density the AONB has a surplus of land, providing considerable flexibility to readjust production to meet the food needs of the resident population under all scenarios. The High Weald could therefore be as close to self sufficiency as is feasible, in indigenous and in-season foods. This conclusion is of course dependent on the assumption that all agricultural land in the AONB is turned over to meeting local food requirements, rather than the supply of the national and

international food market. In effect this assumes that the best financial returns are available from the supply of the local food market.

1. Introduction

The High Weald Area of Outstanding Natural Beauty (AONB) Joint Advisory Committee has set an objective to understand the capacity of the High Weald AONB to meet the food, fuel, water and energy needs of its resident population, with the subordinate objective of understanding the limits to this capacity, imposed by:

- The physical environment – as reflected in crop yield potential
- Farming structure – the number, type and size of farms
- Historical and cultural constraints – land ownership and the value placed on the current landscape
- Economic and environmental policy – landscape/wildlife protection designations, the CAP, regulation and sustainability objectives/requirements

Because these factors form a complex matrix of, often conflicting, drivers and constraints, estimating an 'optimal' mix of land uses (and outputs) to achieve all objectives is difficult. Therefore, as a first step, a simplified approach is preferable, focusing solely on the food production capacity of the High Weald AONB.

In January 2009 the High Weald Joint Advisory Committee commissioned the Centre for Agricultural Strategy of the University of Reading to undertake a study to investigate the potential of the High Weald AONB to supply the food needs of its resident population (hereafter described as the 'local population'), using a scenario-based approach, with these scenarios involving a number of key assumptions concerning future dietary habits and production practices (organic and conventional). This approach, it was believed, would permit a scoping of the limits to the potential of the food production system in the AONB to achieve food self sufficiency. The project work was undertaken over the period January to April 2009 and is reported here. In structure this report contains, first, a statement of the project objectives, followed by two further scene-setting sections, the first providing the reader with some background data on the AONB, and the second discussing some key methodological issues arising from the study. Following this there are several results sections, providing analysis of a number of different scenarios and following these is an analysis of the potential for development of the local food market in the High Weald. The report concludes with discussion and conclusions.

2. Research objectives

The objectives of the research were:

(i) To estimate what proportion of the food currently demanded by the High Weald AONB population is notionally being met by agriculture in the AONB;

(ii) To assess how much of current local food demand could potentially be met by agriculture in the High Weald AONB through changes to land use and farming practice;

(iii) To estimate the proportion of local food demand that would currently be met by High Weald AONB agriculture if the population were compliant with Department of Health (DoH) guidelines on healthy diet;

(iv) To assess how much of DoH-compliant local food demand could potentially be met from High Weald AONB agriculture through changes to land use and farming practice;

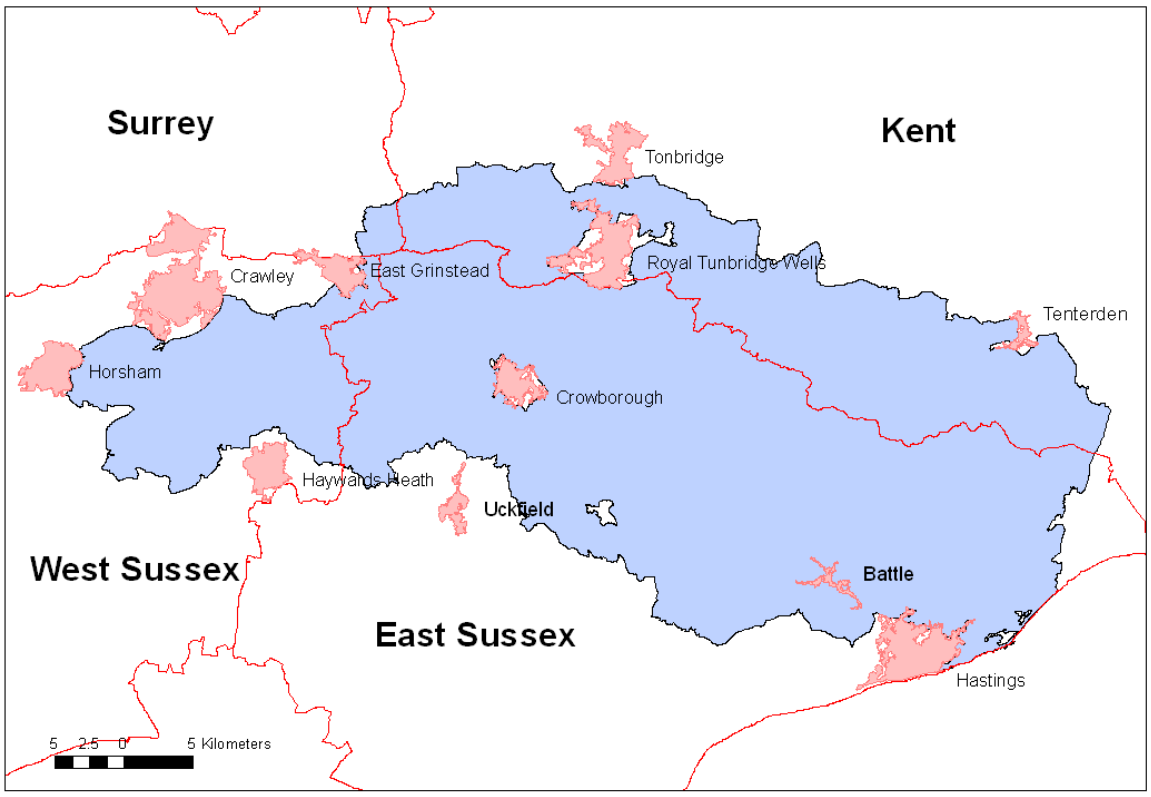
(v) To estimate how conversion to organic methods of production in the High Weald AONB would impact on the ability of local agriculture to meet both current and DoH-compliant food demand.

3. The High Weald AONB

3.1 The High Weald landscape

The High Weald is located at the heart of the Wealden anticline between the North and South Downs. The landform is shaped by underlying bands of sandstone and clay with the harder sandstone forming the high land (the highest ridge rises to 225m) with the lower land being formed from eroded clays. Over the time, natural processes (flooding, erosion etc) have created a hilly landscape of ridges and valleys. The term "Weald" means wilderness or forest and it reflects the historic wooded character of the area which, combined with a comparatively low accessibility, engenders a sense of remoteness even today. The High Weald was designated an Area of Outstanding Natural Beauty (AONB) in 1983. The AONB covers 146,170 hectares and it is the largest AONB in South East England, extending across the counties of Surrey, East Sussex, West Sussex and Kent (see Figure 1). Within the AONB, there are 50 Sites of Special Scientific Interest (SSSI) and 202 Sites of Nature Conservation Importance or Local Wildlife Sites.

Figure 1 – Location of the High Weald AONB



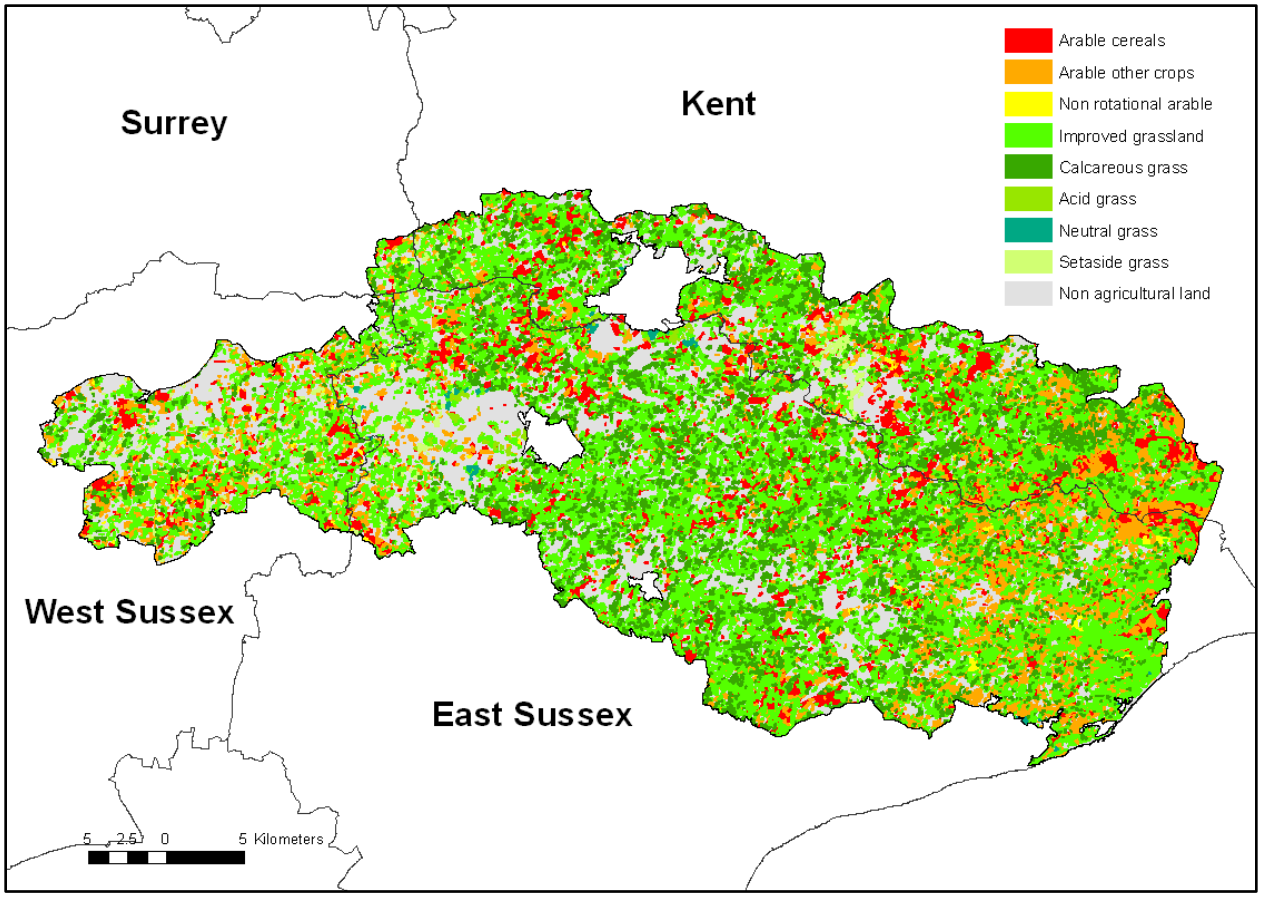
3.2 Historic settlement and land-use

In prehistoric times the High Weald was heavily wooded, with grassland and heathland clearings. During the Iron Age these woodlands became an important source of raw materials for various industries, but although they were heavily exploited they were rarely destroyed, leaving the High Weald area densely wooded. The woodlands were used by early farmers as a seasonal source of food for their livestock (usually pigs), a system known as pannage. Every year farmers would return with their pigs to the same isolated woodland pastures, called 'dens' and ultimately these became permanent places of settlement and some of the surrounding wood and heath was cleared for agricultural use. Clearance was done in an unplanned and patchy way, resulting in the small size and irregular shape of the fields that can be seen even today. Due to the heavy clay soils, the focus of agricultural use has always been livestock production. Most of villages in the area originate from medieval centres of trade and have been located around trading points and along the network of routes that farmers in the past used for driving their animals into the woods. The High Weald landscape reflects its medieval roots with a mosaic of small, hedged, irregular shaped fields and small but abundant woods. It is essentially a pastoral landscape where grazing continues to play an important role in the creation and maintenance of its character.

3.3 Current settlement and land-use

The High Weald AONB has a relatively low population density (although it is highly populated for a designated landscape) with an estimated 120,000 people, within the AONB boundary, living in dispersed farmsteads, hamlets, and small villages (there are approximately 100 villages). However, the AONB boundary excludes the larger towns of Tunbridge Wells, Heathfield and Crowborough even though they are encircled by the AONB. As will be seen in the section below, including these towns would increase the AONB population considerably.

Figure 2 - Distribution of agricultural land in the High Weald AONB (source: Land Cover Map 2000, CEH).



Woodlands occupy a significant proportion (24.5%) of the total AONB area, with more than half of these woodlands designated as ancient (i.e. having been continually wooded since at least 1600AD). Agricultural land accounts for 62% of the total AONB area (see Table 1), with more than half of this (63%) covered by grasslands supporting mainly sheep, but also cattle and pigs. However, on the better land, especially in the east of the AONB (see Figure 2) there is a significant area of both cereals and horticulture. Orchards are scattered across the whole of the AONB, but are concentrated in the Kent High Weald. The High Weald remains one of the areas traditionally associated with the growing of hops. In 2004, the total number of people working in the agricultural sector was just 4,525.

