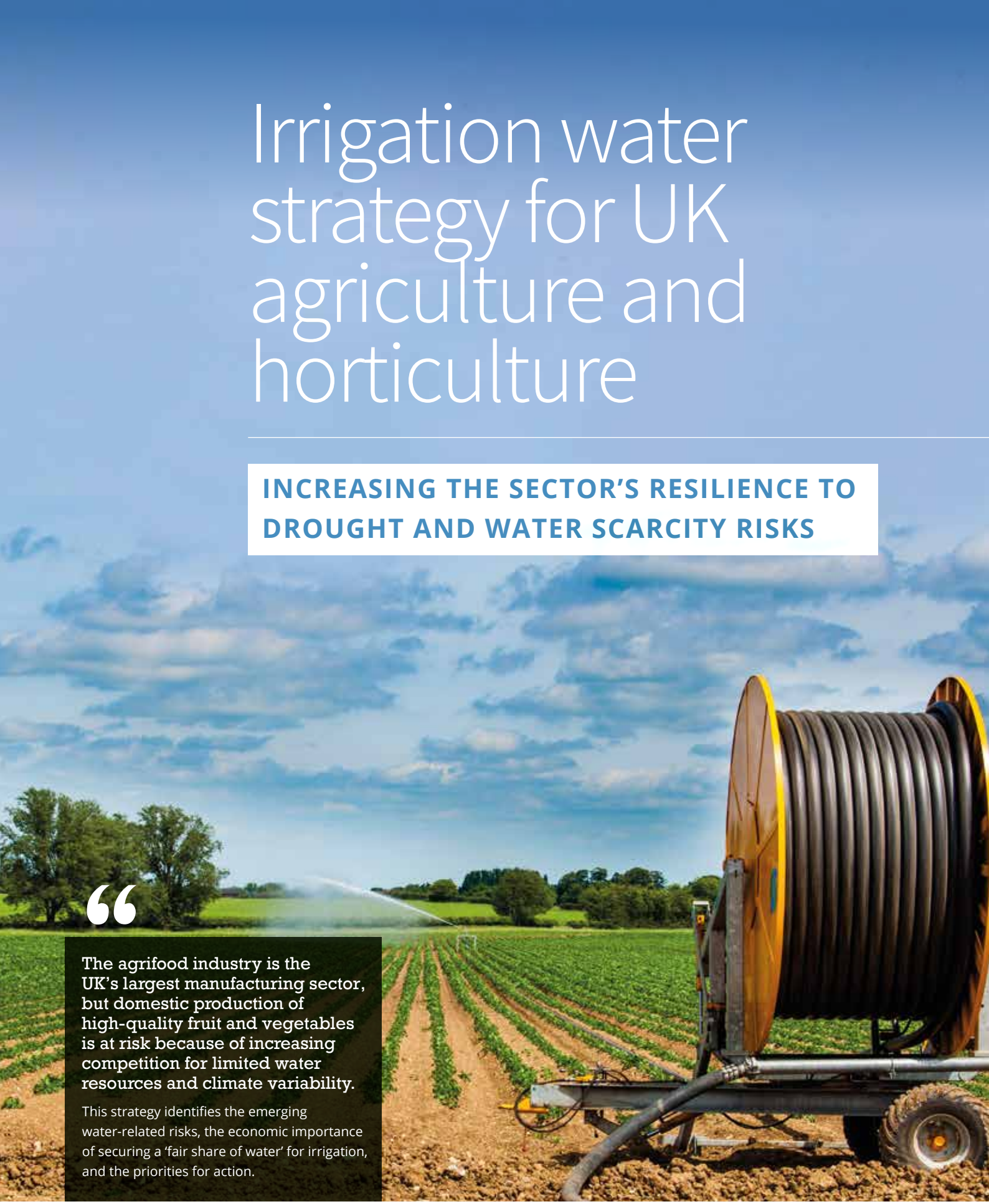
Irrigation water strategy for UK agriculture and horticulture

INCREASING THE SECTOR'S RESILIENCE TO DROUGHT AND WATER SCARCITY RISKS



> The agrifood industry is the UK's largest manufacturing sector, but domestic production of high-quality fruit and vegetables is at risk because of increasing competition for limited water resources and climate variability.

This strategy identifies the emerging water-related risks, the economic importance of securing a 'fair share of water' for irrigation, and the priorities for action.

UK

UKRI

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About Drought

AN IRRIGATION WATER STRATEGY

Irrigated agriculture and horticulture form an integral part of the UK rural economy, particularly in the midlands, east, and southeast England. More than 1,000 agri-businesses, large and small, depend on irrigation to produce high quality fruit and vegetables for the nation's wholesalers, supermarkets, and food service sectors. However, concerns are growing over water allocations, increasing demands and competition among water dependent sectors.

A strategy is needed to ensure that irrigated agriculture receives a fair share of the nation's water resources and uses it in a sustainable and efficient way.

FRESHWATER IS AT THE HEART OF AGRICULTURE AND HORTICULTURE

Most crops grown in the UK rely on natural rainfall and our country is generally perceived to be 'wet'. But rainfall varies significantly across the country, both seasonally and annually. Some regions are much drier than others, and here supplemental irrigation is essential to increase crops yields and meet quality assurance standards for processors and retailers.

Beyond the farm-gate, many businesses service this industry. They provide equipment and farm supplies, post-harvest processing and packaging, marketing services, transport and distribution. In the Anglian region the agrifood industry contributes £34 billion per year to the UK's Gross Value Added (GVA), sustains >150,000 jobs and provides 18% of national farm-gate output.

