GCE A level

1204/01-A

GEOGRAPHY – G4
Sustainability

P.M. MONDAY, 16 June 2014

Examination copy

To be given out at the start of the examination.

The pre-release copy must not be used.

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RESOURCE FOLDER

ADVICE TO CANDIDATES

In this synoptic exercise you will be assessed on your ability to **synthesise knowledge and understanding and skills** derived from your A level course.

You are reminded that assessment will take into account the quality of written communication used in your answers.

The main focus of the material in this Resource Folder is related to two cities, Cambridge and Norwich, and the areas immediately surrounding them. There is also information about food production in the UK and some ways in which it may be increased in the future.

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CITY GROWTH

Figure 1: Selected city growth in the UK, 2000–2010

City	Rank (out of 64) fastest growing = 1	Population 2000	Population 2010	Annual percentage growth
Cambridge	2	109900	125700	1.35
Norwich	7	239400	267200	1.10
UK	-	58886100	62262000	0.56

Source: Cities Outlook 2012

Figure 2: The location of Cambridge and Norwich

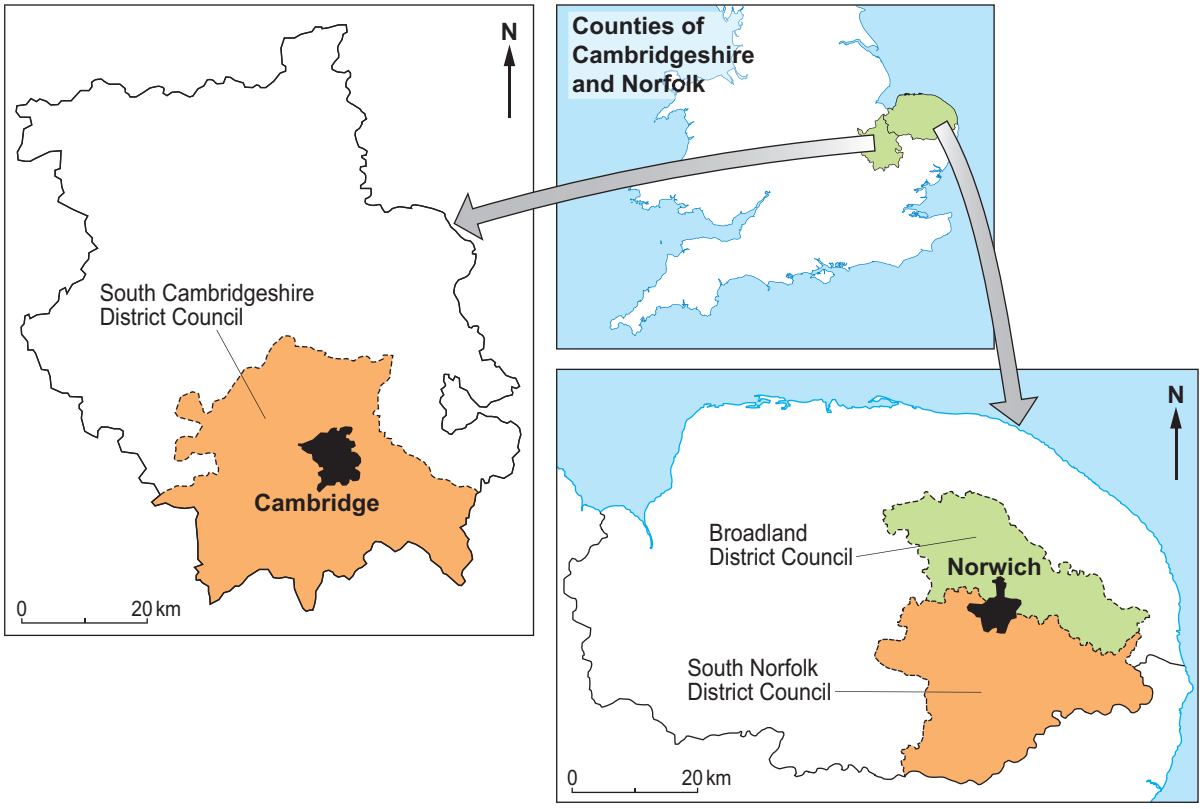

Figure 3: Projected household changes in England, 2008–2033

- The number of households in England is projected to grow to 27.5 million by 2033, an increase of 5.8 million (27%) over 2008, or 232000 households per year.
- One person households are projected to increase by 159000 per year, equating to two-thirds of the overall increase in households.
- By 2033, 19% of households in England are projected to be single person compared with 14% in 2008.
- By 2033, 33% of households will be headed by those aged 65 or over, up from 26% in 2008.

Source: www.communities.gov.uk

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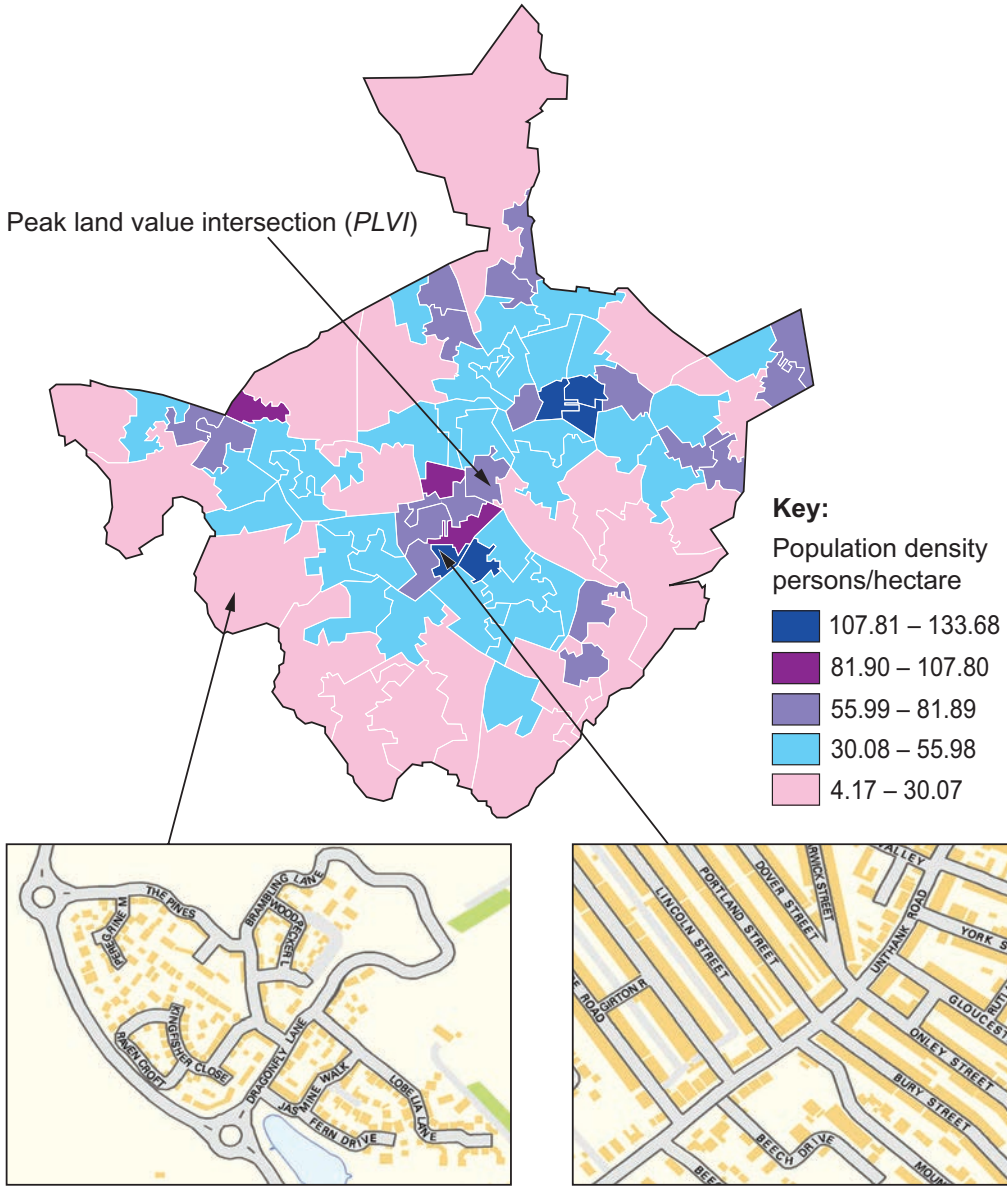
Figure 4: Population density in inner and outer areas of Norwich



A - Recent urban fringe housing estate

Population density 15 persons/hectare

B - 19th century inner city centre housing

Population density 112 persons/hectare

Source: 2001 Census and www.ordnancesurveyleisure.co.uk

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Turn over.

Figure 5: Options for accommodating city expansion

Brownfield sites

- May be toxic waste
- Re-using land
- Buildings may need to be cleared
- Often near to city centres
- Local roads may be congested
- Access to existing water and electricity supplies

Greenfield sites

- Space to expand
- Take up agricultural land
- Near by-passes
- Depend on transport
- Pleasant environment
- May be objections

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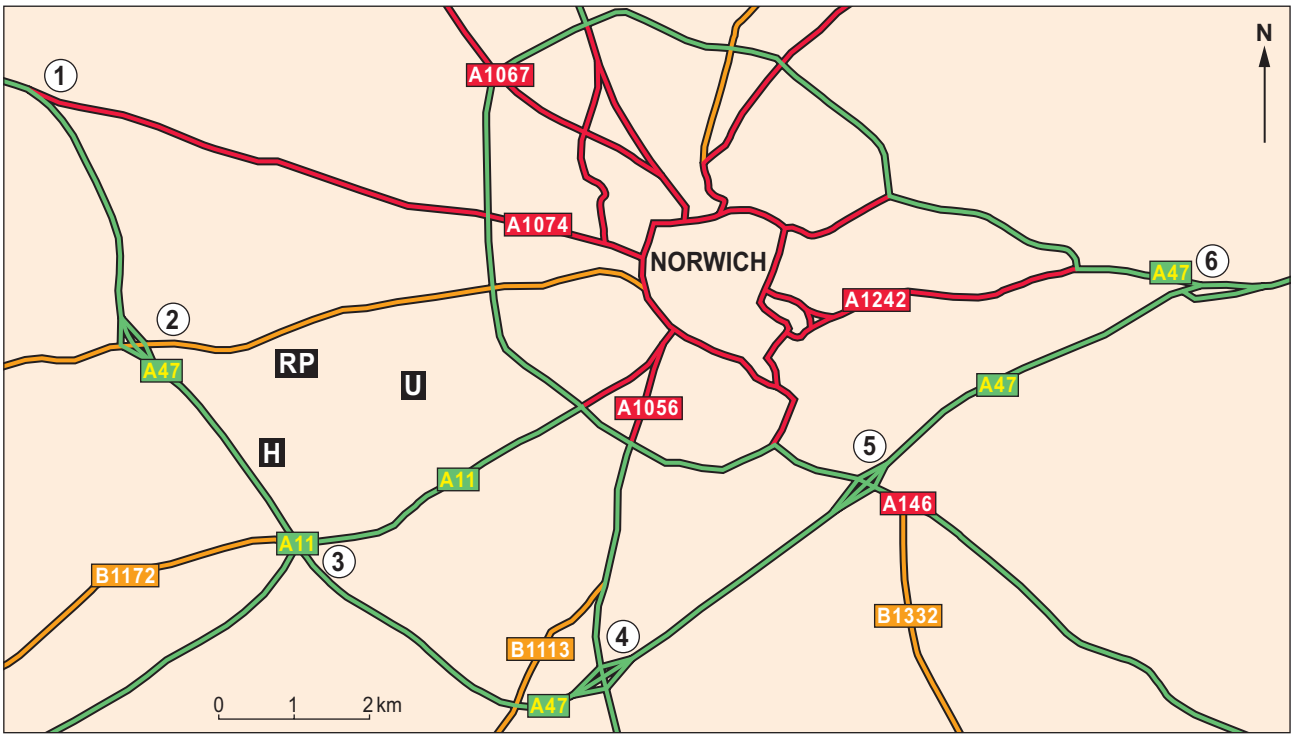
Figure 6: The southern by-pass around Norwich



