



A Summary of Climate Change Risks for the East Midlands

To coincide with the publication of the UK Climate Change Risk Assessment (CCRA) 2012





Introduction

The East Midlands consists of the counties of Derbyshire, Leicestershire, Lincolnshire, Northamptonshire, Nottinghamshire and Rutland and the three main cities of Derby, Leicester and Nottingham. It is home to some 4.5m people¹ and is one of the fastest growing regions in terms of its population². Economically, the East Midlands is a major energy supplier, manufacturer, food producer and distributor. The landscape varies from the upland areas of Derbyshire (which include a large part of the Peak District National Park in the north) to the large flat expanses of Lincolnshire and the coast out to the east. Future climate change³ has implications for all of these places, people, businesses and services but extreme weather events are already having an impact, as was revealed in a series of Local Climate Impact Profiles carried out in 2008⁴. The knowledge and understanding about climate risk to the East Midlands has been gradually developing over the last ten years following the production in 2000 of The Potential Impacts of Climate Change on the East Midlands for the East Midlands Sustainable Development Round Table⁵.

UK Climate Change Risk Assessment

The UK Climate Change Risk Assessment (CCRA) is an independent research project, funded by UK Government and Devolved Governments that analyses the main risks and opportunities to the UK, arising from climate change over the coming years. It provides the underpinning evidence to inform discussions on adaptation action needed in such areas as infrastructure, health, environment and business. It will be updated every five years taking account of new climate observations and improved understanding of future climate change and risks.

The CCRA methodology is novel in that it allows for comparison of over 100 risks (prioritised from an initial list of over 700) from a number of disparate sectors based on the magnitude of the impact and confidence in the evidence base. A key strength of the analysis is using a consistent method and set of climate projections to look at current and future risks and opportunities.

Considerable strides have been made in the last three years, particularly in relation to local government. ‘Well Adapting East Midlands’⁶ is a collaborative project that has enabled the development of a systematic approach to climate change adaptation across the East Midlands. The project involves the nine city and county councils, in association with district and borough councils and other local strategic partner organisations. Consequently there is growing awareness of the challenge as more and more organisations here consider and assess the specific climate risks to their own operations, infrastructure, staff and customers. The UK Climate Change Risk Assessment is very helpful in adding more weight and further compelling evidence to the picture. Climate East Midlands is very pleased to have been involved in the UK CCRA and in helping translate some of its key messages for the benefit of stakeholders in order to continue the journey towards a Well Adapting East Midlands.

The CCRA methodology has been developed through a number of stages involving expert peer review. The approach developed is a tractable, repeatable methodology that is not dependent on changes in long term plans between the 5 year cycles of the CCRA.

The assessment considered population growth, where relevant, but did not quantify the impacts of other societal changes on future risks, for example due to economic growth, or developments in new technologies, or the full range of planned and potential future Government policies or private sector adaptation investment plans.

Excluding these factors from the analysis provides a more robust ‘baseline’ against which the effects of different plans and policies can be more easily assessed. However, when utilising the outputs of the CCRA, it is essential to consider that Government and key organisations are already taking action in many areas to minimise climate change risks and these interventions need to be considered when assessing where further action may be best directed or needed.



Key National Messages

Some key findings show why we must act now to prepare ourselves and our businesses for the future impact of climate change. The research reveals that without action we could see:-

- Increases in the frequency of flooding affecting people’s homes and wellbeing, especially for vulnerable groups (e.g. those affected by poverty, older people, people in poor health and those with disabilities), and the operation of businesses and critical infrastructure systems. Annual damage to properties in England and Wales, due to flooding from rivers and the sea, rises from £1.2 billion to between £2.1 billion and £12 billion by the 2080s. Without action, a range of important infrastructure such as roads and railways may be affected by a significantly increased risk of flooding based on future population growth and if no adaptive action is taken.
- Summer overheating potentially contributing to heat-related health problems. Premature deaths due to hotter summers are projected to increase (e.g. by between 580 and 5900 by the 2050s). This is likely to place different burdens on National Health Service (NHS), public health and social care services. Other health risks that may increase include problems caused by ground-level ozone and by marine and freshwater pathogens.
- Reductions in water availability, particularly during the summer, leading to more frequent water use restrictions and, in the longer term, water shortages. The gap between demand and availability will potentially widen, impacting homes, businesses, schools and hospitals. By the 2050s, between 27 million and 59 million people in the UK may be living in areas affected by water supply-demand deficits (based on existing population levels). Adaptation action will be needed to increase water efficiency across all sectors and decrease levels of water abstraction in the summer months.