Water is at the heart of this industry, arguably one of the most sophisticated food markets in the world. Yet, nearly three quarters of the water volume licensed for spray irrigation is located within catchments that are experiencing severe levels of water stress. Recent droughts and the longer-term threat of climate change – with hotter, drier summers, reduced water availability and increasing water demand – will only heighten concerns about the reliability of future supplies for irrigated agriculture. During periods of water shortage, domestic use, industry, and the environment generally take precedence. Coupled with uncertainties about changes in the way water may be allocated in future, many farm businesses are reluctant to invest in irrigation infrastructure for the long-term. Droughts and water scarcity also threaten the sustainability of irrigated farming and the rural livelihoods it supports.

IRRIGATED AGRICULTURE IS AN INDUSTRY AT RISK

The government is encouraging the food and farming sector to increase productivity through sustainable intensification and to expand markets both nationally and internationally. There is significant potential for growth and opportunities for improving the rural economy, but uncertainty over future water supplies: availability, reliability and quality, will all have important consequences for irrigated farming. This may act as a disincentive or constraint on future growth and investment.

IMPORTING FOOD INCREASES RISKS AT HOME

The UK relies on importing more than 50% of our food, including potatoes from Israel, tomatoes from Morocco, citrus from South Africa and strawberries from Spain. When water shortages threaten home-grown production, wholesalers, supermarkets, and food service sectors may switch to sourcing from other countries which exacerbates the risks faced by home producers.

Water productivity (litres/kg) for two commodities grown in the UK and imported from overseas

UK 11 | ISRAEL 103

UK 59 | SPAIN 110

By importing irrigated produce, we are also exploiting water resources overseas - in effect, we are exporting our environmental problems to other countries that may be less able to manage their water resources and climate risks. Imports may also increase food costs and bring risks of new pests and diseases into our country.

Some imports are inevitable because consumers expect to buy out-of-season fresh fruit and vegetables, but can we afford to continue relying so much on imported food? Producing fresh fruit and vegetables in the UK requires much less water (water productivity) than growing similar crops in countries we rely on for import.

> Irrigation helps produce over 50% of potatoes and 25% of all vegetables and fruit grown nationally. Nearly half of this production is concentrated in Anglian Region.

> 2018 was a stark reminder of the importance in having a drought management strategy, both on-farm and for the agricultural sector

Irrigated agriculture helps 'add value' to the UK agrifood industry

The agrifood industry is the UK's largest manufacturing sector and over 6,600 food and drink businesses source their produce from UK farms. This industry is:

- Worth £112 billion to the economy (8% of total)
- Employs >3.6 million people (14% of total)
- Accounts for 19% of the UK's total manufacturing turnover and buys two-thirds of the UK's agricultural and horticultural produce
- Adds £4 in food processing, wholesale, and logistics, and a further £5 in food and retail catering Gross Value Added (GVA) for every £1 of primary production

AGRICULTURE NEEDS A WATER STRATEGY

Following the 1976 drought, Sir Nigel Strutt advised the Government in 1980 on the future water needs of agriculture and horticulture and the measures needed to promote water use efficiency. At that time, irrigated agriculture in the UK was in its infancy, but the drought was a wake-up call. Farmers responded by investing in irrigation and formed a new independent organisation to promote better understanding of the principles and practices of irrigation - the UK Irrigation Association (UKIA). Since the Strutt Report major changes have taken place in the agricultural sector including substantial growth in irrigation driven by concerns about future drought but increasingly by market demands for quality assurance.

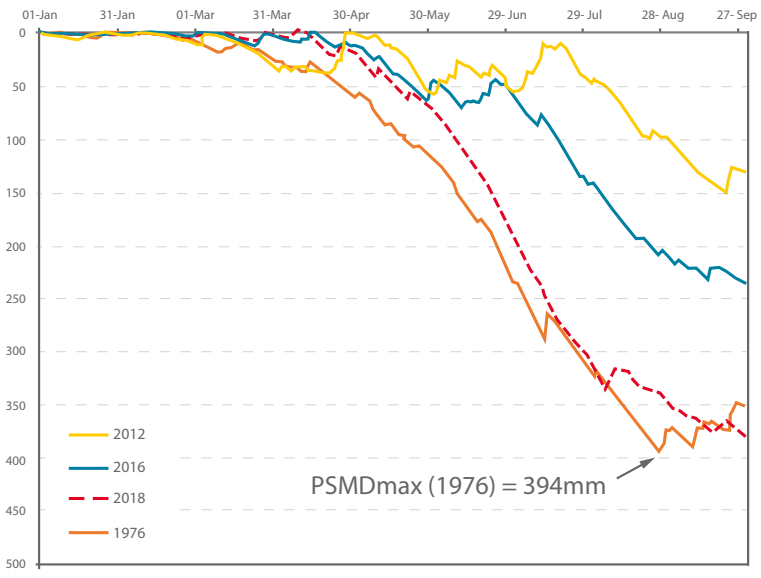
Today, irrigated farming faces unprecedented threats from water scarcity, driven by competition from other water users, over-abstraction and over-licensing in some catchments, changing water regulation, climate change, and drought. Since the Strutt Report, a strategy for irrigation has been neglected. It is now timely for the sector to set out a vision for the future.

This strategy is the next step towards supporting continued abstraction for irrigation, recognising its importance to sustaining the rural economy and the farming landscape, and how it helps to underpin the wider agrifood industry as a primary producer of food crops. The strategy recognises that freshwater resources are limited, particularly in the drier parts of the country, opportunity costs are high, and water is much in demand for public water supply, industry, power generation, the environment, and for amenity.

DROUGHT IMPACTS ON IRRIGATED AGRICULTURE – HOW EXTREME WAS 2018?

