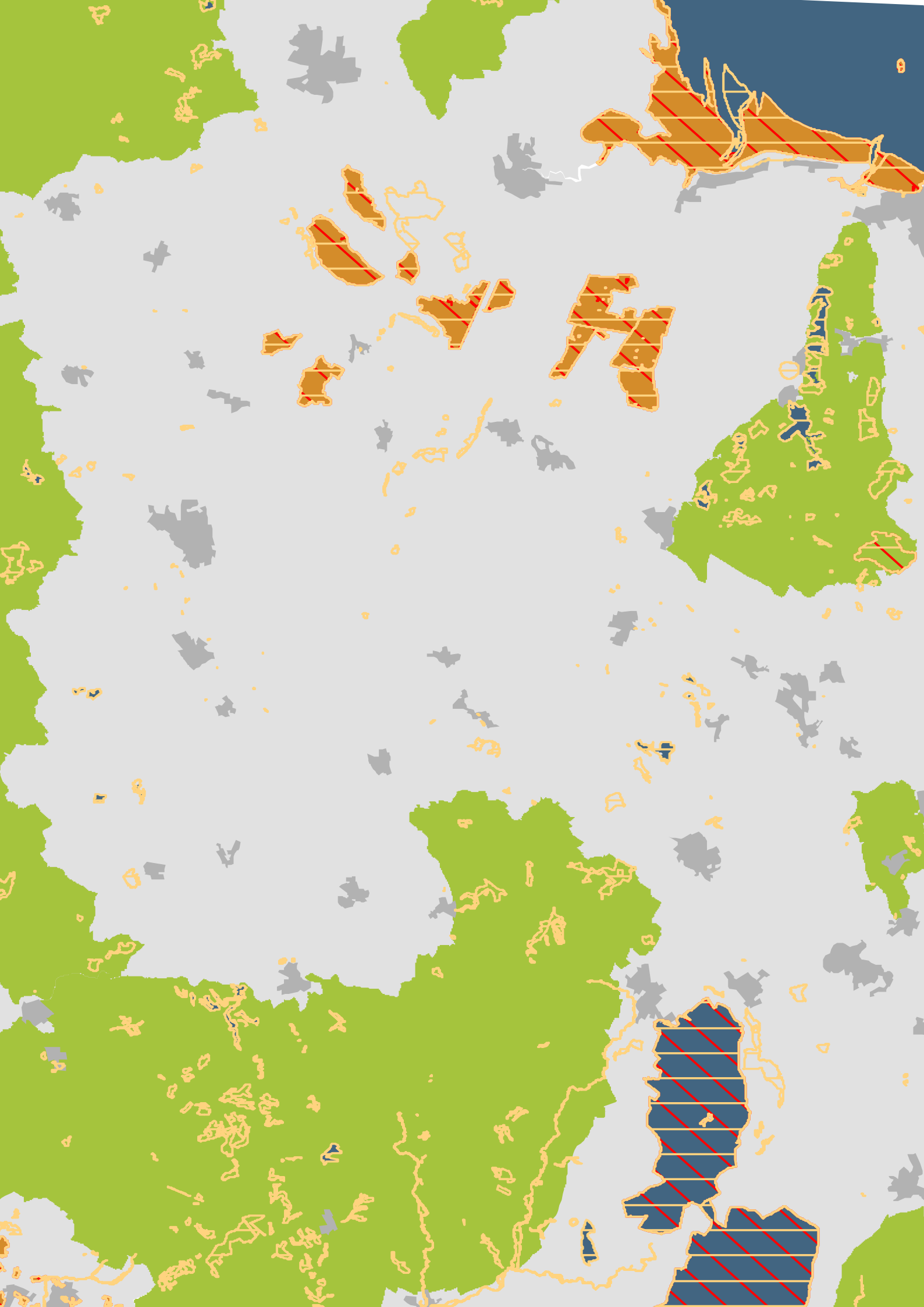
bigdilemmas

2011/2012

# The Future of land use in the South West: Food, water & energy security in the face of environmental change



## Foreword

The Big Dilemmas Project, a prestigious interdisciplinary initiative, was launched in 2010 to gain a better understanding of sustainability dilemmas that local communities grapple with and to propose potential solutions. The University of Exeter is known for world leading interdisciplinary research into 'Climate Change and Sustainable Futures' and for its Environment and Sustainability Institute in Cornwall. It is further 'committed to sustainability and collaboration with local communities to find solutions that will make a real difference to individuals, society and the environment' (CSR Report).

The project works towards solving 'wicked' sustainability problems by investigating and tackling big dilemmas in relation to energy, water & food security, health, biodiversity, poverty and population, It also aims to come to a better understanding of sustainable futures and potential ways forward.

This year, the focus was the **Future of land use in the Southwest: Food, water & energy security in the face of environmental change**. A group of twenty students from across the University were selected to form a think-tank that was supported by stakeholders and academics.

In this document, the students are presenting their research in this area and are offering some alternative ideas for sustainable land use.

**Professor Peter Cox, Professor in Climate Change Dynamics and Harriet Sjerps-Jones, Sustainability Curriculum Development Manager**

**University of Exeter, 2012**

We would like to thank the following people for their insightful contributions to the debates:
Nick Baker (Naturalist and broadcaster), Helen Browning OBE (Soil Association), Peter Burgess (Devon Wildlife Trust), John Channon (Dartington Estate), David Henley (Bicton College) Sean Rickard (Independent agricultural advisor)

Also special thanks to the University of Exeter academics for their time and expert input:
Dr Stewart Barr, Prof Stephan Harrison, Dr Tim Kurz, Dr Mat Lobley, Prof Clive Sabel, Dr Will Stahl-Timmins, Julia Whittaker, Dr Robert Wilson, Prof Michael Winter OBE, Dr Bridget Woodman

And finally
Ashley Rudolph and his graphic design students at University College Falmouth

## Introduction

In the 21st century, as the developed world's living standards attain ever greater heights and expectations, we are becoming increasingly demanding as consumers. We are subsequently making higher demands of our land and expecting it to do more and more for us. We want it to maximise its output of crops, maximise its financial value, provide us with a sense of wellbeing, and balance its own biodiversity. The past two hundred years have seen the world and its land dramatically change, and the human population explode. Nine billion people now exist on earth: all require food, water and energy to survive. Ensuring the security of these three essentials is a global issue.

The South West of England is in a peculiar position with this dilemma. As the largest of the nine English regions, its population of around 5 million residents is relatively small; however, projections suggest that it could reach 6.2 million by 2030 - 17% more than in 2010, and higher than the projected national average of 14.4%. The South West's population is also in constant flux given that it is the UK's favourite holiday destination. 21 million trips were made to the region in 2009, with 38% of these made during the summer season[1]: its food, water and energy supplies must accommodate each one of these visitors.

As the 2012 think tank explored the dilemma, splitting into subgroups to explore food, water and energy security, certain overarching themes began to arise: firstly, it was difficult to look at any one issue in isolation, because each inevitably bumped into another in the search for its own security. Secondly, it was agreed that security is as much about managing our own demand as it is about securing enough supply; to do that requires a great deal of awareness-raising and education. Finally, while there is a great amount of conflict around how land could best be used, there are small solutions which work towards triple bottom line sustainability and towards obtaining a degree of security in one or more of the three areas – and these are solutions which require immediate attention in terms of research and publicity.

[1] South West Tourism Alliance. South West Facts

www.swtourismalliance.org.uk/files/download.php?m=documents&f=100428140006-UKTSSW2009.pdf

This Big Dilemmas pamphlet does not, unfortunately, solve the South West's land use dilemma, but it has been set out to show the development of our research. Part 1 lends an overview of the situation, looking at food, water and energy's unique relationships with the South West, and presenting case studies to demonstrate how they conflict. Part 2, entitled 'Ways Forward', is comprised of three case studies that demonstrate how the dilemma could be approached, either through discussion, part-solution, or a way of using land in alignment with sustainability's triple bottom line of social, environmental and economic security. Part 3, 'Re-thinking the Debate', offers another way of viewing land, and a different approach to the dilemma.

If our findings can be summed up in a single sentence, it might be this: that we simply cannot continue to take a consumptive approach towards land, and remain unaware of how the daily choices we make in relation to energy, water and food place demands upon it. If we are unable to reduce our demand, then we must be prepared to view land use in a more flexible light and to accept otherwise painful trade-offs, because climate change will soon be altering the world as we know it.

**Emma Easy**
Chief Editor

## Land Use Information Graphics

The South-West of England faces multiple, converging and diverse pressures. This chapter presents an introduction to the area of the country covered by this report, and collates some relevant statistical projections for future decades in the region.

The graphic design students involved were presented with complex and challenging data sets from a range of sources. They were given the task of presenting the data visually, and have provided a broad range of responses.

Firstly, **Harry Morris** has chosen to show the level of population growth expected, using projection data from the Office for National Statistics. His graphics reveal the expected levels of population growth in different parts of the region. More and more people living in (and visiting) the South West will inevitably place increasing demands on resources across the region. Supporting this information, **Trevor Thompson** uses data from the same source to show that this population increase is expected largely in older age groups, which is likely to bring its own challenges. **James Burbidge** looks at past data on growth of cities in the area - this reminds us that these pressures are not new, but a continuation of an ongoing reshaping of the society and landscape in which we live.

**Dr Will Stahl-Timmins**
European Centre for Environment and Human Health
Big Dilemmas Information Graphics Coordinator

**Guro Flåten** shows us the unique relationship the South West has with open space. Her graphic shows the surprising amount of the UK's Heritage Coast and sites of special scientific interest that fall within the region - perhaps a reflection of how important this beautiful coast and countryside is to the area. It is interesting to consider this alongside **Lee Martin**'s graphic, which offers a visual comparison of the kinds of agricultural land use in the South West, compared to the rest of the UK. It clearly shows that overall, far more land is given over to farming in the region, with established grassland and woodland much more prevalent here than elsewhere.

For the future, the population increases will lead to higher demand for food, water, energy and space for housing. **Chris Bounds**, **Henry Brown** and **Oli Bussel** have produced a graphic showing three different estimates for the amount of arable land needed, and the amount of land that might be flooded due to climate change - a stark reminder that while the challenges for the future in the region are problematic enough in themselves, several dilemmas in combination can compound such individual effects. Could the region be facing a perfect storm, caused by several such seemingly independent forces acting in unison?

Reference data for information graphics:


South West Observatory Key Data
http://www.swo.org.uk/state-of-the-south-west-2011/population-migration/key-data/

ONS "Population of the South West" presentation
http://www.rtpi.org.uk/download/10055/RISPI-Presentation-22-Sept-James-Harris.pdf

Farm Business Survey
http://farmbusinesssurvey.co.uk/regional/commentary/2009/southwest.pdf

Office of National Statistics website
http://www.ons.gov.uk/ons/regional-statistics/search/index.html?pageSize=50&new query=land&sortBy=pubdate&sortDirection=DESCENDING&region=South+West

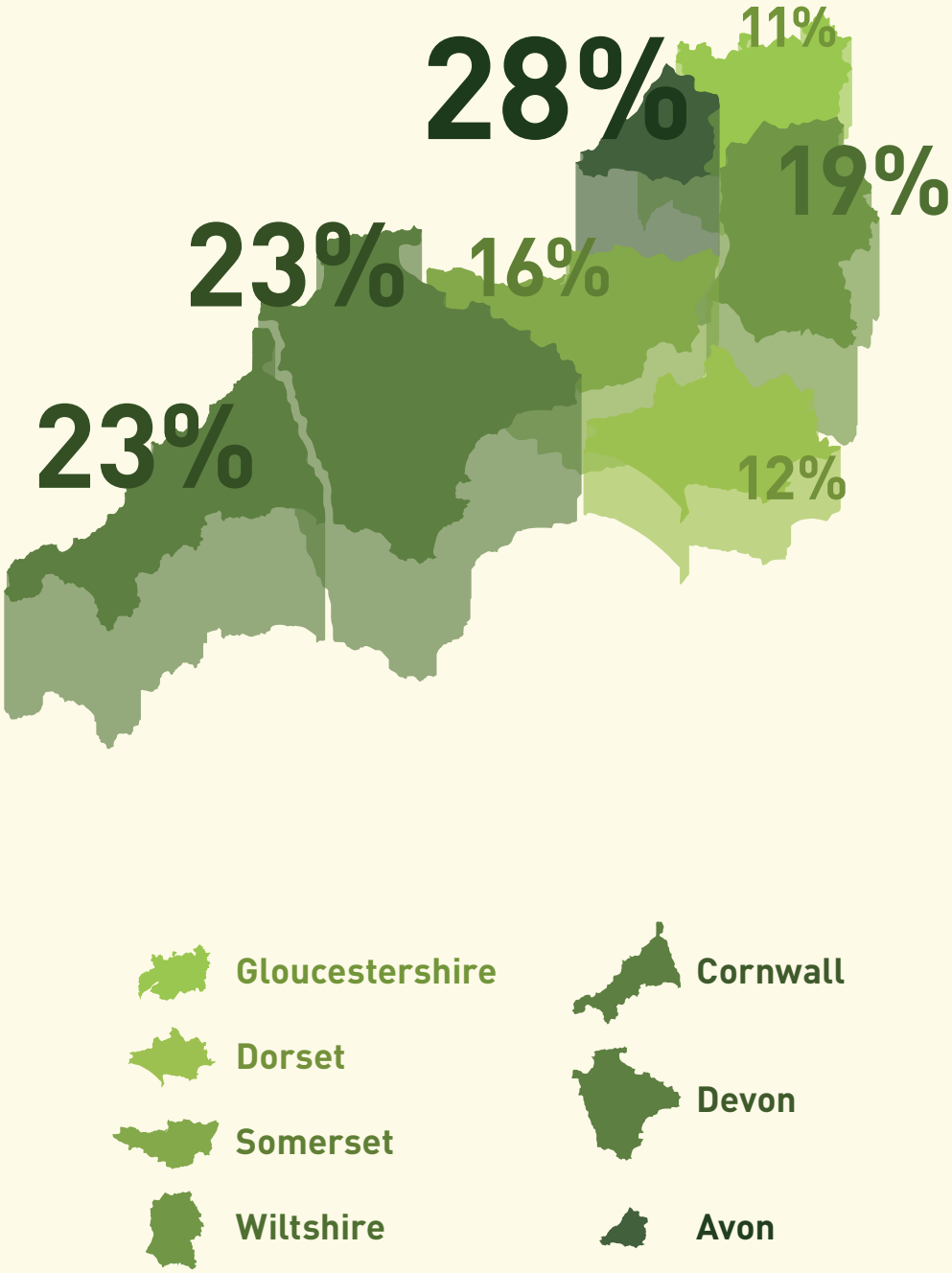
http://www.ons.gov.uk/ons/taxonomy/index.html?nscl=Agriculture+and+Environment