The A47 by-pass to the south of Norwich was completed in 1992. The section built is between numbers 1 and 6 which are intersections with other roads. The route covers former agricultural land. There has been extensive development at all intersections with the exception of 5. Most of the development has been in the form of retail parks, but light manufacturing and distribution services are a close second. 1, 3, 4 and 6 are locations for the park and ride service. Each of these has a very large car park to cope with present, and anticipated future, demand.

Although not at an intersection, the new by-pass created easy access to a new hospital (H) allowing ambulances to avoid congestion.

The ease of access, and plenty of room for expansion, attracted a large Research Park (RP). This was located close to the University of East Anglia (U). Many leading research institutions have located there, including the John Innes Centre, a world leader in crop research.

Source: adapted from a variety of sources

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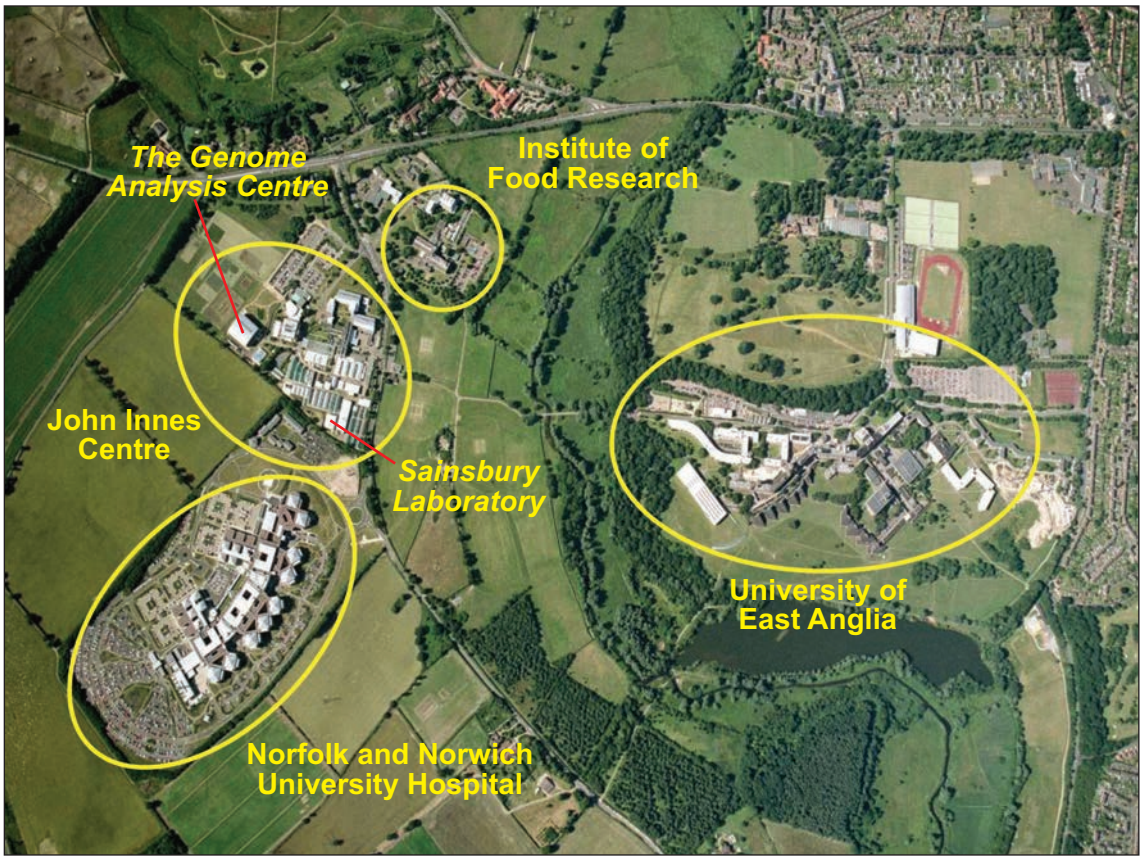
Figure 7: New developments on greenfield sites on the edge of Norwich



Source: www.norfolkfarmingconference.org/downloads/2012/Dale_Saunders.pdf

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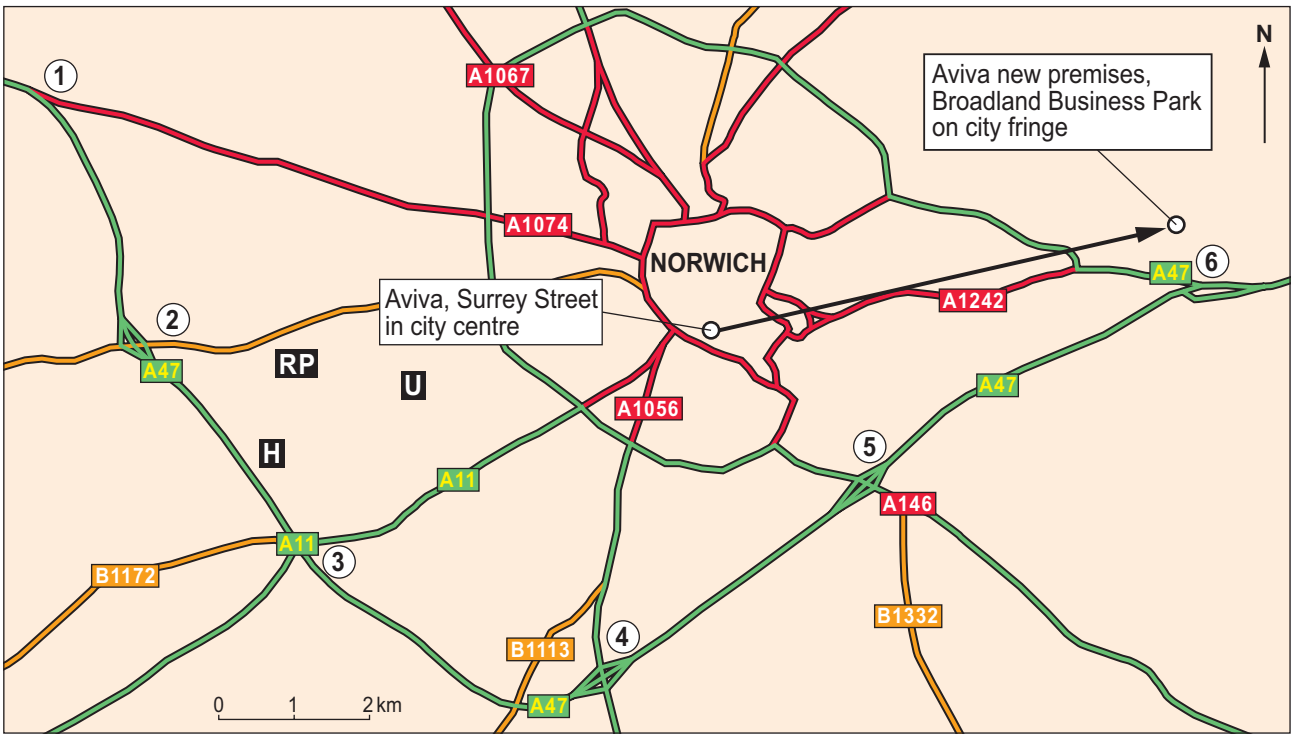
Figure 8: Relocation of part of Aviva's headquarters in Norwich



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Surrey Street

Broadland Business Park

Source: adapted from a variety of sources

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Figure 9: Actual and projected percentage population increase for Cambridge

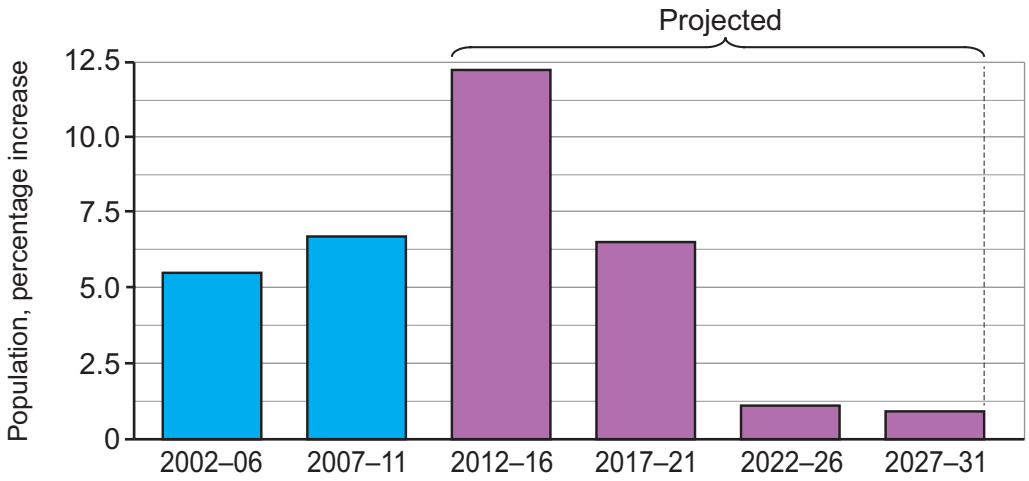
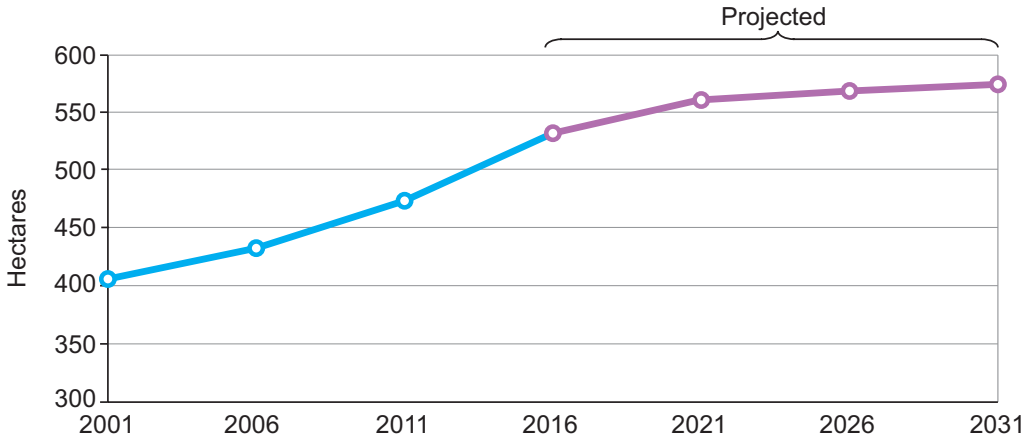


Figure 10: Actual and projected growth in areal extent of Cambridge, 2001–2031



Source: adapted from www.cambridgeshireinsight.org

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Figure 11: Proposed new town in the Cambridge area

Plans for Northstowe, the biggest new town in Britain since Milton Keynes, have been proposed, to include a 10 000 home development to the north-west of Cambridge.