Table 1 - Land use in the High Weald AONB

LCM subclasses	Hectares	% of AONB area
Cereals	12575	8.6
Other arable crops	7959	5.4
Bare fallow	386	0.3
Horticulture	2174	1.5
Temporary grass	7122	4.9
Permanent grass	39331	26.9
Rough grazing (sole right)	3662	2.5
Farm woodland	10246	7.0
Set-aside	4725	3.2
All other land	2120	1.5
Total farmland	90299	61.8
Estimated non agricultural land	55872	38.2
Total area	146171	100.0

Source: June Survey of Agriculture, 2004.

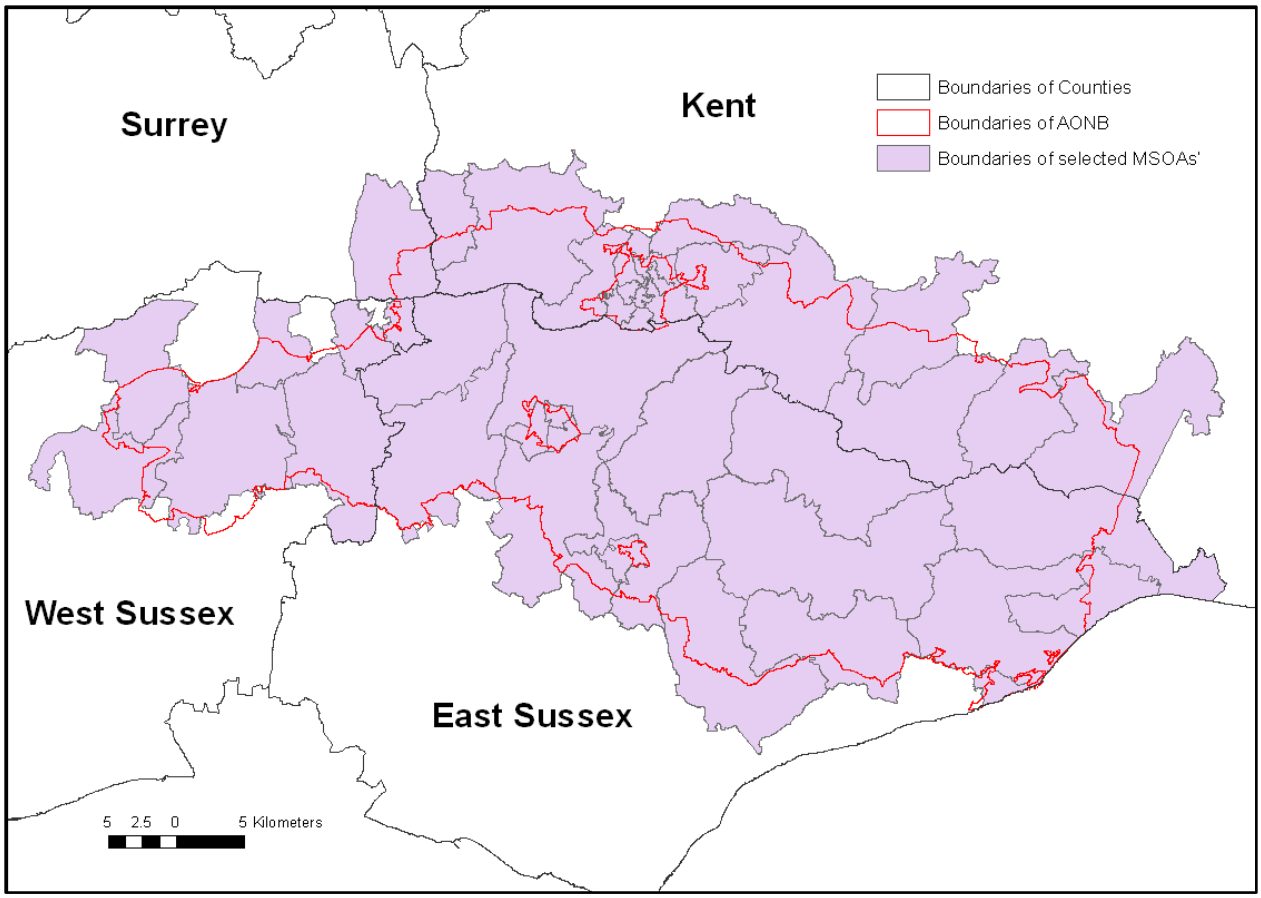
4. Methodological issues

4.1 Defining the boundary of the study area

The data used in this study can be described at a range of scales, including Ward, Parish and Middle Super Output Areas (MSOAs). However, the AONB boundary does not exclusively follow parish or other administrative boundaries, but rather is delineated on the basis of geographical and environmental features. As a means of rationalizing the two, the decision was taken to create a 'notional' AONB boundary, that approximates the original, but which follows administrative boundaries. Obviously, the smaller the administrative unit used for this purpose, the more closely the 'notional' AONB boundary would follow the actual boundary. The smallest administrative unit for which the desired socio-economic data are available is the ward. However, a problem arises from using wards for this purpose because they have been subject to regular boundary changes and other data are not available at this spatial scale. June Agricultural Survey data has historically been available at parish scale. However, Defra have published more recent survey data for the Middle Layer Super Output Areas (MSOAs). As these MSOAs represent the smallest administrative units for which both population and agricultural data are available on a consistent geographical basis (in different time periods) they were chosen to for use in this analysis. June Agricultural Survey data are not available at the level of the MSOA for 2001 (the most recent year for the Population Census), so the closest available match, 2004, has been used instead.

The actual AONB boundary transects a number of MSOAs, resulting in MSOAs with various proportions of their area inside the AONB. A decision rule was therefore necessary to determine which MSOAs should be included in the study area (i.e. the notional AONB) and which should not. After considering a number of ways of determining this, the simple decision rule was adopted that if 20% or more of the area of an MSOA lay within the AONB boundary it should be included in the 'notional' AONB. This low percentage area requirement was adopted in order to minimise exclusion of large areas of the actual AONB from the analysis. As a result, the area of the notional AONB exceeds the area of the actual AONB, as is shown in Figure 3.

Figure 3 - Correspondence between the AONB boundary and the study area (the notional AONB) employed in this report.



For the purposes of the analysis, the resident population of the AONB is defined as that living within the notional AONB boundary. There is an obvious issue with doing this in that there are significant population centres very close to the AONB boundary, including Hastings in the south, and Horsham, Crawley and East Grinstead in the west. It could be argued that because population centres such as these are so intimately linked with the AONB, they should also be included in the analysis. The problem with doing this is that this would significantly skew the food self sufficiency estimates, making them look much less favourable. To overcome this bias it would be necessary to include in the calculations the non-AONB agricultural land in the territorial hinterlands of these population centres. However, to do so would erode the sense that this was an analysis of the AONB and so for that reason they have not been included in the estimate of the resident population. However, as mentioned above, the population centres of Tunbridge Wells, Heathfield and Crowborough, have been included because while they are not officially part of the AONB, they are fully surrounded by it and in this case it can be argued that the territorial hinterland of these urban areas is the AONB itself. In this report, the resident population as defined above, is sometimes referred to as the 'local' population. The effect of creating a notional AONB boundary based on MSOAs, together with the inclusion of the enclosed urban areas of Tonbridge Wells, Heathfield and Crowborough, is to increase the estimated population from 120,000 to 312,174.

4.2 Data sources

The data sources used in this study are shown in Table 2. Using this data a GIS analysis was performed where layers of data representing, for example, the Agricultural Land Classification and agricultural related habitats, were overlaid in order to define the territorial units on which the quadratic programming model of High Weald agriculture is based (see Section 6.1 below).

Table 2 – Data sources employed in the project

Type of data	Dataset	Provider
The areas of agricultural land of different quality in the High Weald AONB	Agricultural Land Classification of England and Wales (ALC)	Defra
Agriculture-related land cover types in the High Weald AONB (eg arable, horticulture, grassland etc)	Land Cover Map 2000	Centre for Ecology and Hydrology (CEH)
Agricultural activity in the High Weald AONB	June Survey of Agriculture	Defra
Population	2001 Population Census	Office of National Statistics (ONS)

5. How much of current food demand is being met by High Weald AONB agriculture?

5.1 Current food demand in the High Weald AONB

The total volume of food demanded by the resident population of the High Weald AONB is estimated by multiplying national estimates of average per capita food consumption, by the number of people resident in the area. The per capita food consumption data used in this study are derived from the Expenditure and Food Survey (EFS) for 2003-04 (Defra, 2005). The EFS is a survey of the food consumption habits of over 7,000 households in the UK, which includes consumption within the home, meals eaten out, soft drinks and confectionery etc. EFS data show the weekly average consumption (in grammes, millilitres, or number of eggs) of 24 major food groups (e.g. all milk and cream), with these groups further subdivided into 167 minor food groups (e.g. milk for infants) and a further 126 food items (e.g. liquid infants milk and dried infants milk). Table 3 shows a list of the 24 major food groups represented in the EFS.

In order to be able to assess the extent to which the current food consumption of High Weald residents is being met, albeit notionally, from local agriculture, the consumption data for these food groups (see Table 3) first needs to be transformed into quantities of the agricultural commodities from which they are derived. This is achieved by means of a conversion matrix, which has been adapted from work recently undertaken by the authors as part of a RELU[1]-funded project undertaken by the School of Agriculture, Policy and Development, the University of Reading[2].

The conversion matrix was constructed by listing the 167 food items given in the EFS survey on one side of a table (the rows), and a list of farm commodities along the columns. At each cell in the tableau a conversion coefficient was then entered, based on the likely proportionate contribution of each commodity to each food item, with many cells containing zero coefficients. So, for example, at the intersection of the Milk commodity with the food item, Dried fruit, a coefficient of zero would be entered, but at the intersection of this commodity with the food item, Butter, there would be a coefficient of 20 (it takes approximately 20 litres of milk to produce 1 kilogram of butter). For single ingredient food items estimation of the conversion coefficient was very straightforward, however for mixed and processed items (for example bread and cakes), various published sources were consulted for guidance on their ingredients (McCance and Widdowson (2002) and various retailer websites, including Tesco and Sainsbury's, for lists of product ingredients). Table 4 presents the results of the conversion of the food consumption data in Table 3 into agricultural commodities. Before estimating annual food demand for the High Weald AONB, the list of agricultural commodities given at Table 4 needs to be pared of non-indigenous foods, i.e. foods that cannot be produced in the High Weald

[1] The Rural Economy and Land Use Programme (RELU) is a £24 million research programme co-funded by the Economic and Social Research Council (ESRC), the Biotechnology and Biological Sciences Research Council (BBSRC) and the Natural Environment Research Council (NERC), with additional funding provided by the Scottish Government and the Department for Environment, Food and Rural Affairs.

[2] Project title: Implications of a nutrition driven food policy for land use and the rural environment. Funded by: RELU. Project website: http://www.relu.rdg.ac.uk/research.html. Relevant publications: Arnoult, M H (2006); Jones, P J & Tranter, R B (2007).

AONB (for example, citrus fruits), plus fish, the bulk of which, in the national diet, is sourced from the sea (see Table 5). Using 2001 population census data, the population (resident population) of the High Weald AONB is estimated at 312,174 (see Section 4). Estimated food demand for the AONB, based on this population estimate, is presented in Table 5.

Table 3 - Major food groups and their constituent food items, as defined by the EFS and used in this study, plus daily per capita consumption (England)

	Food group	Constituent food items (not exhaustive)	Daily per capita consumption (millilitres, grams, number of eggs)
1	Milk and cream	UHT, sterilized, condensed, infants milk, yoghurt, dairy deserts	288.3
2	Total cheese	Natural or processed	16.4
3	All carcass meat	Beef/veal, mutton/lamb, pork	32.3
4	All non-carcass meat	Liver and offals, ham and bacon, sausages, pies	118.9
5	All fish	Fresh, chilled, frozen, tinned, smoked, takeaway	23.0
6	Eggs (fresh)		0.2
7	All fats	Butter, margarine, lard, vegetable oils	26.6
8	Sugar and preserves	Sugar, jams, marmalade, syrup, honey	19
9	Potatoes	Previous year, new crop, imported	84.7
10	Fresh green vegetables	Cabbages, peas, beans, salads	34.4
11	Other fresh vegetables	Carrots, turnips, onions, tomatoes	74.6
12	All processed vegetables	Cans, frozen, dried, juices, crisps	87.6
13	Fresh fruit	Oranges, apples, pears, stone fruit, bananas	115.7
14	Fruit and fruit products (not fresh)	Tinned, dried, bottled, frozen, nuts, seeds, juices	59
15	All bread	White, brown, whole-meal, sliced, unsliced	102.3
16	Flour		8
17	Cakes, buns & pastries	Buns, scones, teacakes, pastries	23.9
18	Biscuits & crispbreads	Biscuits (with and without chocolate), crispbreads	23.1
19	Total cereals #	Oatmeal, breakfast cereals, puddings, rice, pasta	73.1
20	Beverages	Tea, coffee (beans, instant), cocoa, malt drinks	8.3
21	All other foods	Baby foods, soups, spreads, dressings, pickles, ice-cream, salt	99.7
22	Soft drinks	Concentrated, unconcentrated	266.9
23	Confectionery	Chocolate bars, chewing gum, mints, fudges	18
24	Alcoholic drinks	Beers, lagers, ciders, wines, spirits, liqueurs, cocktails	114.3

excluding biscuits, breads and cakes.

