



Research Councils UK

# Growing with agri-science



# Research funded by the Research Councils makes a vital contribution to the UK's economic growth, prosperity and well-being.

We take a variety of approaches to support innovation and deliver impact from research, including the development of collaborative research programmes, investment in major research capabilities, such as national research facilities, and the support of impact-related capabilities.

Often the impact of research is realised through the combination of several investments over time. The Research Councils seek to ensure that the outputs and outcomes of their funded research have significant long-term benefits for the economy and society. This timeline, one of a series, highlights how investments made in research over the long term combine to create a significant impact in particular areas. In addition, research in one area can combine with that from another to drive innovation and make a key contribution to UK growth. For example, funding for long-term field experiments at Rothamsted has generated data that not only provide information on yield output under differing conditions and farming inputs but also insight into the impact of years of air pollution, historic nuclear tests and changing practices on our crops and environment.



# Growing with agri-science

For almost a century Research Council funding for, and investment in, agricultural research and technology has helped British farmers to improve productivity, increase yields, reduce environmental impact and provide safe, affordable and nutritious food for our tables. Research Council-funded research has helped to support farmers in the developing world to introduce new farming practices and to protect their animals and their livelihoods from the threat of disease.

Research Council researchers built on the UK's long tradition of agricultural innovation and from the mid-twentieth century made a direct contribution to the Green Revolution that heralded an era of rapidly increasing global food production. Research at Research Council institutes in the decades after the Second World War initiated long-term data gathering, surveillance and diagnostics projects which now help us to understand and prevent the spread of crop and animal disease. Such efforts contributed to the eradication of rinderpest, only the second pathogen to be declared eradicated in history, and to policy advice to the UK Government which saved the economy around £485M during the 2007-8 bluetongue outbreak. Research Council investment has

helped farmers to grow and rear more produce for society and do so more efficiently, through agri-technology such as the globally adopted grain stripper-header for combine harvesters. Our support has also helped to reduce the environmental impact of modern agriculture – for example, through training thousands of farmers to maintain habitats to support pollinators and helping to understand the total life cycle of a product rather than just simplistic 'food miles'.

Today Research Council investment in agricultural technology and innovation directly supports a farming system with 10,000s of businesses and 100,000s of employees and underpins the food and drink sector – the UK's single largest manufacturing sector. Our support is playing a crucial role in helping the world's growing population to understand and meet the food security challenge. The Research Councils work together with the other main public funders of food-related research and training through the Global Food Security programme.



## Genetics and genomics

**1960s**  
During the Green Revolution, new 'semi-dwarf' crop varieties, including several developed in the UK, and better management practices greatly increase crop yields around the world.

**1979**  
Research Council-funded scientists at the Plant Breeding Institute are the first to clone plant DNA, using wheat.

**1995**  
Research at the John Innes Centre (JIC) confirms synteny in cereals, allowing scientists to use the small rice genome to identify genes in complex genomes such as wheat and barley. The approach is quickly adopted by researchers around the world.

**1996**  
A tomato puree becomes the first genetically engineered food on sale in the UK. The tomatoes were developed from RCUK-funded research into fruit ripening. It was later withdrawn from sale.

**1996**  
Research Council scientists produce Dolly the sheep, the first mammal to be cloned from an adult somatic cell, using the process of nuclear transfer.

**1999**  
Building on fundamental research in the model plant *Arabidopsis*, JIC researchers clone the gene behind the 'semi-dwarf' wheat varieties which led to the Green Revolution, giving breeders fine control over the height of wheat varieties.

**2001**  
RCUK funding establishes the ARK-Genomics Centre for Comparative and Functional Genomics at The Roslin Institute to provide national capability in functional genomics for farm animals.

**2004**  
Chicken genome sequenced. In collaboration, The Roslin Institute and poultry-breeding company Aviagen are now using it to improve pedigree chicken lines, which will benefit chicken production globally. The value of the global chicken market is estimated to be £85bn.

**2005**  
JIC researchers clone the flowering time gene, *Ppd1-H1*, in barley, building on genetics research in *Arabidopsis*. Breeders are now using this knowledge to develop wheat varieties adapted to changing climates.

**2005**  
Rice genome sequenced. Almost half the world's population depend on rice as a staple food.

**2009**  
Cow genome sequenced. The UK has the second largest beef herd in Europe.

**2009**  
Pig genome sequenced, giving breeders access to the genetic tools required to improve pork production and tackle pig diseases, improving animal health and welfare.

