

# Sustainable Intensification Research Platform

## *Working paper*

This document sets a framework to collate input from researchers, policy makers and industry representatives to scope the development of three umbrella projects that will collectively form a research platform on the Sustainable Intensification of agriculture in the UK. It has been written to stimulate further discussion on the scope, governance and content of the proposed platform.

### **Overview:**

The Sustainable Intensification platform takes forward a recommendation of the Green Food Project to develop a programme that brings together researchers working on the productive, environmental, social and economic aspects of farming through coordinated research activities<sup>1</sup>. It will establish multi-disciplinary translational research to develop tools and evidence to help farmers, policy makers and other decision makers improve the productivity and environmental performance of UK agriculture. It is being developed and coordinated in close collaboration with ongoing and emerging NERC, BBSRC and AHDB research activities in this area. The platform will:

- Undertake research to integrate knowledge on different aspects of land management to develop a better understanding of the functioning of whole systems.
- Stimulate collaboration between disciplines, institutions and funders.
- Bring together academics with land management stakeholders to develop a shared understanding of priorities, drive knowledge exchange and set the agenda for long-term research.
- Translate research outputs to develop decision-support tools and guidance to inform farm management and policy development.
- Contribute to activities to demonstrate emerging technologies and techniques so that they can be taken up by government and industry.

The platform will focus on the following themes:

- 1) **Integrated farm management:** Developing and testing productive and profitable farming systems that reduce risks to the environment and deliver an appropriate range of ecosystem services. This includes integrating practices to increase productivity, reduce costs, improve resource use efficiency, control pests and diseases, mitigate greenhouse gasses and pollution, and provide habitats for biodiversity.
- 2) **Delivering benefits at the landscape scale:** Developing approaches to understand the actions that are needed at landscape scales to deliver ecosystem services, productive and profitable farming businesses and biodiversity. This entails:
  - a. Understanding spatial variation in land capability (for food production and opportunities for other ecosystem services) and environmental risk.
  - b. Collaborative governance and decision-making at the landscape scale.
- 3) **Markets, drivers and interactions across the food-chain:** Understanding the wider drivers and opportunities for decision-making on UK farms. These include the influences of climate change, global commodity markets, consumer choice, the development of markets for ecosystem services and the demand for biofuels.

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<sup>1</sup> <http://www.defra.gov.uk/publications/files/pb13794-greenfoodproject-report.pdf>

## Context and drivers

Agriculture accounts for around 70% of the UK land area. It plays an essential role in the rural economy not only through the production of food and agricultural outputs but in the delivery of a wide range of other ecosystem services and environmental outcomes. These include the provision of clean water, the regulation of air quality, water quality, flooding, climate and nutrient cycles, cultural aesthetic and recreational value, and other supporting services<sup>2</sup>. Over the past 60 years, agricultural intensification, initially in response to post-war food shortages, has increased yields but resulted in environmental externalities ranging from water and air pollution to habitat degradation and loss of biodiversity. The total external environmental damage costs (to air, water and soil) from agriculture in the UK have been estimated to range from £1B to £3B per year<sup>3,4</sup>. By the 1990s, global food prices had fallen, allowing a shift in focus in the UK from production to environmental protection through the development of agri-environment incentive schemes, regulatory and voluntary approaches. Today, food security is again rising on the agenda with three global wheat price spikes in the last five years. The Foresight report on the Future of Food and Farming predicted that global food demand is likely to increase by 70% by 2050 due to population growth and changes in consumption patterns. This will take place in the context of increasing pressure on water, land and energy resources, and changing climatic conditions<sup>5</sup>.

The challenge for the UK agricultural sector is one of *sustainable intensification*. This means increasing food production while simultaneously reducing environmental impacts and enhancing the wide range of interlinked ecosystem services that society needs from land. Sustainable intensification needs to account for the inevitable trade-offs between multiple ecosystem services whilst balancing local, national and global priorities. Farmers, land managers and policy makers are faced with a significant technical challenge to measure and value the environmental and social performance of agriculture and to develop markets that reward the provision of these services alongside food production.