After a spate of average to relatively 'wet' summers in England, the heatwave in 2018 highlighted the significant agronomic and economic importance of water for agricultural irrigation and the risks to production. Using an aridity indicator (PSMD), the figure shows how aridity varied between a 'wet' year (2012), an 'average' year (2016) and extreme dry year (1976) at Cambridge.

The data show 2018 was similar to 1976 with virtually no rain between 01 May and 30 July. For many irrigators, this put extreme pressure on peak abstraction rates and highlighted major constraints in irrigation infrastructure. Peak demand for different crops occurred at the same time creating serious problems for prioritising irrigation. Many growers used all their licensed volume and sought additional water via emergency trades. Will the sector be better prepared for the next drought?



WATER STRATEGY - VISION AND THEMES

Water companies are legally required to produce Water Resource Management Plans (WRMPs) every 5 years to identify water-related risks facing public water supplies over the next 25-year period and to set out their strategic investment plans to cope with population growth, socio-economic development, and climate change. Agriculture should adopt a similar approach to forward planning.

HIGH LEVEL VISION

Our vision is to:

- Support economic growth and increase food security in the UK
- Secure a fair share of water and recognise that agriculture is an 'essential' use
- Protect appropriate levels of licensed headroom[1] in future allocations for drought insurance
- Share risks and benefits in water supply investments by fostering multi-sector collaboration with the public water supply, energy, and environment sectors
- Increase water productivity (t/m^3) and water value (£/m^3) in agriculture
- Support knowledge translation to increase resilience to climate and water risks
- Drive innovation in precision water management to improve irrigation efficiency

> If the water supply is cut for any reason our protected crop will perish in under 24 hours (strawberry grower).

> There is a feeling in agriculture that because of Section 57 (Environment Agency's powers to stop abstraction for irrigation during droughts), we are just the nation's safety valve (farmer).

Strategic themes

Through extensive liaison with the UK agricultural and horticultural community, including meetings with key informants, stakeholder workshops, and engagement with industry organisations, the following three strategic themes were defined:

THEME 1 Managing irrigation 'hotspots' and forecasting demand

THEME 2 Addressing regulatory and environmental challenges linked to a changing climate

THEME 3 Working together to build resilience to climate and water risks

These themes align with the WRMP approach water companies adopt to provide rigour and flexibility to their plans to cope with future water risks. They have to (i) understand current water demands and future supply-demand imbalances (ii) assess the environmental challenges due to population growth and climate change, (iii) build resilience into their water infrastructure and supply networks, and (iv) address consumer needs and customer affordability.

Guiding principles

- National in scope with focus on the irrigation requirements of agricultural and horticultural production and protected cropping
- Focus on-farm and therefore exclude water-related risks and issues for post farm-gate packing, processing, and supply chains
- Support short and medium time-scale actions but with long-term challenges in mind
- Focus on water quantity and quality linked to water scarcity and drought
- Address impacts of agriculture on the water environment and impacts of the water environment on agriculture
- Include impacts of a changing climate and agro-economic change

Essential water need

As part of the UK Government's abstraction reform it has reinforced the concept of **"Essential water need"** to describe situations where legal provisions that restrict access to water during low flows can be over-ridden. This applies principally to public water supply and to the environment. The agrifood industry must have similar protection to recognise the vital contribution that water makes to both the food industry and to national food security.

Value and volume

Given the increasing importance of irrigation for quality assurance, this strategy focuses on two critical sub-sectors - outdoor field crops, and protected edibles and ornamentals.

Outdoor field crops

Most irrigation is used to supplement rainfall on potatoes (54%) and outdoor field vegetables, such as carrots, onions, parsnips, and salad crops (31%). Some water is used on soft (e.g. strawberries) and orchard (e.g. apples, pears) fruit, sugar beet, and occasionally on cereals and grass. Most irrigation water is abstracted from surface water (52%) and ground water (41%) sources with the remainder from public water supply, ponds, and harvested rainwater (7%). Abstraction is seasonal, with 68% typically occurring between June and August. A third (32%) is abstracted during the winter months and when river flows are high, and stored in farm reservoirs ready for use in the summer.

Protected edibles and ornamentals

Crops and hardly nursery stock (HNS) are grown under highly controlled environmental conditions in glasshouses and polytunnels. Protected edibles include salad crops, such as tomatoes, cucumbers, lettuces, peppers, herbs, celery, and aubergines. Protected ornamentals include containerised pot plants, pack-bedding, and indoor cut flowers. HNS businesses vary considerably in size depending on markets they supply. Most specialist nurseries concentrate on only a few plant types, whilst others can supply over 1000 different plant species.

RECOGNISING THE ECONOMIC IMPORTANCE OF IRRIGATED AGRICULTURE AND HORTICULTURE

Metric	Outdoor field crops	Protected edibles and ornamentals
Production area (ha)	In a dry year, outdoor irrigated cropping accounts for ~150,000 ha	Total area of glasshouses in 2018 was 2,894 ha. Ornamentals sector covers ~11,800 ha
Water use (Mm^3)	Annual spray irrigation demand in E&W ranges between 82 and 110 Mm^3. Theoretical (unconstrained) demand is nearer to ~200 Mm^3	Total water use for protected edibles and ornamentals is between 17 and 25 Mm^3
Value (£)	Annual net benefit of irrigation in a design dry year is ~£665 million in England and Wales. Average irrigation productivity >£3.30/m^3	No data available on average productivity values, but protected cropping value is ~£1.4 billion
Key production areas	Cambridgeshire, Essex, Hampshire, Hereford and Worcestershire, Kent, Lincolnshire, Norfolk, Nottinghamshire, Suffolk, and South Yorkshire	Bedfordshire, Hampshire, Hertfordshire, Humber, East and West Sussex, Kent, Lincolnshire, and South Yorkshire. Smaller pockets in Cheshire, Hereford and Worcestershire, and Lancashire

[1] Headroom is the difference in water volume between what a farmer uses and what they are licensed to use. There is pressure to reduce headroom. However, this is not a luxury, it is the safety margin to cope with extreme dry years.