The town, which could take 20 years to complete and eventually be home to 25 000 people, will be built on a golf course, farmland and a former airfield.

Plans for the first phase of the town were submitted to South Cambridgeshire District Council in February 2012. They include a primary school, shops, sports centre and open spaces. Its 10 000 homes could provide about half the new homes the council say are necessary in the area by 2031.

Key:

- Northstowe

Source: adapted from www.guardian.co.uk

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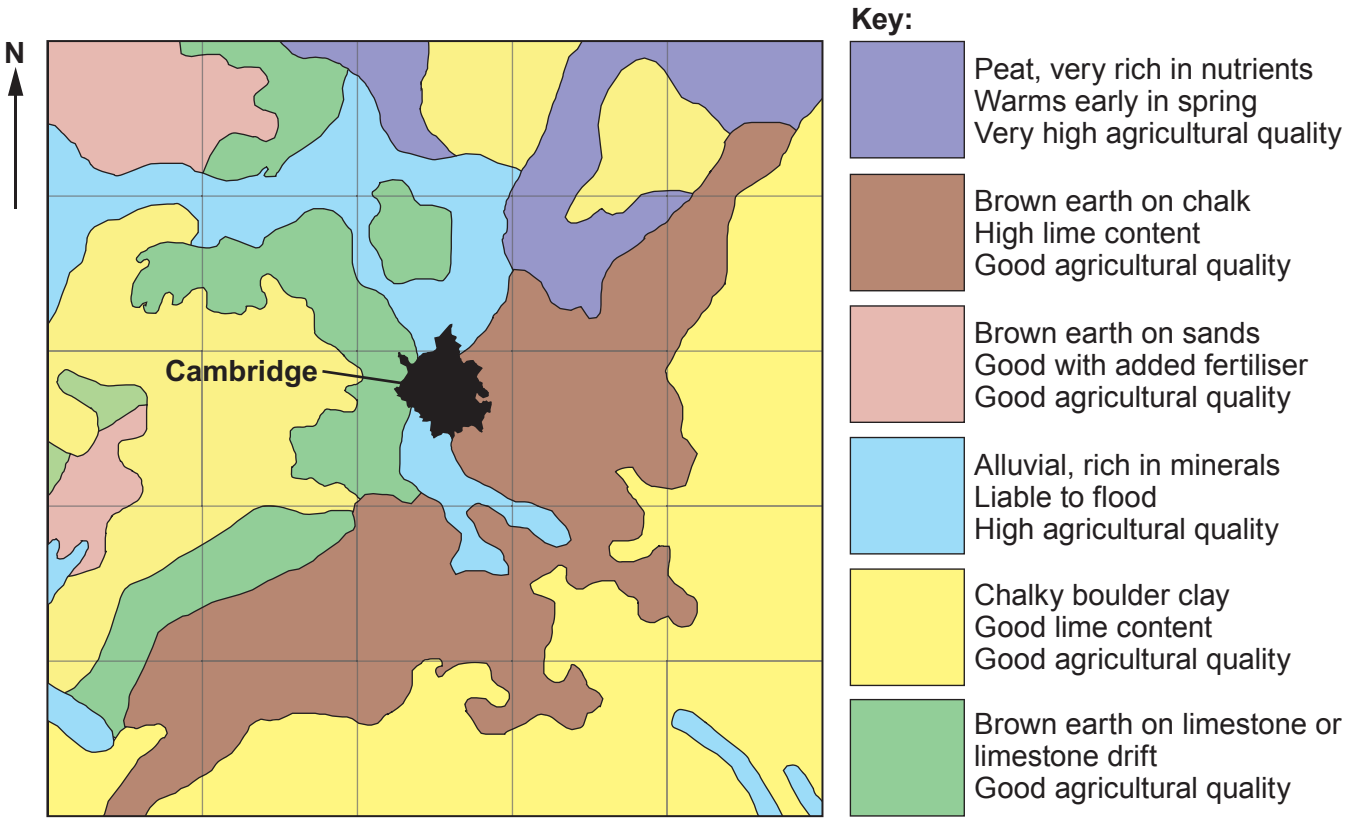
FOOD PRODUCTION

Figure 12: Mean monthly 30 year (1980–2010) climate information for the Cambridge area

	J	F	M	A	M	J	J	A	S	O	N	D
Temperature °C	4	4	7	8	12	15	17	17	15	11	7	5
Days with frost	10	10	5	3	1	0	0	0	0	1	5	8
Precipitation mm	45	33	42	43	45	54	38	49	51	54	51	50
Days with rain	10	8	10	9	8	9	7	7	8	8	10	10
Hours of sunshine	56	73	107	146	190	180	191	187	142	115	68	50

Source: adapted from www.metoffice.gov.uk

Figure 13: Soils in the area surrounding Cambridge



Each grid square covers 10 km × 10 km

Source: adapted from Soil Survey 1974, Rothamsted Research

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Figure 14: Predicted precipitation variability for the Cambridge area

Current event frequency figures	Predicted event frequency		
2012	**2040**	**2060**	**2080**
1 in 30	1 in 16	1 in 13	1 in 11
1 in 20	1 in 12	1 in 10	1 in 8
1 in 10	1 in 6	1 in 5	1 in 4

The table shows how frequently, in years, extreme precipitation events (which may lead to flooding or drought) can be expected.

Source: www.ofwat.gov.uk

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Figure 15: Requirements to produce selected foodstuffs consumed in the UK

Wheat

At least 600 mm precipitation
Temperatures in 7 – 25°C range
Spring planted 100 – 130 growing days
Autumn planted 180 – 250 growing days

UK (thousand tonnes)

Production	15 257
Export	318
Import	902

Rice

At least 1000 mm precipitation
Temperatures in 20 – 40°C range
30 – 50 days as seedlings
70 – 100 days as mature plants

UK (thousand tonnes)

Production	0
Export	0
Import	322

Poultry

No requirements for precipitation provided a water source is available
Can tolerate up to 24°C daily mean, may need shelter under 8°C
Ready for food processing between 5 and 26 weeks
Can breed throughout the year

UK (thousand tonnes)

Production	1 298
Export	227
Import	339

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Figure 15: Requirements to produce selected foodstuffs consumed in the UK (continued)

Haricot beans (for baked beans)

At least 700 mm precipitation
Temperatures in 19 – 28°C range
Currently will not tolerate frost
90 – 120 days from sowing to harvest

UK (thousand tonnes)

Production	0
Export	0
Import	183

Potatoes

At least 500 mm precipitation
Needs 150 mm per month whilst growing
Temperatures in 6 – 25°C range
120 – 150 days from planting to lifting

UK (thousand tonnes)

Production	6 115
Export	554
Import	1 670

Bananas

At least 900 mm precipitation
Temperatures in 27 – 30°C range for optimum growth
Growth stops below 13°C
300 – 450 days from planting but can continue production when mature

UK (thousand tonnes)

Production	0
Export	0
Import	927

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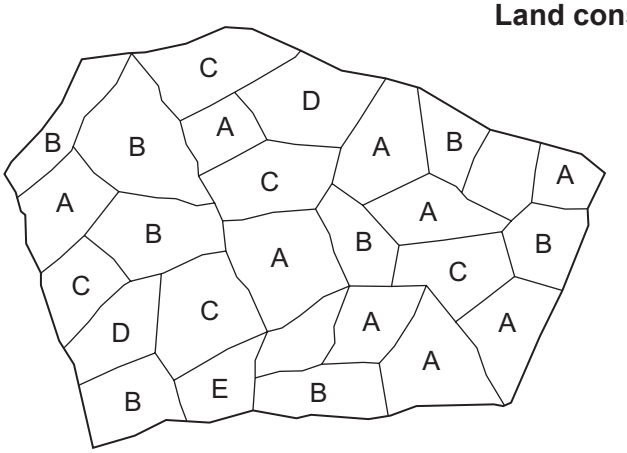
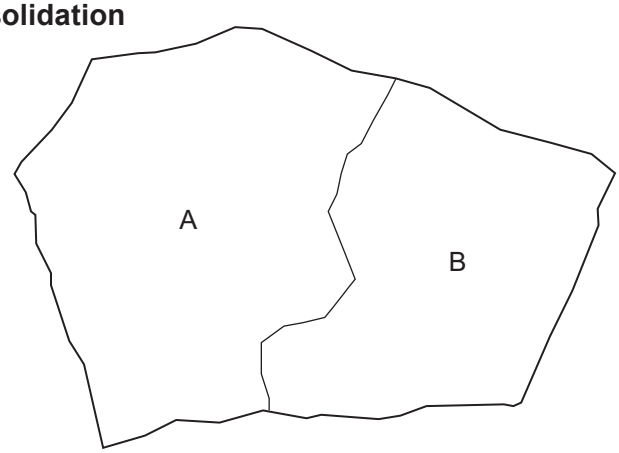
Figure 16: Selected improvements in agriculture that have been widely adopted

Land consolidation



1990
Land belonging to farmers A, B, C, D and E



2010
Land belonging to farmers A and B.
Farmers C, D and E have gone out of business

Genetic modification

Control of pests

Bt maize (a genetically modified crop) is affected by four main insect pests - stemborers, aphids, moths and weevils.

