

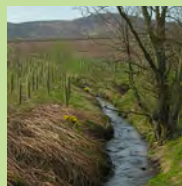


Environmental Change; Food, Land and People



Spotlight 2011-2012

Scottish Government
Strategic Research Programme



Funded by the Scottish Government's
Rural and Environment Science and
Analytical Services Division (RESAS)



The Environmental Change Programme and the Food, Land & People Programme form an interlinked, multidisciplinary strategic research programme (2011-2016), commissioned by the Scottish Government's Rural and Environment Science and Analytical Services Division (RESAS). The Strategic Programme is being delivered by collaboration between scientists across six Main Research Providers (MRPs): Biomathematics and Statistics Scotland, The James Hutton Institute, Moredun Research Institute, Rowett Institute of Nutrition and Health (University of Aberdeen), Royal Botanic Garden Edinburgh and Scotland's Rural College.

The main aims of the strategic programme are:

- To address major policy issues of climate change, land use and food security
- To develop responses to anticipated issues of global change
- To work with stakeholders, including Industry and Policy Makers

This document showcases examples of the outcomes (and aligned activities) from the 2011-12 annual report. The research delivers to five strategic priorities:

Policy and practice

- ▶ **130** reports and briefings for policy audiences
- ▶ **151** influences on policy through scientists' membership of advisory groups
- ▶ **32** specific examples of uptake of advice by policy makers informed by programme research
- ▶ Policy output and impact at Scottish, UK, European and local government levels
- ▶ Policy contributions within climate change, water, land use, animal welfare and animal and plant health, sustainable diets and rural communities

Economic growth and innovation

- ▶ **90** publications for industry and trade audiences
- ▶ **92** consultancies and **27** collaborations with industry in a wide range of areas from vaccine development to improving the energy efficiency of homes
- ▶ **£11m** external income secured to support industry-relevant research
- ▶ Production of tools for the livestock and arable industries to improve animal breeding, farm welfare and control disease
- ▶ Development of new and improved varieties of soft fruit, potato and barley

Collaboration and multidisciplinary working

- ▶ Over **60%** of peer-reviewed publications co-authored with non-programme scientists
- ▶ Programme embedded cross-MRP collaboration and interlinking of natural and social science disciplines
- ▶ Active collaboration with other non-programme research institutions and agriculture and agri-food sectors

Scientific excellence

- ▶ **634** peer-reviewed publications
- ▶ New scientific discoveries that significantly advance their field, with applications across the environment, the food chain and including examples relevant to human health benefit

Growing scientific resilience

- ▶ Training of over **370** PhD and MSc students, **50** of which directly supported by Scottish Government
- ▶ **£18m** of additional research funding from non-Scottish Government sources (and further to the income secured for industry-relevant research)

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learn more? <http://tinyurl.com/strategic-programme>

www.knowledgescotland.org

Modelling CAP reform scenarios



- *Informing Scottish Government on the impact of options for a future Single Farm Payment Scheme*

The Common Agricultural Policy (CAP) is a system of subsidies and programmes for farmers, provided through membership of the European Union. Proposals for reform of the system of payment are in negotiation and the Scottish Government is working to ensure that Scotland's diverse farming needs are well represented and that Scottish farmers get a fair share of the CAP budget.

Programme researchers and Scottish Government policy staff have been working together to develop and test options for a future Single Farm Payment Scheme (SFPS). SFPS is the single largest support scheme for Scottish farmers with a total value of €648 million. Programme analysis has assessed the consequences of changes to SFPS for regions, sectors and potential new recipients to inform both the Pack Inquiry into Future Agricultural Support for Scotland and Scottish Government policy teams in their high-level interactions with Member States.

Analysis of the redistributive consequences of the Pack Inquiry proposals, with increased and reduced rates of payment relative to the 2009 baseline, reveals that there are new recipients and both increased and reduced payments for businesses within the same farm type. Assessing the consequences of this scheme using net change alone would misleadingly underestimate the redistributive effects of change in the basis of payments, particularly for the least favoured area sheep and cattle farm types.

learn more? <http://tinyurl.com/land-use-cap>

The impact of food choice on the planet



- *First study to examine both the health and environmental sustainability of our diet*
- *Shows sustainable diets are practical and achievable*

Research on environmentally sustainable and healthy diets feeds into policy on health, diet and climate change including: the Scottish Government Dietary Goals, the Scottish obesity strategy and the Climate Change Act (Scotland) 2009, which has set targets to reduce greenhouse gas emissions.