THEME 1 - MANAGING IRRIGATION HOTSPOTS AND FORECASTING DEMAND

The demand for irrigation depends on the range of crops grown, soil water-holding characteristics, and local agro-climate conditions, assuming water is available when needed for abstraction. However, the capricious nature of summer rainfall means that supplementary irrigation is generally needed at times when water resources are most limited. Understanding where there are catchment demand 'hotspots' and identifying the 'drivers of change' will help to determine future irrigation demands.

TRENDS IN IRRIGATION DEMAND

Although demand for irrigation water is expected to increase, since 1990, irrigation abstractions have been falling in response to new licence conditions, increased energy costs, increased efficiency, and changes in cropping. For example, the consumption of fresh potatoes in the UK halved between 1981 and 2010, which has reduced the area of potatoes being grown and hence irrigation demand. But the nature and distribution of irrigated production is also changing. Recent dry years and the 2018 drought have highlighted the risks to rainfed cropping - many businesses are now investing in new irrigation infrastructure or upgrading their systems to cope with increased rainfall uncertainty.

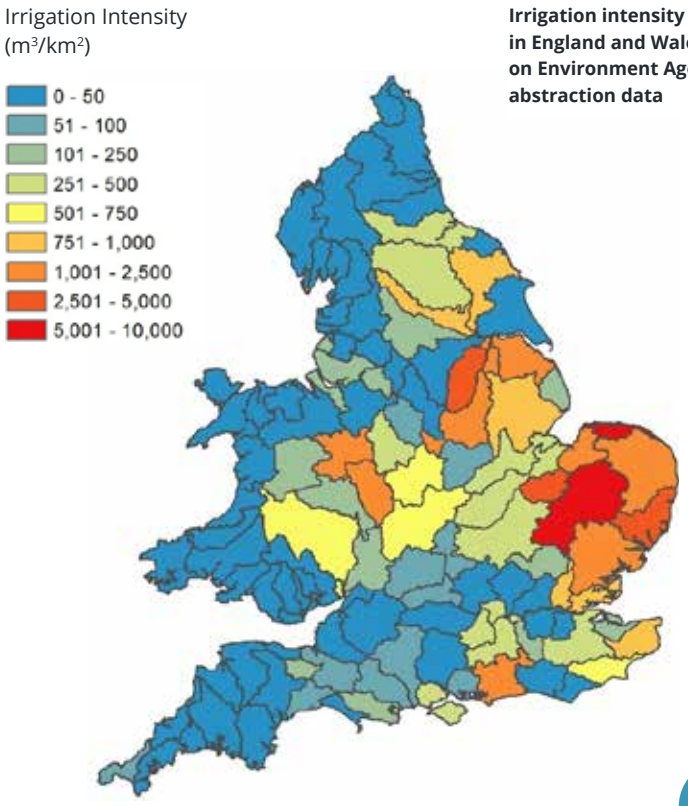
Unlike trends in public water supply, the demand for water for food is not a simple calculation based on likely population and industrial growth and the physics of a changing climate. Rather irrigation demand is linked to food security and future food policies – how much food we want to grow at home, how much we import and export, changing environmental priorities and changing diets. This is a difficult nettle to grasp but is essential to do so for the future sustainability of the agrifood industry.

IRRIGATION HOTSPOTS

Irrigation abstractions vary from year to year depending on summer rainfall, but there are 'hotspots' where catchments are already water stressed and where abstraction for irrigation is most intense (m^3/km^2). The vulnerable areas are identifiable by combining maps of the latest estimates of resource availability with irrigation abstraction. Irrigation abstractions are highest in East Anglia and Lincolnshire, with pockets of high demand in east and west midlands and south-east England. They highlight where acute competition for water and pressures on irrigation sustainability are most likely to emerge.