Modification has allowed control of these four types to be achieved as follows:

- excellent control of 1 pest
- good control of 2 pests
- some control of 1 pest
- no control of other types

Irrigation

Drip

Jet

Sources: adapted from www.oecd.org; www.tamilnet.com; www.bia.gov; http://newschoolthoughtsonafrica.files.wordpress.com; www.crida.in and www.countryfarm-lifestyles.com

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Figure 16: Selected improvements in agriculture that have been widely adopted (continued)

Growing under plastic

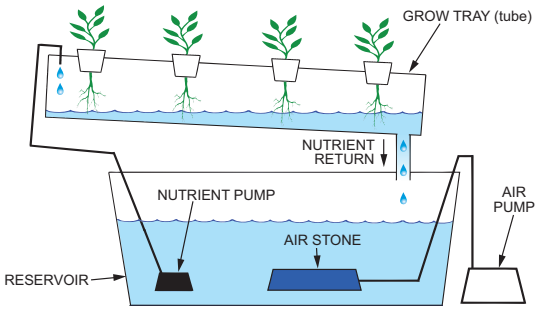
- Temperature and humidity can be raised under plastic sheets.
- Evapotranspiration can be reduced.
- High demand for labour created.
- Many protests arise about plastic sheets being unsightly in areas of great natural beauty.

Source: hortsci.ashspublications.org

Figure 17: Selected methods of increasing food production with scope for expansion

Hydroponics

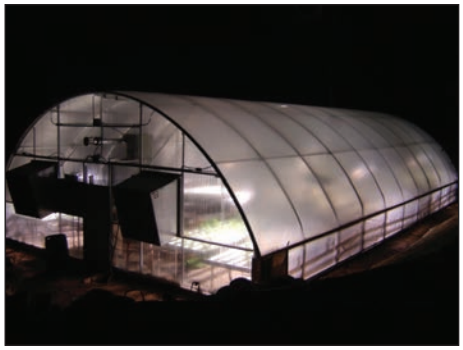
- Plants indoors with roots in nutrient solution optimised for the species.
- Artificial lighting and temperature can be adjusted.
- Largely disease and pest free environment.
- Allows growth of crops unsuited to local environment.



Aeroponics

- Similar to hydroponics but considered more productive for same inputs.
- Plants grown with roots suspended in the air.
- Nutrient solutions sprayed onto the roots at controlled times in optimum amounts.
- As with hydroponics, set up and running costs high especially for energy supplies.

Growing through the night



Source: www.hytechydroponics.co.uk

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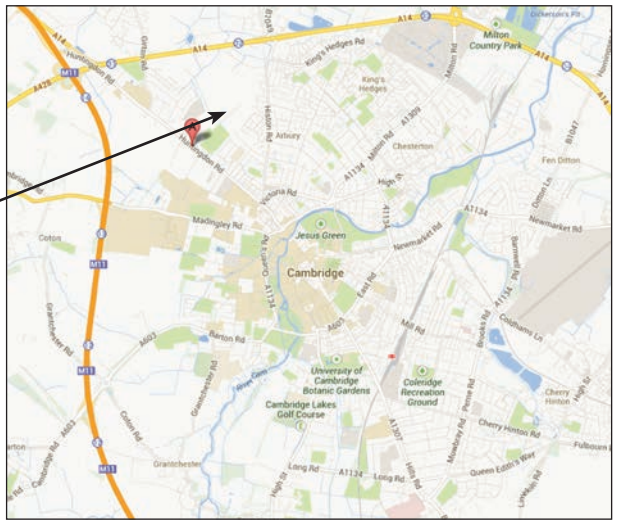
Figure 18: Example of plant research on the fringe of Cambridge



The four challenges of Innovation Farm

Sustainable resources

- Reduce inputs, e.g. disease resistance
- Input efficiency e.g. drought tolerance
- Improving biodiversity, e.g. stewardship schemes
- Alternative energy sources, e.g. willow
- Supplying specialist markets, e.g. pharmaceuticals and fibres

Food security

- Increase crop yields
- Extend growing seasons
- Improve frost resistance
- Extend growing areas
- Improve nutritional content

Health and nutrition

- Improve digestibility for humans and animals
- Healthy characteristics e.g. high in antioxidants
- Improve quality
- Pharmaceutical properties, e.g. combat the effects of Alzheimer's

Climate change

- Resistance to new pests arriving from other climates
- Increase genetic diversity to cope with change
- Suitability of inputs to changed cultivation
- Work undertaken to give consistent yield under variable climatic conditions
- Improvements to suit new UK climatic conditions, e.g. soya beans

Source: www.innovationfarm.co.uk

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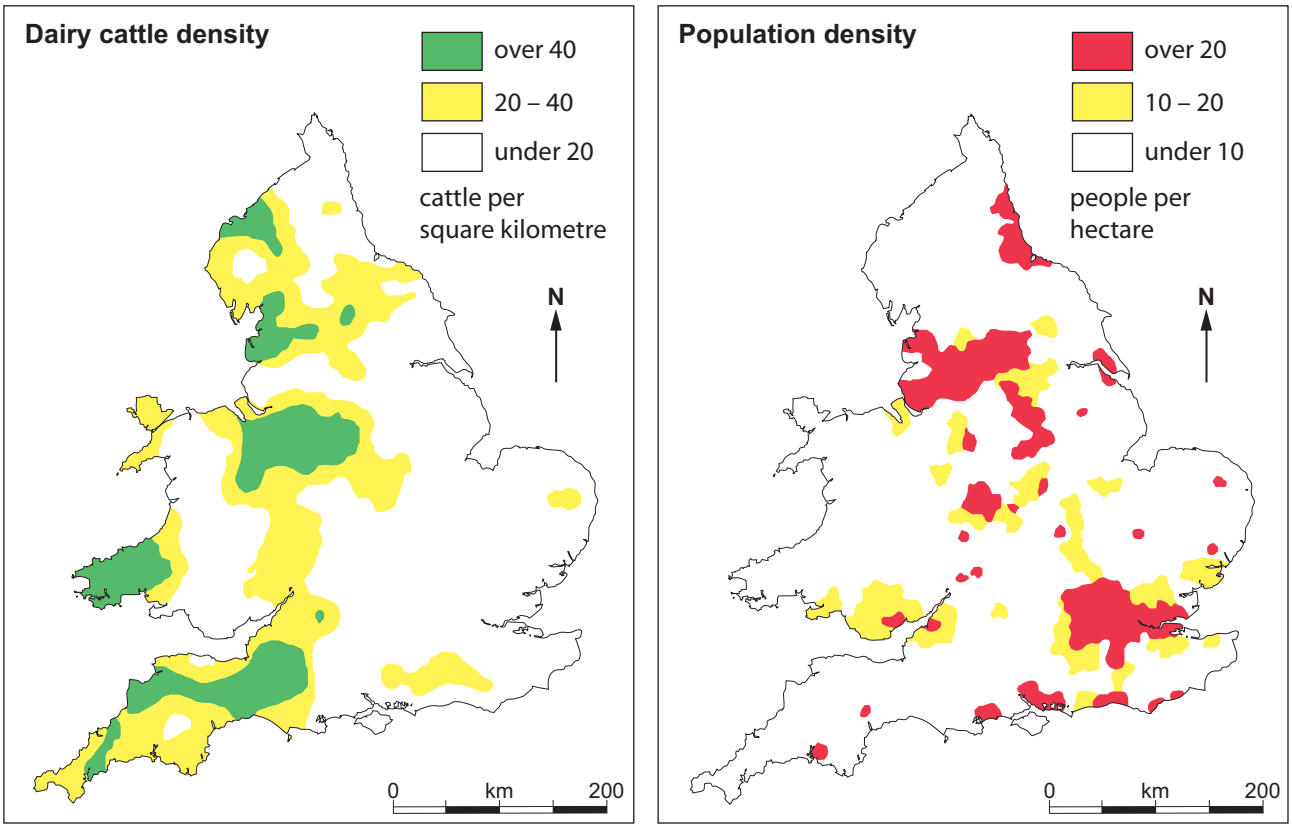
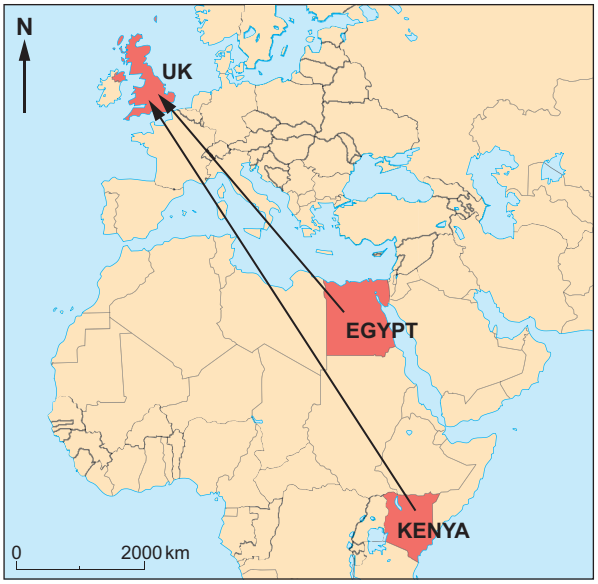
Figure 19: Density of dairy cattle and population density in England and Wales



Source: adapted from www.defra.gov.uk & http://data.gov.uk

Figure 20: Some sources of imported food to the UK

Kenyan fine beans destined for UK supermarkets



Egyptian potatoes available at times when they cannot be produced in the UK

Source: www.archive.defra.gov.uk

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Sources of information and copyright

Figure 1	https://www.centreforcities.org/outlook12.html
Figure 3	www.communities.gov.uk/documents/statistics/pdf/1780763.pdf
Figure 4	www.ons.gov.uk www.ordnancesurveyleisure.co.uk
Figure 7	www.norfolkfarmingconference.org/content/post.aspDale_Sanders.pptx
Figures 9 & 10	www.cambridgeshireinsight.org.uk/population-and-demographics/population-estimates-and-forecasts
Figure 11	www.guardian.co.uk/environment/2012/feb/27/cambridgeshire-ecotown-plans-resubmitted
Figure 12	www.metoffice.gov.uk/climate/uk/ee/prinMet Office/Regional Climate/Eastern England
Figure 13	Soil survey 1974.pdf. Map from Rothamsted Research
Figure 14	www.ofwat.gov.uk/sustainability/climatechange/rpt_com_met_rainfall.pdfrpt_com_met_rainfall
Figure 15	Images: Windu, Signature Photos, Ladywewa, Oriori, LianeM, Dani Vincek, Moving Moment, Zbynek Burival, Maria Meester, T.W van Urk, Stephen Coburn / Shutterstock.com
Figure 16	www.hortsci.ashpublications.org www.bia.gov/WhoWeAre/BIA/ILCA/index.htmIndian Affairs/ILCP htpp://newschoolthoughtsonafrica.files.wordpress.com/2010/11/bt_maize_fields_s.jpgStemborer http://www.crida.in/naip/comp4/images/yellowstemborer.jpg http://www.countryfarm-lifestyles.com/images/Maize-Weevil.jpg www.tamilnet.com/art.html?catid=86&artid=15843#.jpg (2xphotos)
Figure 17	www.hytechydroponics.co.uk/how-hydroponic-systems-work/nft.gif
Figure 18	www.innovationfarm.co.uk
Figure 19	www.defra.gov.uk/publications/files/pb13572-cattlebook-2008-090804.pdf http://data.gov.uk/dataset/population_density
Figure 20	www.independent.co.uk/news/world/africa/kenyarsquos-green-beans-hit-uk-supermarket-shelves-2067630.html?action=gallery&ino=1010-kenya-khe-mwea-group-far.jpg weekly.ahram.org.eg/2009/963/ec2.htmeco01.jpg large-cargo-planes.com/category/air-cargo/jet-air-cargo2.jpg

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GCE A level

1204/01-B

GEOGRAPHY – G4
Sustainability

Pre-Release Material for examination on 16 June 2014.

