Strategic Research Programme

How is your organisation engaged in the development of the strategic research programme?

The Director of the Moredun Research Institute (MRI) and CEO of The Moredun Group, Professor Julie Fitzpatrick, OBE, FRSE, has been involved in the development of the Strategic Research Programmes funded by SEERAD/RERAD and RESAS since her appointment in 2004. She, and other members of the Senior Management Group of MRI, were responsible for creating a “Strategic Plan for Research” along with the other Directors of the Main Research Providers (MRPs) which fed, in turn, into the development of the current Strategic Research Programme and other funding mechanisms provided for by RESAS for the period 2016-2021. The three Themes, “Natural Assets”, “Productive and Sustainable Land Management” and “Food, Health and Wellbeing”, that together make up the Strategic Research Programme, focus appropriately on the principal areas of impact for Scotland where mid- to long-term research and development can make a significant difference to the Scottish economy and its communities. The Themes are based on priority areas as defined and discussed at multiple stakeholder workshops prior to the 2016-2021 Strategic Research Programme starting. The Themes are linked to the expertise, facilities and national capabilities of the MRPs that have built up over the years and decades through sustained funding by the Scottish Government, in contrast to elsewhere in the UK where funding for these areas by the UK government has declined significantly. The focus of MRI’s research has been in the area of prevention of infectious disease of livestock species, where the Institute’s research and development is internationally renowned. MRI has developed its research programmes to complement activities of other animal science Institutes elsewhere in the UK (e.g. Pirbright and Weybridge in Surrey and Stormont in Northern Ireland), to avoid overlap and inappropriate competition for funding. MRI therefore focuses on the most common and damaging infections of Scottish sheep and cattle, the endemic or production diseases, which reduce productivity, adversely affects animal welfare and result in unnecessary (wasted) greenhouse gas emissions.

Is the approach to funding effective in supporting sustained research in priority areas?

Yes, the current funding approach has been effective for MRI’s research under the Strategic Research Programme, the Centre of Expertise (CoE) EPIC, and the Innovation Funds. This has supported the following areas of research:

Theme 1 – Natural Assets
Scottish water quality with respect to microbiological contamination, in particular cryptosporidium and other protozoan parasites. These organisms are the cause of zoonotic disease outbreaks in humans sometimes resulting from reservoirs and are very hard to control through normal water treatment methods.

Ecosystem health risk and management with respect to cryptosporidium and, in the marine environment, campylobacter. These organisms are known to infect humans and multiple animal species and can be spread through environmental contamination on sea and land.

Emerging pests and diseases of animals with a concentration on wildlife interactions e.g. the mud snail and liver fluke which are increasing through climate change and wetland management and the issue of grey squirrels and their negative effect on red squirrels.

**Theme 2 - “Productive and Sustainable Land Management”**

- Vaccine programmes on; Chlamydial abortion, endoparasites (Liver Fluke, Teledorsagia and Ostertagia), ectoparasites (sheep scab) and mastitis, in addition to a programme to improve vaccine production and delivery using novel technologies such as viral vectors. This work provides sustainable alternatives to the use of anti-microbial drugs in food producing animals.
- Diagnostic programmes on; bovine respiratory disease complex (BRD), Bovine Viral Diarrhoea Virus, Johne’s disease, TB in deer, Jaagsiekte, protozoan parasites (toxoplasma, sarcocystis and neospora), endoparasite speciation and anthelmintic resistance. Further research programmes evaluate novel diagnostic technologies from multi-plex platforms to point of care devices. This work allows targeted use of drugs including anti-microbials reducing the risk of anti-microbial resistance (AMR).
- Understanding disease mechanisms to enable development of future intervention strategies: Programmes include those on Chlamydial abortion, *Mycobacterium avium paratuberculosis* (Johne’s Disease), Jaagsiekte, Cryptosporidium, mastitis, Campylobacteriosis, Teledorsagiosis and sheep scab. Further programmes investigate the role of co-infections with respect BRD and endoparasites and vaccine responsiveness.
- Understanding livestock genetic improvement with respect to the interaction of animal genetics and disease susceptibility/resistance, and vaccines with an aim to improve resilience to disease.
- Emergence/prevalence of anthelmintic resistance and the ways in which different usage strategies may help to prolong the life of current drenches whilst maintaining efficiency of production.
- Emergence/prevalence of tick-borne pathogens and the contribution of wildlife/the environment to maintaining populations of livestock and zoonotic pathogens.
- Improved knowledge of the epidemiology of livestock infections with respect to liver fluke, sheep scab, endoparasites, cryptosporidium, and an understanding of the spread of antimicrobial resistance in livestock systems.
- Novel markers for animal welfare.
- Improved understanding of livestock productivity/efficiency and greenhouse gas emissions and methods of minimising waste in primary production.
- Decision support systems for endoparasite management to provide information on best practice for a number of livestock diseases.