The Livewell project was the first study to address the practical issues of achieving a sustainable diet. By integrating dietary requirements for health with a reduction in greenhouse gas emissions (i.e. climate change mitigation), it was possible to show how a balance for dietary requirements for health and environmental sustainability could be achieved. It provides an important first step to guide policy makers towards healthy, yet environmentally sustainable diets for the wider population. This was presented as written and oral evidence to the House of Commons Environmental Audit Select Committee.

Drawing on previous programme research, the Livewell project was funded by WWF-UK and is now being further developed through Strategic Programme funding. This is an exemplar of how additional external funding has built on RESAS-supported skills and research. It has stimulated collaborative projects with the BBSRC Global Food Security programme and provided an essential platform for the Scottish Government research programme into understanding future sustainable diets, as well as generating interdisciplinary collaborations worldwide.

learn more? <http://tinyurl.com/livewell12>

Global partnership to develop novel vaccine



- Global partnership is developing novel vaccines against major parasitic diseases of livestock
- Improved animal health will make a major contribution to food security

Helminth parasites impose considerable constraints on livestock production and impact on food security worldwide. Current control, using anthelmintic drugs, is threatened by the emergence of drug resistant parasites and consumer concerns regarding drug residues in animal products and the environment.

An alternative, greener and more sustainable approach to disease control is using vaccination. Programme researchers are internationally renowned for their work in the prevention and control of livestock disease and are part of a leading global partnership, PARAVAC, to develop novel vaccines against the major parasitic diseases of livestock including, roundworms, tapeworms and fluke.

The €9 million grant, the largest ever to be awarded by the EU in the field of animal health, is funding a series of projects linking 20 different academic and commercial partners in Europe, North and South America, Africa, Asia and Australia. The programme researchers' leading position in this project and in vaccine development has been enabled by sustained funding from Scottish Government underpinned by consistent external grant acquisition in a highly competitive arena.

learn more? <http://paravac.eu/>

Mapping the potato genome



- The potato genome sequence has been mapped and will accelerate the traditionally slow process of developing new potato varieties
- Provides significant potential to contribute to improved food security and the response to climate change

In July 2011, an international team of scientists, collectively known as the Potato Genome Sequencing Consortium (PGSC) published their work on the mapping of the potato genome in the prestigious journal *Nature*. The UK team was led by scientists funded by the Scottish Government with additional funding from BBSRC and DEFRA.

This seminal achievement holds tremendous promise for accelerating the traditionally slow process of developing new potato varieties. This is especially important for traits such as resistance to potato late blight, the causal agent of which '*Phytophthora infestans*' is evolving at a rapid rate. New resistant varieties must be bred and released to keep ahead of this aggressive and economically damaging disease.

New types of potato could contribute to future food security because of improved yield, quality, nutritional value, and resistance to pests and diseases, as well as resistance to abiotic stresses caused by climate change.

The genome sequence has allowed the consortium to develop a panel of approximately 10,000 new genetic markers which can be used to map important potato traits. These markers are now being used by scientists around the world, making it much easier to compare results and to facilitate global collaborations. The production of a comprehensive potato 'microarray', has allowed the expression level of all 39,000 genes in the potato genome to be monitored simultaneously. This is being used to follow gene expression in different parts of the potato plant, plants subjected to different types of biotic and abiotic stress. Research is underway to find the specific genes controlling several important traits (e.g. late blight resistance, tuber dormancy and water-use efficiency) which are of vital importance to the potato industry within the UK.

learn more? www.potatogenome.net

Genetic evaluations of livestock - shortening the route to market



- *EGENES is pivotal in shortening the route to market for animal breeding research*

Livestock breeding is one of the most cost effective tools available to improve profitability since it is also long-lived and cumulative. Benefits quickly accrue across generations.

Traits considered to be of economic importance have changed slowly over decades of selection. Recently traits for health, welfare and environmental impact have been highlighted by farmers as vital to produce socially and legislatively acceptable animals and food. Thanks to Scottish Government and BBSRC-LINK support we were able to broaden our dairy breeding goals to include health, fertility and welfare traits which has not only led to less wastage of animals but also to a reduction in the environmental impact of dairying.