**2011**  
Potato genome sequenced. Six million tonnes of potatoes are grown in the UK each year.

**2012**  
Researchers sequence the genome of the tomato, an economically-important crop species.

**2012**  
An international consortium, including RCUK-funded researchers, sequences the bread wheat genome, seventeen times larger than the human genome. Wheat provides 20% of the calories consumed by people globally.

## The agri-environment

**1943**  
The centenary of the Broadbalk experiment at Rothamsted, which continues to this day to provide a unique long-term study of the effects of different treatments on wheat yields, soil quality and pests.

**1978**  
The first Countryside Survey is carried out. Research Council scientists from the Institute for Terrestrial Ecology and the Experimental Cartography Unit contribute to the survey.

**1987**  
The EU pays member states' farmers through agri-environment schemes to encourage positive environmental impacts.

**1997**  
Scientists at the Centre for Ecology & Hydrology start researching and monitoring agri-environment schemes for government, policy makers and specialists including Natural England and Defra.

**2005**  
The Scottish environmental authorities require applicants for fish farm licences to use autoDEPOMOD, a model developed by Research Council scientists to predict the fate of fish farm discharges, to determine the maximum size of fish farms.

**2008**  
700 farmers, responsible for 400,000 ha of land, are trained to create pollinator habitats through Operation Bumblebee, led by the Centre for Ecology & Hydrology and Syngenta.

**2008**  
Research by the RCUK Rural Economy and Land Use programme comparing the environmental impact of vegetables grown in the UK and overseas encourages policy-makers and consumers to think about life cycle assessment of food rather than just 'food miles'.

**2009**  
The Scottish Environment Protection Agency adopt the SCAIL screening model, developed by researchers at Centre for Ecology & Hydrology, to identify pig and poultry farms where ammonia emissions may cause environmental damage.

**2011**  
Met52, a biopesticide developed by Research Council researchers at Swansea University and commercialised by Novozymes BioAg, goes on sale in the UK. This provides an alternative to chemical pesticides.

**2011**  
The UK National Ecosystem Assessment (UKNEA) is released, providing a baseline for UK ecosystems against which environmental improvements are measured. Many RCUK-funded researchers contributed to the report.

**2012**  
The RCUK Living With Environmental Change programme results in the first use of an ecosystem services payment scheme in the UK, when a water company pays for farm improvements to cut water pollution.

**2012**  
Methods developed by Research Council researchers for assessing the risk to crops from ozone damage are incorporated into UN Protocol for air pollution control.

**2012**  
The EU biodiversity strategy to 2020 is adopted. It uses the UKNEA as an evidence source and a methodology.

**2013**  
As part of Operation Pollinator, researchers are supporting farmers in 14 EU countries to deliver 10,000 ha of multifunctional habitats.

1943

1971

1996

2000

2005

2009

2013

## Tackling pests and diseases

**1952**  
Jim Hirst creates the Hirst spore trap, now used globally to help monitor and forecast the spread of fungal plant diseases, as well as other airborne particles such as pollen.

**1958**  
Pirbright is designated a World Reference Laboratory for foot and mouth disease, providing global surveillance which underpins international control efforts.

**1957**  
Boris Kassanis at Rothamsted manages to produce King Edward potatoes free from potato paracrinkle virus, boosting yields of the variety by around ten per cent.

**1971**  
Chicken breeders start to use the first vaccine against Marek's disease, developed by Research Council researchers. The market for the vaccine is today valued at £400M per year and is estimated to have saved the poultry industry £2bn.

**1989**  
The first live attenuated vaccine against coccidiosis in chickens is produced by Research Council scientists. The coccidiosis vaccine now has an annual market of more than £13M and has helped to avoid the need to add anticoccidial drugs to poultry feeds.

**1989**  
The structure of the foot and mouth disease virus is determined at the Synchrotron Radiation Source in Daresbury. This has enabled the design and development of more effective vaccines against the disease.

**1990**  
Researchers from Pirbright help to eliminate avian leukosis virus from poultry breeding stocks, protecting around 3,200 jobs and a global turnover of £400M.

**1994**  
The Global Rinderpest Eradication Programme begins. Rinderpest can cause 80% mortality of cattle, buffalo, and other cloven-hoofed species. Research Council-funded Pirbright is the World Reference Laboratory for rinderpest.

