SARIC • SUSTAINABLE AGRICULTURE RESEARCH & INNOVATION CLUB

IMPACT SUMMARY

A £10 million partnership between BBSRC, NERC, ESRC and industry to improve the efficiency, productivity and sustainability of UK crop and livestock sectors

https://bbsrc.ukri.org/saric/

https://nerc.ukri.org/innovation/activities/food/saric/

BBSRC bioscience for the future

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E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

Sustainable Agriculture Research and Innovation Club (SARIC)

The agricultural industry manages 70% of UK land in 2018[1] and so has a major impact upon our environment. Agriculture also contributes significantly to the UK economy, generating £4Bn annually through the production of both livestock and crops[2].

SARIC is an initiative to address challenges affecting the efficiency, productivity and sustainability of the UK crop and livestock sectors. The initiative is led by BBSRC and NERC, with support from ESRC, and a consortium of leading businesses.

Together we have invested £10M in research and innovation projects, led by world-class academic researchers, and exploring innovative solutions for agriculture.

SARIC was developed in consultation with trade associations, levy boards, policy makers and academia. The discussions found a need to connect researchers from the environmental and biological sciences with industry, to generate and translate knowledge about the sustainability of agricultural production.

[1] Structure of the agricultural industry in England and the UK at June (Defra 2018)
[2] Total Income from Farming in the United Kingdom (Defra 2018)

SARIC operates as a public-private partnership, with members working together to support pre-competitive research with the potential to generate economic and societal benefits for the UK.

Figure 1. Barley field. Image courtesy of KTN.

"Being a member of SARIC gave us the opportunity to have one door access on cutting edge science in agriculture and to enlarge our network"
Isolde Haeuser-Hahn, Regional Alliance Manager EMEA, Bayer CropScience AG

SARIC Research Challenges

Our research brings together multidisciplinary teams to advance two challenges which were developed with the industry membership:

- Resilient and robust crop and livestock production systems
- Predictive capability and modelling for new technologies, tools, products and services

We have funded 25 grants across 30 Universities and Research Institutes. The funding has been delivered in the form of research and research translation grants.

Research grants generate new knowledge and fundamental scientific insights, to bring benefits to the entire agricultural supply-chain.

Research translation grants support novel approaches to translating existing research data and knowledge into new tools, technologies and other outcomes that create tangible economic or societal benefits.

"SARIC has enabled AHDB to engage with applicants to ensure the delivery of scientifically excellent but also industry relevant outcomes in areas of specific interest to the arable and livestock sectors."

Jon Knight, Head of Crop Health and Protection, AHDB Horticulture

Member Benefits

BBSRC, NERC and ESRC have a strong record in managing collaborative research. Companies report a range of significant benefits from their membership of Research and Innovation Clubs:

- Capacity to influence research in important strategic areas
- Knowledge on the progress of relevant research projects and early access to results
- Opportunity to work with leading researchers and to build strong relationships with them
- Opportunity to identify the best potential industry recruits
- Guidance on other UKRI activities and funding opportunities
- Promotion of companies through relevant activities, objectives and outputs

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Research Grants generate new knowledge and data to address strategic challenges relating to Sustainable Agriculture

Magnesium Network (MAG-NET): Integrating Soil-Crop-Animal Pathways to Improve Ruminant Health
Martin Broadley, University of Nottingham

Impacts of different vegetation in riparian buffer strips on hydrology and water quality
Adrian Collins, Rothamsted Research

Reduced Stomatal Density Wheat: New Prospects for Drought and Pathogen Resistance
Julie Gray, University of Sheffield

Increasing wheat drought tolerance and recovery throughout the life cycle through regulation of plant growth mechanisms
Matthew Paul, Rothamsted Research

Diverse forage mixtures to optimise ruminant animal production, nutrient use efficiency, environmental impact, biodiversity, and resilience
Chris Reynolds, University of Reading

Future-proofing our breeding goals; Breeding for climate resilience in UK dairy systems
Eileen Wall, Scotland's Rural College (SRUC)

Real-time in situ sensing of soil nitrogen status to promote enhanced nitrogen use efficiency in agricultural systems
Davey Jones, University of Bangor

Advanced technologies for efficient crop management: A participatory approach with application at farm scale
Mathew Williams, University of Edinburgh

Increasing the resilience of cereal and oilseed rape production to weather damage
Alan Blackburn, Lancaster University