FUTURE WATER DEMAND DRIVERS OF CHANGE

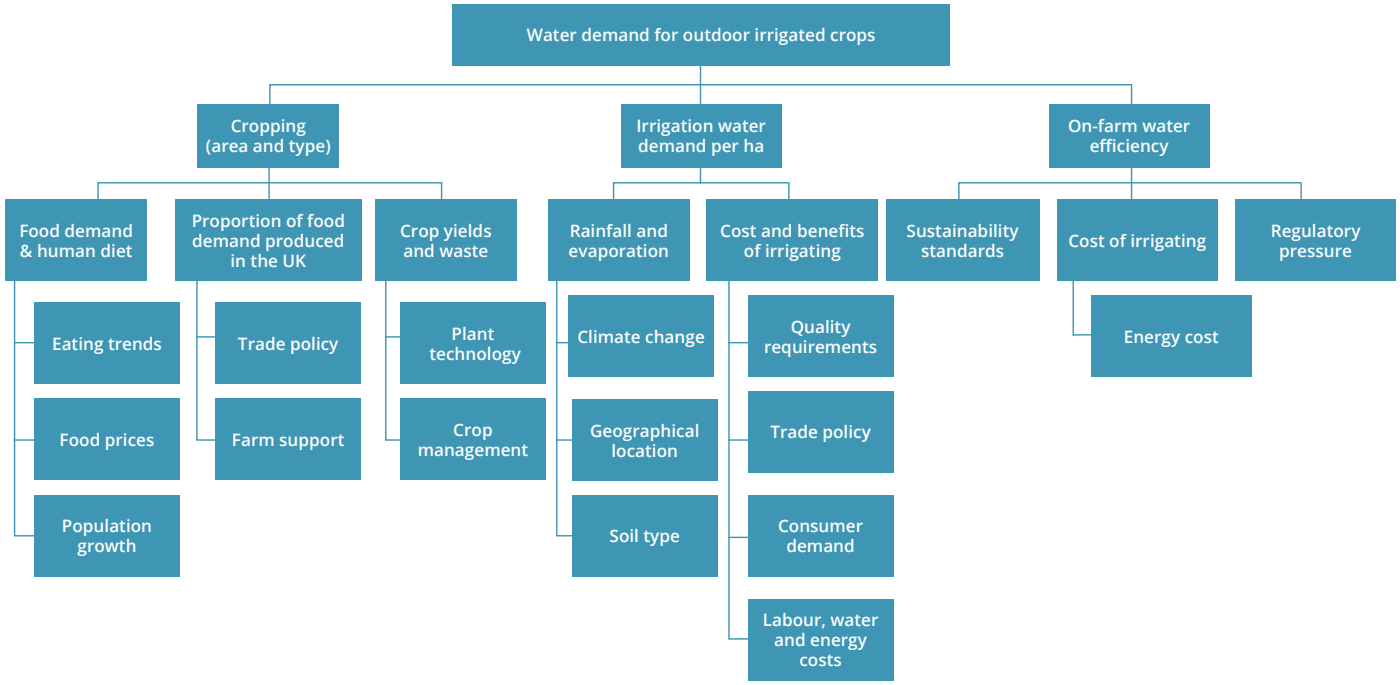
Although estimating the magnitude and location of future irrigation demand is essential for strategic planning of water resources at national and regional levels, the challenge of doing so must not be under-estimated. Forecasting demand in this diverse industry is challenging. Within any sub-sector, whether it be outdoor field crops or protected cropping, family farms or large agri-businesses, there are many factors that influence both current and future water demand: so-called agronomic, economic, environmental, societal and policy 'drivers of change'. In outdoor field cropping, for example, there are a many factors that influence water abstraction and use, many of which have unexpected dependencies.



Irrigation intensity (m^3/km^2) in England and Wales based on Environment Agency abstraction data

> Defining irrigation 'hotspots' will inform future vulnerability assessments and help identify where measures to address water scarcity impacts on crop production are most needed.

Factors affecting water use for outdoor irrigated vegetable crops



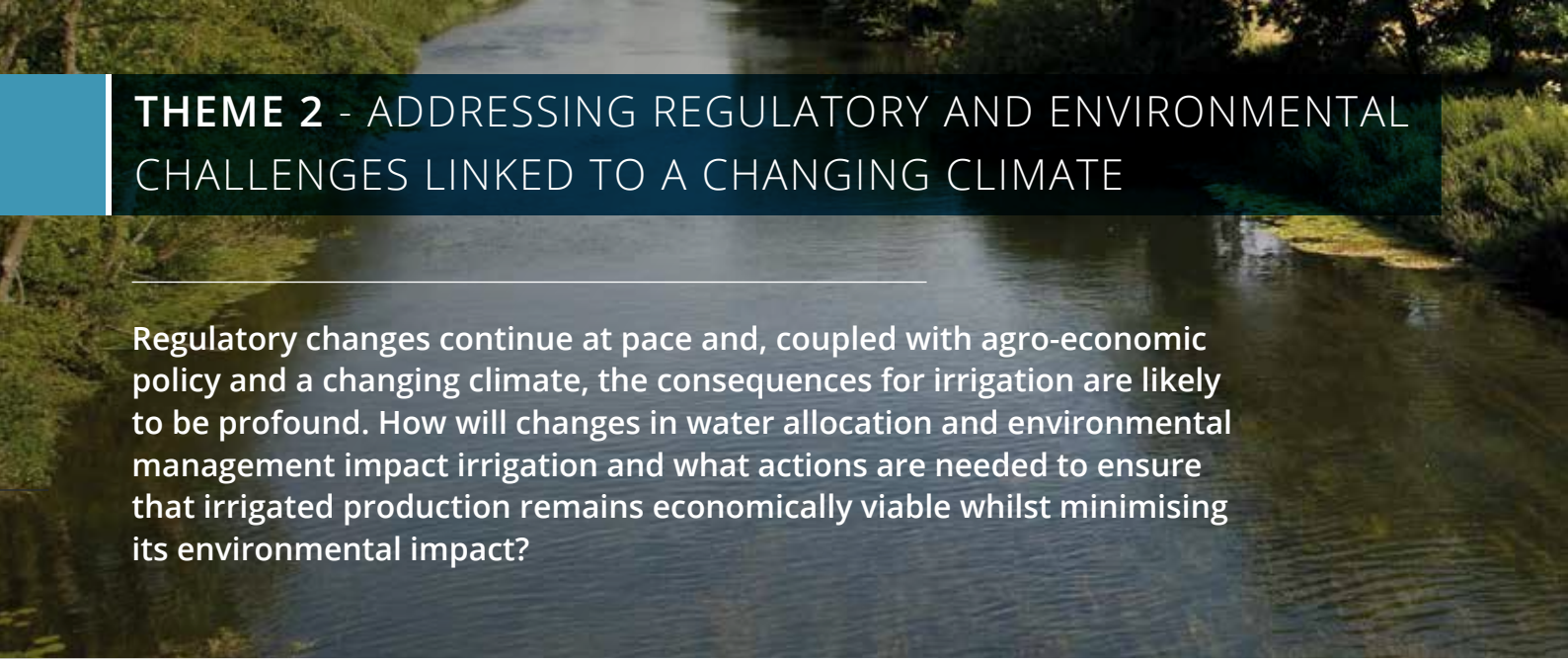
The relative importance of these factors, and how they combine to impact water demand, is complex. Changes in agro-economic policy and government decisions regarding trade tariffs and levels of self-sufficiency can have dramatic short-term impacts. Each factor or 'driver of change' requires careful scrutiny to assess both their relative importance and how they might change in the future. Unfortunately, for both outdoor irrigated crops and protected edibles and ornamentals, much of these base data and equivalent analysis is not yet available.