While some environmental objectives can be achieved in a way that is synergistic with increasing production, others cannot. The debate on improving the environmental performance of farming has focused on *land sharing* (whereby environmental and production objectives are achieved in the same place) and *land sparing* (focusing on environmental objectives at the expense of agriculture or vice versa). In practice, the susceptibility of land to environmental damage and its capability for the provision of food and other ecosystem services varies considerably. A targeted, risk-based approach that maximises the net value of environmental, social and production outcomes is needed,

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<sup>2</sup> Hassan, R., Scholes, R., Ash, N. (2005) Ecosystems and Human Well-being: Current State and Trends, Volume 1. Findings of the Condition and Trends Working Group of the Millennium Ecosystem Assessment. Island Press, Washington, Covelo, London

<sup>3</sup> O'Neill, D. (2007) The Total External Environmental Costs and Benefits of Agriculture in the UK. Environment Agency, Bristol, UK [http://www.environment-agency.gov.uk/static/documents/Research/costs\\_benefitapr07\\_1749472.pdf](http://www.environment-agency.gov.uk/static/documents/Research/costs_benefitapr07_1749472.pdf)

<sup>4</sup> Jacobs (2008) Environmental Accounts for Agriculture. Final Report For project SFS0601: Defra; Welsh Assembly Government; Scottish Government; DARD (N. Ireland).

<sup>5</sup> Foresight (2011) The Future of Food and Farming: Final Project Report. Government Office for Science, London.

capitalising on opportunities for profitable agriculture, protecting sensitive areas and enhancing areas of natural value.

Figure 1 illustrates the potential steps towards a goal of sustainable intensification. Improvements in soil, nutrient and water management and adoption of other good practices derive environmental benefits that are synergistic with improvements in productivity, e.g. reducing water and air pollution, and greenhouse gas emissions. Depending on land capability and environmental risk at a specific geographic location the combined ecosystem service value may be maximised by managing land for intensive food production (position 3b) or for another ecosystem service (position 3a). Position 4 on the diagram may only be achievable as a net result over a large area.

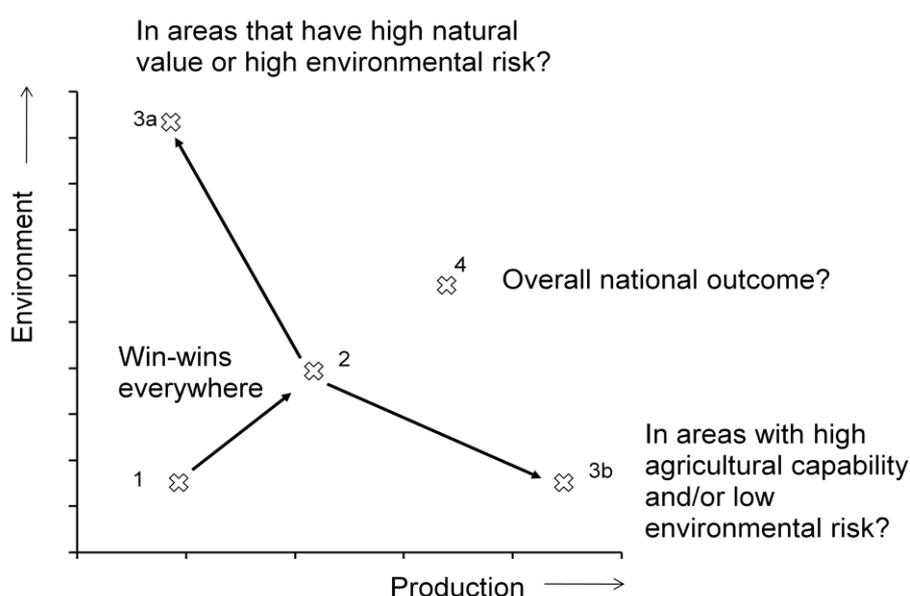


Figure 3: Illustration of trade-offs between agricultural production and environment.

1. Current environmental and agricultural performance.
2. Environmental and production performance can be improved simultaneously through practices that improve the efficiency of nutrient, water and soil management (e.g. precision application of fertilisers, using better performing crop or livestock varieties) or that capitalise on 'functional biodiversity' (e.g. to fix nitrogen or manage pests through the use of natural enemies). Policy levers to encourage uptake of such techniques include regulation, advice and guidance.
3. Localised prioritisation of:
  - a. Environmental outcomes (targeted extensification of food production to protect vulnerable areas or enhance habitats. e.g. buffer strips, set aside or arable reversion). These can be incentivised through agri-environment schemes and developing markets for ecosystem services.
  - b. Food production (targeted intensification in areas of low environmental risk/value).
4. Desired outcome. Whilst this may not be achievable in any single location, it may be achievable as a net result at national scale.