**Theme 3 - “Food, Health and Wellbeing”**

- Food safety with respect to the rapid detection of major food-borne pathogens such as *E. coli* O157, Campylobacter and Toxoplasma species. This work supports vaccine development to prevent serious zoonotic infections of humans, especially *E. coli* which is a particular problem in Scotland.

The approach adopted by RESAS and MRI has been highly effective in that it has allowed mid- to long term investment in areas of research which are challenging, complex, and yet have the potential to result in major benefits for Scotland (and other countries and continents due to the occurrence of similar livestock diseases worldwide). Importantly, the funding provided has underpinned salary costs that have ensured scientific experts have been retained within Scotland where they have delivered exciting and practical research outputs while also contributing to external income generation and sustainable business models for MRI. RESAS funding has supported research which is very unlikely to be supported by multi-national private companies (e.g. sheep and their diseases are seen as low priority by animal health companies, while in Scotland, sheep are a vital contributor to rural communities), diseases of humans linked to animal disease (e.g. *E. coli* O157 where medical funders have not to date supported vaccine studies for livestock).

One criticism of the funding mechanism has been the division of funding into a number of streams (e.g. SRP, CoE, Underpinning Capacity etc.) with insufficient thought and time as to how these might best align with MRP’s skills base or meet the needs of policy makers and others. This has, in turn, resulted in RESAS introducing a very complex and time-consuming reporting structure based on objectives and timelines. MRI understands and agrees completely with the requirement for audit, however, in the view of the Director and MRI Board, the current reporting structure is cumbersome and resource consuming at a point in time when the focus should be on maximising income streams and excellent research outputs. The reporting structure has also limited the resilience of decision making in research prioritisation within MRI.

The ongoing reduction in RESAS budgets has resulted in MRI’s inability to replace many key staff after their retiral. This has, and will continue to, prove challenging in terms of recruiting and retaining the best qualified, young scientists that will be required to deliver the Strategic Research Programme going forward.

**How does your engagement contribute to the delivery of the National Outcomes and the Scottish Government’s Purpose?**

The work of MRI, enabled by the portfolio of strategic research funding from RESAS, addresses at four of the priority areas supporting the Government’s purpose of “Sustainable Economic Growth”; **Investing** in our people and infrastructure in a sustainable way; Fostering a culture of **Innovation** and research and development and; Promoting Scotland on the **international** stage to boost our trade and investment, influence and networks; Promoting **Inclusive growth** and creating
opportunity through a fair and inclusive jobs market and regional cohesion. The long term funding investment for MRI by the Scottish Government has resulted in a specialist animal disease research infrastructure that is unique, certainly in the Scottish context, together with a stable workforce of some of the most respected livestock animal scientists who are developing and delivering practical solutions not only for the farming industry in Scotland, but also across the UK and internationally. RESAS funding has allowed MRI to address some of the longstanding problems of infectious endemic livestock disease by collaborating across many scientific disciplines, including physics and engineering, to find innovative solutions which will drive forward the efficiency and sustainability of livestock farming. By their very nature, endemic diseases are those that are constantly present, lowering efficiency and productivity of farms and also leading to wasted greenhouse gas production when animals fail to make it to market either through death or disease. These diseases are, however, those where the greatest sustainable gains could be made as they are tractable and can be addressed through development of new technologies and approaches including vaccination and precision farming. Endemic diseases are similar the world over and therefore solutions found for the Scottish farming industry will often be applicable elsewhere. A recent example of this is “Barbervax”, the first vaccine against a nematode worm of any species, developed within Scotland at MRI and now commercialised and bringing in royalties to both MRI and Scotland (www.barbervax.com).