NATIONAL FOOD SECURITY DEPENDS ON WATER

National food security is a serious matter and highly dependent of having sufficient water to produce our food needs. The public water supply and environmental sectors are well organised and resourced for future planning. In contrast, the agricultural sector is highly fragmented and currently lacks organisational capacity and funding support to undertake the research needed to produce robust analyses of future demand (across all sub-sectors), to develop innovative technologies to support implementation of precision irrigation, and to engage in collaborative initiatives to support integrated water resources planning.

Knowledge gaps and priorities for action

Outdoor field crops	Protected edibles and ornamentals
Irrigated areas: Scope to derive accurate estimates of irrigated area and proportions of each crop irrigated by combining high resolution satellite imagery with abstraction data **Impacts of agro-economic policy on yields and prices:** Develop revised narratives that describe how national agricultural policies are linked to food security, self-sufficiency, and agricultural trade Develop demand forecasts that take into account **resource availability and reliability at** catchment level Assessment of the impacts of changes in **international trade** agreements and tariffs on UK field vegetables and salads sector where a large proportion of UK supply is dependent on EU imports.	Catchment data needed on **cropped areas, water sources** and patterns of water use Information on **'drivers of change' and policy impacts**, including effects of trade and tariffs on imports and sector expansion or contraction Understanding the **impacts of climate change** on this subsector, and how this may affect production, plants offered, and target markets Assess **impacts of abstraction** reform and investment options



THEME 2 - ADDRESSING REGULATORY AND ENVIRONMENTAL CHALLENGES LINKED TO A CHANGING CLIMATE

Regulatory changes continue at pace and, coupled with agro-economic policy and a changing climate, the consequences for irrigation are likely to be profound. How will changes in water allocation and environmental management impact irrigation and what actions are needed to ensure that irrigated production remains economically viable whilst minimising its environmental impact?

AMELIORATING ENVIRONMENTAL IMPACTS OF IRRIGATED PRODUCTION

Although irrigation has long been practised, in the past 20 years or so, the range of crops being grown, the methods of irrigation, the amounts of water applied, and the areas of land irrigated have all been changing. Some crops, previously rainfed, are now irrigated. Irrigation is about adding value and no longer a low-cost marginal activity. This has led to increased abstraction in some catchments, and an increase in the number of reported environmental incidents that potentially limit achieving good environmental status. Added to this are potential impacts on aquatic ecosystems, protected habitats, and the potential impacts of climate change and regional development.

In the longer term, climate change is projected to increase the frequency and severity of drought events, aggravate resource pressures, and drive a greater economic need for irrigation. Environmental threats include over-abstraction of groundwater, salinisation, and nutrient leaching in areas of intensive irrigated agriculture. There is the risk of soil erosion from intensive irrigation, and wetlands drying out. Although legislation is in place to protect the aquatic environment, the conflicting interests of environment versus irrigated agriculture are likely to become more widespread and pronounced in future.

A range of measures are available. Some are technical, such as adopting precision irrigation, others are socio-technical and location specific. But many are regulatory and involve policy changes and adjustments to institutional management and governance of water at national and regional levels. Several different interventions could deliver similar beneficial outcomes depending on the policy mix and how innovations in technology and management are promoted and implemented on-farm. The debate over the balance between the environment and the level of food security we desire is ongoing. It is complex because of the changing nature of our environment, and our concerns to secure sufficient, high-quality food at an affordable price, whether home grown or imported, and the impact this has on the wider agrifood industry.

IMPROVING DROUGHT RISK MANAGEMENT ON-FARM

Most farmers are well attuned to managing short-term weather-related crop risks, but the key to reducing drought risk on farms is to improve how farmers manage the uncertainty of rainfall and water availability in line with cropping requirements and the markets. One practical outcome from recent research following the 2011-2012 drought was **D-Risk.** This is an intuitive web-based tool to help farmers understand their current and emergent drought and irrigation abstraction risks to support more robust decision-making when changing cropping plans and investing in water infrastructure. Data inputs include crops and areas irrigated, soil types, annual licensed volumes, water sources, and peak abstraction limits. **D-Risk** then provides the farmer with two important metrics – a probabilistic assessment of:

1. how likely they might experience an irrigation deficit, and:
2. how their licensed headroom might change

This provides farmers with a detailed understanding of how future changes in crop mix and/or area might change their drought risk profile; or how any reductions in licensed allocation might impact on their business. It can also help to answer the question: What reservoir capacity do I need to reduce the risks of a drought on my business?

REGULATORY CHALLENGES

Many catchments in which irrigation is concentrated are already over-abstracted and/or over-licensed. Abstraction reform seeks to ensure all catchments are environmentally sustainable. A range of measures including voluntary revocation of unused licences, reducing headroom on what are considered to be under-utilised licences, and facilitating simple water trading arrangements to support economic growth have all been proposed. But abstraction reform must be supported by evidence-based assessments of water need and reliability, particularly during droughts when the responses to irrigation and environmental risks are highest. At present no tools exist to support dialogue between the regulatory agencies with abstractor groups about water needs, and for farming businesses trying to assess their abstraction reliability due to drought restrictions.