Decisions to prioritise particular objectives can be made at a variety of spatial scales. Within fields, for example, skylark plots, beetle banks or uncropped margins can be used to provide habitats or reduce soil erosion. At the field scale, set aside or arable reversion to grassland can be used to increase biodiversity or reduce nitrate leaching. At farm scale, the adoption of nutrient budgeting or precision farming may increase productivity while reducing environmental pollution. At a landscape-scale it may be necessary to coordinate the

activities of a number of land managers e.g. to protect a water catchment or improve the connectivity of wildlife habitats. At national or global scales, reducing farming intensity in one location may simply displace damaging activities to another region or country. Much of the research on sustainable agriculture has focused on smaller spatial scales. A key priority and the focus of the Sustainable Intensification Platform, is to develop integrated land management approaches at farm, landscape and food-chain scales.

The complexity of the interactions between the numerous environmental, economic and social factors provides a major barrier to achieving the goal of sustainable intensification. Although a number of government and industry-led initiatives have been established to identify and address agri-food research requirements, the majority address individual pressures and aspects of land management rather than taking a systems approach. There is relatively little that focuses on the development of tools and guidance to inform whole farm management and decision-making at landscape-scales. This integration of knowledge is currently often left to decision-makers themselves. This is partly due to the fragmented nature of the research-base. There is a relative lack of interchange between groups involved in research on the productive and environmental aspects of agriculture. Environmental and agri-food research also tend to have different funding streams. Further divisions exist between basic and applied science.

The delivery of advice and guidance to farmers has been equally fragmented. Farm consultants often focus on the commercial and productive elements of farming systems whereas government and third sector advice providers often focus on environmental or animal welfare aspects. There is a current policy focus on developing a more holistic approach to advice packages at both farm and landscape scale but this needs to be underpinned by further research.

Sustainably intensifying UK agriculture needs to be supported by more strategic and joined up activities on innovation, research and development and work to incorporate research outputs into productive and sustainable farming systems in a way that can be more easily adopted by industry<sup>6</sup>. This requires research undertaken over appropriate spatial and temporal scales that brings together agricultural, environmental and social scientists.

## **Objectives and Scope**

### ***Overall objectives***

The Sustainable Intensification Research Platform will provide evidence on approaches to improve the economic, environmental and social performance of UK farming. It will investigate ways to improve the contribution of farming to rural growth through improvements in productivity and profitability while reducing environmental impacts, enhancing biodiversity and delivering wider ecosystem services. It will focus on the management of UK farms within the broader context of landscape-scale and national objectives, external drivers and markets.

The outputs will help to build up a holistic view of UK land management to inform decision making by policy makers, farmers and groups that influence UK agricultural land

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<sup>6</sup> <http://www.defra.gov.uk/publications/2012/07/10/pb13794-green-food-project/>

management. Together, the three core projects will work at farm, landscape and national scales to:

1. Investigate the extent to which it is possible to increase overall food production in the UK whilst achieving environmental objectives.
2. Explore where tradeoffs between different production and environmental objectives are tolerable within the overall goal of sustainable intensification.
3. Define short and long-term goals for the sustainable intensification of UK agriculture.

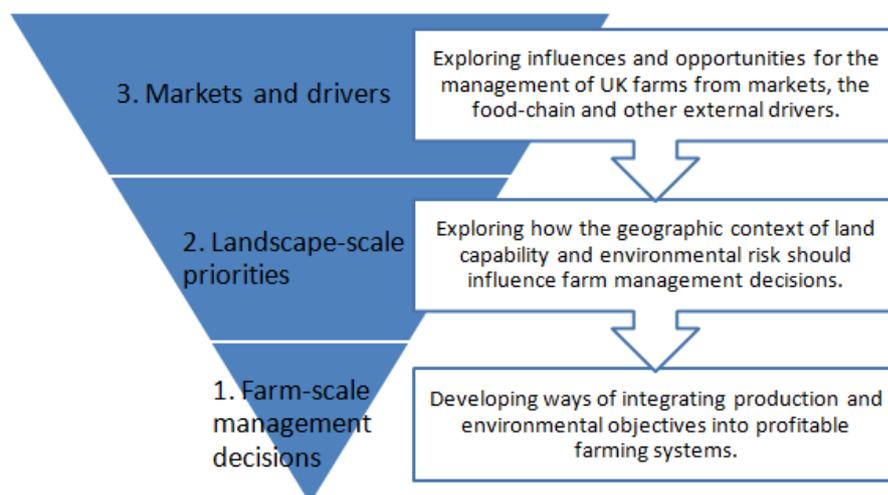


Figure 2: Farm management considerations from global to local scales: the three themes of the sustainable intensification platform.