http://www.defra.gov.uk/statistics/foodfarm/cross-cutting/auk/

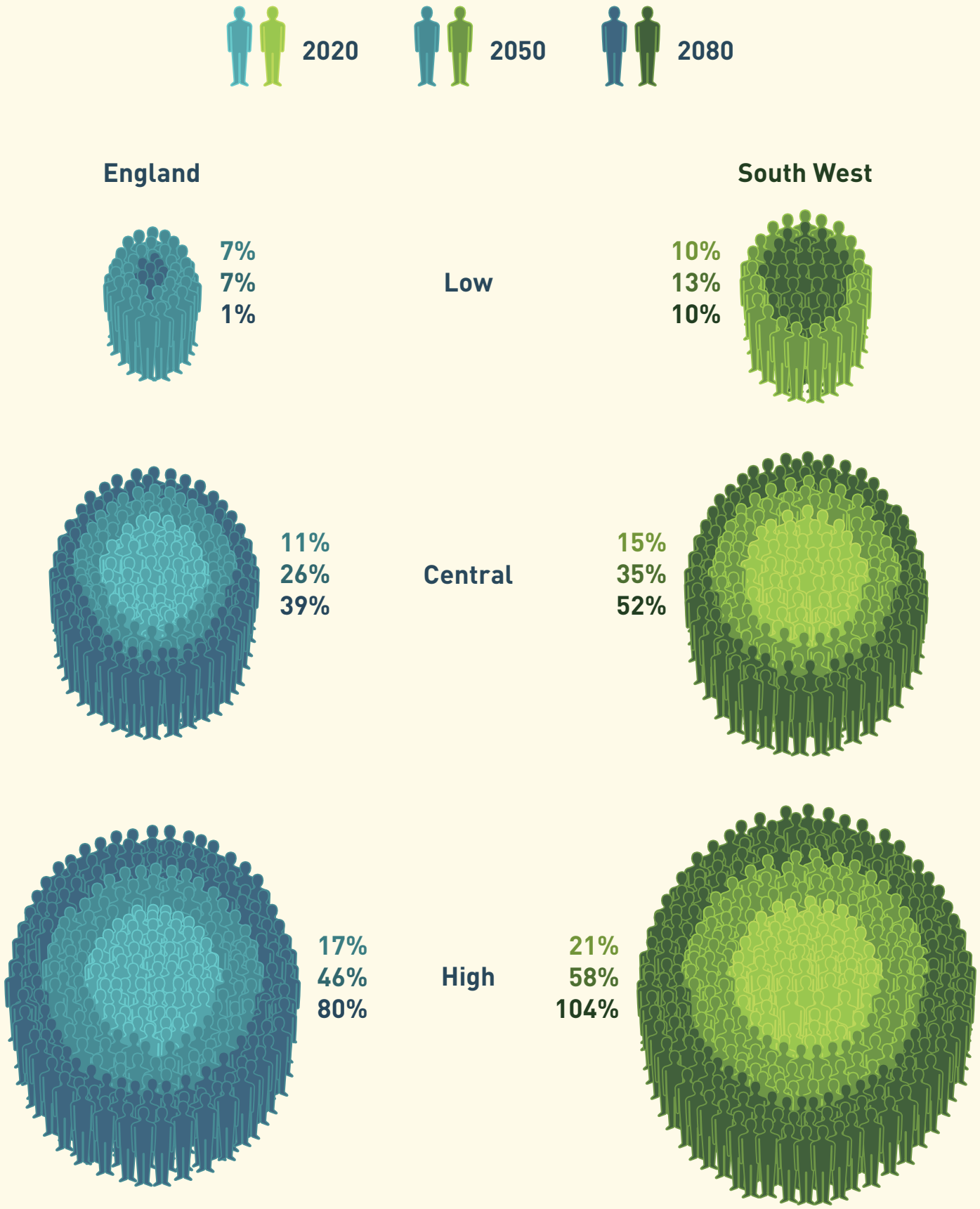
ONS Land Use Change Statistics
http://www.communities.gov.uk/publications/corporate/statistics/lucs2010provisional

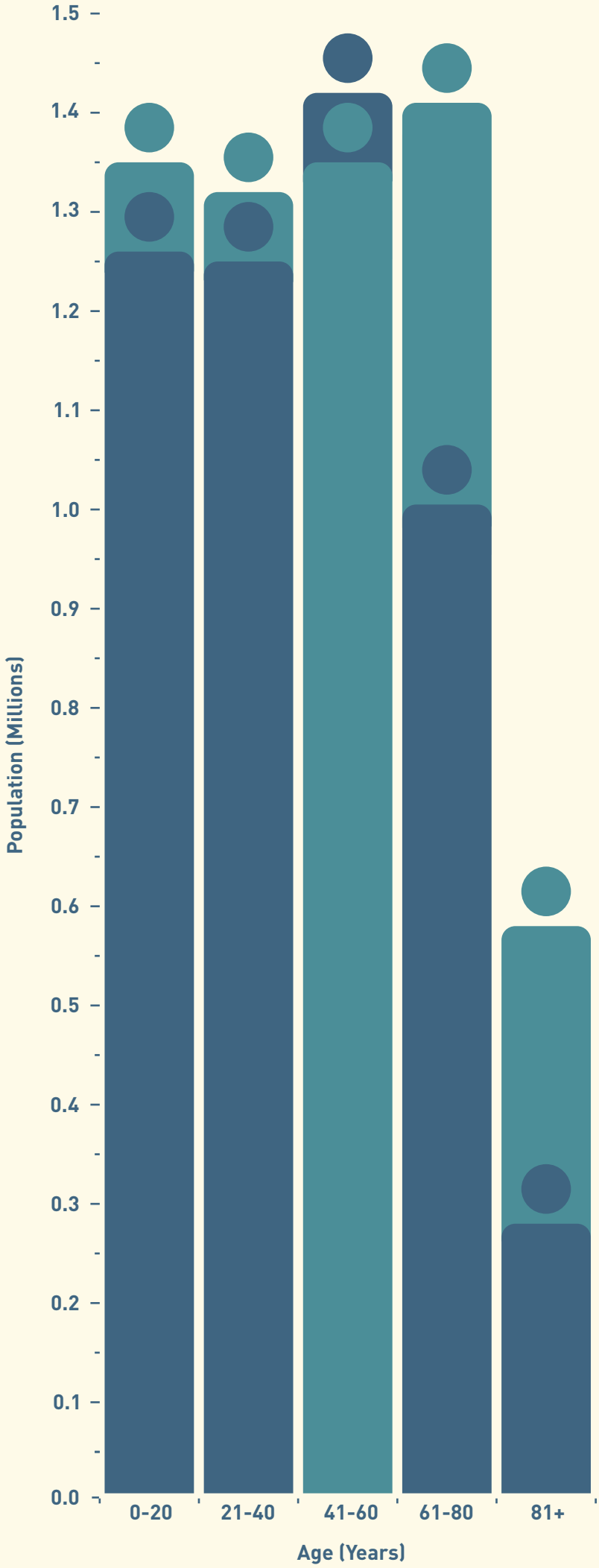
The UK Climate Change Risk Assessment
http://www.defra.gov.uk/environment/climate/government/risk-assessment/

# Estimated Population Growth of the South West



# Population Estimate Comparisons of England and the South West





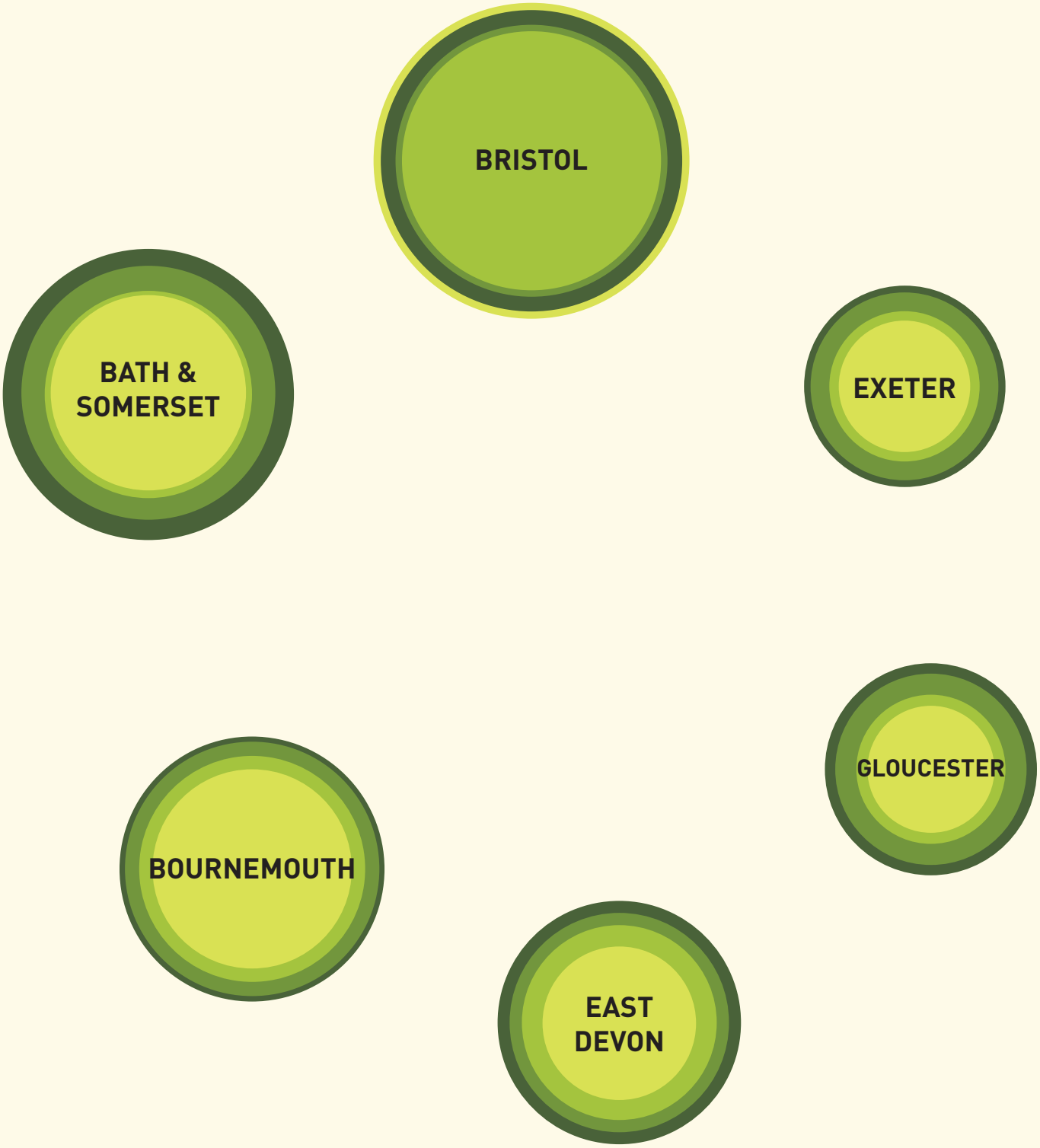

# Estimated Population of the South West

Population (2010)

Projected Population (2035)

1981
1991
2001
2011

## GROWTH OF POPULATION IN THE LARGEST CITIES/ REGIONS IN THE SOUTH WEST OVER THE LAST 40 YEARS.



# DESIGNATED AREAS IN THE SOUTH WEST

## HERITAGE COAST

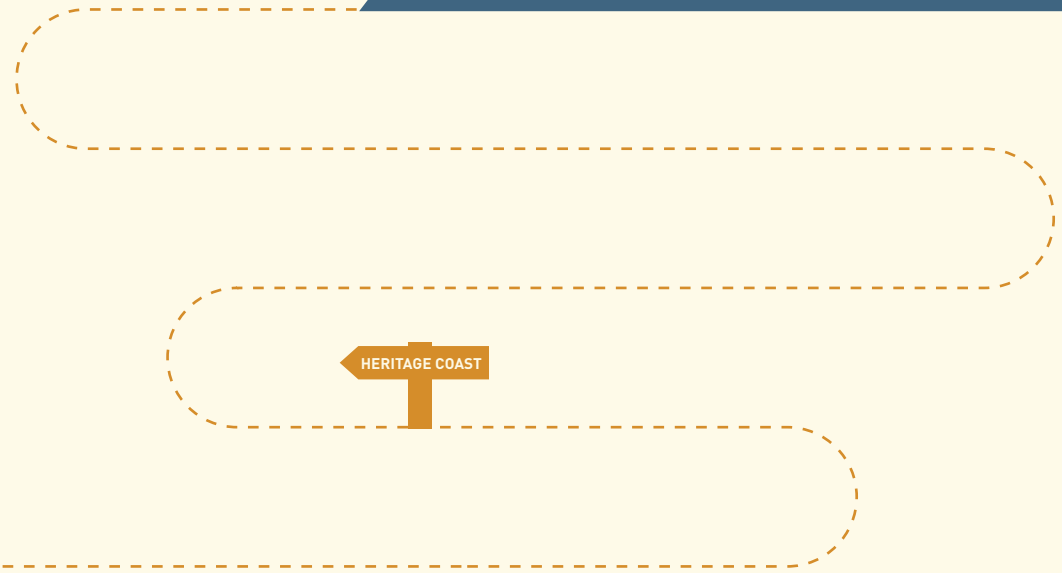
**60%** OF THE UK HERITAGE COAST IS IN THE SOUTH WEST, AND IS KNOWN FOR ITS INCREDIBLE BEAUTY

## SSSI

## NATIONAL PARKS

**7%** OF THE LAND MASS IN THE SOUTH WEST IS NATIONAL PARKS

**638 KM**



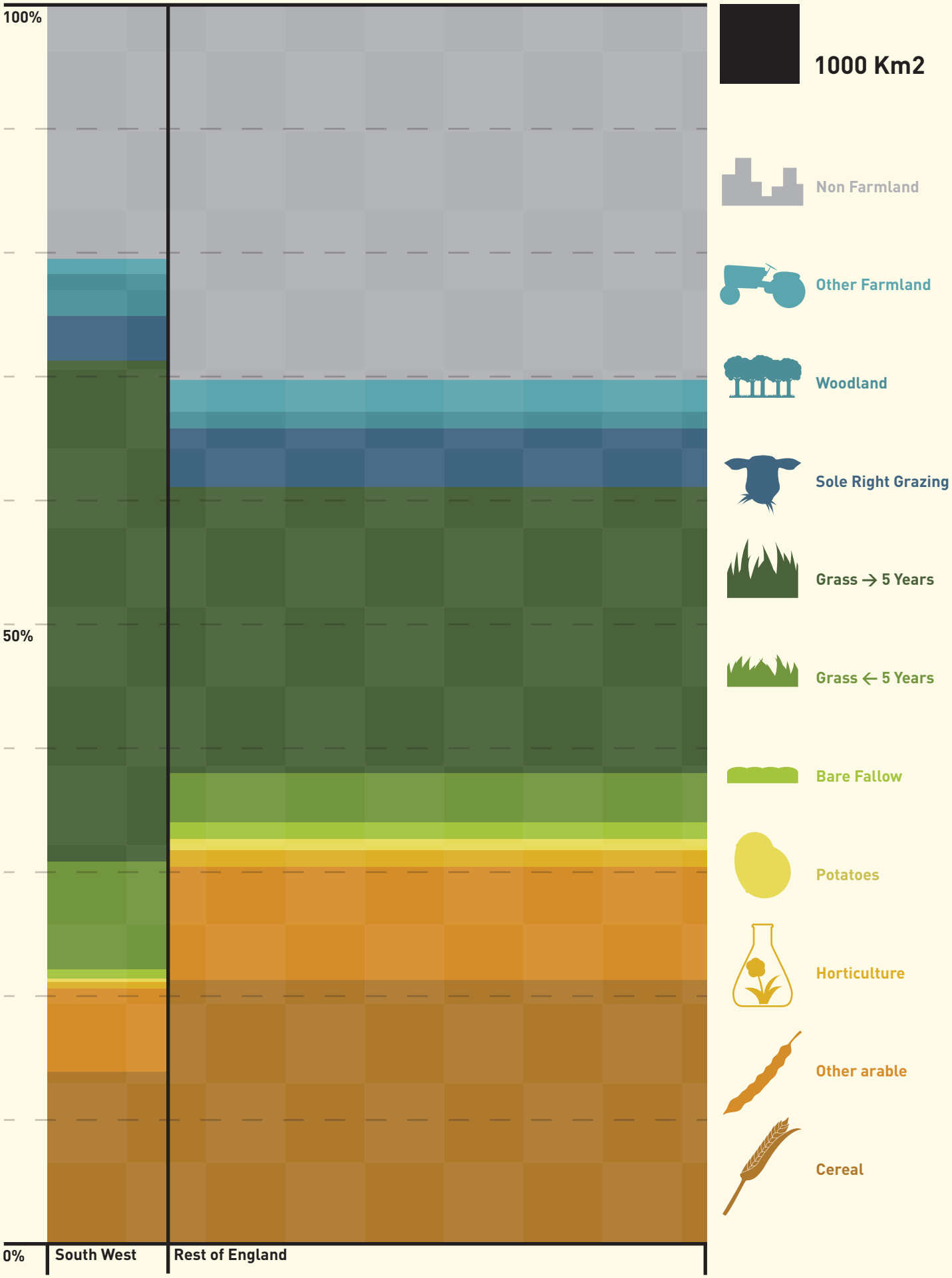

**1057 KM**

SSSI OR SITES OF SPECIAL SCIENTIFIC INTEREST ARE PROTECTED AREAS OF THE UK BECAUSE OF THEIR IMPORTANCE AND BEAUTY.