Table 4 - Average daily per capita food consumption (England) by agricultural commodities

	Agricultural commodity	Daily per capita consumption
1	Milk	560.5
2	Beef & Veal	30.8
3	Mutton & Lamb	9.0
4	Pork	30.3
5	Poultry	37.4
6	Miscellaneous meats	8.3
7	Eggs	1.3
8	Wheat	132.7
	of which non Pasta (pasta)	121.0 (11.7)
9	Barley	6.2
10	Rye	0.8
11	Oats	8.5
12	Rice	20.1
13	Maize	4.5
14	Sugar	45.6
15	Oils & Fats	23.1
16	Potatoes	205.8
17	Fish	19.1
18	Honey	0.6
19	Cabbages	6.4
20	Brussels sprouts	2.1
21	Cauliflower	11.4
22	Salads	9.4
23	Peas	8.6
24	Beans	15.8
25	Other Green Vegetables	13.6
26	Carrots	14.4
27	Turnips & Swedes	3.1
28	Other Root Vegetables	3.6
29	Onions, Leeks, Shallots	13.9
30	Cucumbers	6.1
31	Mushrooms	5.3
32	Tomatoes	26.7
33	Misc Vegetables	26.4
34	Oranges	9.4
35	Other citrus fruits	13.0
36	Apples	24.4
37	Pears	7.1
38	Stone fruits	10.8
39	Grapes	7.9
40	Other soft fruit	4.4
41	Bananas	30.9
42	Melons	5.6
43	Pineapple	0.5
44	Mixed fruit	20.0

Table 5 - Total annual food demand in the High Weald AONB for indigenous agricultural commodities

	Agricultural commodity	Total annual food
1	Milk	64
2	Beef & Veal	3502
3	Mutton & Lamb	1023
4	Pork	3445
5	Poultry	4253
6	Miscellaneous meats	944
7	Eggs	148
8	Wheat (non-pasta)	13759
9	Barley	705
10	Rye	91
11	Oats	967
14	Sugar	5185
15	Oils & Fats	2627
16	Potatoes	23401
18	Honey	68
19	Cabbages	728
20	Brussels sprouts	239
21	Cauliflower	1296
22	Salads	1069
23	Peas	978
24	Beans	1797
25	Other Green Vegetables	1546
26	Carrots	1637
27	Turnips & Swedes	353
28	Other Root Vegetables	409
29	Onions, Leeks, Shallots	1581
30	Cucumbers	694
31	Mushrooms	603
32	Tomatoes	3036
33	Misc Vegetables	3002
36	Apples	2775
37	Pears	807
38	Stone fruits	1228
40	Other soft fruit	500

5.2 Current food production in the High Weald AONB

Current food production in the High Weald is estimated by multiplying the areas of crops and the numbers of livestock produced in the AONB by representative yields. Data on crop area and livestock numbers have been derived from the Defra June Survey of Agriculture for 2004 (MSOA data) (Defra, 2008a), whilst yields information has been obtained from a number of official and other published sources (Defra, 2008c; Nix, 2008; Defra, 2008d). Table 6 shows the crop and livestock areas recorded as present in the AONB in 2004, together with representative yields for these activities, plus an estimate of the total volume of food commodity production in 2004. In generating production volume estimates it has been necessary to combine a number of categories of commodity, in order to accommodate the limits of the data available in the June Survey of Agriculture.

Another factor that needs to be taken into account when generating self-sufficiency estimates is food losses in the food chain, i.e. losses in storage (post farm gate) and transport and waste at the point of sale. For our purposes we can ignore losses in the household, as these do not affect the availability of food for consumption. Defra (2004) report crop losses of 10% in storage, due to shrinkage and rots, while Lundqvist *et al* (2008) estimate food chain losses, conservatively, as 10-15% in the developed world. For the purposes of this study, we have taken a conservative estimate of losses in the food chain of 10%. Accordingly, this adjustment has been made to the yield estimates presented in Table 6 below, where the values in parentheses represent marketable yield, i.e. after adjusting for food chain losses.

Table 6 - Crop areas and livestock numbers produced in the High Weald AONB, with associated yields and total production volumes

	Agricultural enterprise	Representative yield (t per ha, litres per cow, eggs per hen per year, kilograms of meat per animal)	Production of enterprises in the High Weald in 2004 (ha and number of livestock)	Distribution within merged categories	Total volume of output (marketed) (tonnes, million eggs, million litres)
1	Wheat (winter wheat)	8.3 (7.4)	136727		101581
2	Barley (spring)	5.3 (4.7)	1753		8292
3	Oats (winter)	6.5 (5.9)	1763		10311
4	Minor cereals (rye)	6.0 (5.4)	287		1547
5	OSR (winter)	3.3 (2.9)	4870		14268
6	Linseed	1.8 (1.6)	1020		1612
7	Sugar beet	62 (55.8)	2		100
8	Potatoes (maincrop)	45 (40.5)	230		9315
9	Peas (human consumption – vining peas)	4.8 (4.3)	168	151	646
10	Beans (human consumption)	7 (6.3)		17	107
11	Cabbages	32.5 (29.3)	139	18	519
12	Brussels sprouts	13 (11.7)		3	35

13	Cauliflower	14 (12.6)		14	175
14	Salads (lettuce, outdoor)	23 (20.7)		18	364
15	Other Green Vegetables (assumed broccoli)	14 (12.6)		2	28
16	Carrots (maincrop)	65 (58.5)		14	819
17	Turnips & Swedes	60 (54)		2	81
18	Other Root Vegetables (parsnips)	27 (24.3)		10	248
19	Onions, Leeks, Shallots	41 (36.9)		15	565
21	Misc Vegetables (eg courgettes)	20 (18)		5	81
22	Mushrooms, peppers, lettuce & other protected crops	250 (225)	19	11	2498
20	Cucumbers (protected)	470 (423)		4	1692
23	Tomatoes (heated)	423 (380.7)		4	1561
24	Apples (15-50t, desert apples)	30 (27)	2201	1800	48600
25	Pears (15-30	22.5 (20.3)		206	4190
26	Stone fruits	22.5 (20.3)		194	3936
27	Other soft fruit (strawberries, raised bed, 18-23t)	20.5 (18.5)	455		8419
28	Dairy cows (milk yield)	7000	11632		81
	Beef (clean carcass weight)				
29	Steers	343 (195.1)	8857		1728
30	Heifers, young bulls, herd replacements	343 (195.1)	6975		0
31	Calves (cattle under 1 year)	32 (18.2)	14675		27
21	Cows, adult bulls (other cattle over 1 year)	317 (180.7)	11564		293
	Pigs (clean carcass weight)				
33	Clean pigs	76 (49.4)	6167		77
34	Sows, boars	151 (98.2)	817		35
	Sheep (clean carcass weight)				
35	Clean sheep and lambs	19 (12.4)	140570		1743
36	Ewes, rams	27 (17.6)	156069		549
	Poultry				
37	Chickens and other table fowls	1.5 (1)			
	Culled hens (boiling fowls)				
38	Turkeys	10.3 (7.2)			
39	Ducks, geese	2.2 (1.5)			
40	Laying hens	310			

Sources: Nix (2008); Defra (2008c); Defra (2008d); SAC (2008).

Notes to table

Note 1: Livestock weights represent clean carcass weights, which exclude offal, but include bones. Carcass weights in parentheses represent consumable meat after removal of bones (see Appendix A for an explanation of these data). Crop yields in parenthesis reflect marketable weights after accounting for post harvest losses of 10%, due to weight loss and rots in storage (Defra, 2004).

Note 2: For some categories of commodity, for example vegetables and salads, June Survey data are aggregated. Where necessary, aggregate values have been re-distributed across individual commodities using weights based on the national areas of individual commodities recorded in other data sources, such as: Defra, 2007a, 2007b; Defra, 2008b.

Note 3: culling rates p.a. (ie animals destined for the food chain) for different classes of live animal (as recorded in the June Survey of Agriculture) are assumed to be: Steers 100%; Herd replacements 0%; Calves 10%; Cattle over 1 year 14%; Dairy cows 25%; Clean pigs 100%; sows and boars 43%; Clean sheep & lambs 100%; Ewes, rams and other sheep 20%; All poultry 100%.

It has not proved possible to provide estimates of the levels of production of poultry meat and eggs, due to the lack of data on poultry enterprises in the June Agricultural Survey. When generating data at the sub-regional level, for example Medium Super Output Areas, Defra operate a practice of suppressing some data where these are based on so few holdings as to risk breaching confidentiality provisions. It is known that the poultry industry, both for broiler production and eggs, is dominated by a relatively small number of very large producers. It is probable then that there are only a handful of large commercial producers in the High Weald and that poultry data have been suppressed at the MSOA level for confidentiality reasons. This methodological caveat might also explain the apparently very small presence of pig producers in June Survey data for the High Weald. Because of these data limitations, pork and poultry meat will be excluded from further modeling and calculations, although these commodities will be referenced in associated commentary where this is possible.

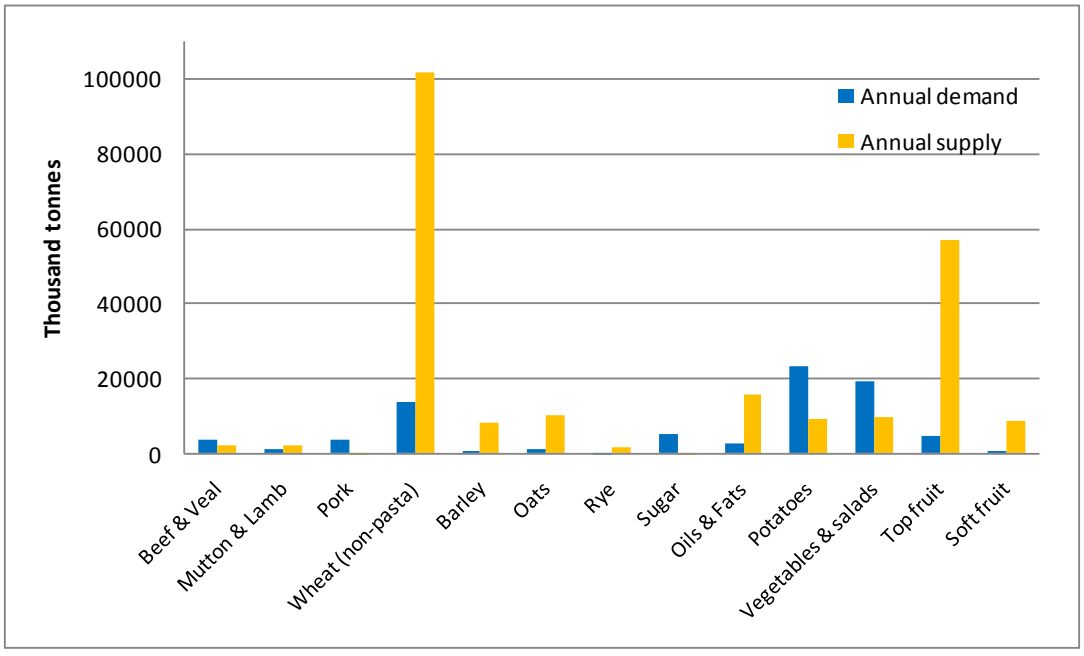
5.3 Current level of self sufficiency

In terms of self-sufficiency it is apparent from Table 7 (and Figure 4) that some agricultural commodities are significantly over-supplied in the High Weald, while others are under-supplied. For crops, there is a surfeit of cereals, oilseeds and indigenous fruit, but shortages of sugar beet, potatoes and fresh vegetables and salads. For livestock products, the High Weald would appear to be over-supplied with milk and lamb, but under-supplied with pork and beef.