**Specific objectives:**

These overarching objectives will be addressed through research in the three themes illustrated in figure 2. Specific objectives within each theme are as follows. These are explored further in annex 1.

**1) Integrated farm management:**

- a. Improve approaches to measure the economic, environmental and social performance of farms.
- b. Understand the economic, environmental and social pros and cons of different farming systems.
- c. Develop and test improved integrated farm management practices that deliver improved economic, environmental and social outcomes.

**2) Delivering benefits at the landscape scale:**

- a. Develop approaches to map land capability and environmental risk to inform the development of integrated farm management approaches that are tailored to local opportunities and constraints.
- b. Understand the need for landscape scale coordination to achieve environmental outcomes.
- c. Investigate the potential for collaboration between farms to achieve wider, landscape scale outcomes and to make more efficient use of resources (nutrients, water etc).

**3) Markets, drivers and interactions across the food-chain:**

- a. Investigate the sensitivity of UK farming to risks and opportunities caused by external factors.

- b. Investigate the influence that different players have on UK land management and their potential roles in driving improvements.
- c. Investigate the interdependencies between different agricultural sectors (e.g. livestock and arable) at local, national and global scales.
- d. Scope opportunities to improve performance through the development of markets and marketing approaches. The potential for developing new UK markets

## Approaches

The Sustainable Intensification Platform will be established as three linked research projects to address the above objectives (annex 2). These will be delivered by multi-disciplinary consortia that draw together organisations, expertise and facilities that represent UK research capability on agricultural, environmental and social sciences. They will draw together field sites, shared datasets, collaborative modelling activities and a multi-disciplinary community of researchers that will act as a platform to catalyse and host future research on sustainable intensification. Such additional research projects hosted on the platform can exploit one or more of these layers of activity (figure 3) and will bring in additional research groups and funders.

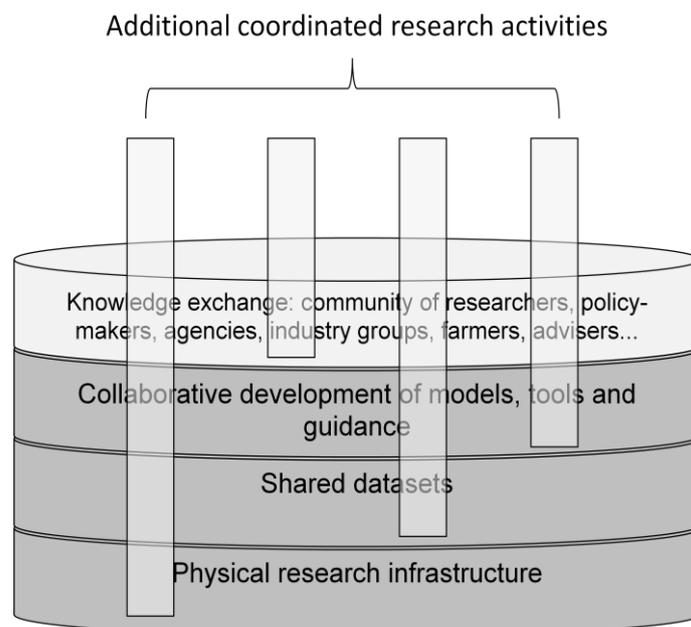


Figure 3: Components of the Sustainable Intensification Research Platform. The horizontal layers represent different types of collaborative activity established through the three core projects. The top layer is an emergent property of the platform approach whereby collaborative working helps develop collaboration and shared understanding of issues and priorities between researchers and the end-users of their research (policy makers, agencies, industry groups, farmers etc). The vertical bars represent additional projects hosted on the platform to explore specific questions. These may exploit one or more of these layers.