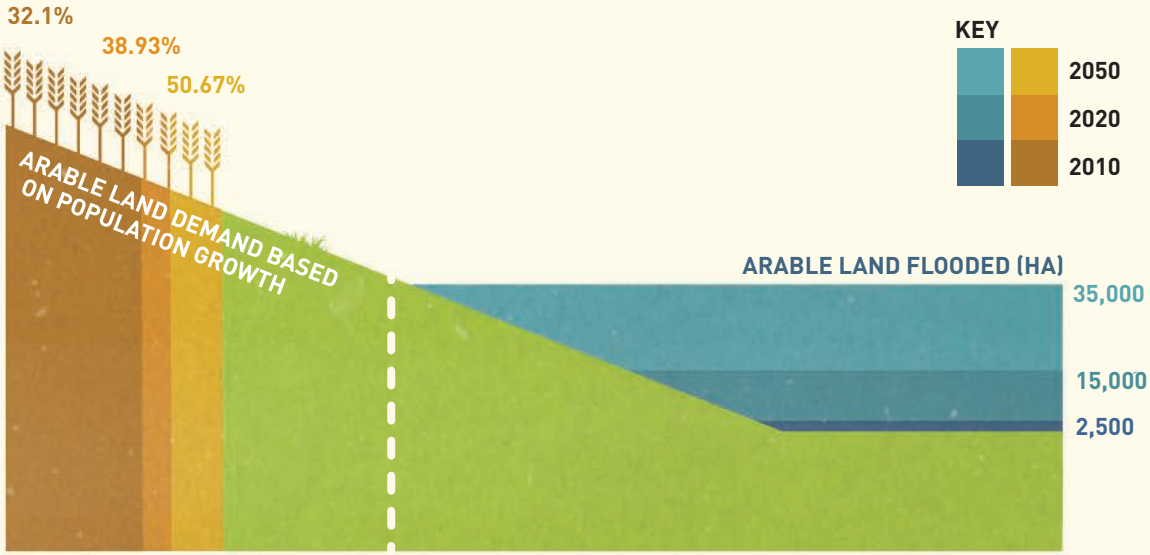
**25%** OF THESE AREAS ARE IN THE SOUTH WEST

IT WOULD TAKE YOU **21 HOURS** TO CYCLE THE ENTIRE LENGTH OF THE SOUTH WEST HERITAGE COAST

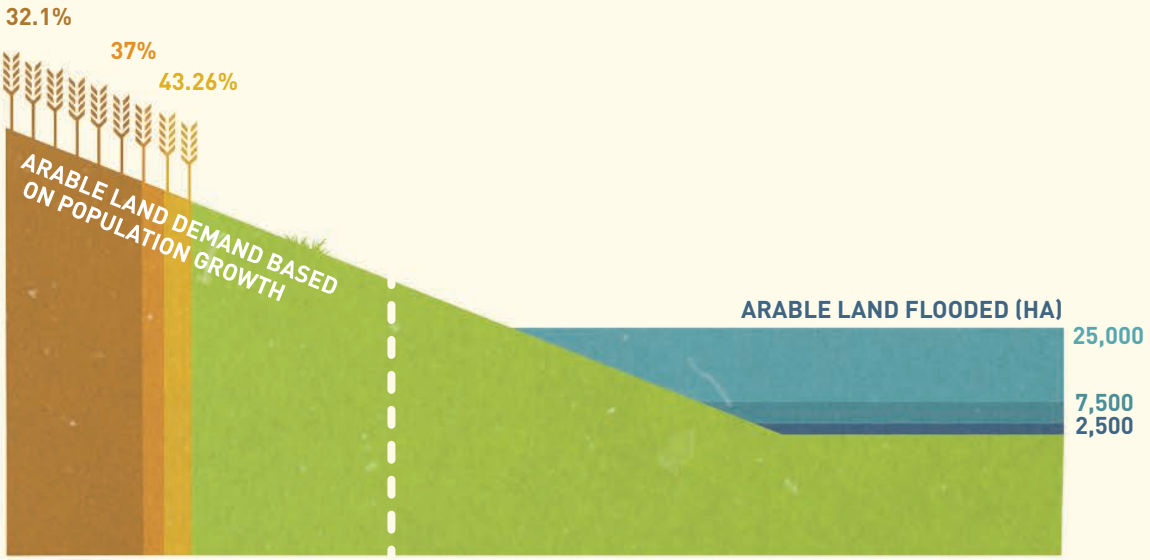
# South West England Land Use Compared to the Rest of England



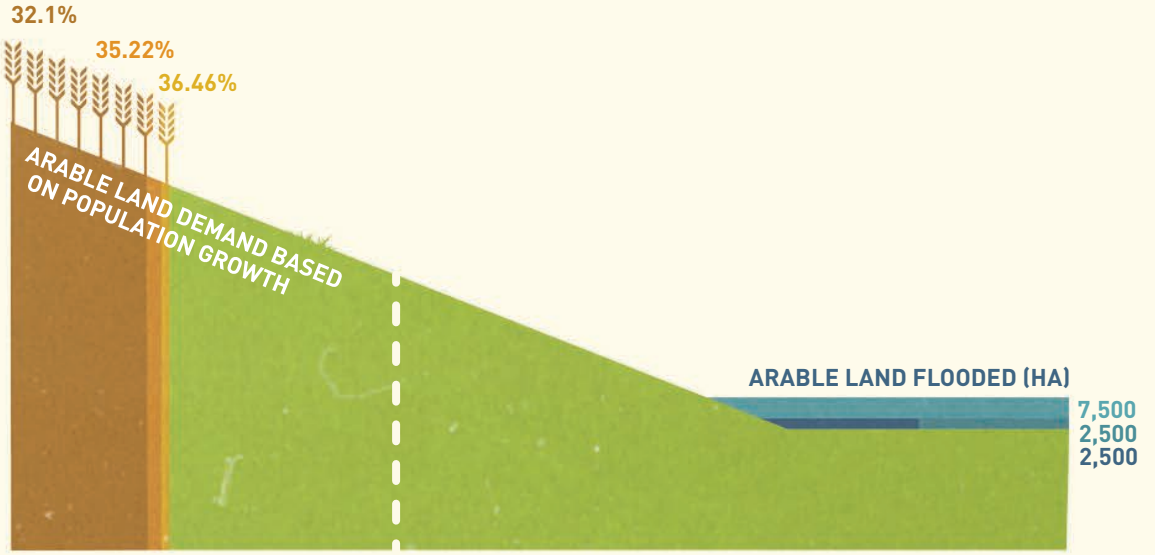
# FLOODING OF ARABLE LAND CAUSED BY CLIMATE CHANGE




## HIGH ESTIMATE




## CENTRAL ESTIMATE




## LOW ESTIMATE

# Part 2: The Dilemmas

## Food Security: The Dilemma

Food security is a multi-pronged issue that has only recently attracted the attention of politicians around the world. It is a very important concern that needs to be considered immediately, both in the South West and on a global scale.

### What is Food Security?

There have been many definitions of Food Security suggested, but one of the best proposed is the 2009 World Food Summit definition:

"Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life."

This highlights the need for equality in access to food both socially and financially, the importance of physical and mental health, and that food should be provided in a safe way. Food security, therefore, is a complex issue that encompasses many different factors. There is no one-size-fits-all solution. It is a trade-off between many varying issues and is a political balancing act.

Food security is not synonymous with self sufficiency. Not all the food we eat has to come from the region where we live. When considering food security in the South West, we cannot segregate ourselves from the impacts and influences of events and decisions in the rest of the country or the world.

### Food Security in the South West

The South West is a dynamic, evolving and varied area of the UK. It has a long coastline, upland and lowland areas, temperate weather and offers many environmental services. For example, Devon is the third largest county in England, but one of the most sparsely populated. This allows room for lots of agricultural activity. However its resident population is growing at over twice the national average. This will mean less space and more people to feed in the future[1], a common theme in many developing countries around the globe. Thanks to the fertile landscape and warm, wet climate, the county has four times more agricultural activity than the national UK average.[2] The agricultural activity mostly consists of livestock farming, with dairying, lowland cattle and sheep, and Less Favoured Area (LFA) cattle and sheep farming dominating.[3] In 2008 around 3.8% of Devon GDP was generated through agricultural activity; other significant revenue streams include tourism, hospitality and manufacturing. The South West is therefore an area that is secure in some agricultural produce. It is able to export the excess produce to other areas in demand, and in return imports crops less favourable to local conditions, such as wheat, which has a preference to a drier climate and flatter land for harvesting. The influence of the county's landscape has shaped its agri-food economy, and this can be seen all over the South West.

[1] DCC (2012) Devonomics: The Devon Story [online] www.devonomics.info/devon-story [accessed on 27/05/2012]

[2] ibid

[3] DCC (2008) Devon Farming: Lobby Information Pack [online]

www.devon.gov.uk/farming-lobby-pack.pdf [accessed on 27/5/2012]

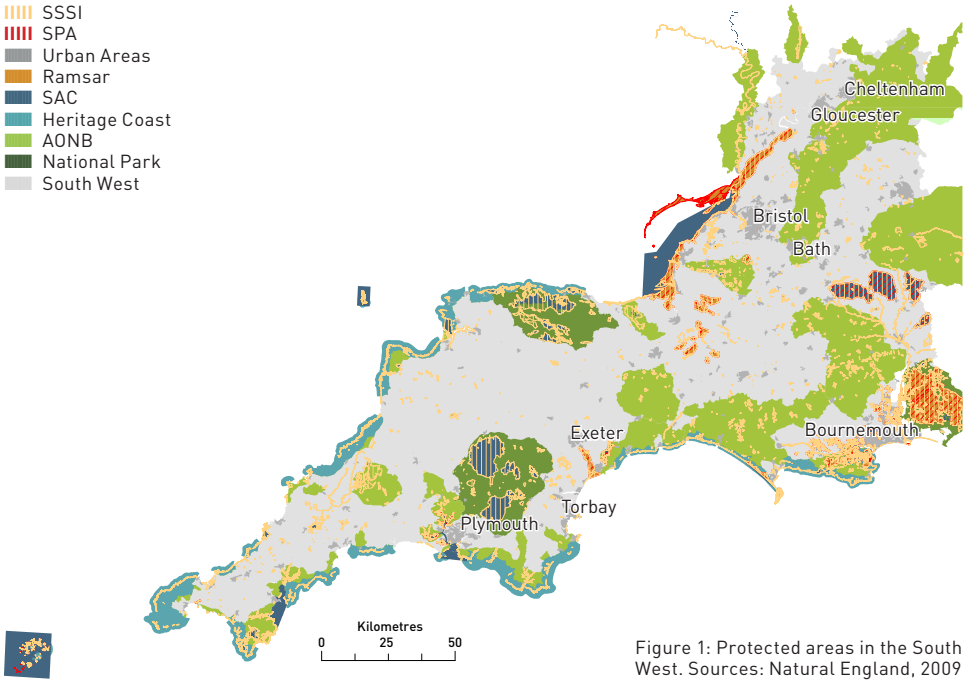
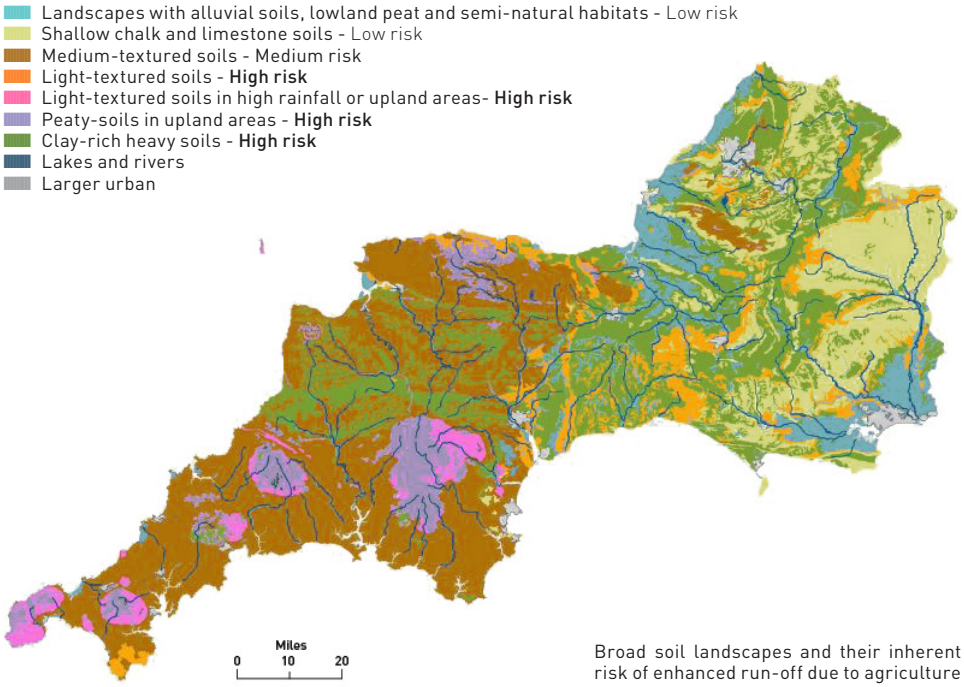



Figure 1: Protected areas in the South West. Sources: Natural England, 2009

## The Land

There are many protected regions in the South West (Figure One). These are often important for tourism as the beautiful views and wildlife bring people and money to the area. These are areas where agriculture and food production are restricted and highly monitored. The negative impacts of farming, such as pollution to waterways or removal of hedgerows to allow easy access for heavy machinery are carefully observed and restricted in order to protect the important resources these areas provide. These resources are often also called 'Ecosystem Services', and are now included in some agri-environment schemes. The protected areas in the South West should be considered in any future plans mapping out food security and agri-food production in the region.