**1998**  
The core structure of bluetongue virus, an economically-important disease of ruminants, is identified using X-ray crystallography at the European Synchrotron Radiation Facility.

**2008**  
Research at Pirbright contributes to successful efforts to control bluetongue virus in UK farm animals, following the 2007 outbreak in south-east England, saving the UK £485M in lost income.

**2007**  
Roslin Institute researchers work with salmon breeders to identify the gene for resistance to infectious pancreatic necrosis (IPN), which kills eggs and young fish in salmon farms. Breeders use this to breed IPN-resistant fish.

**2011**  
The Roslin Institute and the University of Edinburgh create the world's first genetically-modified chickens that do not transmit avian influenza virus to other chickens, protecting the health of poultry and potentially reducing the risk of new human flu virus epidemics.

**2011**  
Rinderpest is eradicated. It is only the second pathogen ever to be completely exterminated. Research Council researchers played a vitally important role in the eradication programme.

**2012**  
Rothamsted conducts a field trial of genetically modified wheat, which uses a natural plant defence mechanism to repel pest aphids.

**2013**  
Research Council-funded scientists develop a synthetic vaccine against foot and mouth disease. It is safer to produce and does not need to be stored at low temperatures, making it easier to use in hot regions.

**2013**  
Research Council scientists find that bacteria responsible for Johne's disease (chronic intestinal inflammation in cattle), and also implicated in Crohn's disease in humans, are widespread in UK rivers and soil.

**1950s**  
An outbreak of tuberculosis leads to wide-spread pasteurisation of milk on sale in the UK.

**1967**  
Researchers at Rothamsted develop the first generation pyrethroid insecticides and license them to six companies. Pyrethroids are safer and more effective than previous insecticides.

**1986**  
Research Council researchers create the grain stripper-header for combine harvesters, now used globally to reduce grain losses and increase grain output during harvesting.

**1983**  
The first genetically modified crop plant is produced, using tobacco as an experimental plant.

**2002**  
Deltamethrin becomes the highest-selling pyrethroid globally, with annual sales worth £132M. It is a second generation pyrethroid created at Rothamsted in the 1970s.

**2005**  
The first satellite with a civilian global positioning system (GPS) is launched. GPS has enabled the development of precision agriculture, improving aspects of farming including field mapping, soil sampling and tractor guidance.

**2007**  
UK and EU regulatory systems for biopesticides - pest management based on microorganisms or natural products - are informed by researchers from the RCUK Rural Economy and Land Use Programme.

**2009**  
Pyrethroid insecticides account for 17 per cent of global insecticide sales.

**2008**  
A device to help some of the most impoverished farmers in Africa maximise crop yields, developed by Research Council engineers, is tested at the Royal Botanic Gardens, Kew.

**2008**  
Push-pull farming practices, developed by UK and Kenyan researchers to protect crops in the developing world from insect pests, are used by 40,000 smallholding farmers in East Africa, boosting maize yields.

**2012**  
Research Council-funded engineers in Scotland work with researchers in Cuba to turn the destructive weed, Marabú, into valuable 'activated' carbon, which has many industrial uses, including water purification.

**2013**  
MySoil, a free smartphone app produced by Research Council-funded researchers to provide soil data for the UK and Europe, has 12,500 users and has received 2.6 million web hits.

## Agri-technology

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The seven Research Councils are:

- Arts & Humanities Research Council (AHRC)
- Biotechnology & Biological Sciences Research Council (BBSRC)
- Economic & Social Research Council (ESRC)
- Engineering & Physical Sciences Research Council (EPSRC)
- Medical Research Council (MRC)
- Natural Environment Research Council (NERC)
- Science & Technology Facilities Council (STFC)

Research Councils UK is the strategic partnership of the UK's Research Councils.

We invest annually around £3 billion in research. Our focus is on excellence with impact. We nurture the highest quality research, as judged by international peer review providing the UK with a competitive advantage. Global research requires we sustain a diversity of funding approaches, fostering international collaborations, and providing access to the best facilities and infrastructure, and locating skilled researchers in stimulating environments.

Our research achieves impact – the demonstrable contribution to society and the economy made by knowledge and skilled people. To deliver impact, researchers and funders need to engage and collaborate with the public, business, government and charitable organisations.

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