MRI’s focus on the development of solutions for the livestock farming industry also addresses the Scottish Government’s National Outcomes such as; “Reducing the local and global environmental impact of our consumption and production” – MRI’s research on disease prevention will help Scotland to achieve its Climate Change targets in the agriculture sector; “Protecting and enhancing the natural environment for future generations” – MRI’s research on wildlife/domestic livestock and human diseases will help to ensure environmental and biodiversity outcomes are considered together with sustainable farming targets post-Brexit and; “Helping to build strong, resilient and supportive rural communities” - MRI’s research on extensively managed livestock will help to maintain profitable farming and stewardship of land in Scotland for future generations. MRI also contributes to Scotland becoming better educated, more skilled and more successful through its post-graduate training programme of 15 PhD students per annum, providing practical project placements for many undergraduate students as well as being renowned for our research and innovation. MRI also works with local and regional schools providing work experience placements for school pupils and working with teachers to develop science resources to support the curriculum for excellence. MRI is leading an initiative to develop a National Science Education Resource to bring together education resources from all the MRPs to help encourage the uptake of STEM subjects in schools. MRI collaborates successfully with multiple universities and other research organisations in Scotland, the UK and further afield. MRI and The Moredun Group provide significant employment opportunities for people in the Lothians, nationally and internationally.

What is the anticipated impact of the UK exit from the EU on the capacity of your organisation to deliver the Programme? MRI has been very successful in attracting funding from the EU, especially from FP-7 and Horizon 2020 funds, where we have been the co-ordinator of two large research programmes, “Paravac” and “Paragone”,...
each funded at 9 million euros over 4 years. “Paragone” is due to finish in 2019. In addition we are and have been partners on a range of other projects including “VetBioNet”, “Aquavalens”, “Toxpox”, “Gloworm” and “Nadir”. The UK exit from the EU is therefore likely to cause a significant downturn in MRI’s income over possibly an extended time period. There is a risk that our European partners dis-engage with our scientists and science, although to date, collaborators have emphasised their wish to retain links with MRI due to both our expertise and specialised facilities. In the last 8 years, MRI has attracted £13.6m from EU funds. We are very keen that the UK and Scottish Government do all that is possible to retain access to EU research programmes and financial support going forward. The UK government has provided new funding opportunities through their Global Challenge Research Fund (GCRF) and are likely to through the UK Industrial Strategy Fund, however this will only compensate if the areas/focus of research funded by the EU match MRI’s area of expertise: prevention of infectious diseases of livestock. To date, the GCRF has funded projects linked to low/middle income countries, where MRI has established collaborations especially in East Africa. Bids have been prepared for submission to The Industrial Strategy Fund to support “Smart Agriculture” and a decision is awaited.

Centres of Expertise

Is your organisation involved in a centre of expertise? If so can you set out this involvement and the timeframe and funding attached?

MRI is a partner in EPIC (the Centre of Expertise for Animal Disease Outbreaks). MRI scientists have been partners of EPIC since its inception more than a decade ago. MRI currently receives only a limited amount of funding via EPIC - £156k per annum, primarily for our role in BVDV disease control/eradication programmes, implementation of diagnostic testing and controls for sheep scab in remote areas of Scotland, and analysis of how farm management practices may influence spread of diseases including *Nematodirus battus* and Cryptosporidium. The low level of funding for MRI results in only a relatively small proportion of scientists’ time being allocated to this work.

For those involved in a centre of expertise what are the benefits and challenges associated with this approach? MRI scientists benefit in playing a role in planning responses to epidemic disease outbreaks (e.g. Foot and Mouth Disease, Avian Influenza), and in linking the Institute’s and the Moredun Group’s research and surveillance facilities to any required emergency response (scenario planning). The collegiate nature of EPIC also facilitates interdisciplinary working, with the possibility of novel projects being developed. A main challenge is that EPIC requires data on which it’s modelling and planning activities are based. It is important that new data, including biological data, is produced and fed into EPIC. This work on generating new biological data (e.g. identification and sequencing of new and emerging pathogens) is often undertaken by MRI and other MRPs in the Strategic Research Programme. The essential link between the Strategic Research Programme and the CoEs is often not fully understood or articulated. EPIC currently uses data generated in earlier programmes of work, and if EPIC is to continue to be current and relevant, it needs to be underpinned by laboratory-based novel research and this needs to be funded under current and future Strategic Research Programmes.
EPIC faces a challenge relating to attracting and retaining the best academic scientists while delivering the rapid and reactive outputs required by policy makers. This area of activity does not always lead to the high impact, peer reviewed manuscripts published in international journals: a key performance indicator for those in HEIs.