This pack was commissioned to coincide with the publication of the UK’s first Climate Change Risk Assessment. While drawing on the CCRA where there is regional or local information (which at times is limited due to lack of data) this pack presents a local perspective of the CCRA risks and opportunities. The pack offers an illustration of what climate change means for people, businesses, community groups, local authorities, and other organisations across key sectors, at the local level, highlighting what is already happening and where there is a strong case for greater local action.

Detailed results from the CCRA are presented in:

- An extensive and comprehensive UK CCRA Evidence Report;
- A suite of technical reports on 11 key sectors.
- The UK CCRA: Government Report, which highlights actions already in place to manage the risk identified in the CCRA, and outlines UK Government plans for the future.

To read these publications, please visit: <http://www.defra.gov.uk/environment/climate/government/>

Cover photos and credits:

- *Old Market Square, Nottingham in the summer heat* (Climate East Midlands)
- *Grantham Station in the snow* (Climate East Midlands)
- *Livestock Market, Melton Mowbray* (Climate East Midlands)
- *Children in the Peak District National Park* (Climate East Midlands)
- *The Major Oak, Sherwood Forest* (courtesy of Chris Guise)
- *Flooding in Louth, 2007* (courtesy of Lincolnshire County Council)



Key Risks and Implications

Some Key Regional Climate Implications



Business

- Increases in tourism and agricultural productivity from warmer summers could be key future opportunities for the East Midlands economy.
- Business and services will be affected by climate risks to buildings and infrastructure
- Private sector awareness of climate risk and levels of resilience are not yet known, but work is underway to address this. Public sector awareness by contrast is very high and region-wide collaboration on adaptation is a key strength.

- Climate change represents a potentially significant issue for all UK business sectors.
- Main climate challenges to businesses include flooding and coastal erosion, increased competition for water, and disruption of transport and communication links.
- The degree to which individual organisations are affected depends upon their level of vulnerability and adaptive capacity.
- There are potentially significant commercial and competitive advantages to be gained for those businesses taking on the challenge.



Health and Wellbeing

- Very large numbers of people live in flood risk areas, which can have direct physical and mental health impacts in the event of a flood.
- More work is needed to understand how and where vulnerable people may be at additional risk from other aspects of climate change and also how to maximise the potential health benefits identified by the CCRA.

- Climate change could have significant implications for the health and wellbeing of the UK population.
- Implications affect public health, the continuity of health and social care services both within the NHS and beyond, the resilience of local emergency services, and the most socially vulnerable.
- There may be some welcome benefits, but there are likely to be outweighed by a range of negative effects.



Buildings and Infrastructure

- Flooding of buildings and infrastructure is the main climate risk in the East Midlands. Much of the land area is low lying and at risk of flood, with some of the most extensive flood prone coastal areas in the UK.
- The East Midlands is a major energy producer for the UK and is also important logistically due to its central location, with main road, rail and air infrastructure. All these are climate sensitive and provide potential for major disruption from future extreme weather events.

- The built environment and infrastructure are already vulnerable to extreme weather such as flooding, storms, heatwaves, and droughts.
- Most of today's buildings were designed for the climate that existed when they were built and are not necessarily equipped to cope with current and future climates.
- Around 70% of buildings that will be in use in the 2050s already exist, but there may be opportunities for innovative building services and urban planning in the UK and overseas.
- The government has already prioritised the need to improve the long-term resilience of new and existing infrastructure networks in the energy, ICT, transport and water sectors.



Agriculture and Forestry

- The East Midlands is a major food provider for the UK and has large areas of prime agricultural land. Whilst there may be some benefits in terms of improved productivity and opportunities to grow new crops, the key longer term threats include reduced water availability for irrigation and increasing flood risk from rivers and the coast.
- The East Midlands has low levels of woodland, so climate risks to trees are significant, although the region is not traditionally a major timber producing or processing area.