> Steps are essential to bring harmony and reduce growing tension between the environment and irrigated agriculture

Building on D-Risk, a new project (D-Risk2) aims to develop a tool to evaluate the joint risks of abstraction restrictions (voluntary and mandatory) when there is not enough water available and insufficient licensed volumes during drought events.

It will improve decision-making regarding water trading, licensed reductions, and the need for reservoir investment. It will help to improve transparency and trust between stakeholders, particularly in water-stressed catchments.

D-RISK HELPS FARMERS MAKE INFORMED DECISIONS ABOUT DROUGHT

D-Risk output for a typical irrigated farm shows how drought impacts the likelihood of an irrigation deficit. On average, there is a 20% probability, or 1 in 5-year chance, of having an annual irrigation deficit of at least 38,000 m³. But there is uncertainty around the average value so it could be more or less. The grey shading shows the uncertainty envelope.

Irrigation deficit

Annual probability distribution of irrigation deficit (dark line) and uncertainty (shaded)

Deficit (m³)	Annual probability of exceeding deficit (%) and lower and upper boundaries of the uncertainty region										
	0	10	20	30	40	50	60	70	80	90	100
Lower boundary	43,000	14,000	0	0	0	0	0	0	0	0	0
Median	111,000	64,000	38,000	10,000	0	0	0	0	0	0	0
Upper boundary	206,000	132,000	97,000	69,000	39,000	0	0	0	0	0	0

Annual probability distribution of irrigation deficit (m³)

Farmers are encouraged to try the D-Risk tool and see how it can support their future drought risk management. visit: http://www.d-risk.eu

Knowledge gaps and priorities for action

On-farm	Off-farm
Support for the development of new integrative technologies to implement precision irrigation, including smart sensor networks and artificial intelligence	Support more flexible collaborative approaches (including trading) that make best use of existing resources
Promote uptake of new tools and technologies to improve irrigation management (scheduling) including improved weather forecasting	Support ongoing initiatives to foster multi-sector engagement to identify opportunities for shared infrastructure investment
Support farm-level initiatives to increase water storage (whether individual or shared)	Develop catchment-based approaches to improve water use and allocation in agriculture
Case studies to highlight how improved irrigation scheduling can reduce nutrient leaching risks	Build ecological resilience in river systems through river restoration to reduce drought impacts
Support farmer-focused initiatives in EA priority catchments	Near real-time river flow information to enable farmers to know when to take advantage of short duration high flows to refill reservoirs, or prior knowledge of likely low flows

THEME 3 - WORKING TOGETHER TO BUILD RESILIENCE TO CLIMATE AND WATER RISKS

The key will be in working together – our water challenges are simply too great for individual sector solutions. We need to forge new relationships and strengthen collaboration between agriculture and all other sectors. But what needs to be done to develop robust solutions that deliver multiple benefits?

A FRAGMENTED SECTOR?

Traditionally, water resources planning in England has focused on securing public water supply and protecting the environment, while water for demands for agriculture were neglected. When water is in short supply, agriculture is first in line for water use restrictions. This approach to water allocation has served well in the past when in most years there has been a plentiful supply of water. But rising demands for water is resulting in increased competition for the available water supply, particularly during droughts. Priorities will still apply but, increasingly, allocation decisions can no longer be made in isolation without regard to other users. A more integrated and transparent approach is essential for water resources planning to take account of all water users.

As water risks within particular regions become more acute there is an urgent need for multi-sector engagement to represent the interests of all sub-sectors, to provide a mechanism for discussion and scrutiny of the water challenges facing businesses, and to create pathways through which new knowledge can be translated.
In 2020 the Environment Agency will publish its national water framework. This constitutes a major shift in water planning and will provide strategic direction to water resources planning, include users outside the water industry, and support collaboration. This has provided agriculture with an opportunity, particularly in the drier regions, to engage in dialogue. Water Resources East (WRE) is one of the five regions identified in the national water framework and is the most advanced in planning using an integrated approach to water resources planning across the Anglian region where there is substantial demand for irrigation.

As the Government moves towards integrated water resources planning, agriculture must proactively represent their interests and role in the planning process. The agricultural sector has traditionally focused on commodities rather than resources and so the approach to water resources is fragmented, with sub-sector interests often driving the agenda for action, particularly during periods of resource stress (e.g. drought or regulatory reform). Specific interest groups form as water issues emerge. Unfortunately, previous attempts to foster collaboration have missed opportunities to build a strategic and joined-up approach to water resources management.

Water companies have combined resources, funding and full-time professionals to provide an effective means for knowledge sharing and developing a well-coordinated voice for responding to water policy and business risks. In contrast, there is no equivalent in agriculture, either regionally or nationally. Agriculture does not have the same access to resources or a 'champion' to represent water for food interests, and an arena through which dialogue and support actions could be effectively channelled, was identified as a fundamental challenge for the industry by the UK Water Partnership.

SUPPORTING EXISTING INITIATIVES

Following the 2011-12 drought the UK Irrigation Association and the NFU together founded the Water for Food Group (WfFG) to support knowledge exchange among scientists and practitioners. This is an informal, independent forum that brings the agricultural and horticultural sectors to work together and build social capital among individuals and organisations with strong interests in securing water for food production, and to provide a strong coordinated voice on water for food.