Broad soil landscapes and their inherent risk of enhanced run-off due to agriculture

If we lay Figure One over Figure Two we can see that many of the areas highlighted in Figure Two as 'high risk upland peaty soil' are areas under protection in Figure One – The Moors. Without this protection these soils would be at an ever greater risk of damage. However, despite these protected areas, in research carried out by the Environment Agency between 2002 to 2008, it was found that around 50% of soils in the South West were degraded (EA, 2002-2008). This is often due to damaging farming activities and poor agricultural management. This damage can cause compaction and erosion of soils, and loss of organic matter and soil nutrients, which are vital for healthy plant growth. This is not sustainable for the future, as without soil there will be no crops to produce our food, and no biodiversity for a beautiful environment to attract tourism. Soil degradation is a serious issue that needs addressing

## Livestock Farming in the South West

As mentioned above, livestock makes up a large percentage of agricultural activity in the South West. The livestock industry has many issues that it should address in order to include itself in a secure and sustainable food system for the future. The issues related to keeping livestock are numerous. Cattles' food source is a key issue. Currently many farmers often feed their animals on a cheap cereal grain-based feed that fattens them to market weight quickly. The cereals used in the feed are grown on land that could otherwise be used to grow food for direct human consumption. Grain production requires significant quantities of fertilizer, fuel, pesticides, water and land. This system of feeding cattle grain is wasteful as calories of energy are lost through the system before it reaches us for consumption. It is therefore not sustainable. The cattle are also often kept indoors for long periods of time, with little space to move around. This can quickly become an animal welfare issue and can also affect the nutrition of the meat. Health and nutrition of the food we eat, particularly in relation to unhealthy saturated fats found in red meat, are also a public health consideration related to livestock. It has been suggested that grass-fed beef raised outdoors for most of the year have higher levels of polyunsaturated fat and vitamins, and lower levels of saturated fat.[4] The theory being that the animal has spent its life in its natural habitat, feeding on the food it has evolved to eat, and so is healthier for us to consume. The South West has lots of pasture land, but in the wet winter months the cattle have to be brought indoors so they do not destroy the fields. There is therefore a trade off between looking after the land and ideals of almost completely outdoor herds in terms of health and nutrition.

There are also many suggestions that we should eat less meat to help combat global warming through greenhouse gas emissions from large numbers of livestock. Ruminant animals produce methane which is a potent greenhouse gas. Agriculture is a significant contributor to this emission.

Animal waste, both in liquid and solid form, releases methane and also nitrous dioxide, another greenhouse gas, into the atmosphere. It can also pollute waterways. Manure waste management plans need to be more thoroughly enforced so that pollution is reduced, and nutrients are not lost from manure. Reusing the manure on the farm is a sustainable alternative to chemical fertilisers, helping crops grow.

**Key considerations for Food Security:**

- Environmental protection and biodiversity
- Ecosystem services
- Landscape and Tourism
- Public Health
- Diet and health equality
- Rural economy and equality
- Political Economy of food and farming
- Global Markets
- Climate Change
- Skills in the agricultural sector
- Mechanisation and technological changes
- Dependence on finite resources
- Distribution and supply issues
- Population change
- Processing and retailing influence
- Wastage
- Political inaction and inefficiency

All of these above points need to be considered in conjunction with the profitability of the farming activity, the needs and demands of consumers, and the impact of farming on the landscape in terms of aesthetics, biodiversity and ecosystem services.

EU financial decisions about subsidies and payments to farmers will continue to affect food production in the South West. Schemes to encourage biodiversity and more sustainable farming practices that look after the land, and other ecosystem services are required to ensure a healthy environment in which we can all live in the future. The prices of commodities on the global trading market will also affect prices farmers receive for their produce in the South West. Encouraging consumers to demand the ability to buy local where possible will help the local economy to stay strong in the face of global change.

**Consumers should be proud to buy British produce and remember farming's central role in securing the nation's economy and environment.**

**Megan Saunders**

[4] Duckett, S.K, et al. (2009) Effects of Winter Stocker Growth Rate and Finishing System on: III. Tissue proximate, fatty acid, vitamin and cholesterol content, J. Anim Sci. 87(9): 2961-70

## Case study 1: Food security versus water security

### Culm Grassland: long term benefits versus short term gains

Culm grassland is a semi-natural environment characterised by heavy clay and a high water table, giving rise to poorly drained soils of low agricultural quality. It supports a wide variety of Biodiversity Action Plan (BAP) species of nationally threatened wildlife, such as the marsh fritillary butterfly and the narrow-bordered bee hawk-moth,[5] and are recognised as an area of high aesthetic value, significant in carbon sequestration, biodiversity conservation and requiring minimal grazing for land management. Culm grassland plays an important role in reducing pollution in watercourses as it acts as a buffer from surrounding intensive agriculture, intercepting and storing rainfall, reducing flooding and releasing the water during periods of drought. Culm grassland today survives on commons, unenclosed ground and unimproved pasture in North Devon and North East Cornwall across the Culm measures region. Whilst Culm grassland is unique to the South West, its case study is exemplary of many other unimproved and regionally specific sites of natural value.

[5] www.devon.gov.uk/dbap-land-flower.pdf

### The Problem

Culm is highly sensitive to changes in agricultural policy and has been degraded and converted through post-war intensification, entailing a combination of fertiliser application, drainage, ploughing and re-seeding to increase economic productivity. Although a small proportion of Culm grassland in agricultural use has been converted to arable or conifer plantations, most is grazed for beef and dairy.

Studies have found estimated output from unimproved Culm grassland is less than half of that expected from agriculturally improved sites, thus recent declines in beef and dairy markets have led to increased intensification. This improvement contributes to the degradation of land character and increasingly strained water sources.

Historically, Culm grassland is a working landscape, managed through the grazing of small plots. Alongside intensification, the abandonment of light grazing on any remaining improved Culm grasslands is contributing to the succession of woody cover and eventual re-forestation. This move away from the traditional pattern of stock rearing has significantly degraded remaining areas of Culm, where mismanagement has greatly reduced the area of habitat for rare species. Subsidies to increase woodland area and carbon sequestration exacerbate this issue, but Devon Wildlife Trust's Working Wetlands project and South West Water's Upstream .

Thinking projects may provide a more regionally appropriate solution. In the near future, it is likely that the climatic and precipitation change may adversely affect the South West's water resources, food production and its natural environment, including Culm grassland. Moreover, population growth may place pressure on food and water resources: directly through the development of larger settlements encroaching grassland that provide these resources, and indirectly through the simple increase of demand. Expansion into Culm grassland also presents flood risk management concerns. Currently, the water industry in the South West depends on chemically- and energy-intensive water treatment works to treat poor quality raw water. This is largely due to diffuse run-off from agricultural inputs, and could be significantly reduced through better maintenance of grasslands and wetlands, simultaneously benefiting the rural landscape and local consumers of water resources.

### Solutions?

Devon Wildlife Trust's (DWT) 'Working Wetlands' project works alongside landowners to recreate a Living Landscape in the Culm area.[6] Advisory services, established through DWT and Natural England to manage Culm grassland, have been successful in helping landowners carry out targeted habitat management, creation and restoration projects.[7] This includes appropriate grazing and burning regimes, important for maintaining high biodiversity, and improving links or 'wildlife corridors' between areas of Culm grasslands.

[6] www.devonwildlifetrust.org/working-wetlands/

[7] www.dogfoot.com/the-wildlife-trusts/beef-butterflies-protecting-wildlife-rich-culm-grasslands-devon-cornwall/

These projects also aim to promote the local agricultural produce and include initiatives such as 'Devon Food Links', strengthening and promoting links between local markets and produce. However, protection of sites remains heavily dependent on agri-environmental schemes such as Higher Level Stewardship (HLS), tying them to livestock farming subsidies. Projects to improve the financial viability of maintaining Culm grasslands, including marketing Culm beef, have had limited success, whilst encouraging 'farm tourism' comes with the added complications of an already highly seasonal economy in the South West. Looking forward, whilst increasing awareness of the carbon intensity of meat production may threaten markets for standard intensive production, benefits may be reaped in the Culm in the production of low input beef and dairy.

South West Water's 'Upstream Thinking' project[8] works to manage water quality and quantity before it reaches reservoirs and water treatment works, considering issues influencing water quality and quantity across the entire catchment. Promoting 'Catchment Sensitive Farming' by improved land management; this seeks to protect the natural capacity of Culm grassland as a water storage and filtration system. Benefits of this include lessening the impact of storms further downstream and reducing agricultural run-off, which in turn reduces the resources needed to treat water. Fewer resources - chemicals, energy and emissions - reduce the detrimental environmental impact, with the associated reduction in revenue costs in the long term. These measures will also reduce costs for farmers and decrease the amount of fertiliser entering watercourses.

[8] www.southwestwater.co.uk/index.cfm?articleid=8329

In conclusion, the Culm Grassland of the South West is a unique habitat and anthropomorphic landscape that has been maintained over centuries by traditional farming practice. Since the 1950s, however, agricultural intensification has altered many of these habitats irrevocably. Multiple and wide-reaching benefits can be seen for careful land management in improving biodiversity, water quality, carbon sequestration and reducing flood risk and energy use. Conflicting food and water security issues have been drawn out here, where agriculturally marginal land has been managed for the benefit of another, previously under-recognised benefit- water quality. In this way, it can be seen that the short-term potential of Culm grasslands for intensification is outweighed by its strengths in water quality management with light grazing. In the future, carbon crediting of grasslands provides opportunities for the financial viability of Culm, and ongoing protection as a resource of high natural and aesthetic value. It is therefore recommended that this cultural landscape is restored and sensitively managed not only for economic importance but also for its traditional agriculture, scenic value and for biodiversity.

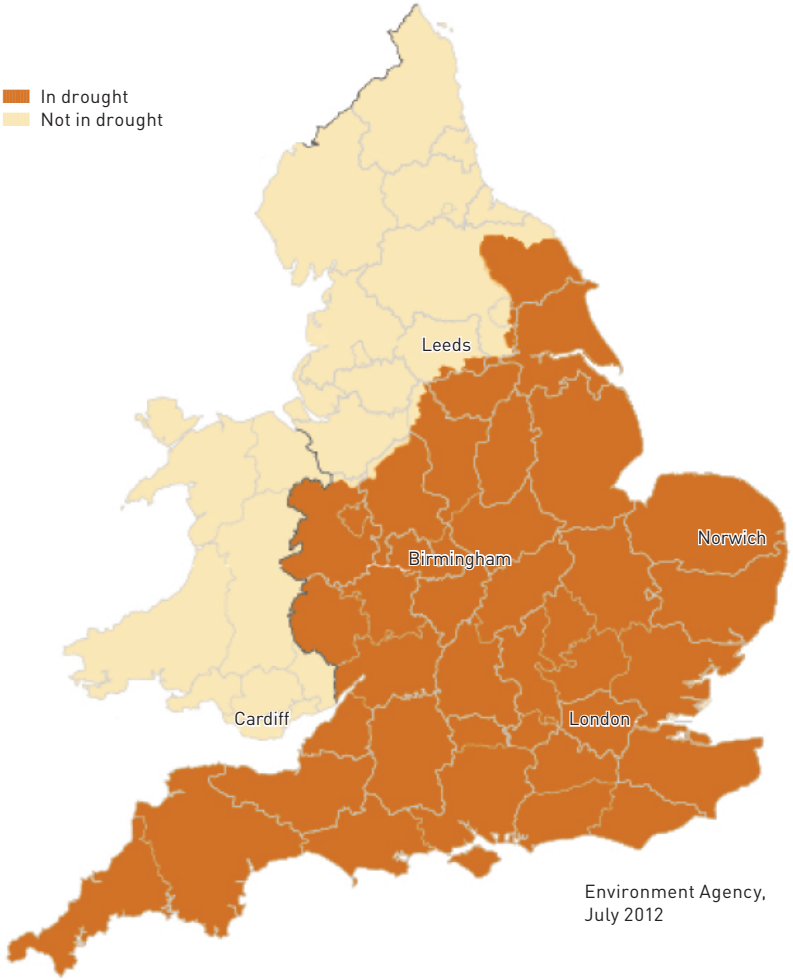
**Conor Reid** and **Honor Mackley-Ward**

Other Sources:
http://jncc.defra.gov.uk/pdf/david_leach%20pres_notesonly.pdf
http://www.northdevonbiosphere.org.uk/assets/Resources/Documents/BAP/Culm-Grassland.pdf
Natural England The Culm Character Area 149
http://jncc.defra.gov.uk/pdf/gateway10%20Feb04.pd
Tallowin et al. (2002) – improved grasslands more productive

## Water Security: The Dilemma

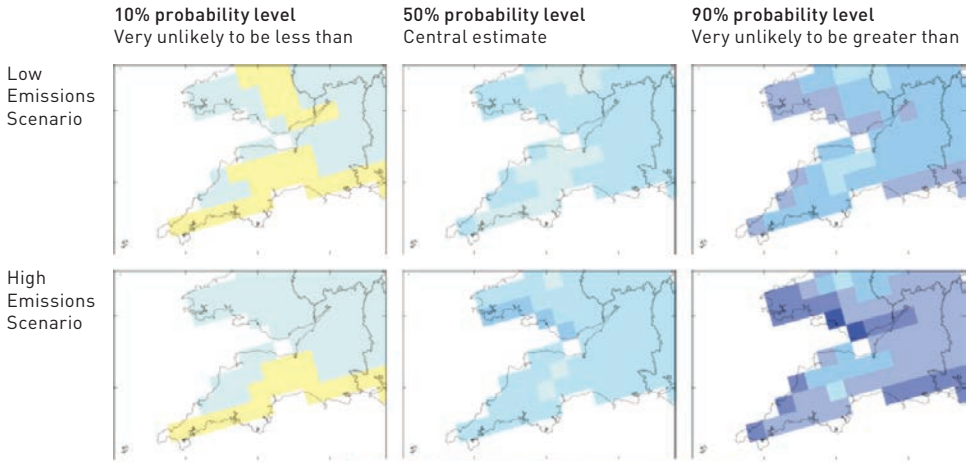
Water security is progressing into a high profile and pertinent issue in the UK. At the time of writing, drought has spread to many of its regions, the South East in particular facing serious challenges. In April 2012, parts of the South West, a region that usually receives plentiful amounts of rain, were classed as being in an official state of drought.[9] Water security has therefore become an issue that must be treated on an equal weight with energy and food security.