Are there any particularly pressing gaps in the issues that are currently covered by centres of expertise? EPIC should focus more on endemic (production) diseases in addition to epidemic diseases. Innovations in biosecurity have the benefit of protecting against multiple diseases simultaneously and a refocussing of EPIC in this area would be beneficial. Greater use of surveillance data, funded by the Scottish Government via SRUC and MRI, could be made by EPIC, feeding into biosecurity across the farming and food industries.

Innovation Funding

Does your organisation receive innovation funding? If so, how has this supported collaborative working and what have the outcomes been? MRI currently only has one project funded via this route. It is a collaborative project with the University of Glasgow that brings together MRI specialists in animal disease with experts from Glasgow in novel diagnostic platforms with the aim of producing a commercial test for liver fluke. In previous years we received funding for SPASE – the Scottish Partnership for Animal Science Excellence. This initiative was not seen as particularly successful by RESAS, however it was for MRI as it initiated entirely new partnerships and sources of external and commercial funding – e g. for aquaculture vaccines. This work has continued to date supported by external funding. MRI has multiple higher educational institute (HEI) partners and we are involved in numerous research funding applications to BBSRC, MRC, NERC and in the near future, UKRI. MRI’s eligibility for access to these funds has been vital to the Institute’s success as in the past, these were denied to the Institute. These, more traditional routes of collaborative funding have been more successful than the “Innovation Funding” route by RESAS where the focus/purpose of the fund was unclear. Innovative opportunities and projects arise from all aspects of the Strategic Research Programme, often suddenly and unexpectedly, making the identification of specific areas with which to bid into the “Innovation Funding” route somewhat artificial. The Strategic Research Programme would benefit from flexibility of rapid identification of innovative outputs by the Director and Senior Management Groups to allow maximum leverage of RESAS (e.g. contract funding) and external funds to fund leading-edge science. Innovation is vital to Scotland’s economy. The contribution of the Institutes, including MRI, should be clearly focused to deliver to this target.

Underpinning Capacity

What activities are supported by funding to underpinning capacity? Over the last 7 years RESAS has provided MRI funding for “Advice and Analytical Services”, “Seedcorn: Training of PhD students and maintaining and enhancing the science base in Scotland”, “Maintenance and development of key long-term data sets of national significance”, “Maintenance of Pathogen, Pest and Tissue Collections”, “Laboratory Services: Animal Model Development and Use, Diagnostic Tests,
Naturally Occurring Disease Studies”, and “Platform Funding – Promoting scientific and financial sustainability”.

In the case of MRI, this accounts for 40% of the Institute’s income from RESAS (£2,096,255 per annum), but due to recent budget cuts, the activities undertaken in the “Seedcorn” and “Platform Funding” have been discontinued from April 2017. The decision to cut these specific activities was due to these areas having the smallest staffing component and salary costs, hence the least damaging impact on maintaining staff posts within MRI. It has however prevented investment in new areas of science under the RESAS budget and reduced MRI’s ability to co-fund externally funded grants. Both these areas continue to be supported by gift-aid from The Moredun Group.

What costs are attached to this and what are the expected outcomes?
A total of £970,302 (46% of underpinning capacity funding) is allocated to support services salaries: the individuals and groups that run our animal, laboratory, field and infectious disease handling facilities. The work undertaken underpins all aspects of the research work undertaken in the three Themes within the Strategic Research Programme.

How secure is this funding stream?
MRI considers this funding stream as secure as it is an absolute necessity for MRI to function as an infectious disease facility and to meet necessary health and safety and animal pathogen legislation. MRI is also a very important national capability for animal and zoonotic disease in Scotland. This may not be the same for other MRPs who have used underpinning capacity funds to support very different research activities and facilities. The infectious disease/pathogen/animal facilities are an essential element of delivering all research outputs under the three Themes of the Strategic Research Programme and of the CoE, EPIC. The current way that the Underpinning Capacity funding is allocated budget-wise is not ideal for MRI as it fails to recognise many of the principal elements of “dual funding support” which many international research institutes receive. Comparisons on funding models should be made with the Pirbright Institute and the Animal and Plant Health Agency, Weybridge, both in Surrey and in Stormont, Northern Ireland, where the latter site is the in the process of re-designing its national facility.