To be opened on receipt.

A new copy of this Folder will be given out in the examination.

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RESOURCE FOLDER

INSTRUCTIONS TO CANDIDATES

A new copy of this Folder will be given out in the examination. **This copy must not be taken into the examination**.

Work through this Folder to make sure you understand all the resources. You may seek help from your teachers or any other sources in this context. You have to apply your critical understanding to an unfamiliar situation.

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Guidelines for using the pre-release materials

The contents of the booklet should be studied carefully. The examples given will help in answering some of the questions on the question paper. To give a fuller answer, it is advisable to look at other material before the examination. This could be similar topics, related to information in other countries, or may be the same countries but in greater depth or on closely related topics. It would be particularly useful to note if other case studies seem similar in nature, or if they show contrasting perspectives to those from the material in this Resource Folder.

Some of the resource materials come from Geography textbooks, but others come from companies, pressure groups, research organisations, governments and private individuals. In some cases they are using information to promote their own interests rather than to represent an impartial view. It is worth considering if they are trying to support a particular interest group and persuade readers to agree with them. In finding other materials, it is worth bearing in mind that they might not be presented in an impartial and objective way.

Material in the Resource Folder may often be related to other themes found in G4, and to other units in Geography AS and A2. These links should be noted, as there will be opportunities to refer to such connections with other work in some of your answers. Being able to link together different parts of your Geography studies is important and will be credited. Such linkages are sometimes referred to as 'synopticity'.

Textbooks, journals, good quality newspapers and television and radio programmes are good sources of information. Probably the most accessible source of geographical information is the Internet, but it is also the one which may be most susceptible to bias and lack of impartiality. Many of the resources are extracted or adapted from sources on the Internet. These sources have the web addresses provided only for copyright reasons. Many are only extracts or shortened versions of fuller documents and some may be inaccessible by the date of the release of this Resource Folder. Following some of these links for greater depth of reading and for more recent updates of material can be helpful but is not essential. It is **not** the intention that by providing these web addresses every one listed is researched.

Each candidate will be provided with a copy of the Resource Folder, for use in the examination, at the same time as the question paper is issued at the beginning of the examination on the day set for the paper.

Copies of the Resource Folder with added notes, or notes from research carried out in the previous six weeks, may not be taken into the examination.

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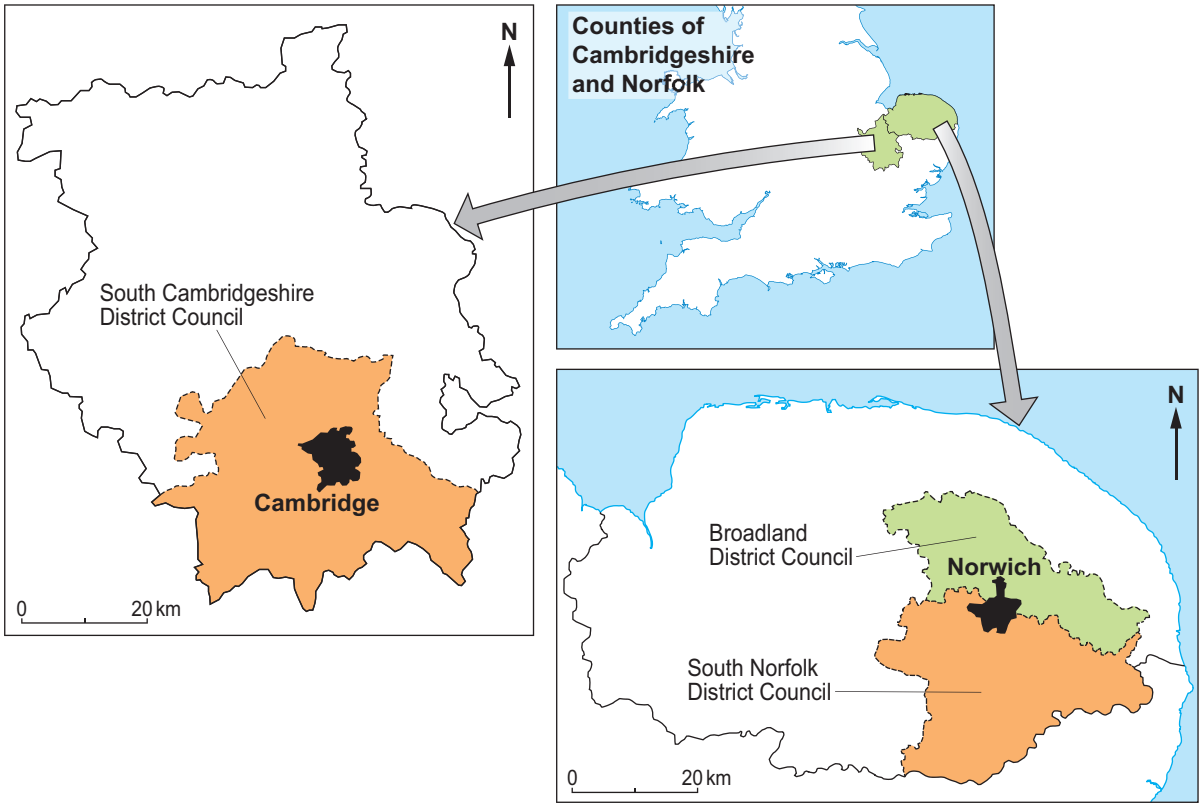

Figure 3: Projected household changes in England, 2008–2033

- The number of households in England is projected to grow to 27.5 million by 2033, an increase of 5.8 million (27%) over 2008, or 232000 households per year.
- One person households are projected to increase by 159000 per year, equating to two-thirds of the overall increase in households.
- By 2033, 19% of households in England are projected to be single person compared with 14% in 2008.
- By 2033, 33% of households will be headed by those aged 65 or over, up from 26% in 2008.

Source: www.communities.gov.uk

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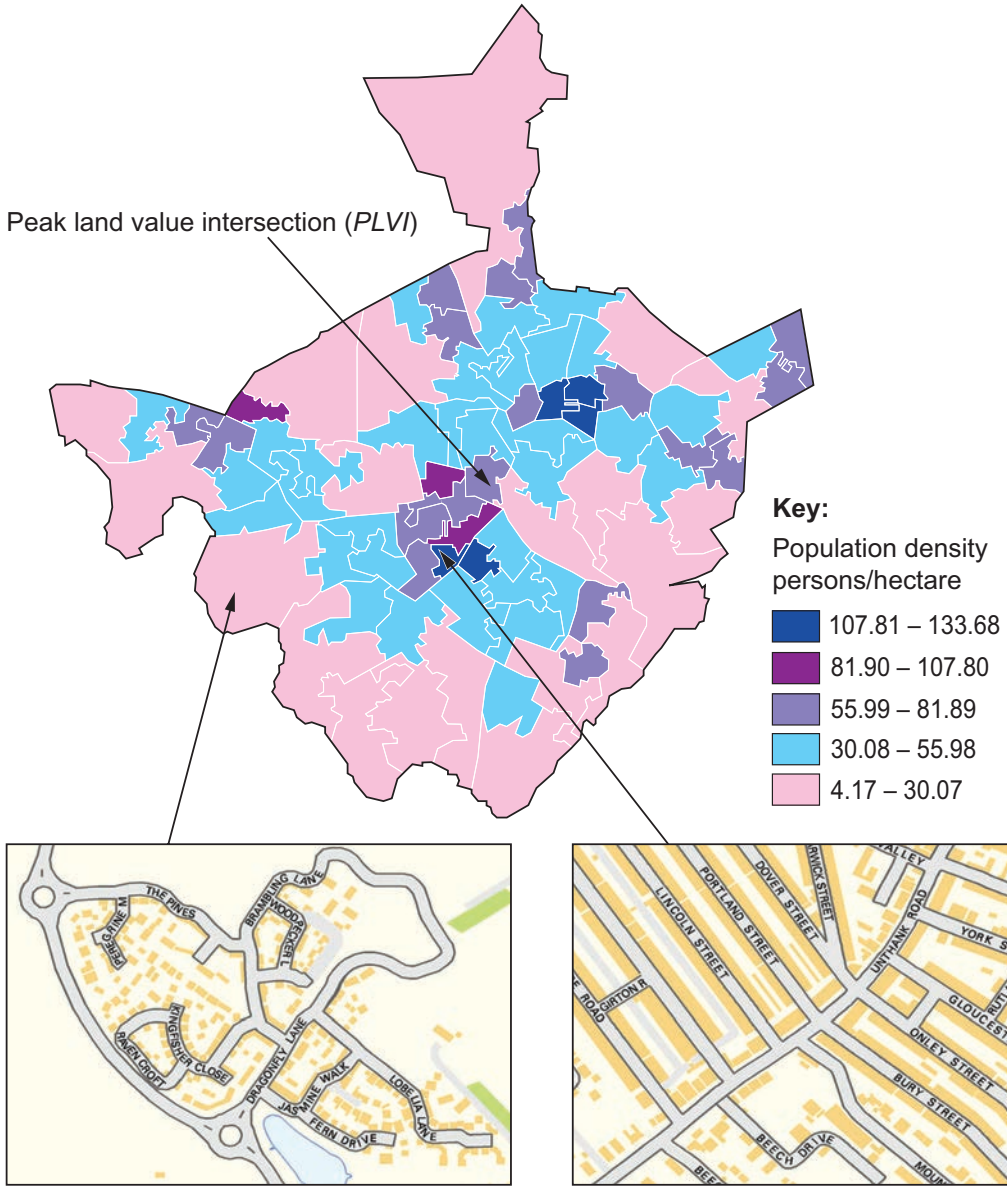
Figure 4: Population density in inner and outer areas of Norwich



A - Recent urban fringe housing estate

Population density 15 persons/hectare

B - 19th century inner city centre housing

Population density 112 persons/hectare

Source: 2001 Census and www.ordnancesurveyleisure.co.uk

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Brownfield sites

- May be toxic waste
- Re-using land
- Buildings may need to be cleared
- Often near to city centres
- Local roads may be congested
- Access to existing water and electricity supplies

Greenfield sites

- Space to expand
- Take up agricultural land
- Near by-passes
- Depend on transport
- Pleasant environment
- May be objections