[9] Environment Agency, 2012

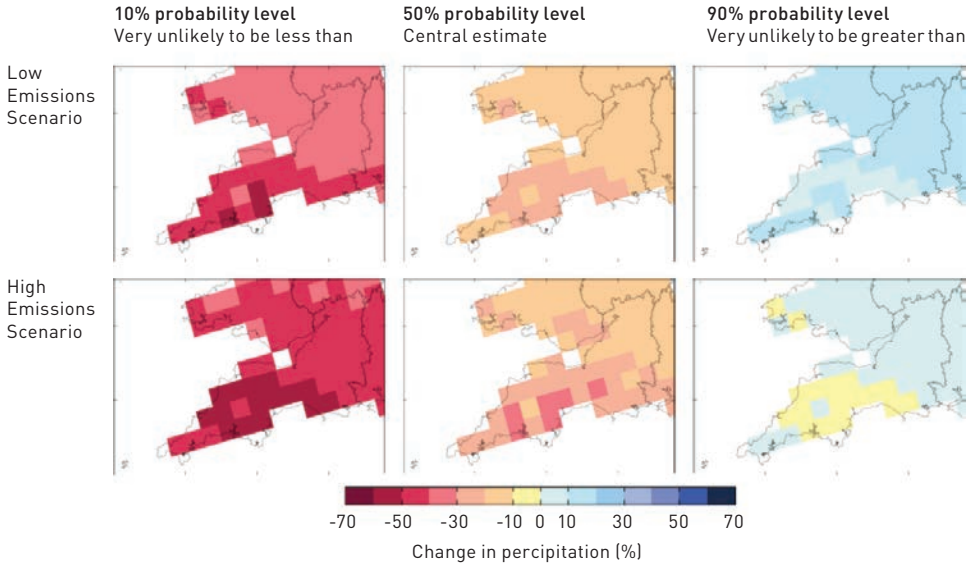



Environment Agency, July 2012

## Precipitation change 2050s Winter




## Precipitation change 2050s Summer




South West water climate adaption report January 2011

Climate change projections indicate that water security will become more challenging for the South West, and that Devon in particular will receive 15% less rainfall annually[10]. By 2050, winter rainfall is expected to increase by 17% under a medium emissions scenario, and summer rainfall is expected to decrease by 20%[11]. This means that the South West's winters may see flash flooding in several areas, and its summers, when demand is at its peak with the tourist season, will place ever more pressure on water resources[12].

[10] Devon County Council, 2005, A Warm Response, Our Climate Change Challenge, A Devon County Council Strategy for 2005...and the Foreseeable Future – Section 8

[11] UK Climate Projections (Medium Emissions Scenario), April 2010 ukclimateprojections.org.uk/content/view/2271/499/

[12] South West Water Climate Change Adaptation Report, January 2011

## What is water security?

Water security can be defined as having "sustainable access, on a watershed basis, to adequate quantities of water of acceptable quality to ensure human and ecosystem health."[13] Water Security is not only about there being enough water around to use: it also has to be of a sufficient quality, and accessible to both humans and the environment and ecosystems amongst which we live. For water security to be achieved, a stable, available source is required, and also sustainable management: both in terms of the organisations responsible for providing it to our taps, and also ourselves as end users.

[13] Norman E, Bakker K, Cook C, Dunn G, Allen D. ,2010, Water security: a primer, A Policy Report–Fostering Water Security in Canada

The issues affecting water security can be broadly looked at under the triple bottom line categories of social, economic and environmental issues.

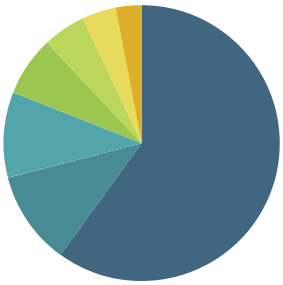
## Social Issues?

According to the UN, a person needs a minimum of 50 litres of water a day for drinking, washing, cooking and sanitation[14]. However, in the South West, 160 litres per person per day are used[15]. The breakdown of public water supply can be seen from this[16] pie chart:

[14] Water for People, Water for Life, The UN World Water Development Report, 2003, World Water Assessment Programme (WWAP)

[15] South West Water www.southwestwater.co.uk/index.cfm?articleid=8202

[16] Stepping Forward www.steppingforward.org.uk/summ/water.htm



**2001 South West water use**

| | |
|---|---|
| **60%** | Households |
| **11.2%** | Agriculture |
| **9.6%** | Industry |
| **7.2%** | Leasire and tourism |
| **4.8%** | Local authority |
| **4.4%** | Commercial and retail |
| **2.8%** | Defence |

Socially, public perception is the critical issue for water security, because consumers are currently disconnected from water's level of availability through paying a water company to provide a service of constant supply through to a tap. The cost of water may well also be involved: water is relatively cheap for all the infrastructure and treatment costs behind it, and while many people attempt to save energy, few attempt to save water, perhaps because many are unaware that water is also a precious resource. According to a CCWater report of 2006[17], only 1/3 of people in water-stressed areas thought that water shortages were a serious problem.

[17] CCWater, 2006, Using Water Wisely, Quantitative research to determine consumers' attitudes to water use and water conservation

Water is important in terms of both physical and psychological human health. As well as needing to drink it for survival, water can also relieve psychological stress. Bathing is a common stress relief method; people frequently request hotel rooms with a sea view while on holiday by the sea. The South West's use of 7.2% of its water for leisure and tourism[18], and the fact that Tourists in the South West use 394 litres of water each per bednight[19], shows the significant role that the region's water resources play in enhancing wellbeing.

[18] Stepping Forward www.steppingforward.org.uk/summ/water.htm

[19] Stepping Forward www.steppingforward.org.uk/tour/water.htm

## Economic issues

The social context links with the economic context for South West water security. As a product that is freely available via rainfall, water is relatively cheap compared with other resources, such as oil. Water's cheapness may well explain in part why water usage is so high – and the logical economic argument is to increase the price we pay for water, in order to reduce demand. If we increase the price, we increase the value, and we therefore reduce its wastage. In the South West we pay a lot more for our water than in other parts of the UK, due to our coastline[20], but the gradual roll out of water meters across England and Wales has shown a reduction in demand of approximately 13%[21]. This may be a way to connect consumers with the value of water, by making them more aware of their usage.

[20] South West Water

[21] Environment Agency, 2008, Water Resources in England and Wales – Current State and Future Pressures

Water's quality is also an economic consideration: as water levels decrease from predicted water stress, pollution in the water becomes more concentrated meaning that more energy and money is required to clean it[22]. If there are cost-effective methods to minimise the treatment, it makes sense to use them. South West Water's Upstream Thinking project is one such example.[23] For more information, Case Study 1.

[22] HM Government, 2011 Water for Life

[23] South West Water www.southwestwater.co.uk/index.fm?articleid=8329

Another aspect of the economic context is that a private company, South West Water, manages the public supply. Since privatisation of the water industry took effect in 1989, there have been clear benefits - according to OFWAT, the industry is now more efficient; £50 billion has been pumped into upgrading the infrastructure, and water quality is at an all-time high[24]. This is, of course, at a cost: in the first ten years of privatisation, water bills increased by 75% in real terms[25], and the region's water security can be seen as a private company's problem. If water were to be renationalised, there may be heightened awareness and public engagement leading to less wastage.

[24] Water UK www.water.org.uk/home/policy/pricereview/longer-term-contex

[25] Company Annual Reports, presented in House of Commons Research paper 98/117 December 98

## Environmental issues

As has already been discussed, climate change is set to impact the South West, giving it potentially hotter, drier summers, and wetter winters. Due to its geology, particularly in the far West of the region[26], the South West's water supply emanates from a large quantity of surface water. This could mean that the South West may struggle to cope with the shift in rainfall patterns, as excess precipitation in winter would not necessarily be stored as groundwater that could be used in the summer. Reliance on surface water is also problematic because it is prone to evaporation[27]. With increasing temperatures, the upland areas will need careful management to ensure that the ecosystem services they provide are not lost.

[26] South West Water Climate Change Adaptation Report, 2011

[27] South West Water www.southwestwater.co.uk/index.cfm?articleid=263

If the South West becomes drier, water quality will be affected as well[28]. Potential problems include sediment in rivers and lakes, nitrates in surface and ground water, pesticides and pollutants. Much of the South West is agricultural, and farming practices have a huge part to play in terms of helping to keep the water in the soil[29]. If the soil is ploughed when it's dry and cracked, more moisture is exposed, which evaporates. If it's then seeded and sprayed with fertiliser, and a large volume of rail falls, the water simply runs off the soil and into the water supply, taking the seeds and fertiliser with it. It's important, therefore, that those who work on the soil understand the link between land and water conservation.

[28] HM Government, 2011, Water for Life

[29] Natural England www.naturalengland.org.uk/ourwork/farming/funding/es/agents/elsoptions/waterandsoil.aspx

Water, of course, is key to life and biodiversity, to food production and to ecosystem services. Two years ago, in a review of England's Wildlife areas, Sir John Lawton suggested that large-scale habitat restoration is required to re-establish ecological processes and ecosystem services. One such habitat is wetland, which is highly bio-diverse, cleans and filters water, and holds it in the ground, reducing the risk of flooding. The restoration of floodplains has a cost benefit ratio of 1:4 so has both environmental and economic benefits.[30] For more information on wetlands, see the Somerset Levels case study on p34.

[30] Lawton, 2010, Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network

Wetland areas in the South West have been on the decline in recent years. The 'Upstream Thinking' Project and the Devon Wildlife Trust's 'Working Wetlands' project are restoring and creating Culm wetland habitats in Devon[31], but the assignment of large areas of land for habitats such as these may well be ambitious given the fact that we want the land for other things, particularly for an increasing population.[32]

[31] SWW/Devon Wildlife Trust Working Wetlands www.devonwildlifetrust.org/working-wetlands/

## Conclusions and Possible Solutions

Achieving, or coming close to achieving water security is a complex challenge, with a multitude of different factors to consider. A balance between social, economic and environmental issues is needed. Land use conflicts add an extra pressure, as the use of land in a river catchment will have a knock-on effect on the quantity and pattern of river flows, and on the quality of water running within them.

[32] South West Observatory, 2009, State of the South West www.swo.org.uk/EasysiteWeb/getresource.axd?AssetID=32491&type=full&servicetype=Inline

Some potential solutions, or steps towards water security are:

- Changing public perception by raising awareness of water scarcity and consumption levels, as well as making information available on how to improve water efficiency in households[33]
- Water metering – to give more of a link between quantity of water used and its value in terms of price[34]
- Encouraging projects whose outcomes provide multiple benefits, e.g. the Upstream Thinking project addresses both environmental and economic concerns
- Adapting water networks, i.e. reservoirs, to cope with the changing seasonal patterns of rainfall
- Changing the way we obtain water, by looking into methods such as rain harvesting. [35]

[33] CCWater, 2006, Using Water Wisely
Quantitative research to determine consumers' attitudes to water use and water conservation

[34] CCWater, 2006, Using Water Wisely, Quantitative research to determine consumers' attitudes to water use and water conservation

[35] Water Aid www.wateraid.org/documents/plugin_documents/rainwater_harvesting.pdf

Two other controversial possibilities, desalinisation[36] and cross-regional water transportation[37], are solutions which may be short-term, expensive and which might not necessarily address the roots of the issue of public awareness and using the land in a water-efficient way. However, these are solutions deployed in other parts of the world, and may have to be deployed to cope with an exploding population.

[36/37] BBC, 2012, www.bbc.co.uk/news/magazine-17600062

**Jemma Davie** and **Ellena Caudwell**

## Case Study 2: Energy security versus water security Hydropower on Dartmoor: Future conflict and the issue of intensification

Water security is a pressing concern for the South West, given the region's dependence on upland areas to source rivers and regulate their flows, while also absorbing great amounts of rainfall. One of the most critical upland areas is Dartmoor, a land we are dependent upon for a number of different uses: for farming, fishing, military purposes, mineral extraction, recreation, a water supply and archaeological heritage[38]. Dartmoor serves as a case study for how conflict could arise when we expect land to provide different types of security in the face of climate change.

[38] www.dartmoor-npa.gov.uk/__data/assets/pdf_file/0016/41254/lab-landuse.pdf

### Dartmoor's importance

Dartmoor is now a national park maintained by the National Park Authority (NPA), but it has been farmed for thousands of years. The land is now privately owned, either by the Duchy, South West Water, the Forestry Commission or small-scale landowners. Dartmoor has some of the highest ground in the South West, particularly on its northern moor: High Willhays reaches 621 m above sea level and Yes Tor reaches 619 m. High points such as these generate a higher return of rainfall, and while areas vary, Princetown recorded an annual average rainfall of 1974 mm between 1971 – 2000[39], compared with 1247 mm as an average for South West England and South Wales during the same period[40].

[39] www.metoffice.gov.uk/climate/uk/averages/19712000/sites/princetown.html

[40] ww.metoffice.gov.uk/climate/uk/averages/19712000/areal/england_sw_&_wales_s.html

Dartmoor's high ground is also covered with blanket bog, which absorbs much of this heavy rainfall, regulating the flow of rivers. Many of Devon's rivers stem from Dartmoor, including the Teign, Dart, Avon, Tavy and the Taw. In 2009, the Environment Agency confirmed that "25 per cent (38) of the 153 surface water 'Water Resource Management Units' in the South West Region are over-abstracted or over-licensed", and that "Seven Habitats Directive sites and Seven Sites of Special Scientific Interest are at risk from, or being damaged by, too much abstraction."[41] If the Eastern area of the South West is to continue to enjoy a high quality water supply, Dartmoor must be carefully water managed.

[41] publications.environment-agency.gov.uk/PDF/GEHO1209BRLB-E-E.pdf

### The current situation

Hydropower on Dartmoor has been scrutinised by The Environment Agency and the NPA. Permits for micro hydropower schemes that utilise the pressure and flow of the river are granted on a case by case basis, taking into consideration abstraction levels, impoundment (the building or raising of weirs), flood risk and fish passage. Many of these current schemes are small-scale and owned by private landowners, who generate electricity for themselves and supply surplus to the national grid via a feed in tariffs. However, the Mary Tavy River supports the largest hydropower scheme in England, and is owned by South West Water.

There doesn't appear to be much conflict between energy security and water security at present on Dartmoor. Generating energy by utilising the force of water is looked favourably upon by locals and authorities, and hydropower is not a new concept, as watermills were used to help with the mineral extraction that took place on Dartmoor several hundred years ago: in fact, it has become part of Dartmoor's heritage. The micro hydropower schemes on Dartmoor apparently carry a minimal environmental impact: they're not considered unsightly, they abstract

water from rivers that is then return once the water has passed through a leat, and the technology doesn't appear to have greatly affected the river's fish stocks and salmon population, salmon being indicators of high water quality. Hydropower stations are expensive to install, but pay for themselves within a couple of years. They've even helped bring the local community together, by being discussed, designed and built in a very inclusive and educational way.