Table 7 – Level of food self sufficiency notionally obtainable in the High Weald, based on current food demand and commodity supply

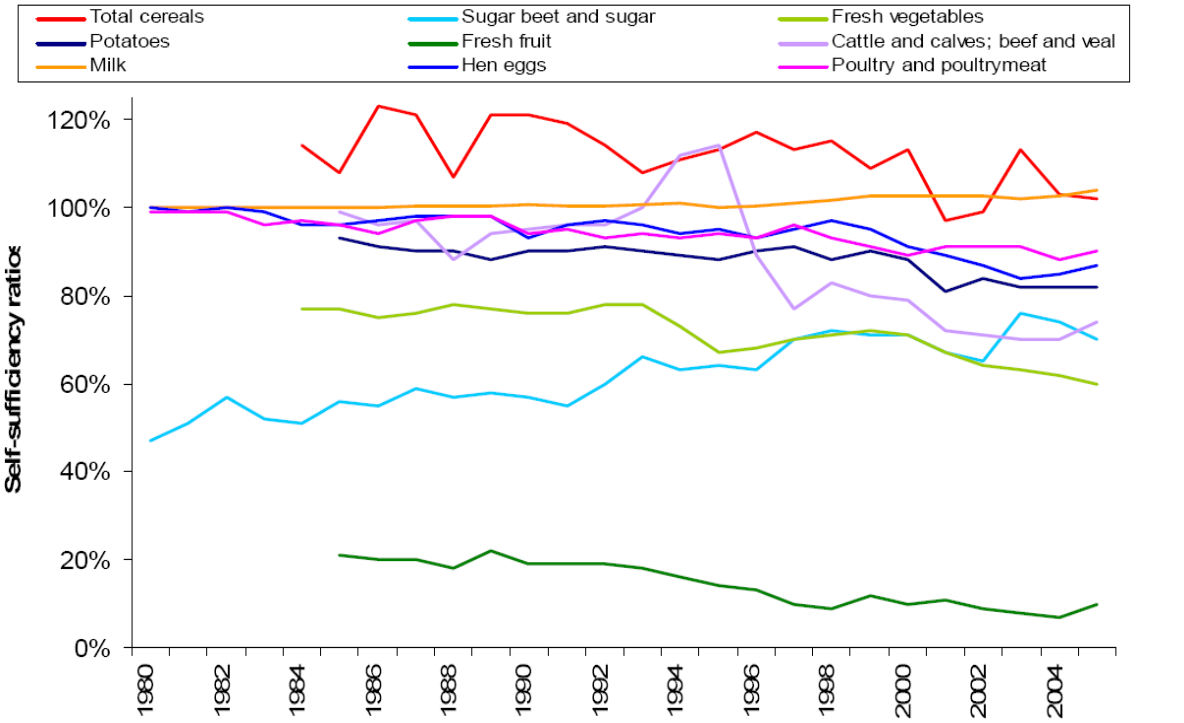
Agricultural commodity	Total annual AONB food demand (million litres, tonnes, million eggs)	Total annual volume of output from the High Weald (marketed) (tonnes, million eggs, million litres)	AONB self sufficiency rates (%)
Milk	64	81	128
Beef & Veal	3502	2047	58
Mutton & Lamb	1023	2293	224
Pork	3445	111	3
Poultry	4253	-	
Miscellaneous meats	944	-	
Eggs	148	-	
Wheat (non-pasta)	13759	101581	738
Barley	705	8292	1176
Oats	967	10311	1067
Rye	91	1547	1702
Sugar	5185	100	2
Oils & Fats	2627	15880	605
Potatoes	23401	9315	40
Vegetables & salads	18967	9418	50
Top fruit	4810	56726	1179
Soft fruit	500	8419	1680

Figure 4 – Estimated annual food demand and supply in the High Weald AONB



Before taking these self sufficiency rates as hard and fast points of reference, a number of other issues need to be considered. Foremost amongst these is the issue of the seasonality of production. Because of the limited growing season in the UK, 100% self sufficiency for some commodities could never be achieved, even if the product was over-supplied in season. The impact of seasonality will vary by commodity, according to the length of the growing season and its storage potential. It is beyond the scope of the current project to assess, on a case by case basis, the effects of seasonality on maximum obtainable self sufficiency rates, but indicative rates might be assumed from an examination of data on the maximum levels of national self sufficiency in the main food commodities achieved over the last 20 years, (see Figure 5). From this figure it can be seen that, on an indicative basis, self sufficiency levels of 100% could reasonably be expected for cereals, milk and lamb, with an approximate self sufficiency level of, say, 75% for fresh vegetables, and perhaps around 20% for fresh fruit, including non-indigenous types – even though these food products are seriously over-supplied, in season, in the High Weald.

Figure 5 Self sufficiency ratios for various commodities in the UK, 1980-2006



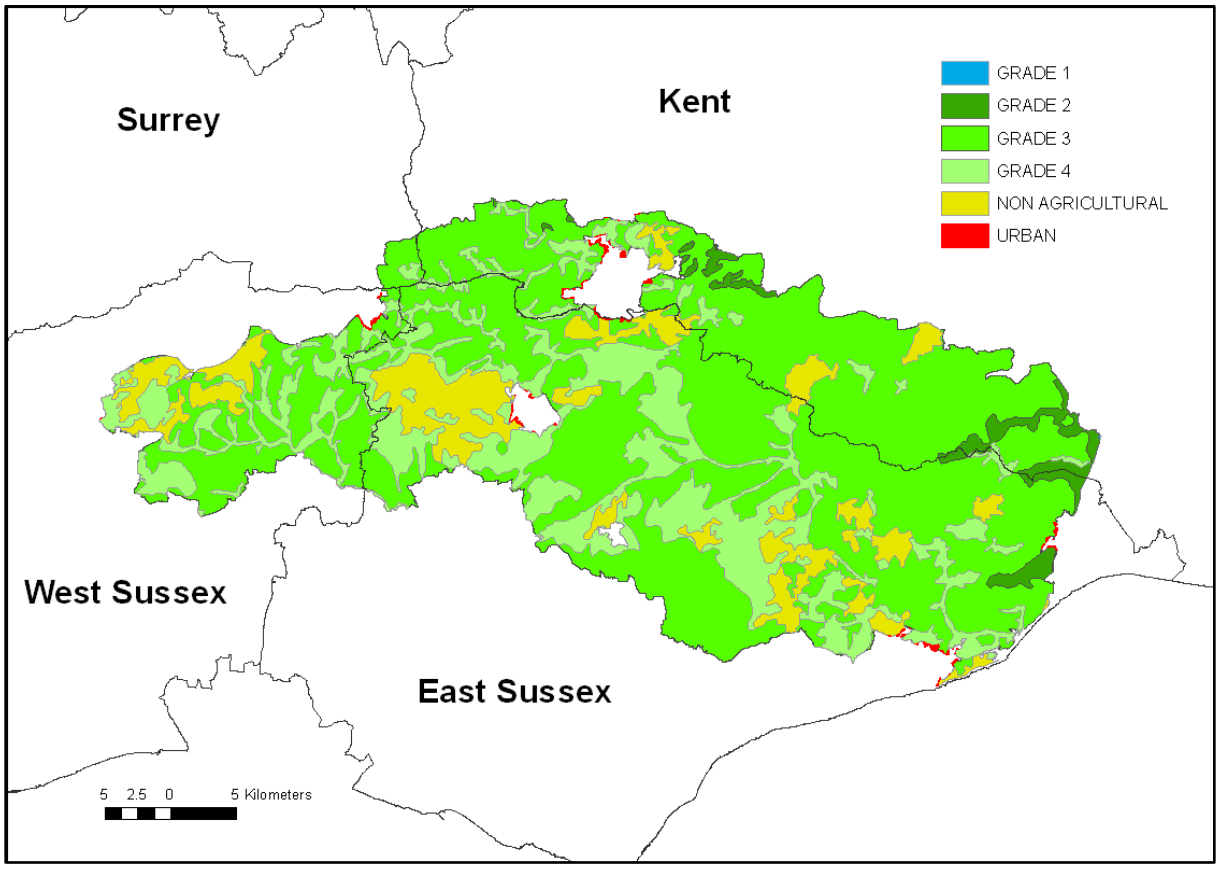
Source: Defra, Agriculture in the United Kingdom, 2005

6. To what extent could food self-sufficiency in the High Weald be improved?

6.1 A quadratic programming model of High Weald agriculture

There is an obvious imbalance between the current food requirements of the High Weald population and the supply from local agriculture. However, there exists the possibility of adjusting that supply, through changed land use, to reduce this imbalance. This section of the report explores the extent to which it might be possible to change the balance of agricultural commodity supply to increase the notional level of food self sufficiency in the High Weald AONB. The basis of this analysis is a quadratic programming model of agriculture in the High Weald. The model captures the agricultural land base in the High Weald, excluding urban areas, water bodies, roads, woodland and other land not used for agriculture. The agricultural land base is partitioned into zones, based on the productive capacity of the various areas of land. This involves the use of the Defra Agricultural Land Classification system (see Figure 6), overlaid with GIS-based data on basic land cover type, i.e. arable land, leys, permanent pasture and rough grazing. By using these two classifications the High Weald agricultural land base has been partitioned into 13 separate zones, as shown in Table 8 below.

Figure 6 – Agricultural Land Classification of the High weald



The model contains an array of agricultural activities for field crops, horticulture and livestock enterprises, each of which uses land. The model objective is the minimization of the difference between actual commodity production and estimated commodity demand in the High Weald. The agricultural activities can be produced at a range of yields per ha depending on the grade of land that is used. These yields are based on appropriate averages for England, with these crudely weighted to reflect the yield potential of each Grade of land modelled. The model is structured such that land cannot transfer from one Grade to another, implying that the basic productivity of land cannot be significantly changed.

Table 8 - Permitted combinations of land cover types with Agricultural Land Classification Grades

	Agricultural Land Classification Grade			
Land cover type	1	2	3	4
Arable	✓	✓	✓	
Ley	✓	✓	✓	
Permanent pasture	✓	✓	✓	
Rough grazing				✓

As Table 8 shows, all land cover types are assumed to be possible in ALC Grades 1 – 3 (Grade 1 being the highest quality land), but in Grade 4 the quality of the land is so poor that only rough grazing is allowed in the model allocation.

Within a particular ALC grade land is allowed to move from one land cover type to another, within certain limits. For example, ley is considered to be part of the arable rotation and so the two are completely interchangeable. Some permanent pasture can also convert to arable and ley within a land class reflecting the possibility for incorporation of land into arable rotations. However, rough grazing cannot be converted to other land types because it is associated with land of generally poor quality and therefore unsuitable for the production of high yielding grasses and arable crops.

The model is constrained to use all land for something, as the abandonment of land in the High Weald is unlikely under any kind of scenario. This constraint is not an issue, except where the local demand for all commodities can be met with fewer hectares than are available. Under these circumstances the constraint may force the model may over-produce some commodities.

6.2 Model validation

The model is first run to generate a 'Reference' run and then following that it is run for a series of Scenario runs. The Reference run is necessary because the model is a simplification of reality and therefore can never be accurate enough to exactly mirror that reality; some random error will always be present. The Reference run attempts to capture present conditions, i.e. actual food production, as

closely as possible and by comparing the results of the Reference run with the current reality the extent and nature of the random error in the model is visible.

The model is not permitted to import animal feeds to support any livestock produced. In the scenario runs the model is required to maximize food and feeds self sufficiency (ie reduce imports to the AONB to zero if possible), and for that reason it is necessary to implement the same requirement in the Reference run. The consequence of this is that the model has to readjust land use to some extent to accommodate the production of a larger area of fodder crops than is the case in reality.

Table 9 shows a comparison of actual food production in the High Weald, set against the Reference run estimate of the same. This table contains summary data; full data can be found at Appendix B. From this it can be seen that the model replicates the actual position very closely, both in terms of the volumes of the various food commodities produced, and the areas of land and numbers of livestock required to produce them. From this it can be assumed that the yield estimates used in the model, and its structure, are reasonable and fit for purpose and that no significant error attaches to the scenario runs to be reported later.