By developing and maintaining dialogue and partnership, the platform will develop a shared research agenda between researchers from multiple disciplines and the end-users of research (e.g. policy-makers, economists, farmers, industry groups and advisers). This will provide a focal point for research activities to:

- a. *Address complex questions:* Foster collaboration between research groups and across disciplines to tackle complex research questions that require holistic, systems-based understanding and collaborative approaches.
- b. *Pool funding:* Providing a focal point to pooling resources between funders to fund larger projects to address the bigger questions
- c. *Share data and resources:* Encourage researchers to share resources, equipment and data to get better value for money. Data and models generated by the project will be archived using open data standards and made freely available. This will support secondary research and industry decision support activities.
- d. *Catalyse long-term research:* Build a research community funded from multiple sources focused on a common purpose and shared experimental sites to develop momentum to tackle key long-term policy questions.

The platform will set in place strategic research focused on long-term needs whilst building capacity to address more immediate, policy-focused questions. Bringing researchers working on more fundamental, strategic questions together with those undertaking secondary analysis for policy benefits both. Fundamental researchers gain a better understanding of the policy context of their work so that they are better able to improve their impact. Scientists undertaking analysis for policy benefit through the interaction by challenging entrenched ways of thinking. The overall aim is to develop a community that has the academic freedom to innovate and explore the broader theme of the platform whilst having the understanding of policy to maximise the impact of research.

### ***Knowledge exchange (KE)***

Whereas researchers often focus their attention on questions that can be answered over a period of 3-5 years, policymakers and industry end users often focus on much shorter timeframes (from days to months). This difference in time horizon creates a barrier to knowledge exchange. To address this, a number of mechanisms will be used to establish short-term knowledge exchange activities whilst undertaking long term research to address strategic questions (see table 1 for examples).

Table 1: Potential knowledge exchange activities.

<b>Timeframe</b>	<b>Activities</b>
<b>~5 days</b>	1. Using researchers working on the platform as a sounding board on sustainable intensification for policy and industry decision-makers. Informal email communication will be used to seek input from a wide range of researchers on policy briefings, requiring minimal input from any individual. This will help decision makers to access information rapidly and give researchers insight into policy direction to inform their future work.
<b>~5 weeks</b>	2. Short knowledge exchange activities including focused workshops and the production of short briefing notes on topics of immediate relevance.
<b>~5 months</b>	3. Establishing small cross-disciplinary working groups consisting of researchers and stakeholders to explore specific questions raised by the stakeholders. 4. Mini projects to synthesise project outputs or review existing literature.
<b>~5 years</b>	5. Identifying long-term policy and industry evidence needs to inform research priorities. Involving end-users in the design of research projects to address them.

The platform will interface with wider demonstration and advisory activities including the Campaign for the Farmed Environment, the industry-led Greenhouse Gas Action Plan, the Voluntary Initiative on pesticides, LEAF, government including Natural England and the Farm Advisory System, commercial advisers, environmental NGOs and others. Where appropriate, research sites will be used to host demonstration activities targeted to local and national audiences.

## Governance

The platform is being developed in collaboration between Defra, research councils and AHDB under the umbrella of the Global Food Security programme. It will follow the structure and governance of existing Defra-led research platforms including the Demonstration Test Catchments<sup>7</sup> and the UK Greenhouse Gas Platform<sup>8</sup>. The three core projects that establish the platform will be managed by a virtual project team under the advice of policy and industry groups and a research advisory group (see Annex 2). A platform coordinator will be appointed to project manage and coordinate activities across the platform. Coordination and knowledge exchange activities will extend to additional projects hosted on the platform funded separately by government and industry on an *ad hoc* basis.

Individuals from a wide range of organisations will be consulted on the development of the Platform. Rather than establish a formal steering group, focused workshops involving the organisations below will be used to provide input to help define project scope and objectives. On-farm research activities will be developed collaboratively between researchers, farmers and other local stakeholders.

## Outputs

Annex 1 describes the scope, objectives and desired outputs of the three themes.

## Outcomes

Major intended outcomes of the Sustainable Intensification platform include:

1. Complex land management questions on the interactions between multiple factors at different scales are answered.
2. Better land management policy based on robust evidence.
3. Improved coordination of UK land management research.
4. Improved communication of research to farmers, policy makers and other land management decision makers.
5. Research is better targeted to address the real challenges faced by land managers, policy makers and others.
6. Research focused demonstration sites will link research activities with wider demonstration and knowledge exchange activities beyond the initial funding period of the platform.