The National Park Authority is pro hydropower, and in 2008 it wanted to see 50% more electricity generated by Dartmoor's rivers by 2012, taking the total from 3 MW to 4.5 MW. South West water is also keen to spread hydropower throughout the entire South West following the success of Dartmoor's hydro power stations. The Environment Agency's statement on hydropower reads, "The UK is committed to generating 15% of its energy from renewables by 2020, and the Committee on Climate Change advises that the electricity sector needs to cut its net emissions of carbon dioxide almost entirely by 2030. Hydropower produces 1-2% of electricity consumed in the UK...there is some potential for the expansion of small scale "low-head" hydropower. This could make a small but useful contribution to our energy use"[42].

[42] www.environment-agency.gov.uk/research/library/position/110175.aspx

If all the old and new hydro potential was developed, 18.5 GW H/Y could be generated on Dartmoor, currently 1.2% of West Devon's demand, enough for 4000 homes. Hydropower on Dartmoor is not going to make the South West anywhere near energy secure – it wouldn't even go as far as to make Dartmoor energy secure.

### The future

The conflict arises with the awareness that climate change will impact the balance of this land. Dartmoor is getting drier, according to the National Park Authority's management plan[43]. The blanket bog which provides so many ecosystem services may dry out with the predicted hotter summers, and this shrinking means that it will not be able to absorb the water expected from the wetter winters. This would seriously affect the rivers upon which we depend.

[43] www.metoffice.gov.uk/climate/uk/averages/19712000/sites/princetown.html

This isn't good news for hydropower, which is reliant on flow and pressure. We also do not know how harnessing every river in Dartmoor will impact on our water security. Privately-run hydropower schemes could easily exchange hands through the selling of land and property, meaning that careful management of these structures cannot be guaranteed. We don't know how the biodiversity of the river life in both the water and the sediment will be affected should the rivers be diverted too frequently with leats and fish passages, which amongst the serious biodiversity issues would affect water quality. As the demand for water for industry and households increases, some of Devon's abstraction licences may be retracted on a priority basis, and whether the priority will be energy security or water security will be difficult to predict. It's not certain that Dartmoor's ecosystems will cope with climate change, and whether hydropower will help or exacerbate the problem.

### The solution?

Hydropower is currently very carefully managed by the Environment Agency, and the support and commitment shown by Dartmoor's community for this renewable energy source provides hope that this technology will not be over exploited in order to hit renewable energy targets. A prioritisation of renewable energy sources for the South West could be considered, with wind, tidal, solar and wave energy looked at alongside hydropower. Dartmoor's multitude of services should be carefully safeguarded, and we should approach the use of land such as this with an awareness that it is stress-sensitive: over-stretching its functions could have serious adverse effects on both the human population and on local ecosystems.

Emma Easy

## Energy Security: the dilemma

### What is Energy security?

In the face of increasing UK energy imports, rising energy prices and climate change, there has been growing concern in recent years regarding energy security both in the UK and globally.

A definition for energy security is inherently difficult to define, but the International Energy Agency's definition takes into account some of the topic's emerging themes. To the EAI, energy security is the "uninterrupted physical availability [of energy, including electricity, heat and transport fuels], at a price which is affordable, while respecting environmental concerns". This definition can be broken down into three distinct themes: availability (which encompasses demand reduction), affordability, and environment. Each can be considered in relevance to the South West's dilemma.

The UK's energy system is set to see dramatic change over the next twenty years and the dilemma faced by both the UK and the South West is how to deliver a secure, affordable and low carbon energy system whilst meeting other challenges such as food and water security.

For the purposes of this document, "Energy" is taken to include Electricity, Heat, and Transport Fuels.

### Energy Security in the South West

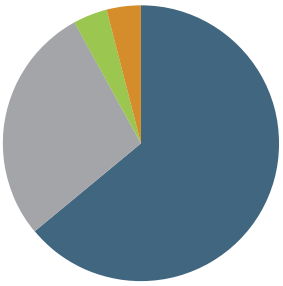
### Availability of Supply

Although electricity, heat and transport fuels are not necessarily discrete entities (electricity, for example, is used to provide heating), each will be addressed separately in order to highlight different features of the dilemma.

**Electricity:** Between today and 2020, approximately one fifth of the UK's electricity generating capacity is expected to reach the end of its operating life[44]. Unless replaced, this will dramatically reduce the operating margins of the grid as a whole, so threatening the availability of supply. The majority of generating capacity in the South West relies on gas and nuclear - in the order of 65% and 28% respectively[45]. Such generation distribution is likely to continue as EDF has recently announced intention to extend the working life of Hinkley Point B, a nuclear plant in Somerset. EDF is also making preparations for construction of another nuclear plant on the same site.

[44] DECC, 2012

[45] DECC, 2011



**Installed capacity in the South West**

| | |
|---|---|
| 2289 | Gas/CCGT |
| 1304 | Nuclear |
| 200 | Renewable |
| 185 | Other |

In addition to these dominant sources, approximately 200 MW of installed renewable electricity generating capacity exists across the South West. The majority of this is found in Devon and Cornwall, which collectively have approximately 20MW of landfill gas and 58MW of onshore wind[46]. However, these figures are drastically below the theoretical physical resource potential of the region, suggested to be in the order of 50,000 MW for onshore wind alone[47]. Although this figure paints a picture of vast untapped resource, which is true in principle, it is important to note that this extent of deployment is very unlikely to be financially viable. Onshore wind generation does present an attractive proposition in relation to land use conflict as a turbine's limited footprint makes land available for other uses such as agriculture. Conflicts are far from removed completely, however, as such land is unlikely to be suitable for some uses such as residential construction.

[46] Regen SW, 2011

[47] Regen SW, 2010

On-shore wind is not the only form of renewable electricity generation. Increasing numbers of solar farms have begun to appear in the South-West, such as those located outside Bridgwater in Somerset, and in Wadebridge in Cornwall, where a solar farm has been constructed under a community ownership scheme.

The South West had an average hourly consumption during 2010 of 3,000 MW[48] so it is clear that there is sufficient potential low carbon supply in the region to meet and even exceed demand. Whilst energy security is not about energy self-sufficiency, this significant generation potential suggests that the South West could have an important role to play in overall UK energy security.

[48] DECC, 2010

The South West's resource potential suggests that the guarantee of supply is less a question of resource availability and more a question of supportive policy and practical implementation with regards potential electricity generation.

Currently the "Big 6" energy companies have a 97% share of the UK domestic electricity market[49]. They also own a high proportion of generating capacity (65%)[6]. The development of new generating capacity in the South West – be it new nuclear or renewable technologies such as wind or energy from waste – often generates considerable public opposition.

[49] Bloomberg, 2012

Whilst an increase in generating capacity in the South West may bring local employment, many communities oppose such developments. Some objections are raised on local grounds, such as pollution or visual impact; others are broader, such as concerns about safety. This raises interesting questions about who gains and loses from energy developments and how decisions affecting local areas are made. One approach to involving communities in the benefits of the energy system has been the development of community owned generating plants.

To date this has most often involved community ownership of wind farms but can also include ownership of other distributed technologies such as solar photovoltaics or anaerobic digestion plants. Community ownership of energy plants is a fairly new approach in the UK, but evidence from Denmark (which has a much longer history of community ownership) suggests that communities with the option of part ownership or profit sharing of energy technologies have a far higher approval rating of the technology and are more likely to respond positively towards its expansion[50].

[50] Toke, D et al, 2008

**Heat:** The majority (over 76%) of households in the South-West are heated by mains-gas and the second largest proportion (approximately 12%) are heated by electricity[51]. Future physical availability of gas is relatively certain, but as native gas reserves are rapidly running out, the price at which gas may be available is becoming ever more dependant upon a number of often volatile geo-political factors.

[51] DECC, 2007

Analysis by the Committee on Climate Change demonstrates that domestic gas bills have increased by approximately 90% between 2004 and 2010, with significant impacts on the number of people in fuel poverty. Oil and electricity prices have also seen significant price rises over the same period.

There are alternatives to the widely used gas, oil and electricity however. These include solar water heaters and biomass boilers, both of which will be eligible for a forthcoming financial incentive from the government[52]. In the case of biomass boilers, it is important to source fuel sustainably.

[52] DECC, 2012

**Transport Fuels:** Like gas, domestic sources of oil are running out, making the UK more dependent upon politically unstable foreign sources. In recent years however, there have been large developments in biofuels and electric vehicles.

The South-West has a large potential resource for the production of liquid biofuels, especially through crops such as oil-seed rape and miscanthus grass.

Production of bio-crops however necessitates the displacement of other land-uses such as food production. It also has substantial implications for biodiversity. Both of these factors are explored in the bio-fuels case study.

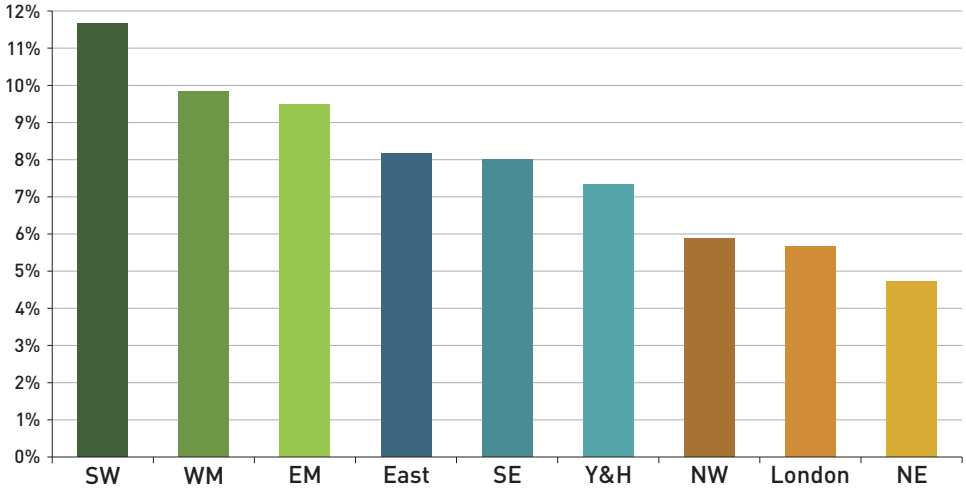
An alternative to traditional transport fuels, and to bio fuels, is the use of electric vehicles; of which many new models have entered the market in recent months. The widespread deployment of electric vehicles would have a number of impacts, including the obvious need for increased supply of electricity and large-scale deployment of charging infrastructure. At present in the South-West, there are only in the order of 50 charging stations[53], compared to several thousand petrol stations.

[53] Nextgreencar.com, 2012

**Demand Reduction:** The corollary idea to ensuring adequacy of supply is a reduction of demand. In 2006, on average 83% of energy used in UK homes was on water and space heating[54]. This shows that efficiency of heating systems, use of renewable heat, and level of insulation are all essential to reducing demand and improving the security of energy supply. However, as shown below, the average housing efficiency in the South-West is the lowest of all English regions.

[54] Boardman, 2010

**The proportion of homes which are very energy inefficient is higher in the South West than elsewhere in England**




Source: English Housing Survey, DCLG; the data is the average for the three years to 2009; England; updated in July 2011

NB. SAP ratings range from 1-100 and indicate the efficiency of a property - a higher number denotes greater efficiency.

This is in part due to large numbers of poorly insulated properties, but also due to a high percentage of homes being in small rural communities which are often without access to the gas network (16% of homes in the South-West are without a mains gas connection), which make wide use of overnight storage heaters[55] - a notoriously inefficient means of heating. Such reductions in demand and improvements in efficiency will also be necessary to meet the stated aims of the UK energy efficiency action plan of a 18% reduction in demand by 2016 in relation to 2001-2005 rates.

[55] DECC, 2007

### Affordability

Lack of efficiency has a huge impact on affordability, with 15%[56] of homes in the South-West in fuel poverty[57]. Affordability of energy is further threatened by reliance on gas-fired generation, with the average domestic energy bill increasing by approximately 75%[58] between 2004 and 2010, driven largely by increases in wholesale gas prices. Whilst low carbon policies are often presented in the media as increasing domestic energy bills, analysis actually suggests that low carbon policies (energy efficiency and low carbon generation) only accounted for 20%[14] of price rises. Consumer Focus suggests that an investment in efficiency improvements for fuel poor households of £3.4bn per year for seven years would be sufficient to eliminate fuel poverty in the UK completely. This sounds an insurmountable sum, but the government currently invests £2.8bn per year in reducing fuel poverty just among pensioners.

[56] DECC, 2012

[57] Defined as spending at least 10% of annual income on fuel.

[58] Committee on Climate Change, 2011

### Environment

Issues surrounding the production and consumption of energy are further complicated by the need to decarbonise the energy sector. The government has pledged to produce 15% of all UK energy from renewable sources by 2020, and to an over-arching target of a 34% reduction in UK CO2 emissions by 2020.

The environmental impact of the energy system is broader than the impact of carbon emissions however. This is demonstrated by the impact on biodiversity in the bio-fuels case study, and the impact on local bird populations that created a major barrier to the construction of the Severn Barrage (See Big Dilemmas Report: 2010/2011).

### Summary

The South-West faces a complex and diverse energy security problem which needs careful consideration for the future with regards to other land uses. Whilst a renewable strategy is perhaps preferable and has huge potential, it is clear that current energy generation is dominated by fossil-fuels. In addition, infrastructural and social conflicts, including lack of public engagement, and lack of up-take of demand reduction measures may be preventing the South West from realising its security potential.

In summary the key issues for the South West are:
- Supply security and generation
- Conflict over alternative land uses
- Engaging the population in the energy system
- Affordability, Efficiency and demand reduction.

**Tom Steward**, **Jess Whiting** and **Matthew Reeder**

## Case Study 3: Energy security versus food security

### Biofuels and biodiversity: the displacement of the dilemma

With the need to suppress rising fuel prices, increase energy security and mitigate climate change, as well as bring rural development opportunities to many areas, biofuels are becoming increasingly popular. Their advantages are reflected in the goals and targets set by many countries and international bodies such as the EU, who wish to see a 10% use of biofuels in the transport sector by 2020. Brazil is a global leader in biofuel production, with its climate well suited to sugarcane growth for ethanol. Although this is positive for the biofuel targets currently in place, the wider implications of crop fuels are often overlooked, with sugarcane labelled as having a "high impact" on biodiversity.

### The problem with biofuels

With finite land resources suitable for crop growth, biofuels provide both direct and indirect competition for food. This takes the form of either directly diverting edible crops to biofuel production, or by creating competition for land use. This competition is thought to have driven an increase in cereal prices, which increased by 30% between 2000 and 2007. This is likely to be exacerbated further with a growing population increasing future demand of both fuels and food.