- Agriculture and forestry are sensitive to climatic conditions; changes in climate have a profound impact on productivity and economic viability.
- Climate change may alter the impact that agriculture and forestry have on the natural environment and the value of the ecosystem services provided.
- Warmer temperatures and carbon fertilisation may present some opportunities to increase yields, in the short term.
- Low water availability in the summer, increased flooding and coastal erosion, increased prevalence of pests diseases, and frequent wildfires may limit opportunities in the longer term.



Natural Environment

- The natural environment (particularly biodiversity) is under pressure already in the East Midlands. This is due to habitat fragmentation, low levels of both woodland and protected habitats and demands for space and natural resources from development and other land use. Climate change will increase this pressure on the natural environment as the ecosystem components are stressed and weakened.
- Important natural assets near the coast are at risk from sea level rise whilst the upland areas of the Peak are threatened (particularly blanket bog).
- There is growing recognition however, of the value and potential of natural interventions to help reduce risk and adapt to climate change such as increasing beneficial habitat and environmental conditions for particular crops and wildlife and beneficial changes to other services provided by the natural environment.

- Climate change may exacerbate and/or alter the pressures placed on the natural environment, especially those caused by human activity.
- Heightened impacts may in turn affect the way humans are able to use the environment – for example growing crops or obtaining high quality drinking water.
- The natural environment is crucial to our ability to adapt, reducing flood risk, cooling cities and storing water.



Key Risks and Implications

Key National Risks from the UK CCRA 2012



Business



Health and Wellbeing



Buildings and Infrastructure



Agriculture and Forestry



Natural Environment

Business



Hotter, drier summers could help to benefit tourism (hotel in Nottingham)

A 2010 report *Climate Change and the East Midlands Economy*⁷ which drew from the latest climate projections and tools, identified the following as critical issues:

Energy production is important to the region's economy and is climate sensitive, as described in the Buildings and Infrastructure section.

Manufacturing is vitally important to the region, accounting for a higher share of employment and output than in any other English region. However, it can be significantly affected by the weather, particularly extreme temperatures and flooding – both of which are likely to increase in frequency in future years. Additionally, drought can affect water-dependent sectors (such as printing or food processing) whilst changing temperatures can impact on demand for different products.

The East Midlands is a relatively dispersed region, with one of the highest levels of commuting of all English regions, meaning that **transport infrastructure** is particularly critical to economic activity. Extreme precipitation can cause increases in road traffic incidents, whilst extreme temperatures may degrade road surfaces. The 2007 floods had serious impacts on road transport in the region, causing sections of the M1 to close.

Agriculture (discussed in the Agriculture and Forestry section) **and tourism** are of key importance to the East Midlands, especially to Lincolnshire and Derbyshire. Tourism in the East Midlands was worth almost £6bn in 2008 and total tourist numbers were just over 144 million. Around 97,000 jobs are supported in the visitor economy.

The climate risks faced by businesses will vary enormously depending upon their location, scale, sector, etc. but the extent to which most businesses and business organisations have assessed their climate risk is likely to be very limited, other than perhaps flood risk. A business survey in association with the Environment Agency has recently been completed to help understand how businesses in the East and West Midlands have been affected by extreme weather and how well prepared they are for future climate. The survey results showed that the main reasons for respondents not taking action to increase their resilience to climate change were that it was not seen as a priority, and it was not seen as being cost effective⁸.

Awareness of climate risk amongst public sector organisations (particularly local authorities) has increased significantly over the last three years due in part to the region-wide, collaborative 'Well Adapting East Midlands' project.

Threats

- The main threats facing businesses are related to flooding, heat and water resources. Flooding can cause both damage to fixed assets, stock, etc. and loss of business continuity.

Limited water resources are likely to be a particular issue for manufacturing and agricultural businesses, which are both significant sectors within the East Midlands economy. The level of flood risk is already high in the region, but more work is needed to assess the numbers of businesses at increased risk of flooding due to climate change.