Scottish Environment, Food and Agriculture Research Institute

How do you work with SEFARI? SEFARI (Scottish Environment Food and Research Institutes) (www.sefari.scot) is the collective of six Scottish Research Institutes, each with their own global capability, expertise and reputation. SEFARI is delivering “Leading Ideas for Better Lives” by working across Plant and Animal Health; Rural Economy, Agriculture; Land and Communities; Climate and the Environment; Food and Drink Innovation; Healthier Food and Science Education. As Director of MRI, Professor Fitzpatrick, is one of the Directors of SEFARI, while Professor Elisabeth Innes of MRI, along with others, was responsible for writing the original bid that led to the funding of SEFARI Gateway.

What additional benefit does it bring to your organisation and does it bring any challenges, if so what? The development of SEFARI Gateway has cemented already
strong working relationships, and improved the impact of the Scottish Government funded Strategic Research Programme. The development of a common brand as well as a common knowledge exchange gateway is better integrating outcomes and communication. SEFARI Gateway has been very effective in co-ordinating events and knowledge exchange that bring together the outputs of the different MRPs. This has been particularly successful in bringing relevant information to policy makers within the SG and to politicians and the public.

Challenges include maintaining the number and quality of events with reducing budgets and looking to the future when less original research is funded, leading to fewer KE outputs.

MRI also has the challenge of maintaining awareness of its world renowned research and development of commercial vaccines, diagnostics and disease control programmes branded for many decades as “Moredun” along with the broader remit of SEFARI. Most of our external funders of research come to MRI through links to our commercial companies, Moredun Scientific, Pentlands Science Park, and the large Scottish charity, The Moredun Foundation. The Moredun Foundation has 14,000 current members, the greatest proportion being farmers, land-owners, vets, consultants and scientists within Scotland and the UK.

If SEFARI is to have major impact, it must promote the collective “house of brands” from all of its partner organisations, in some cases brands which have been in existence for many decades, to maximise national and international reach.

**Contract Funding**

The funds available through the contract research budget have declined significantly. How has this impacted your organisation? MRI has only attracted a very small number of projects funded via this route in spite of making a number of applications over the years. MRI currently has gained support for 2 projects; one looking at the presence, and risk of Toxoplasma gondii oocysts in water supplies working with the drinking water quality regulator in Scotland and the other investigating *E. coli* O157 in wild-shot venison due to concerns raised by Food Standards Scotland. The Contract Research Fund is vital for retaining flexibility when new diseases/situations arise in between funding cycles thus allowing delivery on both the original tendered programme and the emergent issue.

**Additional issues**

What are the key challenges for the research community in Scotland and research funding in the next 10 years? Scotland has an exceptionally strong history of success in the research field of “Agri-Bio-Technology” and the Scottish Government and multiple stakeholders should aim to build on that reputation to support Scotland becoming a global leader in “Sustainable Food Security”. Scotland can and does produce high quality, safe, food while protecting the environment, minimising waste and reducing unnecessary greenhouse gas emissions from agriculture and the food industry. Research and development, supported by the Scottish Government, can and will transform future food production through
innovation and knowledge exchange, thus benefitting Scotland and international communities across the world.

Research and development needs to be continued to support highly efficient primary agricultural production – both for livestock and for the crops/vegetables/fruit sectors in Scotland. These are a vital component of Scotland Food and Drink’s Ambition 2030. Research is also needed to underpin many aspects of the Good Food Nation’s Strategic Plan, especially sustainable agriculture and food quality and safety.

Research on infectious diseases of livestock should focus on reducing waste in primary production. This means producing food with optimal use of natural resources and minimum waste. This will allow targets for reduction of greenhouse gas emissions from livestock in Scotland to be met whilst also providing innovative products – vaccines, diagnostic tests and disease control programmes that can be used internationally thus alleviating climate change impact globally. MRI has produced many of the vaccines currently available for livestock species, especially cattle and sheep. These have reduced the use of anti-microbial drugs in food producing species. Work needs to continue to produce practical outputs that will reduce or prevent current and emerging diseases.