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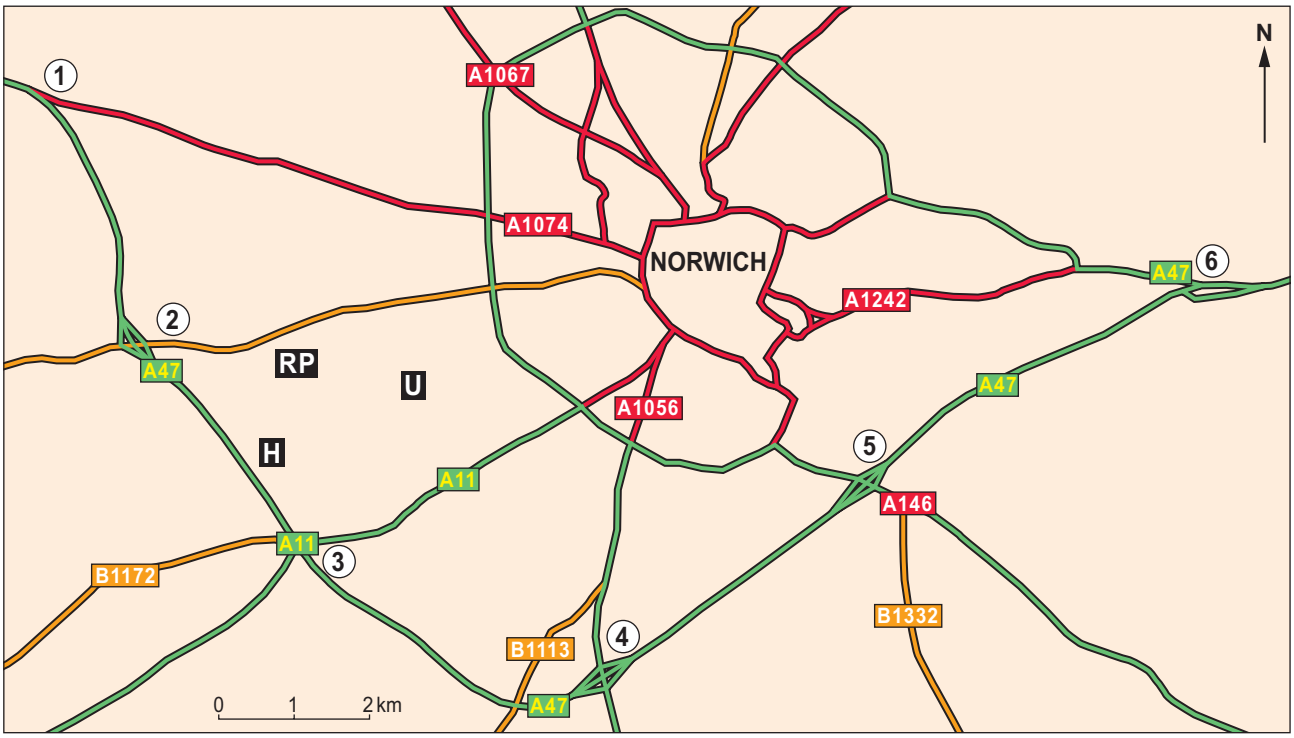
Figure 6: The southern by-pass around Norwich



The A47 by-pass to the south of Norwich was completed in 1992. The section built is between numbers 1 and 6 which are intersections with other roads. The route covers former agricultural land. There has been extensive development at all intersections with the exception of 5. Most of the development has been in the form of retail parks, but light manufacturing and distribution services are a close second. 1, 3, 4 and 6 are locations for the park and ride service. Each of these has a very large car park to cope with present, and anticipated future, demand.

Although not at an intersection, the new by-pass created easy access to a new hospital (H) allowing ambulances to avoid congestion.

The ease of access, and plenty of room for expansion, attracted a large Research Park (RP). This was located close to the University of East Anglia (U). Many leading research institutions have located there, including the John Innes Centre, a world leader in crop research.

Source: adapted from a variety of sources

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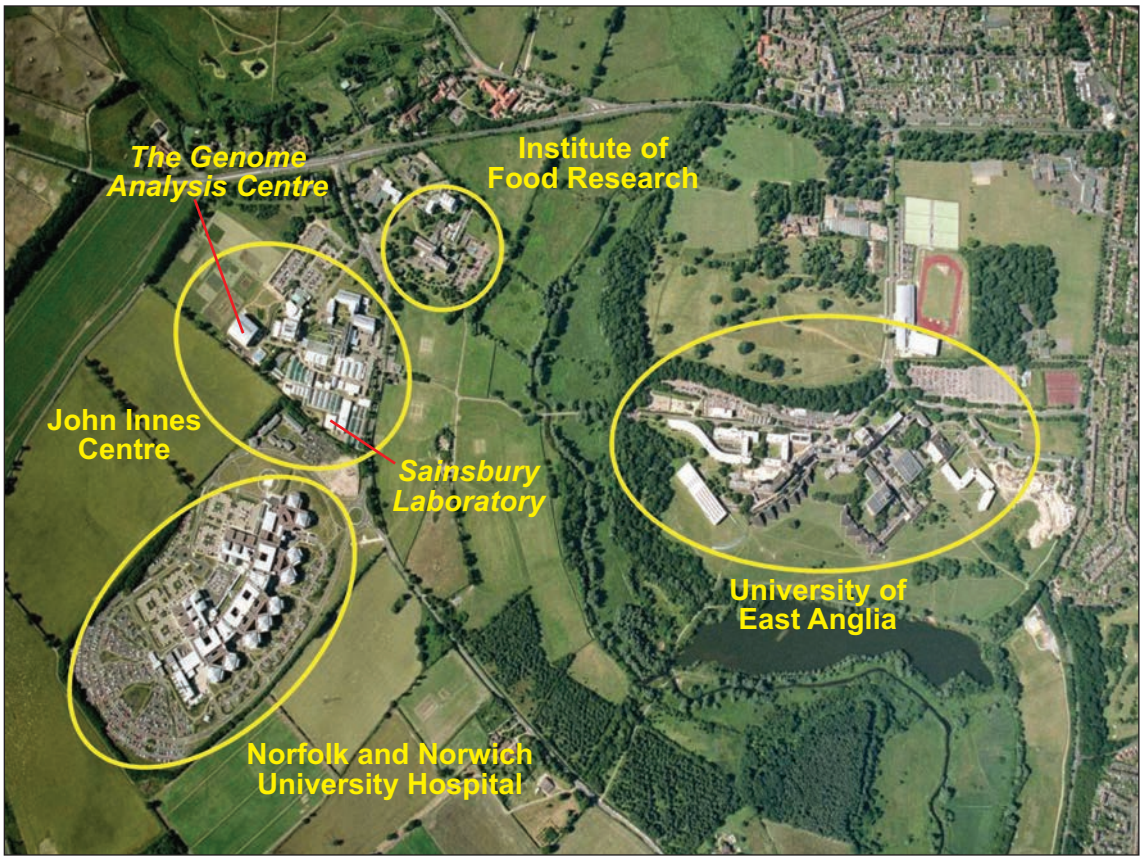
Figure 7: New developments on greenfield sites on the edge of Norwich



Source: www.norfolkfarmingconference.org/downloads/2012/Dale_Saunders.pdf

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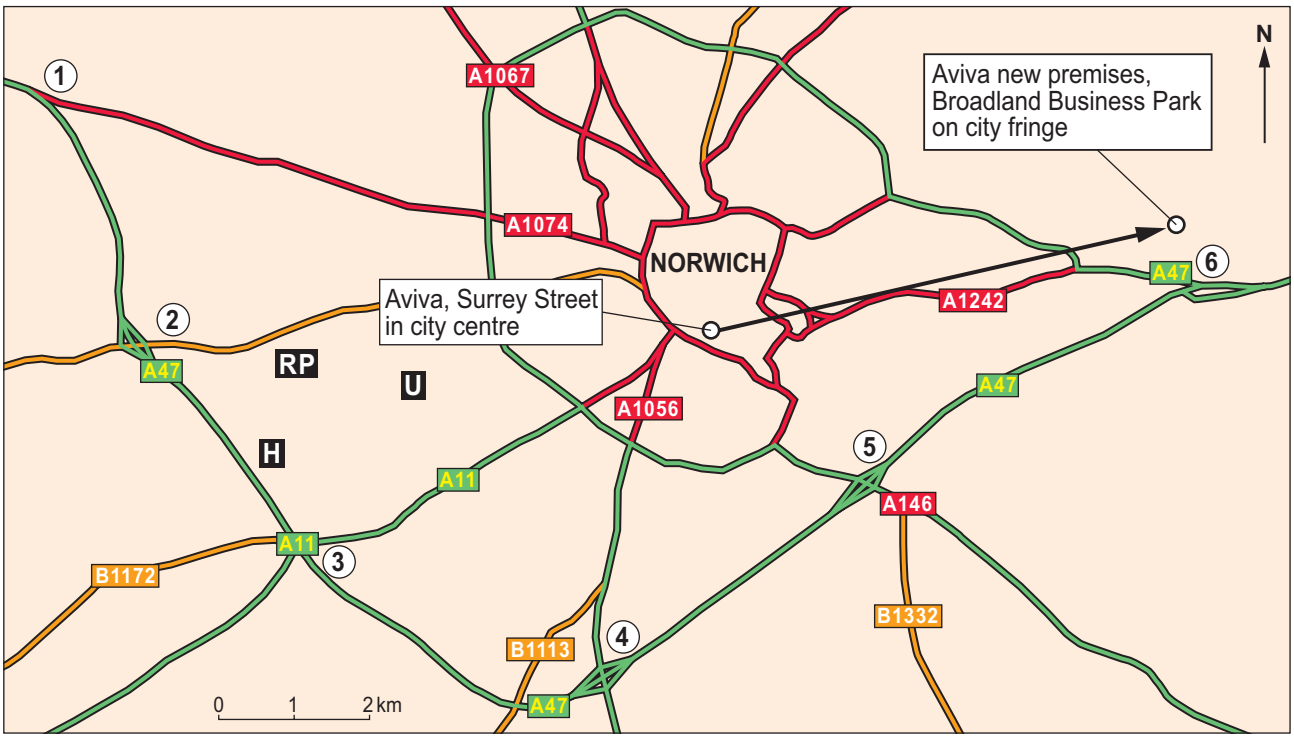
Figure 8: Relocation of part of Aviva's headquarters in Norwich



1204
01B009

Surrey Street

Broadland Business Park

Source: adapted from a variety of sources

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Figure 9: Actual and projected percentage population increase for Cambridge