- Increased insurance claims and potential reduction in mortgage value of properties due to flooding.

This is a significant issue for the East Midlands (compared to other regions) according to the CCRA, in the estimated total value of residential properties at risk of being non-mortgageable and uninsurable due to fluvial flooding due to climate change⁹.

- Loss of assets due to sea level rise (including natural assets such as beaches and built assets such as tourist attractions, historical monuments, etc).

Coastal squeeze could have a significant impact in the East Midlands, including on those businesses dependent on tourism.

- Loss of productivity due to overheating and warm weather periods and increased energy costs for summer cooling

CCRA data suggests that this will become more significant for the East Midlands over the course of this century⁹. Anecdotal evidence from various sources suggests that this is already a problem in a number of workplaces.

- Reduction in available water for abstraction

This could lead to a potential loss of turnover for manufacturing businesses, according to CCRA data⁹.

Opportunities

- The main opportunities for businesses arise from the move to a low carbon economy and delivery of adaptation measures. These have the greatest potential to benefit the financial, utility, manufacturing and consultancy sectors.

Work is ongoing to help make the economic case for adaptation (the macro level) in order to justify investment in specific adaptation measures, which in turn will help to stimulate demand.

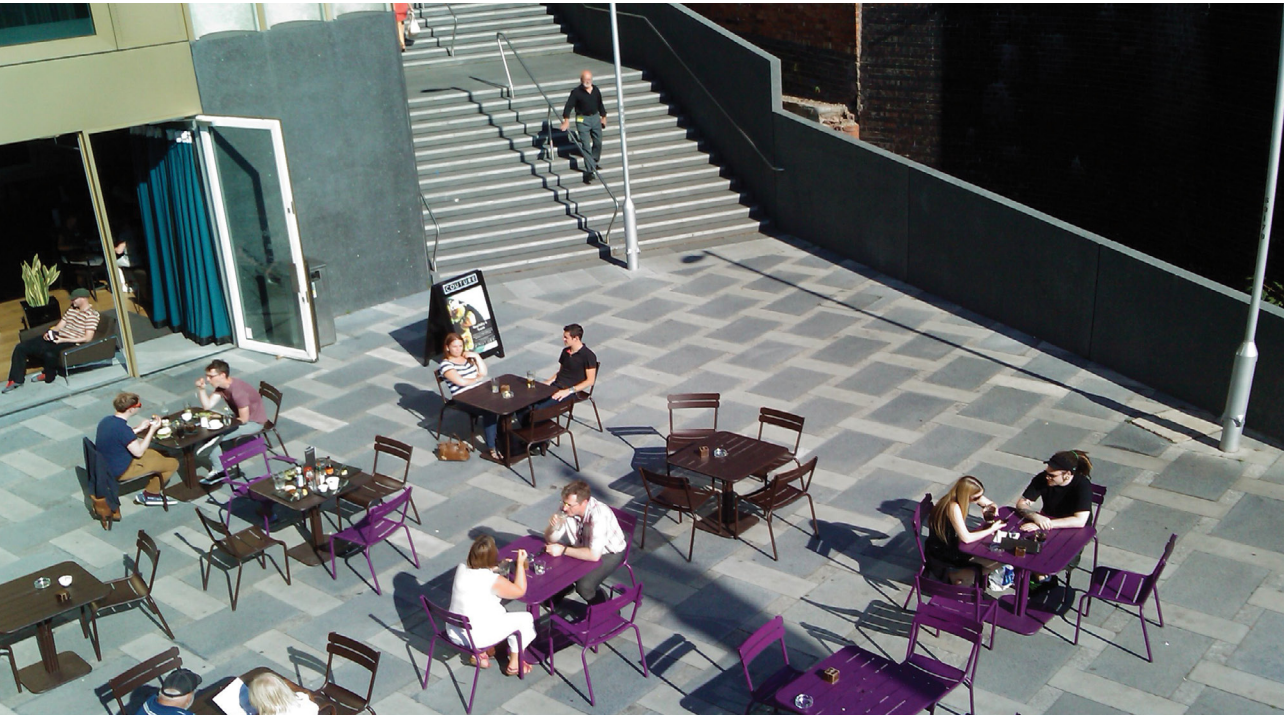
- Changes in domestic weather conditions increase market opportunities (e.g. tourism and leisure industries may benefit from better weather conditions).