However, biofuels can also be extremely damaging to the wider environment, with long-lasting and far-reaching implications. Indirect land use change (iLUC) from biofuel production poses the greatest threat to biodiversity in Brazil and internationally. ILUC occurs when the land required for biofuels displaces other industries, forcing them to deforest pristine habitats. For example, 45% of land converted for ethanol production in Brazil in 2007-2008 was previously used for cattle ranching. Although this means that biofuels were not directly responsible for any deforestation (as the rangeland was already cleared), the land previously used for ranching is no longer available for its original use. This leads to ranches being pushed into forested areas, ultimately resulting in the mass deforestation of the Amazon. This unregulated and indirect land use change can occur due to the prohibition of sugarcane growth in ecologically sensitive areas, but ranch-driven deforestation is completely unmonitored. This has resulted in rangeland being the biggest driver of deforestation in Brazil, and the deforestation of the Amazon being the main cause of global carbon concern as of 2007. Therefore, the biodiversity loss and carbon emissions from this iLUC mean that the full implication of biofuel production remains largely unknown.

Biofuel production also creates further strain on pressured water supplies, with sugarcane requiring 4 litres of water per litre of ethanol produced. This is exacerbated further by deforestation of the Amazon through iLUC reducing humidity levels and affecting watercourses, threatening more fragile biomes with desertification. Direct effects from biofuels also create issues such as water pollution from fertilisers.

Other impacts that biofuels have on biodiversity include general habitat loss, colonisation of invasive species and local extinctions, with plantations supporting a much lower level of biodiversity than natural forests. However, the impact of habitat loss is dependent on the original levels of biodiversity present before conversion. As some regions are more ecologically fragile than others, this full impact needs to assessed on a local scale.

Finally, the incentives for utilising biofuels in the context of reduced carbon emissions are greatly reduced when their imbedded carbon is taken into account. With iLUC, the reality of the CO2 benefits for biofuels are questioned given the fact that fossil fuels are currently required for fertiliser production, transportation, manufacture, labour, operation of farm machinery and processing.

### Implications for the UK

As discussed, biofuel production can be extremely damaging to the environment, with little benefit from their use in terms of carbon emissions. Would these issues arise if they were grown in the UK? Unfortunately, as Britain is already dependent on other countries for food production, it would not be possible to grow biofuels without infringing on land already set aside for food production, adding to the food vs. fuel debate. It is likely that growth of biofuels in the UK would eventually lead to indirect land use change, with more of our food being sourced abroad and so driving unsustainable habitat conversion. This has already been seen when the UK sourced palm oil from unsustainable sources in Indonesia, while food

oils in the UK were set aside for biofuels. However, there are some strategies that can be implemented to improve this situation.

### What can be done to prevent it?

To reduce the competition between food and fuel, the use of edible plants for biofuels could be prohibited, and degraded land unsuitable for edible crop growth could be utilised. Here, biofuel crops could even improve biodiversity through increasing soil quality and decreasing erosion. In India both these methods have been implemented through the use of Jatropha. More investment in other plants with similar flexible qualities for growth whilst boosting biodiversity would be invaluable. However, as some 'degraded' areas are actually very high in biodiversity, this scheme is reliant on an effective working definition of 'degraded' land to be established. Improved plantation management and design through the incorporation of migration corridors and buffer zones would also help reduce biofuels negative implications for biodiversity. For example, in some Brazilian states 20% of plantation area is required to be set aside as natural reserves. The use of no till cultivation and cover crops has also been suggested as a method of reducing impact through improving soil quality. However, incentives may be required to increase the uptake of these schemes.

Well-regulated and mandatory biofuel certification to identify biofuels sourced responsibly and sustainably would aid decision making for countries that require imported biofuels, such as the UK. Currently schemes such as PES (Payments for Ecosystem Services) and REDD (Reducing Emissions from Deforestation and Degradation), ensure imported biofuels are responsibly sourced with minimal impact to biodiversity. However, loopholes in these certifications often result in them being meaningless. As the profit that can be made from biofuels is often much greater than any incentive that agri-environment schemes can offer, the direct and indirect biodiversity costs associated with biofuels could be reduced through increasing the costs associated with deforestation.

Finally, to ensure biofuels are sourced responsibly, all impacts need to be assessed. These include the impacts on carbon emissions, ecosystems, water quality and availability and species composition. Only with this information can informative decisions be made.

### Conclusion

In conclusion, biofuels are a key aspect of many climate mitigation targets, but through lack of research, their full impacts on biodiversity and carbon emissions remain largely unregulated and unknown. Countries that are unable to produce their own biofuels, such as the UK, are likely to turn to imports in order to meet these targets, but in doing so fund this poorly regulated industry. Therefore, in order meet goals and ensure biofuels are sourced ethically, better regulation of production must be demanded. This will ensure biofuels are sustainable, and therefore effective.

**Lucy Ovens** and **Ayman Karim**

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5. Walter, A., Dolzan, P., Quilodrán, O., Garcia, J., Silva, C., Piacente, F. & Segerstedt, A. (2008), A Sustainability Analysis of the Brazilian Ethanol. Unicamp. Brasilia.

## Part 3: Ways forward

### Case Study 4: The Somerset Levels – how conflict can be approached

The value of the Somerset Levels to human and ecosystem life cannot be understated. As Britain's largest lowland grazing marsh ecosystem, this low-lying flood plain stretches back from the Bristol Channel, providing a habitat for migrating bird species in the winter as well as several globally threatened species of invertebrates, fish and plants, which is all the more crucial given that the UK has experienced a huge loss of wetland habitat in recent decades. The Somerset Levels also holds large peat bogs, formed from the accumulation of decaying plants over thousands of years in the waterlogged soil. Peat bogs are irreplaceable ecosystems and huge carbon stores.

Furthermore, the Levels are also directly beneficial to the South West population. They form part of Bristol Water's catchment area, providing the region with an important source of water, and their rich soils provide extremely fertile farmland, a source of food and also employment. The intensive agriculture pressed upon the Levels is only made possible, however, through the act of constantly draining the land.

It is this act of drainage that has created a land use dilemma. Lowering the water level creates profitable agricultural land, but risks compromising the area's wetland ecosystems. Intensive agriculture also risks polluting water systems, damaging wildlife and potentially compromising the area's role as a water supply. A significant conflict has arisen in the Levels, between Levels, between stakeholders who would like drainage maintained and even increased to benefit agriculture, and stakeholders who want water levels restored to preserve wetlands and water supply.

In addition, population growth and climate change are two factors likely to place pressure on areas like the Levels. Any attempt to address this conflict must consequently take these future scenarios into account, whilst trying to balance the current land use issues.

#### Biodiversity

The UK has lost around 50% of its wetland areas since 1945[1]. The Levels are therefore an increasingly unique habitat, with additional international importance given that they support around 20,000 migrating wildfowl each year, and key populations of invertebrates and plants. As a result, around 22% of the land area forms Sites of Special Scientific Interest (SSSI), and several of these are classed as World Wetland Sites.

[1] Junghanns, D. A. (1987). Conservation designation in the Somerset levels: A study of local attitudes. Landscape and Urban Planning, 14, 451-461

The leaking of agricultural chemicals and fertilisers into the water course, and the continual drainage and re-seeding of large areas of land, has posed a real threat to these ecosystems since intensive farming began in this area. As climate change makes rainfall more extreme and sporadic (see Water Security Overview, p21), wetland ecosystems reliant on high water levels may be at threat.

### Water supply

The Levels provide 68 different water sources that supply over 1 million people around 300 million litres per day[2]. The number of households in this catchment is set to increase by 21% from 2001-2021[3] meaning an even greater demand for water. With climate change's effect on rainfall, Bristol Water will need to take steps to ensure a continual water supply for the future. As 74% of the land in the water company's catchment area is classed as 'good/moderate agricultural land'[4], agricultural pollution needs to be carefully managed to ensure that it doesn't risk compromising an increasingly valuable water supply.

[2] Bristol Water. Strategic Environmental Assessment of Bristol Water's Draft Water Resources Plan www.bristolwater.co.uk/pdf/environment/wrp2010/APP10/Bristol%20Water%20Draft%20Environmental%20and%20Social%20Costs.pdf Accessed 01 July 201

[3/4] Ibid

### Food production

While attempts have been made to drain parts of the Somerset Levels since the Roman era, intensive, mechanised drainage was put into effect in the 1970s. Despite this, the area is still highly susceptible to flooding[5] and water levels are carefully regulated by the Internal Drainage Boards, who lower water levels in winter to try and prevent floods occurring. Water levels can take up to 6 weeks to return to a viable level for agriculture after flooding, meaning that farmers place pressure on authorities to increase drainage and lower the water levels.[6]

[5] BBC News (May 2012) http://www.bbc.co.uk/news/uk-england-somerset-17950604 [accessed on 8/05/2012]

[6] DEFRA (2002). SOMERSET LEVELS AND MOORS ESA: Guidelines for Farmers. http://collections.europarchive.org/tna/20081027092120/http://www.defra.gov.uk/corporate/regulat/forms/erdp/esa/slmesaguide.pdf [accessed on 18/05/2012]

The lowering of winter water levels coincides with the arrival of thousands of migrating birds, who seek wetland habitats. Any attempts to increase food production through intensifying agriculture still further will need to be balanced against the need to maintain water levels for winter migrations.
Approaching the conflict

While the Somerset Levels are a unique area, the dilemma created by the need to balance food production, conservation and water supply is replicated throughout the South West. Several attempts have been made to address this dilemma through careful management, involving a variety of stakeholders, and aiming to ensure both long-term environmental and economic sustainability. These attempts can provide a valuable reference point for the rest of the region.

The Somerset Levels Environmental Stewardship Scheme pays farmers for keeping the water table raised, keeping areas of permanent grass and using traditional farming methods, as well as responsibly managing ditches and hedges. These actions keep the water table raised and reduce the leakage of fertilisers and pesticides into the water course, whilst also ensuring that farming is still economically viable.

The Somerset Water Management Partnership (formally the Parret Catchment Project[7]), provides a forum for a range of stakeholders such as local authorities and the RSPB, who try to develop a more sustainable approach to water management in the Levels. Members of the public can also attend meetings, ensuring public participation.

[7] Parrett Drainage Board (2010) Parrett Drainage Board. www.somersetdrainageboards.gov.uk/Southlake_FC_IDB_newsletter_2_Autumn_2010.pdf [accessed on 22/05/2012]

Avon Wildlife Trust's North Somerset Wetlands Programme aims to restore and reconnect areas of wetland in the Levels.[8] The reconnection of wetlands is crucial to their future survival. The scheme ultimately aims to ensure that the area is sustainable from the triple bottom line of economic, environmental and social sustainability: much like the previous scheme, it involves local communities, local authorities and landowners.

[8] Avon Wildlife Trust. www.avonwildlifetrust.org.uk/wildlife/project_nslm.htm Accessed 01 July 2012.

Water Adaptation is Valuable for Everybody (WAVE) is a European project involving 6 regional authorities in several countries, including Somerset County Council. The project aims to develop water management systems to better withstand the effects of climate change that are fully integrated into regional planning. In the UK, Somerset County Council is working with the Environment Agency, Farming and Wildlife Advisory Group, the RSPB, Somerset Drainage Boards Consortium and Somerset Wildlife Trust, to enable a variety of projects, ranging from improved flood modelling and prediction to wildlife conservation.[9] As well as involving multiple stakeholders, the emphasis that this project puts on addressing the impacts of climate change is something that must be incorporated into any future management schemes, especially bearing in mind the significant impact climate change will have on wetland ecosystems.

[9] Somerset County Council www.somerset.gov.uk/irj/public/services/directory/service?rid=/wpccontent/Sites/SCC/Web%20Pages/Services/Services/Environment/Somerset%20Water%20Management%20Partnership [Date Accessed 29/05/2012]

## Conclusions

The Somerset Levels provide a clear example of the dilemma faced all over the South West and much of the UK, where the need to maintain food supplies frequently clashes with the need to maintain water supplies and preserve biodiversity. Lowering water levels may increase food production but risks compromising valuable water sources and irreplaceable ecosystems. Likewise raising water levels ensures a steady water supply and protects ecosystems, yet compromises agriculture, reducing food production and, potentially, economic activity. Fortunately, some significant efforts have been made in the Somerset Levels to find a sustainable compromise between these conflicting land uses, which can provide some useful guidance for attempts of a similar sort in other areas in the South West.

**Danielle Smith** and **Oliver Rubenstein-Baylis**

Other sources:
Natural England http://www.naturalengland.org.uk/ourwork/farming/funding/closedschemes/esa/somersetlevelsandmoors.aspx [Date Accessed 29/05/2012]
IDBs (Date unknown). North Somerset Levels Internal Drainage Board. http://www.nslidb.org.uk/Assets/NSLIDB_Policy_and_Requirements_for_Environmental_Mitigation%20.pdf [accessed on 20/05/2012].

## Case Study 5: Anaerobic digestion: sustainable solutions

Energy security is of vital importance to the South West, and is of increasing importance in the face of increasing fossil-fuel energy prices and their supply instability. Today, the issues of energy security are increasingly attracting interest, partly due to the record-breaking highs of petroleum fuel in July 2008, and also from concern for how to reduce fossil-fuel-derived greenhouse gas (GHG) emissions. The issues of energy price and supply are gradually influencing the discourse around the future of food security and are of high importance for ensuring the sustainability of agricultural food production in the South West.

Rising fossil-energy prices will have a dramatic impact on the future sustainability of the economy of the South West. Modern industrial agricultural food production is heavily dependent on fossil-fuel based inputs including liquid fuels, pesticides, and nitrogen-based fertilisers. Developing alternative energy sources such as renewables should be a major component of the South West's strategy to deal with rising and turbulent energy prices in the future, as potential fossil fuel supply shortages threaten food security.

Increasing energy efficiency will be central to securing sustainable economic growth in the South West and for sustainable food production. This can be achieved through the reduction of energy consumption through increasing efficiency, careful management of resources and through minimising waste.

**Solutions – renewable energy generation?**

Anaerobic Digestion (AD) occurs when microorganisms break down biomass in the absence of oxygen. The process produces a biogas, a mixture of 60% methane, 40% carbon dioxide and other trace gases. Biogas can be combusted to generate electricity and heat, or the biogas can be cleaned and fed back into the mains gas grid. The material left over at the end of the process is a nutrient-rich digestate, which can be used as fertiliser as it is rich in plant nutrients, including nitrogen, phosphorus and potassium.

Almost any biomass can be fed into AD plants, including biodegradable household wastes and livestock slurry, to release energy. AD can accept waste from our homes, supermarkets, industry and farms, which means less waste going to landfill, and therefore less greenhouse gas emissions from the landfill site going into the atmosphere. Anaerobic digesters can also be fed with purpose-grown energy crops, such as maize (although there has been varied and ongoing debate regarding whether these crops should be prioritised for food or fuel production).

Another benefit to AD is that the wastewater originating from the original biomass and formed as a by-product of the breakdown reactions can be recovered from the digester. This water can be fed back onto land, which can be valuable in periods of drought. Removing the water also makes digestate lighter to transport and makes it more resilient when applied to soil, as it is less likely to be lost as runoff.

AD can help reduce fossil fuel dependency and reduce GHG emissions, because the carbon in the biomass is part of the carbon cycle. The carbon released back into the atmosphere from the combustion of biogas was previously removed and stored by plants. If new plants are grown, they will be taking the carbon back out of the atmosphere again, and the system is therefore carbon neutral. By contrast, the carbon in fossil fuels has been sequestered in the earth for millions of years, and the combustion of fossil fuels raises the overall levels of carbon dioxide in the atmosphere.