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<sup>7</sup> <http://www.lwec.org.uk/activities/demonstration-test-catchments>

<sup>8</sup> <http://www.ghgplatform.org.uk/>

## **Funding**

The core objective of sustainable intensification will require long-term research. This will be initiated by a first phase of research for which Defra is proposing to invest up to £1.5m per annum over five years. This will fund the establishment of three core projects covering the three themes detailed below. The platform will link closely with planned and ongoing activities funded by BBSRC, NERC, AHDB and others. It will also interface with European and international collaborative activities (e.g. EU Joint Programming Initiative on Food Security, Agriculture and Climate Change).

## **Contact**

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## **Annex 1: Consultation on themes**

### ***Theme 1: Integrated Farm Management***

#### **Drivers and scope**

Farmers face a wide range of often conflicting sources of advice and information upon which to base management decisions. The term ‘integrated farm management’ has been used to describe farming systems that take a holistic approach, combining modern, traditional and natural approaches to maximise productivity and reduce environmental impacts. The main focus of this theme is to develop and test integrated approaches to farming that bring together the wide range of management practices that have been developed in response to individual pressures through previous research into viable farming systems. These include approaches focused on:

- Crop selection and rotations (e.g. inclusion of legumes, maize etc)
- Grassland management
- Livestock husbandry (incl. genetics, nutrition, fertility, health and welfare)
- Management of pests and diseases
- Soil management and cultivation techniques
- Fallow management for biodiversity/production benefits.
- Nutrient management
- Habitat management
- Emerging technology

These will be treated as the building-blocks of integrated farming systems under this theme.

#### **Objectives**

***To develop, demonstrate and assess ways of integrating land management approaches into improved farming systems that enhance production and environmental outcomes.***

This theme will integrate previous research on agriculture and its environmental impacts to inform the design of improved farming systems and management practices. It will do this in the context of spatial and food-chain considerations emerging from themes 2 and 3. Core to this theme will be ongoing work to integrate data streams and models that represent environmental, production and economic elements of farming systems. Priority areas are likely to include:

#### **1. Business planning (designing farming systems)**

- Developing tools and information to inform business planning decisions by comparing the risks and opportunities provided by alternative farming systems. These will help farmers to assess the scope for changing their farming system or business structure, including assessing the potential for adopting:
  - Novel farming systems.
  - Extensive vs intensive systems.
  - Mixed vs specialised systems.
  - Business models based on emerging markets for ecosystem services.
  - Opportunities for adding value to the farm business, e.g. through anaerobic digestion, energy generation, on-farm food processing facilities etc.
  - Specific technology or practices to improve productivity.

## 2. Integrated farm management

- Bringing together and testing models, decision support tools, guidance, field techniques and metrics to inform integrated farm management. Guidance on the use of these techniques needs to be simplified and customised for farms based on their geographical context derived from work in theme 2.

## 3. Metrics and indicators of farm performance

- Developing improved indicators/metrics to allow farmers or advisers to assess the productive and environmental aspects of farm performance will be a key objective for the platform. These are needed to:
  - Inform farm management decisions
  - Design appropriate policy monitoring and evaluation approaches
  - Underpin the development of benchmarking systems (theme 2)
  - Underpin farm assurance/ corporate social responsibility schemes (theme 3)
- Developing and trialling improved environmental monitoring technologies.

## 4. Social science, economics and policy interventions

- The above activities will take explicit account of practical, economic and social considerations. This will require socio-economic research on the way in which on-farm decisions are made, perceived and actual constraints.

**Question 1: Please propose changes as necessary.**

### Approaches

A small number of existing/emerging farm-scale research facilities will be selected to host research and development activities under this theme. These may include university farms, research institutes, agricultural colleges, research council funded farm platforms and/or sites established through other programmes such as the Demonstration Test Catchments. The aim will be to cluster related research projects and knowledge exchange activities onto the same field sites to build up an integrated understanding of processes with high spatial and temporal resolution data-sets.

**Question 2: Please suggest specific approaches that would help deliver these objectives.**

**Question 3: Please suggest suitable research facilities to host this work**

### Outputs

Outputs may include:

1. **Metrics/indicators of farm performance** against environmental, economic and social criteria (for use by farmers, advisers and regulators).
2. **Decision support tools.** The platform will develop evidence to underpin the development of 'decision support tools'. Such tools may include paper or computer-based guidance aimed at farmers or their advisers. These will integrate tools for pest management, nutrient management, soil management, agri-environment planning, environmental risk and other aspects of farming and land management.
3. **Outputs to inform policy** including the design of advice and incentives (e.g. agri-environment schemes)
4. **Demonstration to industry** of emerging research outputs