The CCRA draws on a number of sources to discuss how tourism numbers may change within the UK, including a Metroeconomica 2006 report which predicts that 'in absolute terms, however, all regions will have increasing numbers of tourists during the 21st century'⁹.

- Reduced winter heating costs.

This could be a modest benefit, particularly to businesses with large heating bills.

Health and Well-being



More time outdoors due to warmer summers could benefit health and wellbeing

The most significant issue for the health of the East Midlands is the large numbers of people living in flood risk areas. According to the National Flood Risk Assessment 2011, the number of residential properties at risk of flooding (from rivers or the sea) in flood zones 2 and 3 is estimated at 209,047 and the number of people living in these properties is estimated at 491, 261¹⁰.

A 2001 report on the Health Effects of Climate Change in the UK notes ‘An important consideration affecting the likely number of casualties [in a flood] is that occupants of single storey houses and mobile homes are much more likely to suffer loss and injury or death because they cannot escape or move their property to upper floors¹¹’. This is particularly important in coastal areas.

Other important issues affecting health and wellbeing in a changing climate are social factors, such as deprivation. This is the subject of recent research on behalf of the Joseph Rowntree Foundation which found ‘Low-income households are less able to make their property resilient, and to respond to and recover from the impacts of floods. The ability to relocate is affected by wealth; so also is the ability to take out insurance against flood damage¹²’.

Excess heat is likely to become more of a health problem over time, with increases in mortality due to heat waves e.g. the 2003 heat wave led to a 17% increase in deaths for all ages and a 21% increase in deaths for people aged over 75 across the East Midlands⁷.

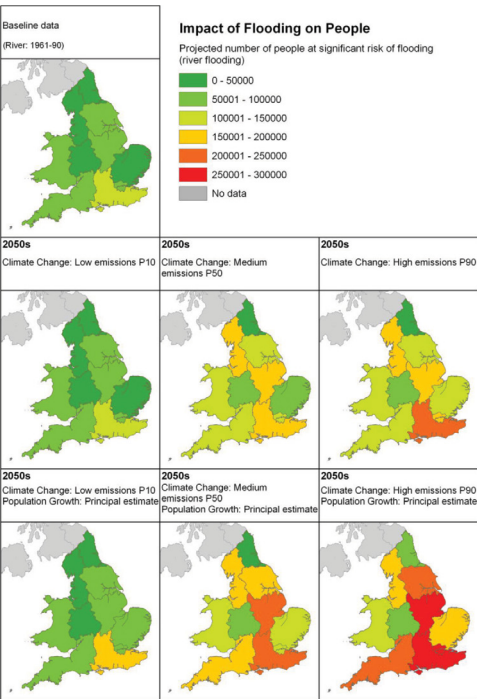
‘In the case of heatwaves’ the JRF research noted ‘social factors include: social isolation; loss of public spaces; fear of crime, which leaves people unwilling to leave their homes or open their windows; and inflexible institutional regimes and the lack of personal independence in nursing homes¹²’.

Hence health and wellbeing impacts from flooding and heat waves are likely to become more of an issue over time in the most deprived areas of the East Midlands, which are concentrated in the urban centres, coast and former coalfield areas. These areas are where health inequalities are already wide and where climate risk might exacerbate them further – but this requires further research.

Threats

- Increased temperatures may lead to increased levels of mortality and morbidity due to heat. This confirms existing knowledge and correlates with findings from recent heat waves. With a high projected increase in elderly people¹³, this could be more of a risk in the future in the East Midlands.
- Increased flooding may lead to increased number of deaths, injuries and people suffering from mental health effects as a result of flooding. Despite large areas of the East Midlands being at flood risk, the region has escaped some of the consequences from major flood events experienced in other parts of the country in recent years, though the likelihood of flooding is increasing due to climate change.
- Increased temperatures combined with increased periods of time spent outdoors may lead to an increased risk of the number of skin cancer cases and deaths. This is not only a threat to the general public, but also to staff working outdoors, an issue which has been picked up in local authority climate change risk assessments¹⁴.