## Langage Farm, Plymouth

Langage Farm is a highly successful dairy farm near Plymouth, which also manufactures yoghurts, cream, cheese and other dairy products onsite to supply major supermarkets retailers.

Following pressures on the agricultural sector from increasing input prices, including energy, and from increasing environmental constraints, Langage took the initiative to generate its own energy from waste, using AD. AD presented the ideal solution to meeting the farm's energy requirements, utilising waste productively and reducing its carbon footprint.

Power requirements are the primary driver for digester size and the energy requirement of Langage is high, so manure feedstock alone does not generate enough biogas. Additionally, manure needs to be pasteurised for pathogen control, which absorbs some of the cost benefits. Food waste from external sources was selected as the primary feedstock, since this has a much higher biogas yield due to its high sugar content. Food waste also has better trace elements and the food waste usually goes to landfill, where Greenhouse gas emissions are released into the atmosphere.

While it costs a considerable amount of money to construct a large AD plant, Langage successfully obtained funding from Waste Resources Action Programme's (WRAP) Environmental Transformation Fund (ETF) to assist the construction of the AD plant. The plant is profitable at around 5 years payback.

In addition, landfill sites are not only a source of greenhouse gas emissions, but are also running out of capacity. AD can assist with changes in waste legislation in The Waste Strategy 2007: this aims to help England move towards a zero waste economy by diverting food waste away from landfill by 2020.

The AD plant is a sustainable energy solution, turning can local food waste into electricity, which is greener and a more cost-effective way of treating food waste than using landfill or incineration. With the added benefit of providing organic fertiliser, which aids water security, AD can truly contribute to a more sustainable South West.

Katherine Garvey

## Case study 6: Integrated Farm Management: achieving food security without damaging the environment

Conventional farming practices caused environmental havoc during the productionist era after the Second World War, although agri-environmental schemes, such as the Entry Levels Stewardship Scheme (ELS) have been designed to reverse this trend. Organic farming is often seen as the ultimate way to farm in an environmentally responsible manner, but give lower yields than conventional farming, making this a less attractive option for farmers who generally operate under very low margins. Integrated Farming Management has been called the Third Way, providing a 'middle course between the extreme constraints of organic farming standards and the increasingly unacceptable pursuit of intensive cereal monocultures' and achieving yields higher than organic farming although lower than conventional farming.[10]

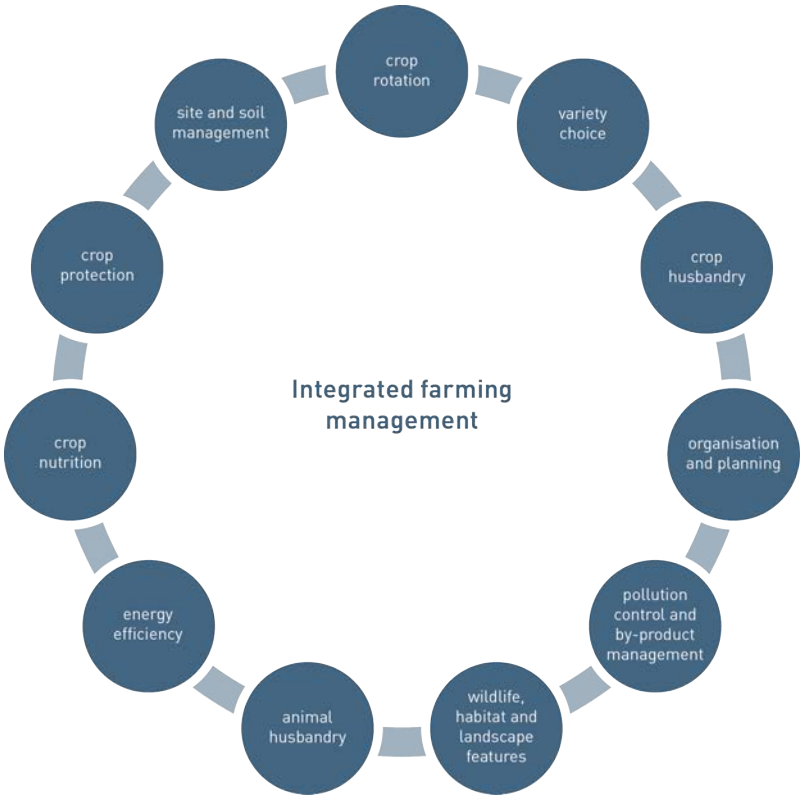
[10] Morris, C and Winter, M (1999) Integrated farming systems: the third way for European agriculture? Land Use Policy 16: 193-205

### What is integrated farming management?

Integrated Farming Management (IFM) is "A whole farm policy aiming to provide efficient and profitable production which is economically viable and environmentally responsible. It integrates beneficial natural processes into modern farming practices using the most appropriate technology and aims to minimise the environmental risks while conserving, enhancing and recreating that which is of environmental importance."

IFM tries to get the most out of a farm's resources, including its soil, water, air, staff, machinery, capital, wildlife habitats, landscape and archaeological features. Targeting inputs, reducing risk and minimising waste have environmental as well as financial benefits..

### What are the elements of IFM?



## IFM in action: LEAF

One organisation that has adopted IFM is Linking Environment and Farming (LEAF). LEAF "works to balance the needs of consumers, society, the environment and the farmer, encouraging sustainable farming systems through the adoption of Integrated Farm Management (IFM)."

LEAF is a charity that focuses on education and generating awareness amongst farmers and consumers. LEAF empower farmers to improve their water management via an online tool, which enables them to assess their water use, determine risks and maximise efficiency. The tool focuses on

- Better distribution and monitoring
- Improved irrigation
- More efficient washing systems
- Protecting water quality
- Recycling and reusing.

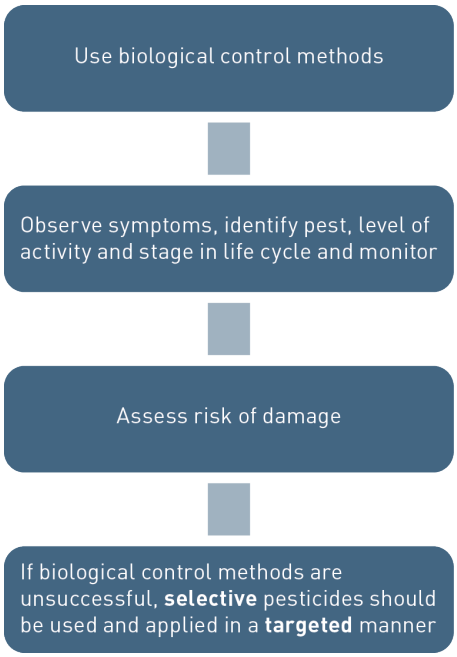
LEAF have also produced a six point guide, called 'Simply Sustainable Soils' (www.leafuk.org/resources/000/595/601/LEAF-Simply_Sustainable_Soils.pdf)

The guide is designed to help farmers improve the performance, health and long-term sustainability their land. It outlines how farmers can assess their fields including the most productive as well as the least productive fields to build-up a long-term picture of their condition and how it changes over time.

The guide covers:

1, Soil Structure
2, Drainage
3, Compaction
4, Soil Organic Matter Status
5, Soil pH & Nutrients
6, Biological Health

A third way that LEAF adopts the IFM practice is in the publication of the LEAF Handbook for Integrated Farming Management, which educates on crop protection. According to the Handbook, crop rotation, variety selection and biological control should be the first line of defence against weeds, pests and diseases. Only when these do not provide adequate control should agrochemicals be used:




## Conclusion

IFM is one strategy that successfully enables a farm to run in a more self-contained manner: making the most of its resources, reusing and recycling its waste, and taking a holistic attitude towards how its land is used. The result is land which is worked in as sustainable a fashion as possible, while environmental knock-on effects caused by needless pollution, artificial fertilisers and pesticides are minimised. What is also important is that IFM attains towards the triple bottom line of environmental, economic and social sustainability: yields, although not as high as conventional industrialised agriculture, are still higher than organic, making IFM economically viable, and those who work on the land gain invaluable skills and knowledge about the land's environmental balance.IFM's man drawback is its slow spread through the farming community. Far less research has been conducted on iFM compared to conventional farming practice, and a great number of farmers are not aware of IFM, nor are willing to take on board the requirement to learn new knowledge and skills in order to put it into practice.[11] Were IFM publicised and pressed more by local authorities and influential bodies, and if more research were to be carried out, then perhaps yields could be increased, and knowledge and practices improved even further.

**Jane Keylock** and **Emma Easy**

[11] Morris, C and Winter, M (1999) Integrated farming systems: the third way for European agriculture? Land Use Policy 16: 193-205

## Rethinking the Dilemma

### Wellbeing and environmental volunteering

As we move towards a period of increasing economic, social and environmental uncertainty, it is crucial that we build and retain inner resilience to be able to deal creatively to unpredictable change and challenges. Partly in response to this, recent years have seen a global shift in government level awareness that the purpose of life is not merely to accumulate commodity but to increase its qualitative value[12]. The UK is no exception: in 2011, the Coalition government commissioned the Office of National Statistics to research national measurements of wellbeing[13]. Factoring human wellbeing into decision-making proves challenging, however, as the nebulous phrase has multiple interpretations. The definition is used here, as "a dynamic process that gives people a sense of how their lives are going through interaction between circumstances, activities and psychological resources"[14]. This incorporates social factors such as trust, belonging and supportive relationships as well as physical, mental and spiritual wellbeing.

[12] SIS (2012) Life beyond growth, ISIS Acadamy, Tokyo

[13] MHF (2011) Measuring wellbeing: an introductory briefing, Mental Health Foundation, London

[14] NEF (2009) National accounts of wellbeing: bringing real wealth onto the balance sheet, New Economics Foundation, London

When considering tensions and trade-offs between different land uses in the South West, it is critical to maintain awareness of how prioritising different land uses affects human wellbeing through the provision or restriction of access to the natural environment. This is particularly a concern in the South West as the area is known for its tourism, and uses the natural environment for recreation, sport and visual pleasure.

The need to increase levels of health and fitness in the South West is an urgent priority, with average or above average levels of obesity in the South West (apart from Devon)[15] along with about 1 in 10 adults experiencing mental ill health at any one time. Maintaining access to the natural environment has been widely proven to alleviate these issues, most notably Kaplan's seminal work on mental wellbeing that portrays nature as a restorative environment through involuntary 'soft' attention arising in nature. At the same time robust evidence on the effect of physical activity on mental health exists, and the South West has the highest proportion of adults undertaking the recommended amount of sport or recreation which is widely proven to improve mental health[16] – a concrete argument for retaining public access to the natural environment. In addition, people hold strong emotional attachments to landscapes and ecosystems that facilitate a sense of place and belonging that heighten wellbeing. As is evident by the large influx of population to the South West through tourism, the benefits from being outside are not confined to South West residents but extend to the multitudes of people travelling each year to reap the benefits of dwelling in green and blue spaces.

[15] www.apho.org.uk/addons/_105055/atlas.html?HPT=B&config=

[16] SWPHO (2007) Indications of Public Health in the English Regions: 7: Mental health South West Regional Summary, South West Public Health Observatory

However, conflict arises when land use prioritises functions that compromise recreational access, the proposed increase in South West mining to improve energy security being a key example of this. Tungsten, one of the [14] strategically critical minerals according to the EU, is important to the energy sector, and is used in the manufacture of smart technologies that help to reduce energy demand. In addition, MIT has recently devised a new method of solar energy generation called 'solartrap' to which tungsten is central[17]. With the price of tungsten continuing to rise due to global commodity consumption rising, investors and geologists are turning towards indigenous resources. The Hemerdon mine in Devon displays attractive prospects as it contains the fourth largest tungsten reserve in the world, the largest outside of China[18]. However, concerns are

[17] www.economist.com/node/21542157

[18] www.telegraph.co.uk/finance/commodities/9216073/Devon-tungsten-mine-moves-towards-China-challenge.html

emerging around the environmental impact on one of the South West's beauty spots, for as well as the 90 acre pit and the 120 acres for the plant around it, an additional 430 acres of dumping ground is required. As ecosystems are said to provide cultural services such as intellectual, spiritual and cultural inspiration as well as recreational opportunities, the increase of mining in such stunning scenery and ancient common land may well have adverse affects on human wellbeing through the restriction of access. Inhibiting recreational use of land in the South West may also have an economic impact via a drop in visitors.

On the other hand, activities that promote human wellbeing through access to nature can also contribute towards solutions to land use dilemmas. Environmental volunteering is a perfect example.

The severe coalition budget cuts have weakened the capacity of traditional service providers such as the Environment Agency, and therefore reduced the workforce that maintains the health of the natural environment that is vital to water and food security. Exploring alternative methods of delivery is therefore of particular importance especially in the context of intensifying environmental issues that accompany climatic change - environmental volunteering can help breach this gap as it includes the delivery of environmental education, restoration, conservation and monitoring. One illustration of this is the strengthening of water security via the restoration and monitoring of Exmoor mires by South West Water's 'Upstream Thinking' project. This involves the public in conservation activities such as building dams with peat, wood and bales.

In addition to the enhancement of wellbeing gained from access to nature, environmental volunteering can serve as a method of facilitation social interactions and sense of community, social capital, trust and networking. This sense of belonging and place is key to inner resilience, with social interaction also helping to reduce conflicts in land management through increased conversation and deliberation between stakeholders.

Environmental volunteering also has the added bonus of increasing pro-sustainable behaviour change as participants have the opportunity to experience embodied learning about ecosystems, leading to an increase in understanding and therefore a decrease in our negative impact on the natural environment.

Nothing less is required to deal with the tensions and conflicts between food, energy and water security than a shift in our cultural attitudes. This shift, that would tackle the severance between humanity and the natural world, would position wellbeing as intrinsic in any land use decisions and not as a marginalised aspect of the process. Although a big ask, if this cultural myth which underlies all environmental issues was re-jigged, a different attitude could result which would lead to trade-offs becoming obsolete, and economies of wellbeing replacing economies of growth.

**Sophia Campbell**

## Credits

**Art Direction**
Harriet Sjerps-Jones
Will Stahl-Timmins

**Authors and Contributors**
Alex Begg
Sophia Campbell
Ellena Caudwell
Imogen Crookes
Jemma Davie
Emma Easy (Editor)
Katie Garvey
Ayman Karim
Jane Keylock
Honor Mackley-Ward
Lucy Ovens
Matthew Reeder
Conor Reid
Oliver Rubinstien-Baylis
Megan Saunders
Danielle Smith
Tom Steward
Jessica Whiting
Whinda Yustisia

**Graphic Design**
Harry Morris

**Information Graphics**
Chris Bounds
Henry Brown
James Burbidge
Oli Bussell
Guro Flåten
Lee Martin
Harry Morris
Trevor Thompson

**Project Leaders**
Professor Peter Cox
Harriet Sjerps-Jones

**Supporting Academics**
Associate Professor Stewart Barr
Dr Tim Kurz
Dr Matt Lobley
Dr Will Stahl-Timmins
Dr Bridget Woodman
Julie Whittaker
Professor Michael Winter OBE
Associate Professor Clive Sabel

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