Table 9 - Comparison of actual crop outputs and production areas and livestock outputs and numbers, with the Reference run estimates of the same

	Food production volumes in the High Weald AONB (tonnes unless otherwise specified)		Crop production areas (ha) and livestock numbers (LSU) in the High Weald AONB	
	2004 actual	Reference run	2004 actual (June Census)	Reference run
Cereals	121730	121729	17473	18026
Other arable crops	25295	26048	6289	6626
Field-scale vegetables	2914	2914	139	109
Horticulture crops	5750	5750	19.2	20
Top fruit	56726	56726	2201	2328
Soft fruit	8419	8419	455	479
Milk (million litres & LSU)	81	81	11632	12381
Beef (tonnes & LSU)	2047	2050	24378	24373
Lamb (tonnes & LSU)	2292	2290	25602	25758
Forage crops	n.a.	248430	n.a	9023

6.3 Results – enhanced self-sufficiency

Table 10 shows the outputs of the modeling exercise in terms of the readjustments that could be made within High Weald agriculture to meet current demand for food commodities. As can be immediately seen, the model is able to make sufficient adjustments to fully meet current food demand. Referring back to Figure 4 it is apparent that the largest adjustments would have to take place for cereals, top fruit, potatoes and vegetables and salads. Potatoes, vegetables and salads are undersupplied at present and the model has increased production to meet demand by taking land from wheat and top fruit production.

What is also apparent is that the High Weald is currently a significant exporter (out of the region) of cereals and top fruit and that, as a consequence of all land being turned to local uses, there is more land available than is necessary to meet local food demand. Because of the constraint that the model use all land, the model has accommodated this surfeit of arable land by significantly expanding the area of fodder crops. Some of this extra forage is used to support the near doubling of beef animal numbers required to meet local demand, while the remainder is assumed to represent the over-supply of a range of food commodities (fodder crops are taken as a proxy for these), from perhaps 20,000ha of land, for export from the region.

Table 10 - Current food demand compared to self-sufficiency-driven adjusted food supply

	Current food demand	Scenario run supply (enhanced self-sufficiency scenario)
Cereals	15521.3	15521
Other arable crops	33987.7	33986
Field-scale vegetables	11859.9	11855
Horticulture crops	4332.3	4332
Top fruit	4810	4810
Soft fruit	500.3	500
Milk (million litres)	63.7	64
Beef (tonnes)	3502.3	3502
Lamb (tonnes)	1023.4	1023
Forage crops		957163

Obviously High Weald agriculture cannot supply non-indigenous foods and foods out of season, so this result can be interpreted as indicating that High Weald agriculture has enough land of sufficient quality to potentially supply all indigenous food demand in season. With respect of pork and poultry meat, these are commonly produced off relatively small land areas, so there should be no barrier to self sufficiency in these foods. The issue in these cases is the supply of feeds. Most producers of poultry meat and pork buy in concentrate feeds, effectively renting additional land from elsewhere. There is no question that sufficient pigs and poultry could be produced for these purposes in the High Weald, the only question is whether the region could be self sufficient in pig and poultry feed. The likelihood is that it could, bearing in mind there would be an effective surplus of 20,000ha of arable land (see above) after meeting demand for indigenous foods in season.

7. Socio-economic scenarios

7.1 Healthier diets

7.1.1 How would food demand in the High Weald change under a DoH-compliant diet?

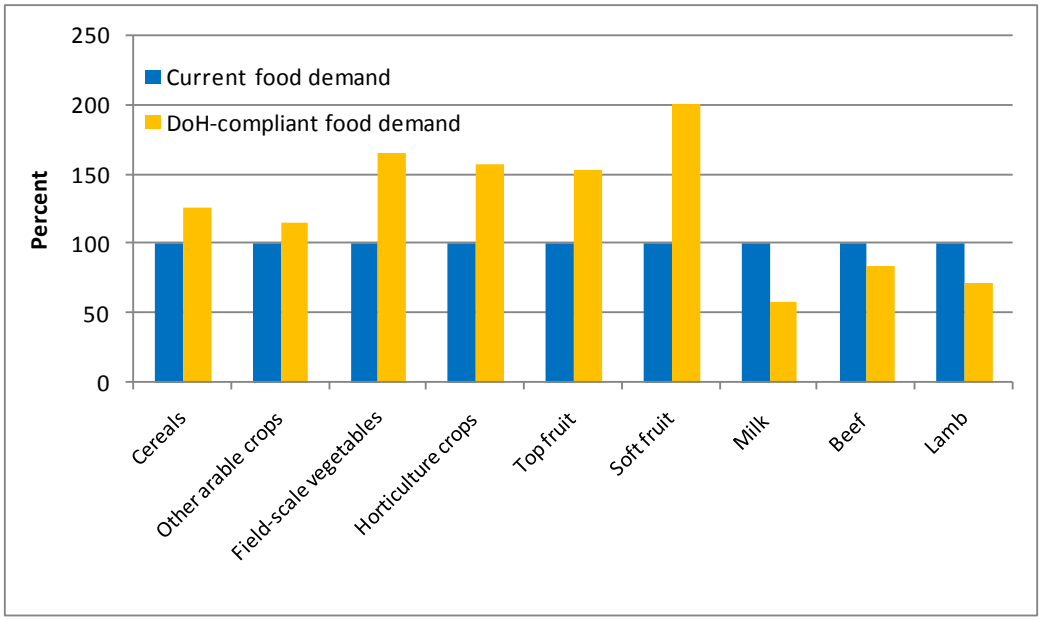
This scenario assumes a change in the dietary pattern of the population of the High Weald AONB, comprising a switch to a healthier diet. For these purposes it is assumed that the population becomes compliant with UK Department of Health guidelines on healthy eating (DoH, 1991). Other dietary guidelines are available, but it is noted that there are no significant differences in the recommendations of the DoH guidelines and those of other agencies (see, for example, WHO, 2003; USDA, 2005). A summary of the impact of these guidelines on nutrient intake can be found in Appendix C. It is estimated that, under the healthier diet, food commodity demand in the High Weald AONB is adjusted (following Arnoult, 2006), as shown in Table 11 and Figure 7.

Table 11 - Revised food commodity demand in the High Weald AONB resulting from compliance with DoH dietary guidelines.

	Current food demand	Healthier diet food demand	Percent change
Cereals	15521	19516	26
Other arable crops	33988	39023	15
Field-scale vegetables	11860	19664	66
Horticulture crops	4332	6823	58
Top fruit	4810	7374	53
Soft fruit	500	1007	101
Milk (million litres)	64	37	-42
Beef (tonnes)	3502	2961	-16
Lamb (tonnes)	1023	735	-28

Under these guidelines there would be, averaged over the population, a 25% increase in demand for cereals, with higher rates of increase for minor cereals. In addition, there would be an increase of over 50% in demand for vegetables and fruit and very significant declines in demand for dairy products and red meat. For a breakdown of changes to demand for individual food commodities, see Appendix Table C2.

Figure 7 – DoH-compliant food demand in the High Weald AONB expressed as a percentage of current food demand



7.1.2 How self-sufficient would the High Weald be with current levels of food production and DoH-compliant food demand?

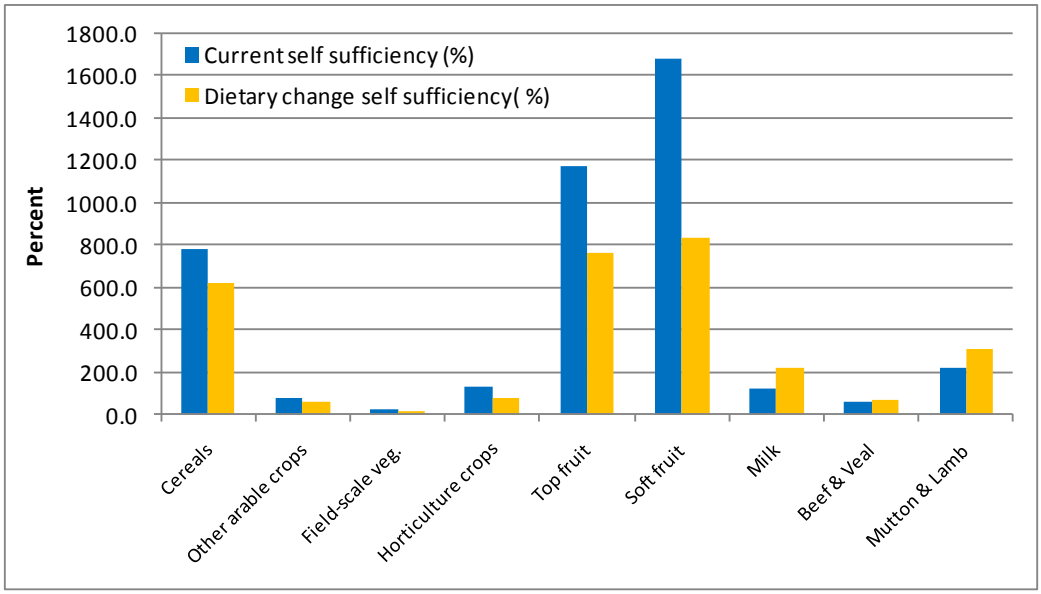
Table 13 – impact of dietary changes on food self-sufficiency in the High Weald AONB.

Agricultural commodity	Current volume of food output (marketed) (tonnes, million eggs, million litres)	Revised food demand – healthy diet (tonnes, million eggs, million litres)	Self sufficiency percentage
Cereals	121730	19516	624
Other arable crops	26049	39023	67
Field-scale vegetables	2914	19664	15
Horticulture crops	5750	6823	84
Top fruit	56726	7374	769
Soft fruit	8419	1007	836
Milk	81	37	221
Beef & Veal (tonnes)	2047	2961	69
Mutton & Lamb (tonnes)	2293	735	312

Table 13 and Figure 8 show that the adoption of a healthier diet has mixed impacts on self-sufficiency. Some products that are currently over-supplied become slightly more so under a healthier diet, for example mutton and lamb and milk, while other products would be slightly less over supplied due to increased demand, for example top and soft fruit and cereals. The undersupply of field-scale vegetables is exacerbated under a healthier diet due to increased demand. In general it can be concluded that, with production remaining as it currently is, it would not be any easier to achieve

food self-sufficiency in the High Weald should through adoption of the healthier diet, although the excessive over-supply of some commodities would be somewhat curtailed.

Figure 8 – Level of food self sufficiency in the High Weald AONB currently and under the assumption of dietary change



7.1.3 How self-sufficient could the High Weald be with DoH-compliant food demand?

Table 14 – Impact of dietary changes on food self-sufficiency in the High Weald.

Agricultural commodity	Actual food demand under DoH dietary guidelines (tonnes, million litres)	Healthy eating scenario run supply (tonnes, million eggs, million litres)
Cereals	19516	19517
Other arable crops	39023	39027
Field-scale vegetables	19664	19665
Horticulture crops	6823	6829
Top fruit	7374	7372
Soft fruit	1007	1007
Milk	37	37
Beef & Veal (tonnes)	2961	2960
Mutton & Lamb (tonnes)	735	735
Forage crops		400497

Table 14 shows the outputs of the modeling exercise, i.e. the readjustments that could be made within High Weald agriculture to meet demand for food commodities under the assumption that the

population adopts a diet consistent with DoH healthy eating guidelines. Table 14 shows that agriculture in the High Weald could respond as much as necessary to meet revised food demand. As is the case with the first scenario run, this adjustment has been made possible by the fact that the High Weald already produces a surplus (which is exported out of the region) of wheat and fruit and by scaling back supply of these commodities to a level consistent with local demand, large tracts of arable land are freed up for the production of those commodities that would be undersupplied at current levels of production. Indeed, so much land is made available that there would be a surplus even after all food demand is met. Again the model has dealt with this (i.e. in meeting the requirement that all arable land is used for something) by greatly expanding the area of forage crops – there is no constraint on the production of these in the model.

7.2 Organic agriculture

7.2.1 How would conversion to organic farming impact on the ability of High Weald agriculture to meet current food demand?

This next scenario explores the impact on food self-sufficiency in the High Weald of agriculture adopting organic methods of production. Conversion to organic agriculture would involve loss of yields in the case of most commodities and this would have an obvious impact on the ability of High Weald agriculture to supply the food needs of the local population. In order to estimate these aggregate impacts, the per hectare yield losses associated with organic agriculture first have to be estimated. For this purpose averaged organic yield estimates for the East and South East regions of England are taken from a study recently completed by the Centre for Agricultural Strategy on behalf of the Soil Association (Jones & Crane, 2009). As part of this work, data from 176 organic farms were drawn from the Defra Farm Business Survey dataset and this data was analysed to provide yield estimates for a range of agricultural commodities on a regional basis. The full regional organic yields data derived from Jones & Crane (2009) are presented at Appendix D. For those products not covered in that study, yields estimates were derived from other published sources (see, for example, Lampkin, *et al.*, 2006).