**Question 4: What other outputs would you like to see?**

## ***Theme 2: Delivering benefits at the landscape-scale:***

### **Drivers and background**

The Green Food Project Geographic areas sub-group acknowledged that “different landscapes have different comparative advantages at enabling production of certain benefits to society, whether that be for food, non-food crops, particular ecosystem services or types of biodiversity”. Exploiting these advantages means management decisions need to be taken in the context of local priorities. “It makes sense to use the most valuable land (in either economic or environmental terms) for what it is best suited to, working within environmental limits, and ensuring that at an aggregate level we have the right balance between economic and environmental improvement”. Land managers and their advisers need access to information to help them derive the greatest value from their land to themselves and wider society<sup>9</sup>.

Research in this theme will draw on a range of landscape-scale research activities already in existence including the NERC Biodiversity and Ecosystem Services programme, the Demonstration Test Catchments and the National Ecosystem Assessment follow-on project. Outputs will support improved targeting of public and private sector advice and incentives to farmers, e.g. better targeted agri-environment schemes.

### **Objectives**

***To develop approaches for land managers and their advisers to account for spatial variation in land capability and risk across a range of agricultural production, ecosystem service and environmental criteria to benefit their businesses and society.***

Specific priorities in this theme include:

#### **1. Spatial targeting**

- Bringing together datasets, maps and models to understand spatial variation in land management priorities to maximise production, agricultural competitiveness and environmental performance. This includes current and future:
  - Land capability for food, biodiversity and ecosystem services
  - Ecosystem service provision
  - Ecological networks and habitat connectivity
  - Environmental risk (to water, air, soil, biodiversity and flooding)
  - Social perception of land management priorities.

#### **2. Building multi-functional landscapes**

- Investigating the mix of land uses that are needed to establish multi-functional landscapes. Work will focus on the level of heterogeneity needed for resilience of agriculture and the environment. This will include trade-offs and synergies between bioenergy and food production and the ecological role of different farm types. It is important that it also considers the likely timescales needed to achieve changes.

#### **3. Social science and governance of land management**

- Scoping the potential roles of:
  - Collaboration between farms to achieve wider, landscape scale outcomes and to make more efficient use of resources (nutrients, water etc).

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<sup>9</sup> <http://www.defra.gov.uk/publications/files/pb13799-greenfoodproject-geographicsubgroup.pdf>

- Farmer groups in disseminating information and feeding into local decision-making groups such as those established through Nature Improvement Areas, the Environment Agency pilot catchment-based approach or other local schemes.
- Farm benchmarking to improve performance against a range of indicators.
- Local stakeholder groups in setting objectives at landscape scales.

**Question 5: Please propose changes as necessary.**

### **Approaches**

A number of landscape scale study areas will be identified to host research in support of the above objectives. Selection of study areas will be based on the following criteria:

1. Existing research activities, infrastructure and datasets.
2. Representation of a broad set of UK farmed landscapes.
3. Compatibility with the location of research on integrated farm management research hosted under theme 1.

A key focus will need to be on the development of techniques that can be applied to less well studied parts of the country. Additional fieldwork, monitoring, surveys and social science will be established to augment existing datasets and monitoring activities in these case-study landscapes where appropriate.

It will be important for researchers in each study area to work with farmers, and local and national stakeholders.

**Question 6: Please suggest specific approaches that would help deliver the objectives above.**

**Question 7: Please suggest suitable research facilities to host this work**

### **Outputs**

Outputs may include:

1. **Models and Geographic Information Systems** that combine information on environmental risk, land capability, biodiversity and ecosystem service provision. These will need to draw together existing spatial data including (1) agricultural land classifications, (2) environmental risk mapping approaches e.g. for diffuse pollution and greenhouse gas emissions, (3) water availability and vulnerability to climate change and (3) biodiversity and landscape value. Such maps would then be ground-truthed on case-study farms and will develop mechanisms for targeting agri-environment schemes and other land management policy.
2. **Information on the role of advice, incentive and other policy levers**
3. **Farmer-led collaborative landscape management approaches** to influence the delivery of ecosystem services across landscapes.
4. **Farm benchmarking systems**
5. **Landscape-scale demonstration sites.**

**Question 8: What other outputs would you like to see?**

### ***Theme 3: Markets and drivers***

#### **Drivers and background**

On-farm decisions are influenced by a wide range of external factors including resource availability, fluctuations in market prices, availability of incentive schemes or payments for ecosystem services, weather conditions and access to finance. These vary considerably between different farm types. Climate change, fluctuating commodity prices (e.g. food, fuel and phosphorus) and emerging technology are likely to shape the future farmed landscape in the UK. A wide range of actors in the food production and supply chain also influence on-farm decision making. This occurs both bottom-up (by the suppliers and regulators of inputs) and top down (by markets and consumers of outputs), figure 4. Understanding the influence and potential trends in these drivers and the role of different actors is vital in designing resilient land management systems and policy approaches.