Biological crop protection: a new 'slow down/speed up' strategy for aphid management
David Chandler, University of Warwick

Restoring soil quality through re-integration of leys and sheep into arable rotations
Jonathan Leake, University of Sheffield

Research Translation Grants use existing data and knowledge to develop new tools and technologies for economic or societal benefits

Enhancing Innovation in Barley Integrated Disease Management with the application of an innovation systems approach to research translation
Fiona Borthwick, SRUC

CROPROTECT: a knowledge exchange system to support UK growers in sustainable crop protection to allow efficient crop production
Toby Bruce, Rothamsted Research

Enhancing nutrient use efficiency from biosolids for a resilient crop production system
Ruben Sakrabani, Cranfield University

Biosolids, Yield, Organic amendments in Soil: research to mitigate Leaching and Denitrification: BYOSOLID
Andy Whitmore, Rothamsted Research

Measuring plant available phosphorus to increase crop yields and minimise nutrient leaching
Hao Zhang, Lancaster University

Delivering a decision-support framework 'soilquality.org.uk'
Elizabeth Stockdale, University of Newcastle

Real-time predictions of pesticide run-off risk: multi-scale visualisations of water quality risks and costs
Alexis Comber, University of Leeds

Low-cost fibre optic matting for direct live-mapping of livestock weight to improve feed efficiency
Bruce Grieve, University of Manchester

Hand Held Technologies for Assessment of Nutrient Digestibility
Alison Kingston-Smith, Aberystwyth University

Novel animal-mounted sensor technology to improve efficiency and sustainability
Carol-Anne Duthie, SRUC

Development of a PCN population advisory tool that provides robust advice and management
Peter Urwin, University of Leeds

SLURRY-MAX: Holistic decision-support for organic slurry storage and treatment
Claire Waterton, Lancaster University

Breaking the Barriers to Soil Testing on Pastures (Breaking-STEP)
Davey Jones, Bangor University

Grassland Management
Paul Burgess, Cranfield University

How climate change might affect the dairy sector

Climate change will impact livestock by increasing both heat stress and the frequency of extreme weather events such as droughts. In dairy cows, heat stress can reduce milk yield and quality, fertility, and increase susceptibility to disease.

The outcomes of the project:

- Analysed over 463,000 daily records from approx. 90,000 cows and data from ~900 bulls;
- Developed a detailed understanding of the relationship between weather and livestock phenotypes;
- Identified key production and fitness traits, and biomarkers, that can be incorporated into breeding programmes;
- Cost-benefit analysis of breeding cows for improved tolerance to unfavourable weather will be carried out to inform future breeding programmes.

Future impacts:

- The outcomes of the project will help to assess demand for feed and water under different weather and climate scenarios, and to embed climate resilience into long-term planning decisions, supporting the UK national dairy evaluations of Agriculture and Horticulture Development Board (AHDB).

Figure 2. Image courtesy of SRUC.

SARIC project: Future-proofing our breeding goals: Breeding for climate resilience in UK dairy systems, 2015-2019

Project team at SRUC:

- Eileen Wall
- Davina Hill
- Ian Archibald
- Mike Coffey

Collaborations:

- National Milk Records
- Dairy Australia
- GenTORE (https://www.gentore.eu/), an EU H2020 project led by INRA

Soil-Crop-Animal Pathways to Improve Ruminant Health

Low magnesium (Mg) status (hypomagnesaemia) can lead to serious health problems in cattle and sheep, such as tetany/staggers, often with high fatality rates. The project aims to develop novel and resilient Mg management strategies in the UK ruminant sector.

The outcomes of the project:

- Predictive soil maps of hypomagnesaemia-sensitive regions for England, N. Ireland and Wales are being developed using public and private sector data;
- Over 300 survey responses from agronomy, fertiliser, and veterinary sectors, asking about magnesium use, will inform alternative management options;
- High magnesium hybrid ryegrasses are being developed along with new crop management strategies to increase leaf Mg concentration in forage grasses;
- A decision support tool will allow the comparison of economic benefits of the various Mg nutrition options at farm-to-regional scales.

Impacts:

Significant international impact through a follow on project GeoNutrition (www.geonutrition.com) funded by Bill & Melinda Gates Foundation;

- BBSRC Innovator of the Year 2018 International Impact Prize.