- Increased winter precipitation would lead to an increase in pollutants discharged from combined sewer outfalls, which may increase risk of human disease at the coast. This requires further research to determine the level of risk to the East Midlands.
- Increased sea temperatures would lead to increased marine pathogens and harmful algae blooms which may impact on human health. The largest rate of warming in UK sea-surface temperature (1984-2008) is found in the Southern North Sea¹⁵. Some human, shellfish and fish pathogens are likely to increase but some may decrease. More research is needed.



Impact of flooding on people. (UK CCRA 2012)

Opportunities

- Increased temperatures may lead to decreased levels of mortality and morbidity due to cold. This is an important opportunity, as the number of excess winter deaths in the East Midlands (for all age groups) was 2,400 in 2010/11, according to the Office for National Statistics¹⁶.
- Increased temperatures combined with increased periods of time spent outdoors could lead to increased vitamin D levels and improved physical and mental health of people. This is another welcome health and wellbeing benefit and has knock on benefits for leisure and tourism. Some East Midlands local authorities report as much as a 100% increase in attendance at events such as fairs, carnivals and outdoor shows during periods of very warm weather, with Derby City Council’s Tourist Information Centre experiencing a 20% rise in visitor numbers during the August 2003 heat wave¹⁷.

Buildings and Infrastructure



Derby Station, Winter 2011

In 2006, there were 1,849,000 households in the East Midlands, 8.6% of the national total, but the numbers are projected to grow more quickly than anywhere else in the country (37% by 2031)².

In the East Midlands, flood risk is a major economic and social issue in low lying inland areas. The region also contains some of the most extensive flood prone coastal areas in the UK. Approximately 17% of the land area in the East Midlands is at risk of flooding. Significantly, 20% of the region is low lying and protected by drainage and flood defences and over half of the best and most versatile agricultural land is situated less than five metres above sea level¹⁸.

Due to its central location in the UK, the East Midlands is important logistically, with major road and rail routes passing through, including the M1 and A1 (north-south) and the M69 and A14 (east-west) along with the Midland Main Line and the East Coast Main Line⁷. East Midlands Airport is the UK's largest pure cargo airport¹⁹. As a large and dispersed area, the East Midlands has one of the highest levels of commuting amongst the English regions⁷. It is also home to an important logistics sector, so the potential for extreme weather to disrupt travel is significant.

The East Midlands is a major producer of energy, with its coal-fired power stations accounting for 10-15% of the UK's total capacity⁷. It is also already one of the driest regions in the UK in terms of rainfall and recent work by the Environment Agency on future water resources suggests that maintaining water supplies in the 2050s will be particularly challenging in the Midlands²⁰.

Infrastructure providers and some national agencies have recently published reports under the Climate Change Act's Reporting Power, so a great deal more evidence and interpretation is now in the public domain alongside the UK CCRA²¹.

Threats

- Increased flooding may affect a significant proportion of buildings and infrastructure
The CCRA confirms the significance of future flood risk by highlighting that the biggest projected increases in Estimated Annual Damage are in the South West, Yorkshire and Humber and the East Midlands⁹.
- Increased summer temperatures may affect conditions in buildings and the urban environment and may lead to heat related damage and/or disruption to energy and transport networks.
Such risks are understood to some extent in the East Midlands, but are further quantified in the CCRA by the example of the number of days when a maximum daily temperature of 26°C is exceeded here. This is projected to rise by 8 days/year by the 2020s, 19 days by the 2050s and 32 days by the 2080s under a 'medium emissions scenario, central estimate' (from a baseline of 10 days/year)⁹.
- The 'Urban Heat Island' effect may become more common and more significant in large cities and may increase demand for cooling.
This may be a problem in the East Midlands (and is subject to current research), though it is not projected to be on the same scale as for those areas with much larger conurbations.
- Changes in water availability, particularly reductions in the summer, may lead to increased water shortages, affecting the supply for the public, businesses and industry.

This is flagged up as an issue by the Environment Agency and the water companies, particularly in the longer term and is may also be exacerbated by high population growth^{20, 22, 23}.