Specifically what is the estimated impact of withdrawal from Europe on the research community and funding available to rural, food and environment research in Scotland?

MRI stands to lose substantial funding which needs to be replaced by other sources of funding. 14% of MRI staff are non-UK EU citizens. These individuals are seen as essential to MRI’s ongoing research within Scotland as they help to make MRI truly internationally competitive. It is important that Scotland leads the way in ensuring support for non-UK EU citizens who are vital to the research, development and commercialisation agenda for Scotland.

What steps do the Scottish Government and research organisations need to take to address those challenges?

In response to a range of new challenges and opportunities SRUC and Moredun are exploring new ways of working and collaborating to deliver:

- game-changing technologies for livestock health, welfare and production in support of Scottish rural development and global food security and safety.
- enhanced primary agricultural production with a focus on grassland and grazing systems in support of Scotland Food and Drink’s Ambition 2030.
- global leadership in the integration of livestock research and development, animal disease surveillance, knowledge exchange, and training to address the grand challenges of sustainable food systems.
- novel approaches to precision agriculture in integrated farming systems with emphasis on upland and hill areas.
- blueprints for sustainable and profitable future farming systems that integrates multi-species, livestock/cropping, agroforestry.
- Protection of human health by reducing reliance on interventions with anti-biotics, pesticides, and reduction in zoonotic infections.
innovative solutions for future farmers, food producers, processors, retailers and landowners. These will include breeding tools, vaccines, diagnostic tests, health planning, farm and ecosystem management strategies. These together will maximise production, minimise waste, and contribute to Scotland’s circular bio-economy.

The proposed strategic alliance will build on the complementary expertise and capacity of both organisations in animal health, welfare, genetics, disease surveillance, nutrition and farming systems. Initially the alliance will create collaborative teams in areas of strength to attract investment from Scottish, UK, EU and global funds. These teams will cross disciplinary boundaries to maximise opportunities to leverage new sources of investment and share facilities, equipment and resources.

More generally, there should be increased dialog between the Scottish Government/RESAS and the Board of Directors running organisations such as The Moredun Group. This will allow debate and decisions to support currently highly successful and innovative business models in research, development and knowledge exchange. The Scottish Government should continue to invest in organisations which have developed and maintained innovative and sustainable business models, such as those of MRI and The Moredun Group, an outstanding example of a successful public/private model in Scotland.

The Moredun Foundation can trace its origins back to 1920 when the Animal Diseases Research Association was founded which was dedicated to the improvement of livestock health and welfare through research and education. The Moredun Foundation was formed on 30 June 1994. The Moredun Foundation is a company limited by guarantee governed by its Memorandum and Articles of Association (as amended) dated 9 September 2004. The liability of members in the event of a winding up is limited to £1. The company is recognised by Her Majesty’s Revenue and Customs as a Scottish Charity, No SC022515 and is registered as a charity with the Scottish Charity Regulator. The Moredun Foundation has three wholly owned trading subsidiaries. Moredun Research Institute (SC149440) carries out research into infectious diseases in livestock, Moredun Scientific Limited (SC107439) carries out development work into vaccines and diagnostics and provides product testing services, Pentlands Science Park Limited (SC148767) is a property management company. Moredun Research Institute has six wholly owned subsidiaries, one of which has a subsidiary registered in Australia.

The Institute, MRI, is closely aligned to the commercial subsidiary companies – Moredun Scientific, a contract research organisation testing livestock vaccines and drugs for European registration, and Pentlands Science Park, one of the very few science parks with a Livestock Health Research Institute at its core. Profits from the commercial companies are transferred by gift-aid to the Moredun Foundation which then, in turn, transfers gift-aid back to MRI to support further research. As such, The Moredun Group is a not-for-profit company/charity. In the financial year 2026-17, MRU benefitted by £1.3 million from these sources, half of which was transferred in cash, while the other half was through contracted services and shared administrative salary support.
The Moredun Group undertook an economic assessment by Biggar Economics in 2015. This indicated a GVA of 9.6 in terms of income leveraged and 5.6 in terms of jobs supported. The greatest proportion of benefit was to Scotland in terms of income leveraged and to Midlothian in particular in terms of jobs. This indicates the benefits of The Moredun Group to Scotland locally, regionally and nationally.