Figure 3. MagNet on-farm mineral soil sampling. Image courtesy of the University of Nottingham.

SARIC project: Magnesium Network (MAG-NET): Integrating Soil-Crop-Animal Pathways to Improve Ruminant Health, 2016-2020

Project team:

- Martin Broadley, Beth Penrose and Diriba Kumssa, University of Nottingham
- Louise Ander, British Geological Survey
- Alan Lovatt, Aberystwyth University

Collaborations:

- Several industry groups (Pet Advertising Advisory Group, Agricultural Industries Confederation), and individual companies (Germinal, NRM Laboratories and Yara), as well as AHDB provided significant contributions to this project.

"Pasture management and grass breeding options arising during this project present exciting opportunities to reduce the incidence of Mg deficiencies in grazing ruminants"
Louise Ander, British Geological Society

Managing runoff and water quality with different riparian buffer strips

Runoff from agricultural land, and the pollution it carries, continue to cause problems for flooding and water quality. This project is investigating the impacts of different vegetation in buffer strips on runoff and pollution loss from agricultural land, over five years.

The outcomes of the project:

- Plots have been constructed to assess the capacity of three different types of buffer vegetation (novel high sugar grass, deciduous woodland, bioenergy trees - willow) to reduce runoff and water pollution;
- Soil and herbage samples from the plots, and water samples from 7 rainfall events in 2017/18 are being analysed to assess the effects of the experimental treatments to date;
- National scale scenario modelling and cost-benefit analysis will be undertaken to scale up the experimental results;
- The outcomes were shared with Defra, Environment Agency, Natural England, Forest Research, AHDB, and water companies, and will feed into policy development.

Figure 4. Riparian buffer strips damage. Image courtesy of Rothamsted Research.

SARIC project: Impacts of different vegetation in riparian buffer strips on hydrology and water quality, 2016-2020

Project team at Rothamsted Research:

- Adrian Collins
- Martin Blackwell
- Rob Dunn
- Jane Hawkins
- Ian Shield

Demonstration and dissemination:

- Plots were visited by Welsh Water, South West Water, Forest Research, Dartmoor National Park, Dartmoor Hill Farm Project, and South West National Farmers' Union Dairy Board & Environment Canada.

Advisory tool for potato cyst nematodes

Potato cyst nematodes (PCN) are important soil pests that cause major economic losses to potato growers. The industry seeks an improved, evidence-based, management framework to control PCN in soil, to reflect the reduction in pesticide usage due to environmental and cost implications.

The outcomes of the project:

- Improved the current AHDB advisory PCN management tool by adding additional functionality and accuracy for the factors influencing PCN multiplication, including temperature, tolerance of the potato variety to the pest, and the emerging control strategies of biofumigation and trap-cropping;
- The updated tool will be hosted on the AHDB web-site and will benefit UK potato growers;
- The project was linked to an additional NERC International Development Innovation and Impact Award to adapt the PCN population advisory tool for use in South America.

"The project has provided an excellent opportunity to work with the group at the University of Leeds"
Matthew Back, Harper Adams University

Figure 5. Potato cyst nematodes. Image courtesy of the University of Leeds.

SARIC project: Development of a PCN population advisory tool that provides robust advice and management, 2017-2019

Project team:

- Peter Urwin, Howard Atkinson, Anne-Kristin Koehler andF. Moulton, University of Leeds
- Matthew Back, Ivan Grove and William Watts, Harper Adams University

Collaborations:

- AHDB
- Barworth Agriculture

Demonstration and dissemination:

- Project was showcased at an industry event BP2017; AHDB agronomists meetings, AHDB SPot Farm Results Days.

Devising user-friendly support for better slurry storage, treatment and use

Good management of livestock slurry is more important than ever since the new 'farming rules for water' (April 2018). Slurry management, often thought to be determined by individual farmers' decisions, is also shaped by wider constraints including weather, farm infrastructures etc. Probing beyond the actions of individual farmers, this qualitative research was able to understand why - despite best intentions and sound scientific advice – slurry is often poorly managed, and suggests both social and technical solutions.

The outcomes of the project:

- Technical recommendations for improving the usability of existing decision support tools based on consultation with cattle farmers, agricultural advisors and agricultural students;
- A prototype decision support tool for slurry management on beef farms;
- Sharing of outcomes with AHDB, Department of Agriculture, Environment and Rural Affairs Northern Ireland and Catchment Sensitive Farming in England.