Opportunities

- Milder winters may reduce demand for heating, reducing costs for businesses and the public, and reducing carbon emissions.
- In the long-term, milder winters may reduce cold weather related damage, delays and disruption and associated costs for infrastructure providers, businesses and the public (although the natural variability in the weather will mean that extreme events will still occur).
These opportunities are understood and are welcomed by East Midlands organisations who have considered climate change risks, although there is some uncertainty over how soon any benefit is likely to be realised, particularly in light of recent cold winters.
- There may be further opportunities for innovative building services and urban planning in the UK and overseas, for example in the design of sustainable buildings and developments.
There are a number of pioneering architects and developers across the region who have planned, designed and built sustainable buildings and projects, for whom this could be an advantage.

Agriculture and Forestry



Climate change could increase risks to livestock from heat stress and diseases (Melton Mowbray Livestock Market)

Agriculture is a significant economic sector, employing almost 40,000 people and accounts for around three quarters of land use in the East Midlands. The region accounts for a large share of national high-quality agricultural land, producing a fifth of England's total crop output (including around one quarter of England's vegetable, oil seed rape and sugar beet output) and around one-tenth of England's total livestock output (in particular, 16% and 20% of England's poultry and eggs output respectively)⁷.

Most of the highest quality agricultural land is in Lincolnshire which is the most productive county for wheat, oil seed rape, cereals, poultry, horticulture (especially leeks, broccoli, cauliflower and cabbages) and bulbs.

To the west of the East Midlands mixed, dairy, and livestock farming are more common along with well known associated products like Stilton Cheese, Bakewell Pudding and Melton Mowbray Pork Pies.

There is less woodland cover in the East Midlands than any other English region (5% of land use) and a relatively limited amount of commercial forestry²⁴.

In the short to medium term flooding and water availability are likely to have the biggest impact on agriculture in the East Midlands whereas in the longer term, gradual changes in temperature and precipitation are likely to have a significant impact.

There are particular risks to food production associated with coastal flooding. A coastal flood event could cause widespread inundation because the land is so low lying and could lead to salination of the soil and consequent long term loss of productivity, as well as disrupting distribution whilst roads are impassable.

Different crops can be affected by different temperature changes. The 2003 heatwave caused an average 20% reduction in yield across Europe, whilst drought can include losses in both crop and livestock⁷.

Threats

- Crop losses and other impacts on high quality agricultural land due to flooding.
This confirms a known and highly significant issue for the East Midlands.
- Higher summer soil moisture deficits, increasing demand for irrigation to maintain crop yields and quality.
- Increased competition for water resources in the summer and pressures to reduce abstractions.
The East Midlands is currently drier than the UK average, and water availability, particularly for irrigation, is already a limiting factor for agriculture in some parts of the region, so it is likely to become an even more significant issue in the future, particularly where there is growing competition for water²⁰.
- Reduced timber yield and quality due to drier conditions and an increase in the frequency of drought
The CCRA also comments that 'the area suitable for five major forest species is expected to decline in projected 2050s and 2080s climates in East and West England and notes a 'Potential increase in forestry pests and diseases'⁹. The risks to all woodlands from a changing climate and increased pests and diseases could be significant given the relatively low level of woodland cover overall in the East Midlands, although the level of commercial forestry is relatively small²⁴.
- Potential for increased potency in existing, or introduction of new livestock diseases
This may be more of an issue for the west of the region where dairy and livestock are more common.

Opportunities

- Increased yields for current crops (e.g. wheat, and sugar beet, potatoes) due to warmer conditions and/or effects.
The CCRA comments that UK farms provided 64% of the UK's refined sugar in 2009 (worth £241m) and that the East Midlands was the second largest producer. Sugar yields due to climate change effects and technological change could increase by more than 50%, so this could be an important economic opportunity⁹.
- New crops (including non-food crops for energy or pharmaceuticals) and tree species may be able to enter production, due to warmer conditions
This is another important opportunity, with potential for crops like grapes, garlic and rocket and non-food crops like Miscanthus (an energy crop) identified in the CCRA as potentially suitable for the East Midlands as the climate changes⁹.