EGENES (Edinburgh Genetic Evaluation Services) is pivotal in shortening the route to market for animal breeding research. For example, we consult with and take feedback from industry on newly significant traits to secure improved genetic measurements and gathering techniques. EGENES produces 200 separate evaluation runs annually on sheep, beef cattle and dairy cows.

Work by EGENES has led to the production of genomic evaluations of dairy cattle for the first time and has successfully reversed the decline of fertility in dairy cows.

The benefit of gene selection research nationally is substantial; it is estimated that genetic improvement in British dairy cattle over the last 20 years has been worth £2.4 billion.

EGENES is directly funded by DairyCo for dairy evaluations and Eblex for sheep and beef.

learn more? <http://tinyurl.com/egenes-evaluation>

Land-use decision making in Scotland



- *Significant differences were observed for the decision making systems and process within large scale land management organisations compared to individual 'family' farms*
- *Research findings fed directly into the Scottish Government's Land Use strategy*

The study demonstrated the importance of cross-sectoral analysis to understanding land-use decision making. Consistent attitudinal groups were found across land use sectors and Scotland's four geographic regions. Where attitudes and priorities differ within specific sectors, similar orientations such as economic, multifunctional or community stewardship, can still be identified.

The findings of this study demonstrate the increasing professionalisation of decision-making processes among large-scale public, private and charitable land managers. This is in contrast to a perceived lack of access to assistance for individual and household-level decision-makers within smaller farms.

Family-farm decision-making is based on previous experience and whatever training or exposure family members have had to new ideas, whereas a corporate approach is more likely to be based directly and systematically on expert guidance. Both approaches have their strengths and weaknesses, but larger entities can more easily afford to bring in specialist advice in the decision-making process.

learn more? <http://tinyurl.com/land-use-scotland>

Underpinning development of a commercial health food range



- The "Simply Fuller Longer" food range was developed by Marks & Spencer (M&S) plc with expert input from programme scientists
- The project took the concept of protein-induced satiety from the laboratory to the supermarket shelf

The Simply Fuller Longer™ (SFL) range of dishes was based on research with human volunteers which demonstrated the efficacy of high protein, moderate carbohydrate diets in sustained appetite control, leading to weight loss. The interaction took the concept of protein-induced satiety from the laboratory directly

to application in the commercial food industry setting, with great commercial success for the industry partner.

M&S has 20 million weekly customers and since its launch in January 2010 SFL has become the number one diet brand in store. By April 2011 M&S had increased its share of the food market and food sales by 3.3%, with the SFL range increasing its growth by more than 50%.

Further work is underway to assess the efficacy of the range. This work has attracted the interest of other food manufacturers and retailers, prompting new interactions with other major food companies.

learn more? <http://tinyurl.com/appetite-health>

Successful control of parasitic worms in sheep by vaccination



Gastrointestinal nematode parasites are a major cause of poor growth rates in young lambs. In the UK alone, nematode parasites, of which *Teladorsagia circumcincta* is the primary causative agent, have been estimated to cost the sheep industry in excess of £84 million per annum.

Teladorsagia circumcincta is endemic in the UK, and is currently the major cause of financial loss due to parasitic gastroenteritis in sheep in temperate regions worldwide. Research funded by the Scottish Government has developed a recombinant vaccine cocktail which controls worm numbers in the sheep host and also limits pasture contamination. The levels

- A vaccine cocktail has been developed which controls worm numbers in sheep and limits pasture contamination
- The levels of protection are higher than in any other equivalent vaccine system

of protection are higher than in any other system using a recombinant vaccine against a parasitic nematode in the definitive host. This vaccine is now protected by a filed patent. There are ongoing discussions with a major international pharmaceutical company for its further development.

learn more? <http://tinyurl.com/sheep-vaccine>

Impact of consumer attitude to animal welfare



- Improved labelling systems, clear information and improved access to welfare education campaigns can benefit public understanding

In the current economic crisis the effect of price on purchasing decisions is growing stronger and this may strengthen the contradiction between consumers' stated intentions and their purchasing decisions for higher welfare food products.

The Programme's behavioural economics models assess the influence of various factors on consumers' and farmers' behaviour in relation to animal welfare. The research has found that access to information, knowledge and education significantly influence the Scottish, British and EU consumers in their willingness to purchase welfare friendly food products. Improved labelling systems, clear information and improved access to welfare education campaigns can collectively benefit public understanding.