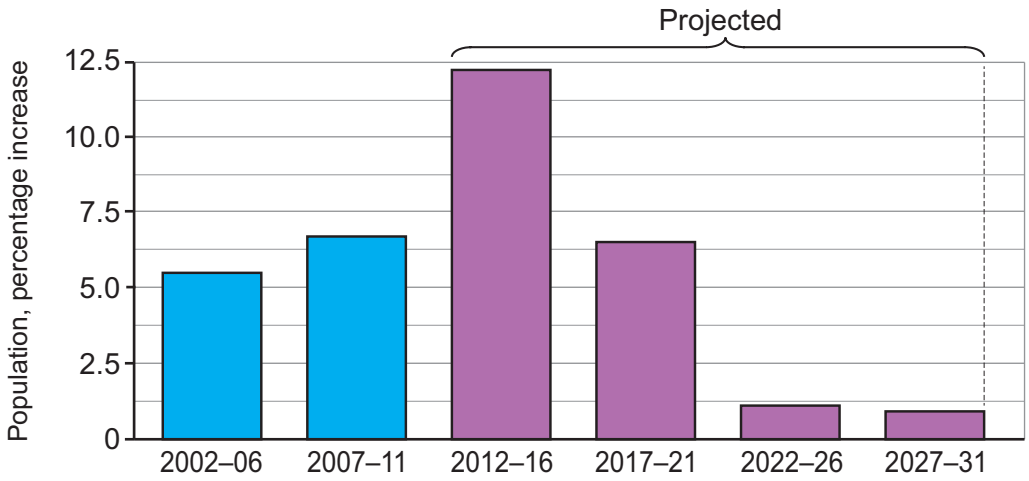
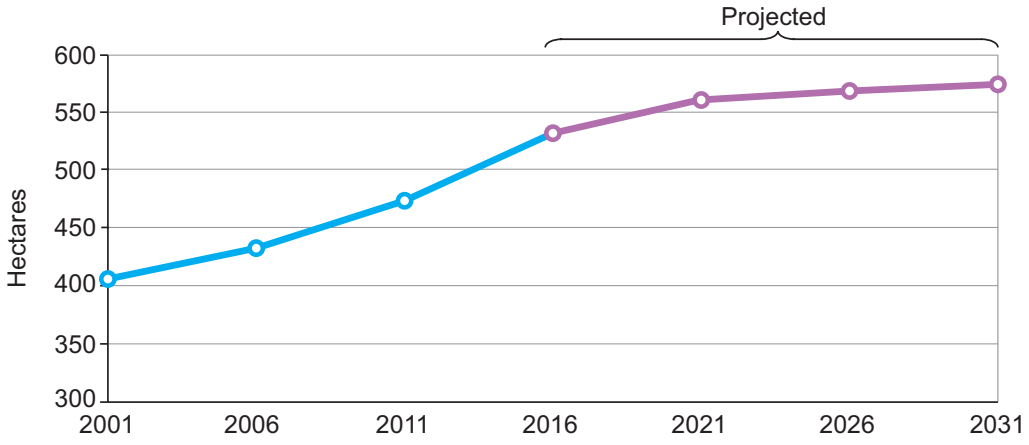


Figure 10: Actual and projected growth in areal extent of Cambridge, 2001–2031



Source: adapted from www.cambridgeshireinsight.org

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Figure 11: Proposed new town in the Cambridge area

Plans for Northstowe, the biggest new town in Britain since Milton Keynes, have been proposed, to include a 10 000 home development to the north-west of Cambridge.

The town, which could take 20 years to complete and eventually be home to 25 000 people, will be built on a golf course, farmland and a former airfield.

Plans for the first phase of the town were submitted to South Cambridgeshire District Council in February 2012. They include a primary school, shops, sports centre and open spaces. Its 10 000 homes could provide about half the new homes the council say are necessary in the area by 2031.

Key:

- Northstowe

Source: adapted from www.guardian.co.uk

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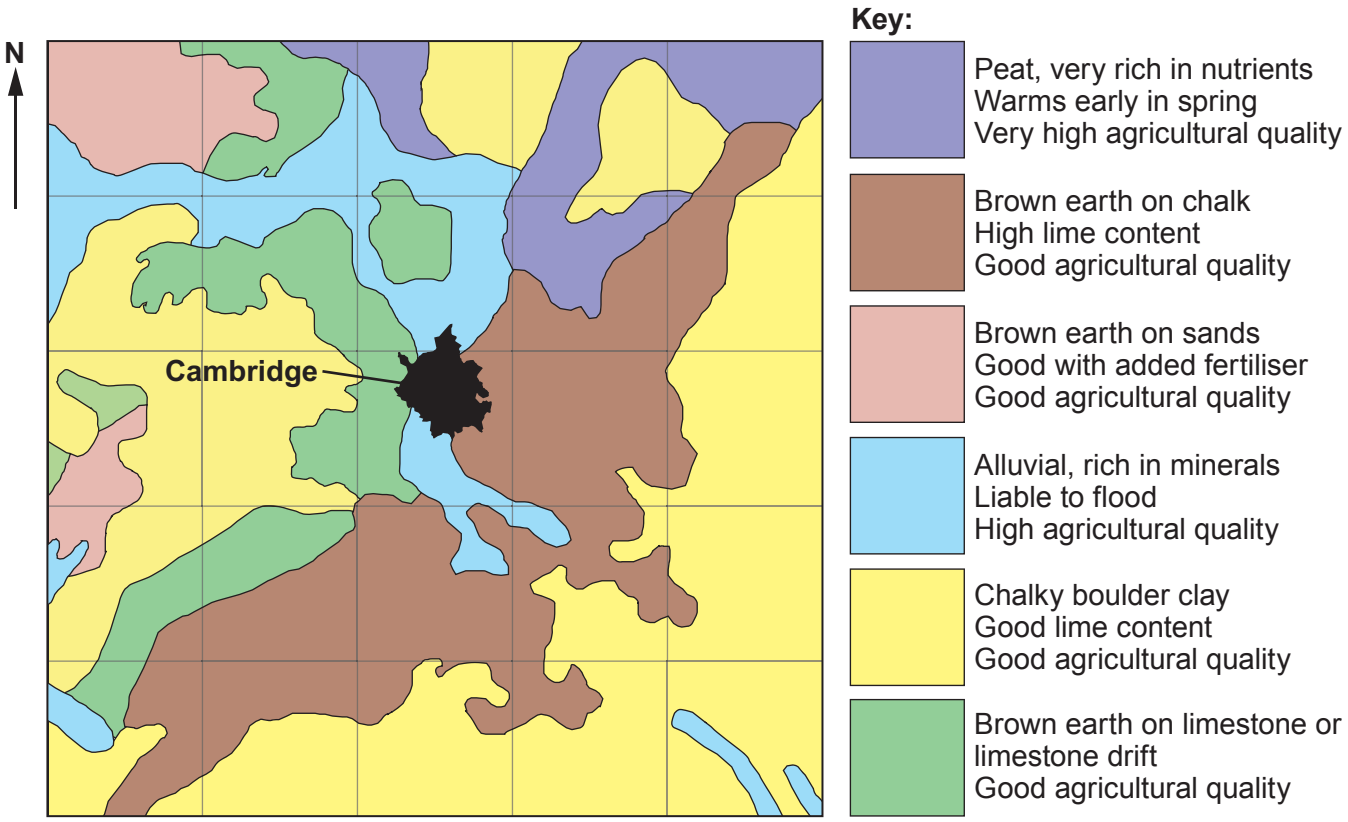
FOOD PRODUCTION

Figure 12: Mean monthly 30 year (1980–2010) climate information for the Cambridge area

	J	F	M	A	M	J	J	A	S	O	N	D
Temperature °C	4	4	7	8	12	15	17	17	15	11	7	5
Days with frost	10	10	5	3	1	0	0	0	0	1	5	8
Precipitation mm	45	33	42	43	45	54	38	49	51	54	51	50
Days with rain	10	8	10	9	8	9	7	7	8	8	10	10
Hours of sunshine	56	73	107	146	190	180	191	187	142	115	68	50

Source: adapted from www.metoffice.gov.uk

Figure 13: Soils in the area surrounding Cambridge



Each grid square covers 10 km × 10 km

Source: adapted from Soil Survey 1974, Rothamsted Research

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Figure 14: Predicted precipitation variability for the Cambridge area

Current event frequency figures	Predicted event frequency		
2012	**2040**	**2060**	**2080**
1 in 30	1 in 16	1 in 13	1 in 11
1 in 20	1 in 12	1 in 10	1 in 8
1 in 10	1 in 6	1 in 5	1 in 4

The table shows how frequently, in years, extreme precipitation events (which may lead to flooding or drought) can be expected.

Source: www.ofwat.gov.uk

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Figure 15: Requirements to produce selected foodstuffs consumed in the UK

Wheat

At least 600 mm precipitation
Temperatures in 7 – 25°C range
Spring planted 100 – 130 growing days
Autumn planted 180 – 250 growing days

UK (thousand tonnes)

Production	15 257
Export	318
Import	902

Rice

At least 1000 mm precipitation
Temperatures in 20 – 40°C range
30 – 50 days as seedlings
70 – 100 days as mature plants

UK (thousand tonnes)

Production	0
Export	0
Import	322

Poultry

No requirements for precipitation provided a water source is available
Can tolerate up to 24°C daily mean, may need shelter under 8°C
Ready for food processing between 5 and 26 weeks
Can breed throughout the year

UK (thousand tonnes)

Production	1 298
Export	227
Import	339

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Figure 15: Requirements to produce selected foodstuffs consumed in the UK (continued)

Haricot beans (for baked beans)

At least 700 mm precipitation
Temperatures in 19 – 28°C range
Currently will not tolerate frost
90 – 120 days from sowing to harvest

UK (thousand tonnes)

Production	0
Export	0
Import	183

Potatoes

At least 500 mm precipitation
Needs 150 mm per month whilst growing
Temperatures in 6 – 25°C range
120 – 150 days from planting to lifting

UK (thousand tonnes)

Production	6 115
Export	554
Import	1 670

Bananas

At least 900 mm precipitation
Temperatures in 27 – 30°C range for optimum growth
Growth stops below 13°C
300 – 450 days from planting but can continue production when mature

UK (thousand tonnes)

Production	0
Export	0
Import	927

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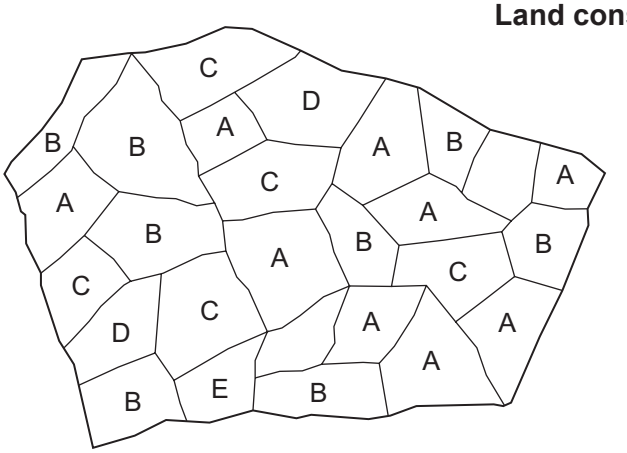
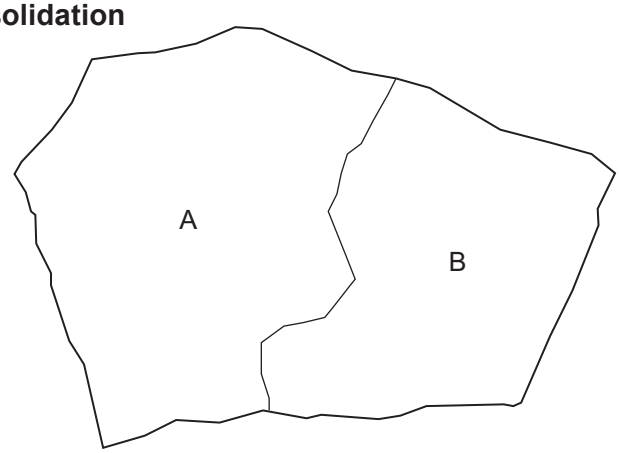
Figure 16: Selected improvements in agriculture that have been widely adopted

Land consolidation



1990
Land belonging to farmers A, B, C, D and E



2010
Land belonging to farmers A and B.
Farmers C, D and E have gone out of business

Genetic modification

Control of pests

Bt maize (a genetically modified crop) is affected by four main insect pests - stemborers, aphids, moths and weevils.