Natural Environment



There is growing interest in the East Midlands in using 'natural interventions' to help reduce climate risk (sustainable drainage scheme in Leicester)

Natural England's State of the Natural Environment in the East Midlands report 2008²⁵ comments on the importance of a healthy natural environment in providing a range of public services, including clean air, clean water and healthy productive soils and as security against the impacts of climate change. It goes on to describe some of the key features of the region's natural environment: The East Midlands includes nearly 90,000Ha of the Peak District National Park and Lincolnshire Wolds Area of Outstanding Natural Beauty (AONB). These two designated landscape areas together comprise 9% of the East Midlands, which is lower than the national average of 15%. Outside these areas, the character of much of the region's landscape is classified as changing or in a neglected state.

There are 401 Sites of Special Scientific Interest (SSSIs), covering 11% of the region, including over 60,000ha in The Wash, the largest SSSI in England, which has internationally important bird populations.

There are also nationally significant heathlands in Nottinghamshire, Sherwood and the Lincolnshire Cover Sands as well as the most northerly population of Pasque flowers in England.

There are important semi-natural woodland complexes in the ancient forests of Sherwood (Nottinghamshire), the Bardney Limewoods (Lincolnshire), Rockingham Forest (Northamptonshire) and Leighfield Forest (Leicestershire).

The East Midlands has some of the most productive agricultural systems and soils in the country (34% of England's Grade 1 soils).

The Peak District National Park receives 22 million visits each year, almost one third of all visits to national parks in England.

A complex range of impacts on the natural environment arising from climate change have been documented and both Impact Examples (published alongside this report) elaborate on some of these. However, following the production of the 2010 report for Climate East Midlands 'Adapting through Natural Interventions'²⁶, there has been growing interest in the potential for using natural systems and processes to adapt to particular climate impacts and improve habitats, biodiversity, landscape, amenity, etc. at the same time.

Threats

- Results suggest that there would be an increase in the fire danger index across the whole of the UK by the 2080s, based on UKCP09 projections.

An increasing risk of wild fires has been identified by the Peak District National Park Authority in its climate change risk assessment²⁷.

- Coastal change, water availability changes and species range shifts: Coastal zones, uplands, semi-natural grasslands, wetlands and freshwater are particularly vulnerable.

Coastal squeeze (the reduction in the area of intertidal habitat as a consequence of sea level rise and the action of flood defences) could have a big impact on a number of internationally and nationally important nature conservation sites along the coast²⁸.

- Changes in soils, invasive non-native species, pests and diseases become increasing pressures to biodiversity and ecosystem services.

For example, a shift to a drier regime for blanket bog habitats (in the Peak District) would have important implications for biodiversity through species loss but also lead to the underlying peat soils becoming more unstable and prone to erosion²⁷.

- New conditions may favour generalist species, pests, diseases and invasive non-native species, leading to a reduction in biodiversity and disrupting ecosystem services.

Given that the natural environment is already challenged in the East Midlands, all direct and indirect climate related threats could affect the extent and condition of habitats and the species that depend upon them.

- Phenological mismatch may lead to disruption of food species and put species and ecosystem services at risk.

A decline in ground beetles and other invertebrates as a result of drier moorland habitats or invertebrate availability could become out of step with breeding waders²⁷.

Opportunities

- Better conditions for some flora and fauna, although this will tend to favour generalist species that are more adaptable over the specialists that are more specific in their habitat requirements.

Cetti's Warblers, Little Egrets and Comma Butterflies have all been found to have migrated further north in recent times²⁹. Some specialised species within the East Midlands, for example some of the rare species of beetles and spiders that live on ancient oaks in the Sherwood Forest National Nature Reserve, may not be able to move as the climate changes.

- Increased productivity in forests and woodlands due to increased temperatures where drought, pests, pathogens and other pressures are not limiting factors.

This is a welcome benefit, particularly given the relatively low level of woodland in the East Midlands, although may be partly offset by potentially lower water availability.



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Where next?

Climate East Midlands is the climate change partnership for the East Midlands, bringing together stakeholders from the public, private and voluntary sectors to help support local action on the causes and consequences of climate change.

Please visit our website or contact us to find out more.

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