The estimation of changes in livestock yield consequent upon organic conversion is slightly less direct than is the case for crops. In the case of dairy account has to be taken of both a milk yield reduction, reflecting less intensive production, reduced use of concentrates and sometimes lower yielding breeds, plus lower stocking rates, due to the use of more grass-based feeding regimes. For beef and sheep, it is assumed that there is no reduction in yield of meat per animal, but that there is a reduction in stocking rates, with consequent reduced output per hectare.

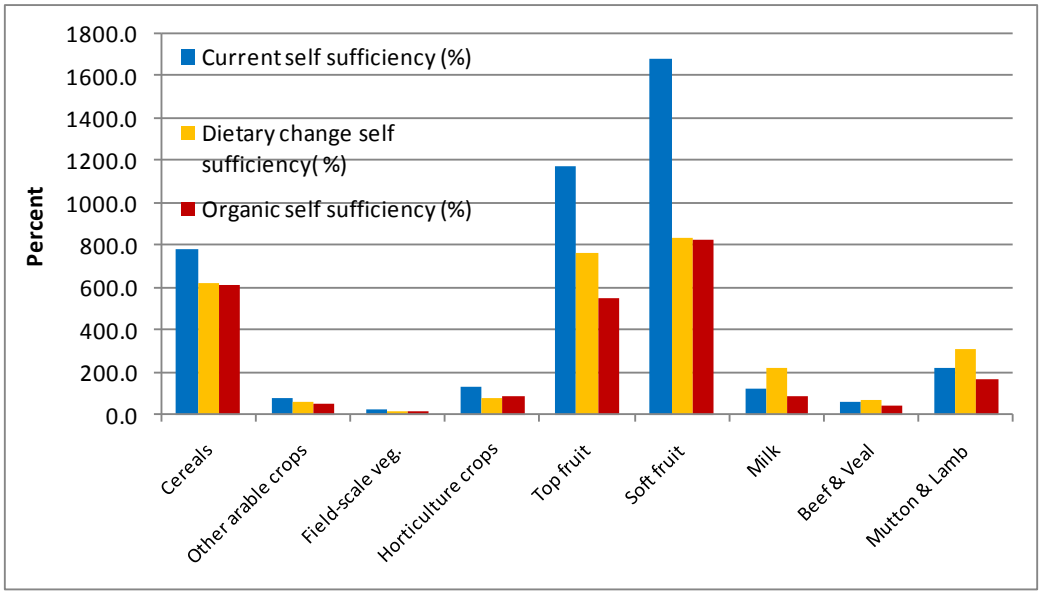
Table 15 and Figure 9 show that under organic methods of production output of cereals from the High Weald would fall by 21% and other arable crops by a little under 31%. However, even under these circumstances cereals would be over-supplied, based on current levels of demand, with 600% of the requirements of the local population being produced. Also still over-supplied would be lamb, in spite of a 23% fall in supply. The 38% fall in field scale vegetables output would aggravate the existing

under supply of these products to the local population, with self sufficiency falling to 15% under organic agriculture.

Table 15 – The impact of conversion to organic methods of production on food self-sufficiency in the High Weald under current levels of demand.

Agricultural commodity	Current conventional food supply (tonnes, million litres)	Estimated organic supply (tonnes, million litres)	Percent change	Organic self sufficiency percentage
Cereals	121730	95837	-21	618
Other arable crops	26049	18084	-31	53
Field-scale vegetables	2914	1801	-38	15
Horticulture crops	5750	3968	-31	92
Top fruit	56726	26743	-53	556
Soft fruit	8419	4126	-51	825
Milk	8143	5619	-31	88
Beef & Veal (tonnes)	2047	1576	-23	45
Mutton & Lamb (tonnes)	2293	1765	-23	173

Figure 9 - Level of food self sufficiency in the High Weald AONB currently, under the assumption of dietary change, and under organic methods of production



It is interesting to note that in spite of significant falls in the yields of crops, the self sufficiency ratio under organic methods of production is broadly similar to the healthy diet scenario for cereals and soft fruit. However, while the effect on the self sufficiency ratio is the same, this convergence is caused by loss of supply in the former case and increased demand in the latter.

7.2.2 How would conversion to organic farming impact on the ability of High Weald agriculture to meet DoH-compliant food demand?

This scenario examines how well organic agriculture could meet local food demand if that demand was based on a population diet that was consistent with DoH healthy eating guidelines. Again for this purpose the QP model of the High Weald has been used, this time with yields that are representative of those obtainable under organic agriculture.

As Table 16 shows, even under organic management practices, with associated lower yields, the model projects that High Weald agriculture could supply the food requirements of the local population when these are consistent with DoH guidelines. The model projects that High Weald agriculture could compensate for the lower yields associated with organic agriculture by expanding the area of production of various commodities, using as a resource, or land reserve, the arable land formerly given over to the production of cereals for export out of the region. This use of this land reserve is reflected in the lower volume of fodder crops produced than under the conventional healthy eating scenario. As has been previously stated, fodder crops are over-produced in both scenario runs as a way of soaking up surplus arable land.

Table 16 – Impact of dietary changes on food self-sufficiency in the High Weald under organic agriculture.

	Actual food demand under DoH dietary guidelines (tonnes, million litres)	Healthy eating and organic scenario run supply (tonnes, million eggs, million litres)
Cereals	19516	19517
Other arable crops	39023	39027
Field-scale vegetables	19664	19665
Horticulture crops	6823	6829
Top fruit	7374	7372
Soft fruit	1007	1007
Milk (million litres)	37	37
Beef (tonnes)	2961	2960
Lamb (tonnes)	735	735
Forage crops		372390

8. Increasing self sufficiency through developing the local food market

The preceding sections of this report have provided an estimation of existing agricultural production and current human consumption of food in the High Weald area. Further, consideration has been given to different scenarios based on adjusting production to optimize self sufficiency for the region and around moving to a more healthy diet. This section of the report explores some of the opportunities and barriers to moving towards greater self sufficiency through creating a more localized food network (Detailed discussion of the local food sector in the UK is contained in Appendix E).

Supermarkets and the food service sector, with their global sourcing policies, currently dominate the food supply chain in the High Weald, as with most other areas in the UK. Therefore any move towards local food self sufficiency will require significant structural changes in relation to the food distribution infrastructure and associated behavioral changes in relation to consumer purchasing patterns.

Due to the geographic spread of production and processing for many every-day food products, particularly processed multi-ingredient products, there is only a narrow range of products that may be sourced locally. For this reason the majority of existing local food sales nationally are fresh products, ie fruit and vegetables, dairy products, and meat, as well as fish in coastal areas. By coincidence it is in largely these areas that, as the analysis above shows, there is currently a disparity between consumption and production in the High Weald, with particular shortfalls in local production of beef, potatoes and vegetables. It makes sense therefore that priority should be given to the development of the local food market in these relatively high value, high volume, perishable products, as part of a policy promoting greater local food self sufficiency. This goal may be achieved by a number of means, such as expanding sales from existing business, as well as by developing new supplier businesses. Existing activities associated with these product categories in the High Weald would provide the basis from which to expand the reach and density of local food production and consumption (a detailed review of these is beyond the scope of this report). Further, some of these supplier businesses, both within the High Weald and more generally the UK, make excellent exemplars of successful business models. These exist both at a large scale, such as local food hubs which supply supermarkets (for example, Plumgarths in Cumbria), as well as smaller scale activities such as individual farmers' markets. All of these benefit from government support of various kinds, including those that focus on local food, such as Regional Food Groups and county based Food Links programs.

In addition to the structural changes in the supply chain that would be necessary to achieve greater food self-sufficiency, there is also the challenge of creating consumer acceptance. Although lots of consumers recognize the benefits of local food, many, at the moment, face numerous obstacles to purchasing large amounts of it and their good intentions are not always fulfilled. However, these three priority products are ideally suited to a local supply chain, as consumers are already aware of the benefits to be had from consuming them when produced locally, including the general

provenance and food safety of British production of beef and potatoes, as well as the freshness benefits from a short supply chain for vegetables.

In summary, there would appear to be significant potential for increasing the food self sufficiency of the High Weald, particularly for such products as beef, potatoes and vegetables. Efforts to develop a local food market in these products would go a long way to encouraging an increase in supply of these products, as farmers would respond to the development of niche markets, with the opportunities it provides for capturing a price premium. Further, progress towards this goal may be achieved in an incremental manner, as and when many of the contingent structural and behavioral changes are implemented. What is apparent, however, is that change of this kind will require visionary and enduring leadership at all levels, from individual suppliers and retailers to policy makers.

9. Discussion and conclusions

9.1 Self sufficiency

Based on current levels of food demand the High Weald does not come close to total food self-sufficiency, due to a lack of balance between local food supply (production) and demand. It is apparent from the results presented above that High Weald agriculture is currently producing a very significant surplus of some food commodities, such as cereals, milk, top and soft fruit, with the bulk of production of these commodities being exported out of the region, ie the High Weald is a food exporting region. At the same time agriculture in the High Weald is under-producing other food commodities, e.g. beef, potatoes and field-scale vegetables. This imbalance results from agriculture in the region producing for the national rather than the local food market.

In general it can be concluded that changing the balance of foods demanded, i.e. by the population adopting a healthier diet, would not increase self-sufficiency rates in the absence of changes to supply (i.e. with unchanged levels of production). This observation is consistent with *a priori* expectation, because a healther diet would involve increased demand for fresh fruit and vegetables, which are more subject to seasonality and indigeneity constraints than the red meats and dairy products that would be replaced.

However, the potential is there for the High Weald to increase levels of self-sufficiency in indigenous foods, because while there are notional shortages of production of some commodities, e.g. beef, potatoes and field-scale vegetables, the land used in producing the surpluses (of wheat etc) is very much greater, in area terms, than the amount of land that would be required to make up the deficiency of products in supply shortfall.

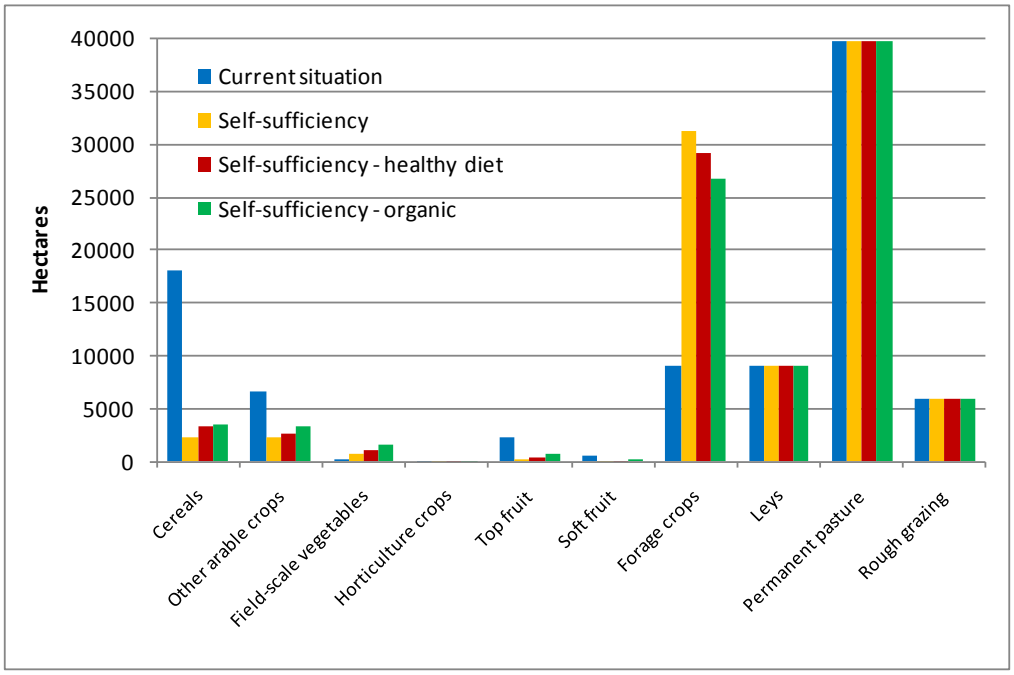
For reasons explained elsewhere, it has not been possible to include pig and poultry products in the calculations above. However, some general conclusions can be drawn with respect of these. While the hosting of these enterprises does not use very significant areas of land, even in the case of free range production, significant areas of land would be required for feed production. Given the size of the agricultural land surplus in the High Weald, and under the assumption that all land be turned over to production of food for the local market, it is likely that there would be ample spare land for the production of pig and poultry feeds and so the region could also be self-sufficient in these products.