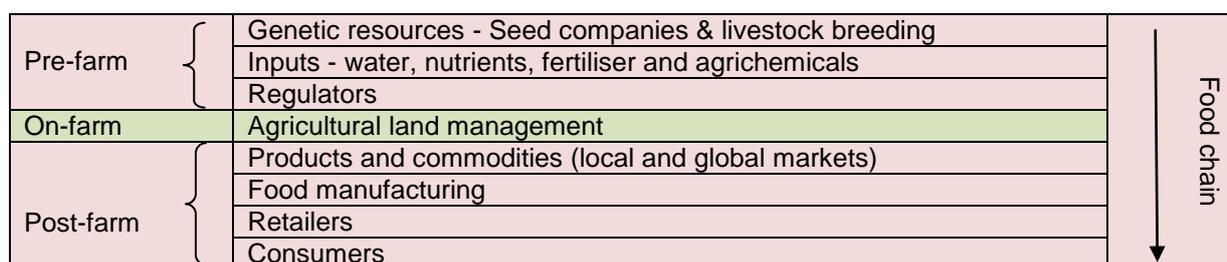


Figure 4: Elements of the food production and supply chain

#### **Objectives**

***To investigate the main drivers that influence UK farm management and predict how they are likely to change in the future.***

Key research areas include:

#### **1. Global trends and scenarios**

- Undertaking sensitivity analyses to identify the most significant external factors that influence UK land management. This will help to identify future opportunities and risks. This will need to consider:
  - Supply and demand for UK agricultural products
  - Risks and opportunities arising from price volatility and global economic trends
  - Likely constraints and opportunities provided by climate change
  - The role of regulation
  - Shifts in consumption patterns
  - Resource availability (particularly water and nutrients)
- Reviewing and synthesising scenarios that have been developed through previous research activities and horizon scanning projects commissioned by industry and policy groups. These should be used to look at likely impacts on the structure and viability of the UK agriculture sector, implications for production, the environment, food security, the balance of trade, land use and landscape.

#### **2. Understanding the whole food-chain**

- Assess the influence that different players have on UK land management. This will look at the food-chain (figure 4) from a farmer's perspective to understand the influence of agrichemical companies, suppliers, distributors, supermarkets, consumers and others in affecting the way that land is farmed.

- Investigate the interdependencies between different agricultural sectors (e.g. livestock and arable) at local, national and global scales.
- 3. Opportunities to improve performance**
- Investigate:
    - The potential role of markets for ecosystem services in achieving sustainable intensification. These include carbon trading and water company-led schemes.
    - The influence of consumers on land management and the potential role of corporate social responsibility schemes. This should build on previous research assessing farm assurance and labelling schemes.
    - Risks and opportunities associated with a circular economy and the recycling of materials to land.
    - The potential for developing new markets for agricultural outputs.

**Question 9: Please propose changes as necessary.**

### **Approaches**

Research undertaken through this theme would use a variety of social science, economic, agronomic and environmental modelling techniques. Operational research will be needed to look at the functioning of the food-chain and to identify areas where policies could impact. The work will need to capitalise on existing activities such as the National Ecosystem Assessment, the Foresight report on the Future of Food and Farming, activities undertaken through the Global Food Security programme and other horizon scanning activities. Approaches could include developing models of farmer decision making using farmer and stakeholder inputs.

**Question 10: Please suggest specific approaches that would help deliver the objectives above.**

### **Outputs**

Outputs from theme 3 will include:

- Improved economic and climate scenarios for research and policy analysis.
- Identification of future risks and opportunities.
- Improved evidence on the potential role of industry led schemes.
- Guidance on social and sustainability metrics for food labelling and assurance schemes.
- Scoping new markets for ecosystem services.
- Information to inform the development of policy approaches to encourage the food supply chain to work with farmers to encourage sustainable intensification practices.

**Question 11: What other outputs would you like to see?**

**Annex 2 – proposed structure:**