Figure 6. Image courtesy of Shailesh Shrestha, SRUC.

SARIC project: SLURRY-MAX: Holistic decision-support system for organic slurry storage and treatment techniques for maximum nutrient use efficiencies, 2016-2018

Project team:

- Claire Waterton and Emma Cardwell, Lancaster University
- Lisa Norton, CEH Lancaster
- James Gibbons and David Chadwick, Bangor University
- Katrina Macintosh, Queen's University Belfast
- Ruben Sakrabani, Cranfield University
- Shailesh Shrestha, SRUC

Demonstration and dissemination:

- Disseminated leaflet containing key messages of the research across the agricultural and nutrient management sectors;
- Report detailing how public and private sectors might support better slurry management across the UK: http://wp.lancs.ac.uk/slurry-max/report/

CROPROTECT

Much of current crop protection on farms is based upon pesticides. Alternative approaches, including integrated pest management (IPM), rely upon improved knowledge exchange. The CROPROTECT online platform www.croprotect.com was developed to support growers by providing evidence-based approaches to implementing alternatives to pesticide controls.

The outcomes of the project:

- The project engaged with users and built a network of early adopters who co-designed it;
- CROPROTECT platform has over 1000 users including farmers, agronomists and researchers who can access information via website or through the app, and report incidents;
- Farmers and agronomists can obtain practical management recommendations for pests, weeds and diseases, as well as report on those that are of concern to them;
- Research and policy community can access information about which pest, weed and disease targets are of concern to farmers;
- CROPROTECT is being maintained by Rothamsted Research and used to engage with the farming community.

Figure 7. CROPROTECT App. Image courtesy of Rothamsted Research.

SARIC project: CROPROTECT: a knowledge exchange system to support UK growers in sustainable crop protection to allow efficient crop production, 2014-2017

Project team:

- Toby Bruce, Keele University
- Jon West, Rothamsted Research

Industry support:

- AHDB, AICC, Agrii, AgriChatUK, Hutchinsons, NFU

Demonstration and dissemination:

- Farmers Guardian, 3 December 2015;
- UK-US Plant Health workshop, National Science Federation, United States Department of Agriculture & BBSRC, October 2016;
- Global Food Security workshop on "Alternatives to Pesticides", London, 23 May 2016.

On-farm diagnostics to assess nutrient digestibility for beef and dairy farmers

The accurate assessment of nutrient digestibility is key to using resources efficiency on livestock farms. This project develops a new methodology for real time assessment of feed use and quality based on Near-Infrared Spectroscopy (NIRS) analysis. The researchers are collaborating with ABAgri, the leading feed manufacturing company.

The outcomes of the project:

- Application of NIRS to faeces, in combination with feed analysis, will allow on-farm diagnostics, opening up the ability to make measurements on fresh samples, and extending functionality of the existing hand-held NIRS devices;
- Combining image analysis with NIRS will increase accuracy of predictions;
- Will enable more precise, strategic feeding, with monitoring of individual animals and herds for on-farm nutrient (slurry) management.

Figure 8. NIRS to assess nutrient levels. Image courtesy of ABAgri.

SARIC project: Hand Held Technologies for Assessment of Nutrient Digestibility, 2017-2019

Project team:

- Alison Kingston- Smith, Jon Moorby and David Leemans, Aberystwyth University
- Gary Atkinson, Lyndon Smith and Melvyn Smith, University of West England
- Chris Reynolds and David Humphries, University of Reading

Collaborations:

- ABAgri are providing the equipment for the project and access to raw data.

Demonstration and dissemination:

- Results will be presented at the British Society for Animal Science meeting in 2019.

Managed by BBSRC and NERC, SARIC is a partnership with ESRC and a consortium of companies with interests in enhancing the sustainability of crop and livestock production in the UK.

"Through SARIC, Cawood Scientific has made a number of new connections with academic groups that we had not previously worked closely with. As a result of this Cawood Scientific is now looking to develop a new service in collaboration with one of these new connections." **Duncan Rose, NRM Laboratories**

"The Club has enabled us to access research in agricultural production systems. Working in collaboration, we can ensure healthy and resilient land management to benefit both agriculture and water protection, which means our customers continue to receive excellent drinking water and helps us keep costs, and customer bills, down." **Tara Froggatt, Dŵr Cymru Welsh Water**

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