9.2 Land use

As can be seen from Figure 10, change in the pattern of land use in the High Weald AONB, as a consequence of the scenarios, is not major. One obvious change, that perhaps needs explanation, is the switch out of cereals into fodder crops production. This change is, in fact, more apparent than real. Under current conditions, there will be some import of animal feeds into the region, in the form of concentrates and forage crops, i.e. High Weald agriculture is effectively leasing land elsewhere to supply feed stocks for animals. Because the model is constrained to supply the local food market, i.e. exports from and inputs to the region are not permitted, the model is constrained to supply all animal feed stocks. It achieves this by switching land out of cereals and other arable crops production

(which are being over-supplied) and into the production of forage crops – the area of which increases threefold. However, this should not be taken to mean that the areas of fodder crops would, under such circumstances, increase at the expense of cereals, as it is likely that, under these conditions, much the same crops would be grown as at present, but they would be destined for animal feeds rather than for the human food chain. As the figure also shows, the area of grassland remains constant. Because there is a surplus of arable land in the High Weald AONB there is no pressure (for the purposes of meeting local food demand) to bring more grassland into the arable rotation (i.e. plough it up). Also, although the model is constrained to supply all animal forage requirements, it is preferable, from a modeling perspective, to do this via increased forage crop production rather than by an increase in the area of grassland. For these reasons there is no pressure to change the area of grassland under any scenario, or change the mix of grassland types.

Figure 10 – Effect of scenarios on land use in the High Weald AONB



9.3 Farm system and structure

Obviously, increasing the level of food self-sufficiency in the High Weald would involve some changes to land use and, ultimately, farm structures. The extent of these changes would vary according to scenario. The least significant changes would probably occur under the first self-sufficiency scenario reported here, i.e. current demand levels and conventional production technologies. The driver of these changes would be the need to increase the supply of beef, potatoes and other fresh vegetables, which are currently under-supplied in the AONB. Any assessment of the consequences for farm structure of these changes in land use is complicated by the land use and structural changes in train as the result of both the recent (2003) reform of the CAP, and current market conditions. Most commentators suppose that the de-coupling of Pillar I support payments will lead to more market-oriented production decisions, the consequence of which will be a loss of economically marginal enterprises, particularly in the livestock sector. This might lead to the simplification of farm systems,

as marginal enterprises are abandoned, and an acceleration of the loss of less efficient producers. One of the most significant on-going changes in the UK agriculture sector at present is consolidation in the dairy sector, driven by years of low milk prices, with less efficient producers ceasing production and remaining producers increasing average herd sizes and average milk yields. A consequence of this will be that with fewer, more productive, dairy animals, there will be reduced beef supply from the dairy sector. This will impact on the ability of High Weald agriculture to raise beef production to meet local demand and there would need to be more dedicated beef herds than would otherwise be the case. Increased beef production may take place on farms that cease to be dairy units, but many of these will be sold off, often as lots, to multiple buyers. Many of these smaller lots will be bought by incomers to agriculture, some of who may farm beef animals for lifestyle reasons. Some of this land will of course be removed from agricultural use. An increase in small-scale beef production is a distinct possibility as a result of the recent CAP reforms and the re-structuring in the dairy sector and this trend lends itself to an increase in direct marketing and short food chains supplying the local market. In terms of structural change in the agriculture sector, the general trend is for a polarization of farm systems, with a proliferation of very small-scale farms (hobby and part-time farms) and an increase in the average size and intensity of an increasingly small number of remaining commercial farms. Whether the recent CAP reforms will accelerate this trend, as expected, is open to debate. If the recently experienced rises in food prices continue in the longer term, this will have the effect of retaining more marginal production and producers, as they remain in profit on the basis of market returns alone. However, higher market returns will also make more capital available to the industry and this will increase levels of investment in new technologies and may also drive changes in land ownership. In this context, increased local demand for beef would further enhance beef prices and the consequence of this would likely be to retain former dairy producers in the industry, but as beef producers, operating beef suckler herds.

The consequences, for farm structure, of a drive to increase the supply of vegetables and salads (to meet current demand) would be less extreme. The increased supply would be most likely to come from existing arable and horticulture producers, as the areas of land required to meet presently unfulfilled demand would be relatively small. Also, the extent to which unfulfilled demand for these products could be met is also constrained by seasonality and indigeneity issues. It has been assumed above that a maximum of around 75% of total demand for vegetables and salads could be supplied by domestic producers. This would mean local producers in the High Weald increasing production of these products, from the current area of around 500 ha, by around 20% (as they currently supply around half of local demand). An increase in supply on this limited scale could be met by existing producers without the requirement for wholesale farm restructuring. This would involve the diversion of relatively modest areas of land from cereals production (i.e. the better quality land) to the production of potatoes, field-scale vegetables and some salads, as well as an increase in the area under protected horticulture production, i.e. using both glass and polytunnels. The total area of protected crops in the High Weald AONB, according to June Survey of Agriculture data, is around 20 hectares and so this might as much as double in area, particularly if there is a need to extend the growing season to maximize market share. Some increase in the potatoes and field-scale vegetables area might occur in any event, as a consequence of the CAP reforms, as it is no longer necessary to produce cereals, oilseed and protein crops (the former 'eligible' crops) in order to receive support payments

(i.e. the move away from the area based payments system to the Single Farm Payment). An increase in root crops production might also be desirable from the point of view of benefiting arable rotations. There might be some constraint put on an expansion of the horticulture area arising from availability of labour, but the additional labour requirement would likely be met readily enough from the casual and migrant workforce.

The impact of a change to a healthier diet would be to reduce demand for beef, so the current under-supply would no longer be an issue, and it would also increase demand very significantly for vegetables and salads. Demand for cereals and fruit would also increase, but these are already being heavily oversupplied in the AONB. The higher demand for vegetables and salads (around 60% higher) would mean that more former cereals land would have to be diverted to the production of these products, in order to achieve self sufficiency, than under the conventional demand scenario. There would probably be no requirement to plough up permanent pasture to meet this additional vegetables and salads demand, but there might be a small reduction in the area of grass leys. Under the conventional self-sufficiency scenario the area under production of these crops would have to increase by about 20% to meet feasible demand, under the healthy eating self-sufficiency scenario, the area would have to increase by a further 60% or 360ha, taking the total planted area to 960ha. An increase in production area of this magnitude would be well within the capability of existing arable farms as far as field-scale vegetables is concerned, but such an increase in horticulture outputs would perhaps be beyond the reach of existing producers and so new horticulture enterprises and farms would have to be established. As the establishment of glasshouses is expensive, this would probably lead to an increase in the area of polytunnels. Under the healthy eating self-sufficiency scenario, with both increased demand and a higher share of domestic demand being met from local production, the area of protected crops grown could feasibly be expected to rise from 20ha at present, to nearer 60ha.

The most significant changes to farm structure would probably occur under the organic conversion self-sufficiency scenario, due to both lower crop and livestock yields and the farming system changes that would be required under organic methods of production. The most significant change would be the introduction onto arable farms of new rotations involving legume-based leys, most of which would carry livestock. These legume-based leys are necessary to maintain soil fertility, particularly nitrogen, in the absence of inorganic fertilizers. Under organic systems, even on arable farms, perhaps up to a third of the total area would be leys at any one time. Effectively, specialist arable farms in the AONB would cease to exist, with these being replaced by mixed arable and livestock farms. As the introduction of dairy infrastructure is prohibitively expensive, most of these new livestock will be beef and sheep, with these being produced largely under grass-based feeding regimes at fairly low stocking rates. The loss of specialist arable farms and their replacement with mixed farm types would have a very significant impact on the landscape of the High Weald, leading to the establishment of significantly more grazing land, and perhaps also an increase in livestock fencing and hedges. It is also possible that field sizes would decline due to the need to accommodate stock and more complex farm rotations. Significant improvements in biodiversity would result from these changes. Labour use in agriculture in the High Weald would also increase, perhaps by as much as 70% (Jones and Crane, 2009), due to a combination of: higher rates of mechanical crop protection operations; higher rates of livestock management; and more complex farm rotations. This may require additional housing for farm workers. The trend towards much larger dairy units would abate

under this scenario, as there are limits placed on dairy herd sizes by organic certification standards, for example, the requirement that all livestock must have access to grazing; this would prohibit indoor reared herds for example. The more complex rotations found on organic farms would mean an increase in the number of smaller-scale enterprises, particularly livestock, and this may provide a stimulus to the development of more direct and short-chain food marketing. Because of lower yields, more land would be required to produce the food demanded, but this would not mean more land being brought into production in the High Weald AONB, for example former set aside land, as the AONB has a surplus of land with respect of meeting local food demand.

9.4 Conclusions

A surplus of agricultural land, relative the size of the resident population, allows High Weald agriculture considerable flexibility to readjust production to meet the local food needs under all of the scenarios examined here, including a move to a healthier diet and the adoption of organic production practices. The High Weald could therefore be as close to self sufficiency as it is feasible to be in indigenous and in-season foods under the scenarios, even after accounting for food losses in the supply chain. This conclusion is of course heavily dependent on the assumption that all land in the High Weald AONB be turned over to meeting the food requirements of the resident population, rather than the supply of the national and international food market. In effect this assumes that the best financial returns are available from the supply of the local food market.

Of course, the issue arises of how local food chains could be encouraged to develop to the extent necessary to make a noticeable contribution to local food self sufficiency. Fortunately, consumers are already well disposed to short supply chains for the three priority products (those currently under-supplied) identified from the analysis, i.e., beef, potatoes and vegetables. Further, successful business models for the local supply of these products already exist, such as local food hubs for supermarket distribution, or direct selling at farmers markets. However, progress will only be achieved in increasing self-sufficiency levels through sustained leadership of the numerous individual projects that would contribute, incrementally, to the changes to the food chain that would be required.

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Appendix A – Estimation of bone content of animal carcasses

After slaughter, there are three points in the food chain where there are losses (by weight) to animal carcasses. These are:

1. Carcass dressing
2. Carcass cutting
3. Consumer exclusion

1. Carcass dressing

After slaughter, certain parts of an animal carcass are routinely removed (a process known as dressing) at the abbatoir, these being the head, tail, lower legs and the viscera (which contribute to the offals), hide, some fat and blood vessels.

2. Carcass cutting

The dressed carcass is portioned up into cuts for sale. This will lead to losses of more of the carcass such as some fat and some bones (from cuts that are sold boneless). Some meat cuts will however be sold bone-in.

3. Consumer exclusion

While come cuts of meat are purchased bone-in, these bones will be excluded by the consumer at some point before meat consumption. The rate of bone-in meat purchases varies according to species, with very low proportions for beef, and much higher proportions for lamb and poultry. Appendix table A.1 shows carcass weight losses at each stage in the processing chain and the resultant proportion of the dressed carcass that is available for consumption.

Table A.1 – carcass weight loss at each stage in the processing chain

Processing stage	Losses at each stage of the processing chain (%)			
	Beef	Lamb	Pork	Poultry
Carcass dressing	38	46	26	12.5
Carcass cutting	43	25	26	12.5
Consumer exclusion		10	9	18
Percent of dressed carcass available for consumption	57	65	65	69.5

Sources: Wulf (1999); Juniper (2003).

Note to table: These data have been drawn from multiple sources, some of which are taken from the US context . The data should therefore be treated as illustrative only.

Appendix B - comparison of actual food commodity production in the High Weald AONB with the QP model Reference run outputs

	Actual food commodity production in the High Weald ('000 litres, tonnes)	Reference run food commodity production ('000 litres, tonnes)
Wheat	101580.7	101580
Barley	8291.7	8292
Oats	10310.6	10310
Minor cereals	1547.1	1547
Vining peas	645.8	646
Beans	107.1	107
Peas & beans for stock feed	N. A.	9573.7
Potatoes	9315	9315
Sugar beet	100.4	100
Oilseed	14268.2	14268
Linseed	1612.1	1612
Cabbage	518.6	518
Brussel sprouts	35.1	35
Cauliflower	175.1	175
Salads	364.3	364
Other green vegetables	27.7	28
Carrots	819	819
Turnips & swedes	81	81
Other root vegetables	247.9	248
Onions, leeks, shallots	564.6	565
Miscellaneous vegetables	81	81
Other protected crops	2497.5	2497
Cucumbers	1692	1692
Tomatoes	1560.9	1561
Apples	48600	48600
Pears	4189.9	4190
Stone fruits	3936.2	3936
Other soft fruits	8419.4	8419
Fodder crops	N.A.	238856
Milk	8143	8100
Beef	2047.3	2050
Lamb	2292.5	2290

Appendix C - A summary of the impact of the DoH healthy eating guidelines on nutrient intakes

Table C1: Nutrient intake recommendations (DoH, 1991)

As percentage of energy intake			As quantities per day	
Total fat	33%		Cholesterol	< 300 mg.day-1
SFAs	10%		Salt	< 6 g.day-1
TFAs	< 2%		Sodium	< 2.36 g.day-1
MUFAs	12%		Fruit & vegetables	> 400 g.day-1
PUFAs	6 to 10%		Fibre	> 18 g.day-1
Total carbohydrates	<50%			
Free sugars	< 10%			
Protein	10 to 15%			

Total fat is restricted to a third of energy intake, with attention given to specific fatty acids, like saturated (SFAs) and trans fatty acids (TFAs), which increase the levels of blood lipids and the risk of coronary heart disease. Cholesterol, which is the source of the same kind of condition, is restricted as well. Conversely and to offset the intake of those fatty acids, levels of mono– or polyunsaturated fatty acids (MUFAs and PUFAs) are kept high.