The WfFG is proving to be an invaluable link between irrigation abstractors, the regulator, and government but its activities are limited. It lacks resources – funding and full-time planning professionals to get involved in serious planning initiatives. The WfFG will need substantial resources to strengthen and broaden its activities to engage in agricultural water planning and studies to enable agricultural and horticultural sub-sectors to better understand their water needs, to discuss water supply-demand imbalances in regional 'hotspots', and to identify options for shared solutions and investment. Food processing and packaging business sectors also need to play a stronger role as they too rely on water along the value chain. It is important not to duplicate existing effort, but rather identify new areas for action to support the WfFG to ensure the latest knowledge is made available.

WATER FOR FOOD GROUP (WfFG)

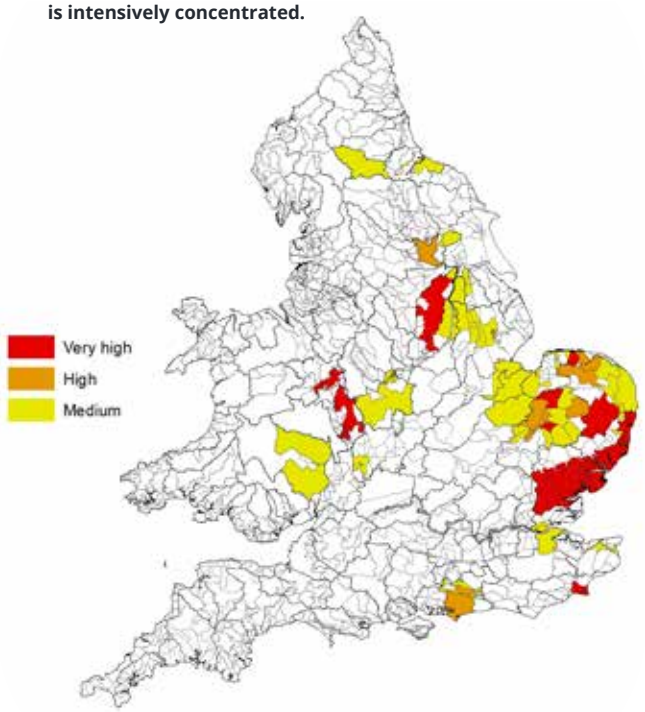
Membership includes: Association of Drainage Authorities (ADA), Agriculture and Horticulture Development Board (AHDB), Central Association of Agricultural Valuers (CAAV), Country Land and Business Association (CLA), Cranfield University, Environment Agency (EA), Envireau Water, East Suffolk Water Abstractors Group (ESWAG), Food and Drink Federation (FDF), Horticultural Trades Association (HTA), Institute of Grocery Distribution (IGD), Lark Abstractors Group, National Farmers Union (NFU), Thet Abstractors Group, University of East Anglia (UEA), UK Irrigation Association (UKIA), and Water Resources East (WRE). The Group meets regularly, it operates informally and encourages membership from 'individuals' within organisations who have a keen personal interest in water for food. The forum encourages open and frank discussion on current and future issues among people who know and trust each other.

> WRE has demonstrated the power of multi-sector collaboration in the Anglian Region – this model now needs to be translated across the agricultural and horticultural sector.

WATER RESOURCES EAST – AN EXEMPLAR FOR MULTI-SECTOR COLLABORATION

In 2015, recognising there was a growing gap between available supplies and water demand in eastern England, Anglian Water initiated their flagship initiative, Water Resources East (WRE). This was a pioneering programme to promote a multi-sector and collaborative approach to water resource planning, bringing together regulators, business, and researchers in the water, agriculture, power, and environmental sectors. Through extensive engagement and advanced modelling, WRE looked at future demands and potential trade-offs across all sectors to identify options to build resilience into regional water resources management and planning. Fundamental to the core vision for WRE was recognising that future water scarcity is a shared problem which needs collaborative solutions. (http://www.waterresourceseast.com)

Irrigation water risks - many catchments which are over-licensed and/or over-abstracted are also areas where irrigated production is intensively concentrated.



POWER OF COLLABORATION

A coordinated and coherent voice for agriculture is also needed at the local (catchment) level. As scarcity (or threat) increases, there are greater incentives for individuals to organise and take collective action to defend a common good, rather than relying on the actions of individuals. Water abstractor groups (WAGs) can make a real difference – when they form, farmers come together to share experiences and defend their right to irrigate, to build more transparent channels of communication between themselves and the regulator, to foster a stronger commitment among their members to use water more efficiently and sustainably, and to provide a strong collective voice to influence future water policy. Ten WAGs already exist in various forms, but more are needed to bring abstractors together.

Knowledge gaps and priorities for action

- Support regional-level measures for the water regulator and farming businesses to work together to reduce drought impacts on agriculture and the environment
- Identify actions to foster stronger multi-sectoral collaboration, such as sharing data, access to improved weather forecasts, devolved responsibilities for catchment-scale water management, and trading portals
- Identify measures to enable the agricultural sector to engage with other sectors to reduce sector vulnerability to climate and water risks
- Identify existing gaps in understanding including data needs, information, and evidence to underpin implementation of this strategy, and agree on how these gaps should be addressed, including funding and delivery mechanisms
- Define projects for action including case studies, policy briefings, water valuations, and supporting regional Knowledge Transfer Partnerships (KTPs) with key businesses and organisations
- Identify where and how agricultural abstractors can usefully engage and contribute to local initiatives, including catchment-based approaches and river partnerships

FURTHER INFORMATION

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This booklet can also be downloaded from:
http://aboutdrought.info/
http://www.ukia.org

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Supporting organisations

NFU

UK Centre for Ecology & Hydrology

UWE Bristol University of the West of England

UKRI Engineering and Physical Sciences Research Council

UKRI Economic and Social Research Council

UKRI Arts and Humanities Research Council

UKRI Natural Environment Research Council

UKRI Biotechnology and Biological Sciences Research Council

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