Modification has allowed control of these four types to be achieved as follows:

- excellent control of 1 pest
- good control of 2 pests
- some control of 1 pest
- no control of other types

Irrigation

Drip

Jet

Sources: adapted from www.oecd.org; www.tamilnet.com; www.bia.gov; http://newschoolthoughtsonafrica.files.wordpress.com; www.crida.in and www.countryfarm-lifestyles.com

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Figure 16: Selected improvements in agriculture that have been widely adopted (continued)

Growing under plastic

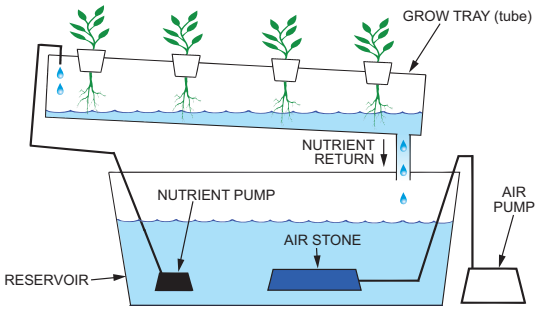
- Temperature and humidity can be raised under plastic sheets.
- Evapotranspiration can be reduced.
- High demand for labour created.
- Many protests arise about plastic sheets being unsightly in areas of great natural beauty.

Source: hortsci.ashspublications.org

Figure 17: Selected methods of increasing food production with scope for expansion

Hydroponics

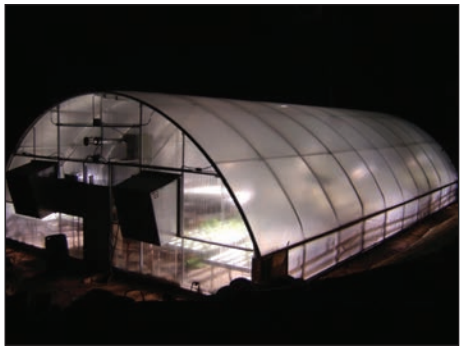
- Plants indoors with roots in nutrient solution optimised for the species.
- Artificial lighting and temperature can be adjusted.
- Largely disease and pest free environment.
- Allows growth of crops unsuited to local environment.



Aeroponics

- Similar to hydroponics but considered more productive for same inputs.
- Plants grown with roots suspended in the air.
- Nutrient solutions sprayed onto the roots at controlled times in optimum amounts.
- As with hydroponics, set up and running costs high especially for energy supplies.

Growing through the night



Source: www.hytechydroponics.co.uk

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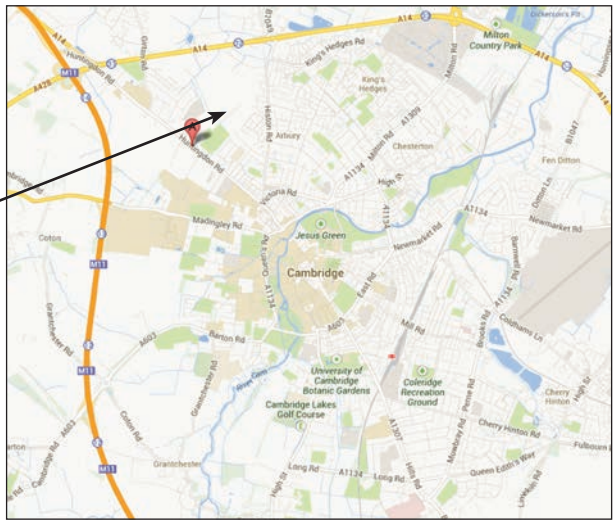
Figure 18: Example of plant research on the fringe of Cambridge



The four challenges of Innovation Farm

Sustainable resources

- Reduce inputs, e.g. disease resistance
- Input efficiency e.g. drought tolerance
- Improving biodiversity, e.g. stewardship schemes
- Alternative energy sources, e.g. willow
- Supplying specialist markets, e.g. pharmaceuticals and fibres

Food security

- Increase crop yields
- Extend growing seasons
- Improve frost resistance
- Extend growing areas
- Improve nutritional content

Health and nutrition

- Improve digestibility for humans and animals
- Healthy characteristics e.g. high in antioxidants
- Improve quality
- Pharmaceutical properties, e.g. combat the effects of Alzheimer's

Climate change

- Resistance to new pests arriving from other climates
- Increase genetic diversity to cope with change
- Suitability of inputs to changed cultivation
- Work undertaken to give consistent yield under variable climatic conditions
- Improvements to suit new UK climatic conditions, e.g. soya beans

Source: www.innovationfarm.co.uk

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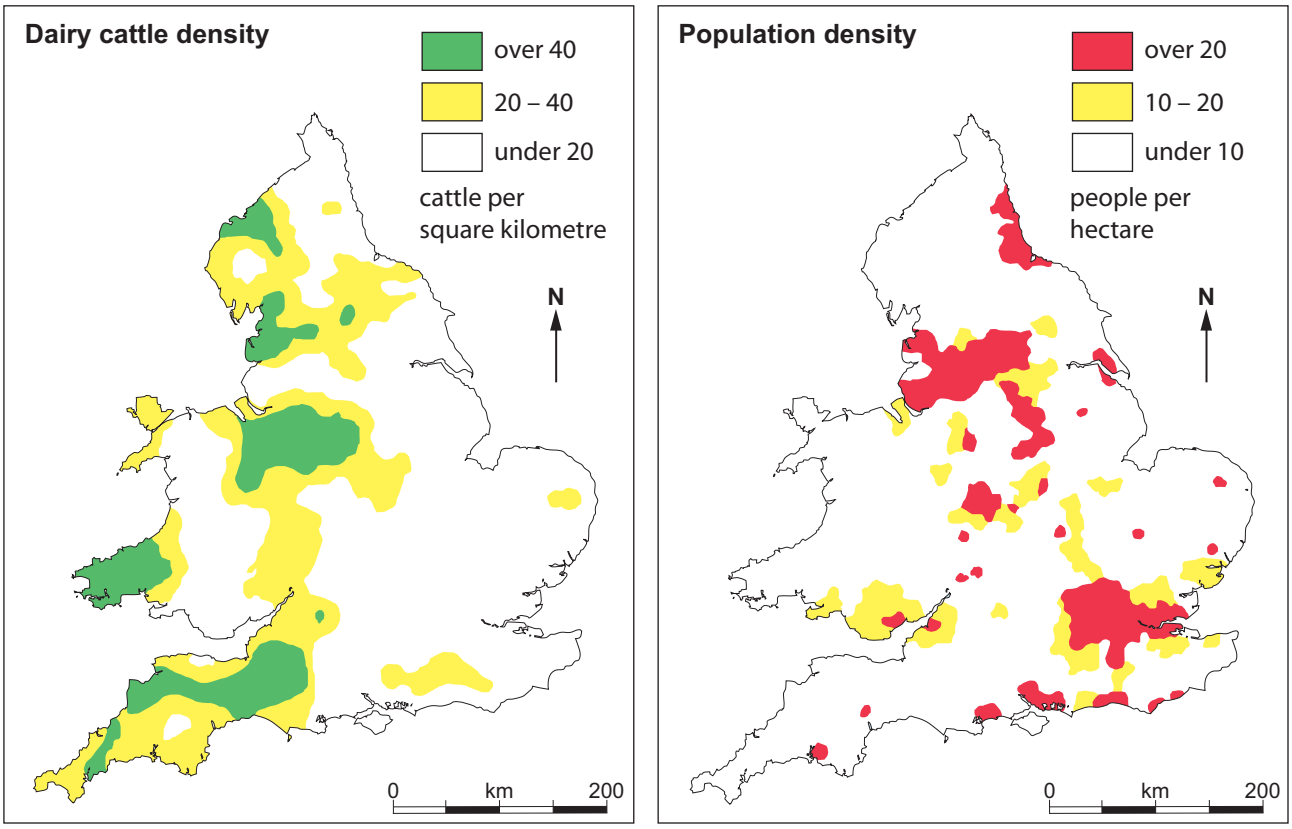
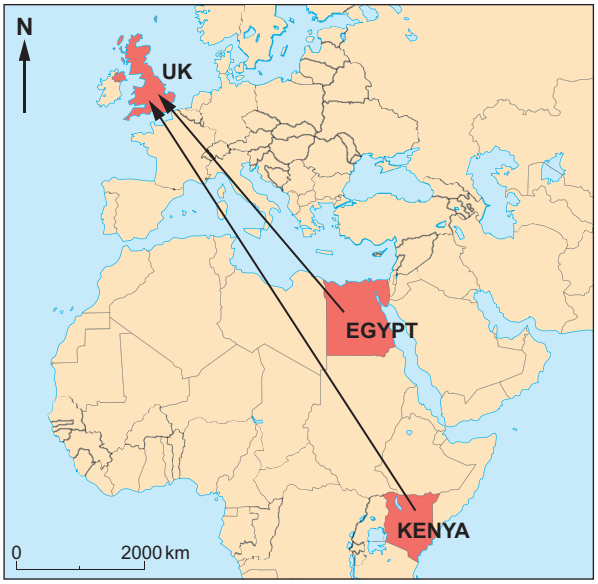
Figure 19: Density of dairy cattle and population density in England and Wales



Source: adapted from www.defra.gov.uk & http://data.gov.uk

Figure 20: Some sources of imported food to the UK

Kenyan fine beans destined for UK supermarkets



Egyptian potatoes available at times when they cannot be produced in the UK

Source: www.archive.defra.gov.uk

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Sources of information and copyright

Figure 1	https://www.centreforcities.org/outlook12.html
Figure 3	www.communities.gov.uk/documents/statistics/pdf/1780763.pdf
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Figure 15	Images: Windu, Signature Photos, Ladywewa, Oriori, LianeM, Dani Vincek, Moving Moment, Zbynek Burival, Maria Meester, T.W van Urk, Stephen Coburn / Shutterstock.com
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