Protein and sugar (either free or as total carbohydrates) are restricted too, and so is sodium (salt), one of the very few minerals for which guidelines are given. Fruit and vegetables on the other hand are encouraged, as is dietary fibre, with daily amounts set at 400g and 18g, respectively. Although physiological requirements vary with age, gender, etc., suggested requirements for men are 2,500 kcal per day, and 2,000 for women.

Table C2 Revised food commodity demand under the assumption of compliance with DoH healthy eating guidelines

	Agricultural commodity	Total annual food demand (million litres, tonnes, million eggs)	Percent change in demand resulting from healthier diet	Revised annual food demand (million litres, tonnes, million eggs)
1	Milk	63.73411	-42.2	36.838
2	Beef & Veal	3502.249	-15.46	2960.8
3	Mutton & Lamb	1023.384	-28.16	735.2
4	Pork	3445.394	-18.23	2817.3
5	Poultry	4252.731	9.81	4669.9
6	Miscellaneous meats	943.7878	-25.54	702.7
7	Eggs	147.8222	-9.61	133.6
8	Wheat (non-pasta)	13758.83	27.15	17494.3
9	Barley	704.9982	1.84	717.9
10	Rye	90.9675	64.3	149.5
11	Oats	966.5297	19.46	1154.6
14	Sugar	5185.148	-31.38	3558
15	Oils & Fats	2626.687	-5.24	2489
16	Potatoes	23401.39	23.41	28879.7
18	Honey	68.22563	45.93	99.6
19	Cabbages	727.74	101.21	1464.3
20	Brussels sprouts	238.7897	101.21	480.5
21	Cauliflower	1296.287	101.09	2606.7
22	Salads	1068.868	45.84	1558.8
23	Peas	977.9007	71.86	1680.6
24	Beans	1796.608	34.48	2416.1
25	Other Green Vegetables	1546.448	9.81	1698.2
26	Carrots	1637.415	101.16	3293.8
27	Turnips & Swedes	352.4991	101.18	709.2
28	Other Root Vegetables	409.3538	101.21	823.7
29	Onions, Leeks, Shallots	1580.56	73.53	2742.7
30	Cucumbers	693.6272	45.79	1011.2
31	Mushrooms	602.6597	101.21	1212.6
32	Tomatoes	3036.04	51.66	4604.5
33	Misc Vegetables	3001.928	42.77	4285.8
36	Apples	2774.509	64.28	4557.9
37	Pears	807.3366	71.53	1384.8
38	Stone fruits	1228.061	16.37	1429.1
40	Other soft fruit	500.3213	101.22	1006.7

Appendix D - Weighted organic crop yields by region (t/ha)

	East	East	North	North	South	South	Wales	West	Yorks &
Wheat	6.0	4.4	4.7	4.9	6.8	5.1	4.1	4.8	5.2
Barley	3.0	3.7	8.6	5.9	4.2	4.0	3.5	4.8	4.3
Oats	2.5	2.4	3.6	3.2	2.3	2.7	3.5	2.7	4.9
Mixed cereals	3.1	2.7	N.A.	1.1	N.A.	5.6	4.1	5.6	N.A.
Oilseed rape	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Linseed	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Peas/beans (stockfeed)	3.6	2.5	1.1	N.A.	0.7	2.3	3.3	3.2	2.7
Potatoes	37.4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	27.7	19.0
Sugar beet	66.3	52.3	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Source: FBS data 2006 - authors' own calculations.
Note: Where an organic crop yield is not available, the yield for that crop from a neighbouring region is used as a replacement in the calculations below.

Appendix E - Review of the local food market in the United Kingdom

E.1 What is the 'local food' sector?

Before undertaking any discussion of 'local food' it is important to recognise that there is no a widely accepted definition of it. The most commonly used approach defines local food on the basis of the proximity of production to consumption. Within this geographic zone approach, different groups define local on the basis of a range of distances of food travel: (i) consumption within 30 miles of production (eg The National Farmers Market Association); within a county (an example of this being Direct from Dorset), within a region (eg the Peak District) or even a whole country. Other groups have developed different approaches to defining the notion of local food. For example, the Soil Association Charity[3], does not define any particular geographic criteria for local food, but rather sees it as a process, or a direction to be heading, and hence encourages continuous steps towards shortening the food supply chain. Still others define local food on the basis of consumer perception. Brown and Geldard (2008), for example, propose working towards a definition that encompasses the wide range of expectations that UK consumers have about local food, including that it is British, produced in season, produced in a specified area, sold within a limited distance of that area, and finally, considered by the consumer to be local at the point of purchase.

For some stakeholders, such as those working at a national policy level, this lack of clarity surrounding what constitutes local food presents major difficulties, the most obvious of which is that the actual size of the local food sector is difficult to determine, as there is an absence of hard information about production and sales. In part this is due to differences in definition, but there are also difficulties with collecting information from the many small businesses that make up the sector. Using a purely geographic definition (i.e. food that is sold within 30 miles of where it is produced) the local food market has been estimated at around 1.5.% of the total food market (Brown and Geldard, 2008). Using a broader geographic definition (i.e. food produced and consumed within the same English Regional Development Authority area), the local food market is estimated to be around 6% of the total food market (Defra, 2003).

E.2 Local food products, including their production and distribution

Due to the geographic spread of production and processing for many every-day food products, particularly processed multi-ingredient products, there is only a narrow range of products that may be sourced locally. For this reason the majority of existing local food sales are fresh products, i.e. fruit and vegetables, dairy products, and meat, as well as fish in coastal areas.

While this is not always the case, businesses engaged with the local food market tend to be small in scale, many of them micro enterprises, often family owned with less than five employees. Many smaller local food producers traditionally sell to local outlets, such as farm shops, farmers markets, local delis and the like. As such, local food offers existing farmers a diversification option, for both food processing and marketing. Local food also has an important incubator function, that is, it

[3] The Soil Association Charity campaigns for sustainable food and farming, and is the sister organization to Soil Association Certification which certifies organic enterprises.

provides a low-barrier route for the entry of new participants in the food market, as well as allowing for experimentation with new product lines.

Food distribution is dominated by supermarkets and food service sector who collectively account for in excess of 95% of food sales. These organisations operate on a business model that requires continuous supply of relatively consistent products, something that is difficult for many smaller producers to achieve. Interestingly, some organisations that operate in the supermarket and food service sector include local food in their sourcing policies. However, it is only a very small portion of their overall sales. Brown and Geldard (2008) report that the supermarket chain Waitrose[4] offer 1200 local products (defined as being produced within 30 miles of the branch of sale) from 450 suppliers, most of whom deliver direct to the branch. Other supermarkets are reported to have many more local food lines, such as Tesco with 7000, although they use the much larger region of England to define local. Booths, the supermarket chain based in the North West of England, reports that one quarter of the food they sell is regional. In addition, many organisations in the food service sector provide local food. These include certain NHS Trusts and some restaurants, as well as wholesalers, such as 3663, who have been reported to source 563 products from 81 local suppliers.

In spite of the worthy efforts of some of the supermarkets, it is the non-supermarket retail outlets where the bulk of local food is sold. These include independent retail outlets, such as independent butchers and bakers , food co-operatives, farm shops, farmers markets and box schemes. The efforts of fruit and vegetable gardeners also contributes to the supply of local food.

In addition to retail outlets, many local food networks also include organisations that facilitate links between businesses. Existing Regional Food Groups and the county based Food Links programs help as facilitators of these networks. Amongst other functions, a key challenge is aggregating supply, something that is very important for meeting the existing expectations and requirements of the larger food chain organizations, such as the supermarkets. Local food hubs appear to offer a business solution for this, acting as wholesalers by collecting production from a number of independent producers in the region and subsequently distributing to larger retailers and the food service sector. Plumgarths in Cumbria, is reported to be one of the oldest local food hubs in the UK with some 250 product lines from around 30 producers. They also assist with supplier vetting and sourcing, as well as product presentation.

E.3 Local food purchases

Food culture in the UK is becoming more aspirational and there is increasing demand for healthier foods that are more convenient and ethic ally produced, as well as meeting existing expectations in relation to taste. More and more consumers are becoming interested in what they eat, where their food comes from, and how it is produced. A strong and growing interest in local food and seasonal products is part of this trend. The Slow Food movement, which emerged in Italy almost 20 years ago in response to the opening of a 'fast food' McDonalds Restaurant in Rome, is an extreme manifestation of this trend.

[4] Waitrose, according to Brown and Geldard (2008), are the leading local food supermarket in the UK.

As previously discussed, local food may be purchased from many different outlets and in different types of purchasing events, ranging from everyday shopping at supermarkets, to more recreational trips in specialist food outlets. Local food can also be purchased when consumers are eating away from home, although the number of restaurants offering this is limited.

Consumer surveys (Defra, 2008e; FSA, 2003 and 2007) have identified strong emotional drivers that underpin purchasing of local foods, although these are moderated by strong countervailing barriers to purchasing it. The main reasons for buying local products are: (i) public perceptions of high standards of freshness and taste (particularly for fresh fruits and vegetables) as well as authenticity (by not being associated with mass production) and knowing the source or provenance of the product; (ii) support for local community, including the food producers and retailers, many of whom are located in small towns and rural areas; and (iii) perceived environmental benefits resulting from, for example, more sustainable transport arrangements.

However, as mentioned above, there are barriers to the purchase of local food, which are more often practical in nature. These include: restricted availability (supply), which can add to the time associated with food shopping; the lack of information on what and where to buy, a result from limited promotion; and cost (local food may be more expensive than the bulk produced commodity equivalent). Associated with the issue of limited availability is the seasonality of local production, although this may also be seen as a marketing advantage, as scarcity and exclusivity due to limited supply, can provide a justification for significant price premia.

Market research suggests that most consumers buy at least some local food, but that they generally buy relatively small amounts and a fairly narrow range of products. While local food consumers are therefore evident in all demographic segments, the heavy users tend to be older, married women living in rural areas. Interest in local food also tends to be higher when eating at home, rather than when eating out. One recent study (Defra 2008e) which profiled buyers according to the amount of local food purchased, identified the following four segments:

- Devotees (23%) who buy frequently
- Persisters (25%) who make an effort to buy based on the perceived benefits
- Abstainers (36%) who find it difficult to overcome the barriers to purchase despite having some recognition of the potential advantages
- Cynics (16%) who don't buy at all

In terms of expanding the local food market, the study concludes that the most effective group to target would be those in the middle ground, i.e. attempt to 'convert up' Abstainers to Persisters.

E.4 General benefits of local food

The potential benefits from a more localised food network are many and maybe considered from the economic, social, health and environmental perspectives.

In terms of the economic benefits of local food, there is potential for farmers may capture a greater proportion of the retail price for their produce (or add a price premium). There are also likely to be additional revenue streams to associated local food processors and retailers. To the extent that these additional revenues remain in the local economy, they could have a large multiplier benefit through adding to employment in other 'service' industries in the local community. An additional economic benefit, that can also accrue, is increased tourism due to local branding and recreational shopping opportunities, with this bringing more revenue into the local economy.

The main social benefit of local food is that of adding to the size and integration of local communities, many of which may be in relatively sparsely populated areas. The health benefits are seen to come from the encouragement that local food provides to the purchase of more fresh and unprocessed food products.

In environmental terms benefits may be enhanced to the extent that food miles are reduced and more 'environmentally friendly' farming methods encouraged. However, while there is an expectation that local food would result in less food miles, the evidence for this is not so clear and some Life Cycle Analyses have suggested the carbon footprint from some local foods is higher than the longer chain alternative due to the fact that they do not benefit from economies of mass transport.

An additional benefit from local food is its contribution to food security, where the goal is to provide everyone with access to safe, nutritious food which they can afford and in quantities they need. Although local food does not address all of these issues it does help to diversify the food network and therefore add to its resilience.