This is of particular importance to policy audiences in view of the EU Strategy for Protection and Welfare of Animals 2012 – 2015, where providing consumers and the public with appropriate information is one of the six strategic actions. For commercial audiences, the research directly informs improvements to the means by which customers are informed about welfare friendly products, e.g. clear labelling and information on welfare issues such as conditions of animal transport (EFSA 2010, Scientific Opinion Concerning the Welfare of Animals during Transport, EFSA Panel on Animal Health and Welfare, European Food Safety Authority) and beak trimming (Scottish Government, 2012. Codes of practice for the welfare of laying hens). This research will directly impact on the way industry informs, and responds to, the higher demand for welfare friendly products from a better informed public.

learn more? <http://tinyurl.com/welfare-policy>

Human colonic bacteria respond to changes in dietary fibre



- Significant implications for the health impacts of different types of dietary fibre
- Potential for the development of new prebiotics based on plant fibre and starch
- Poses the challenge that dietary advice will need to become more refined and personalised

The activities of microorganisms that colonise our gut exert an important influence on human health. They have been implicated not only in gut disorders, but also in diabetes and obesity.

Research has shown, for the first time, major temporal changes in the composition of human gut microbiota in response to changes in the main source of dietary fibre. Additionally, the remarkable inter-individual variation in starch fermentation associated with the altered bacterial profiles has been revealed. Importantly, the study also shows for the first time that the majority of the most dominant species of human gut bacteria detected by molecular methods have been cultured.

This result has significant implications for the health impacts of fibre consumption by showing that different types of 'fibre' can have profoundly different effects on our gut bacteria and their metabolism. It demonstrates that there is considerable potential for the development of new prebiotics based on plant fibre and starch but also shows that individuals can vary markedly in their responses depending on the initial makeup of their gut microbiota. Consequently, dietary advice and policy may need to become more refined and personalised as our knowledge increases.

Funded by Scottish Government, the work received additional support from the World Cancer Research Fund and has led to the participation in two new EU-funded projects (FibeBiotics, SATIN) a BBSRC Case studentship and commercial interest.

learn more? www.fibebiotics.eu

Mitigating the impact of climate change on European freshwater



- *Pan European collaboration to develop strategies to mitigate the impact of climate change on European freshwater ecosystems*
- *Working across nations to share key messages and strategy successes*

REFRESH is a European Union (FP7) and Scottish Government- funded research project which will enable water managers to design cost-effective restoration programmes for freshwater ecosystems at the local and catchment scales, taking into account the expected future impacts of both climate change and land-use change in the context of the Water Framework and Habitats Directives.

REFRESH recognises the importance of fully and effectively engaging stakeholders as a key mechanism for success. REFRESH is consulting across the freshwater community, including science, conservation and regulatory agencies, Non Government Organisations, water companies, land owners and farmers. REFRESH will better define the pressures affecting water quality and assess which measures can be best implemented to mitigate water quality problems, their economic implications and the impact of climate change on freshwaters.

REFRESH, valued at €597,530 to the James Hutton Institute (including a RESAS contribution of €144,643) is an exemplar of how Scottish Government funding for research expertise within the Strategic Programme is developed and extended through external collaboration.

learn more? <http://tinyurl.com/refresh-partners>

Cooperative Network to Prevent and Control Zoonoses (CoZEE)



- *Coordinated approach to prevent and control Zoonoses*
- *Programme researchers, academia, government agencies, industry and public health are working together in a cohesive network*

Zoonoses are diseases or pathogens transmitted between animals and people and may involve a wide range of infectious agents. Around 62% of all known human pathogens and 75% of emerging diseases are zoonotic and pathogens may be transmitted by direct contact or through contaminated food or water supplies. In Scotland, several zoonotic pathogens such as *E.coli* and *Cryptosporidium* often hit the headlines and are a real concern to veterinary and public health practitioners.

Prevention and control of zoonoses requires a coordinated approach involving many different sector groups in particular those involved in veterinary and public health, agriculture, environment, water and land management and the food and drink industry. The new Cooperative Network brings together individuals and groups across Scotland with an interest in zoonoses to enable cross disciplinary knowledge exchange and collaboration to improve the prevention and control of zoonotic disease.

The launch meeting of the Network (May 2011) involved scientists working across the Strategic Research Programme along with representatives from academia, government agencies, industry and public health. Several new collaborations, working partnerships and funding applications have been fostered as a result of the network.

learn more? www.cozee-zoonosis.net