CO-OPERATIVE RESEARCH PROGRAMME FELLOWSHIPS AWARDED FOR 2021

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Theme 1 : Managing Natural Capital for the Future					
Acquisition of Primordial Germ Cell (PGC) technologies to enable secure preservation and reliable utilization of chicken genetic resources Preservation of genetic resources is a very important issue to the sustainable production of food. PGC technologies secure preservation and take much less place, funding, time and effort than the maintenance of the strains of chicken *in vivo*. Applying connection of germ cell collection to a gene bank is very important to maintain biodiversity for chicken production. This fellowship will include training, technology transfer, and tool development resulting in better preservation and utilisation of chicken germplasm to maintain biodiversity via a gene bank programme. Chicken genetic diversity is globally contracting and preservation by national programmes charged with protecting such resources is essential. Furthermore, university populations which are threatened by limited funding, further undermine our national capacity for research. The fellow will work on developing procedural areas to increase the efficacy of PGCs and particularly a gene edited (DDX4-) host, a methodology developed at the host institute.	USA	USDA-ARS	United Kingdom	The Roslin Institute at the University of Edinburgh	9
Design principles for improved innovation and knowledge systems for forests and natural resource management in a changing climate The aim of this study is to examine the design of different innovation system approaches and assess their impact on research outputs, decision-making, and the relationships between researchers and decision makers. There has been considerable discussion about the appropriate means for providing and managing knowledge to inform forest and natural resource management. Researchers have pointed to the need for different modes of research and new types of organisation that can better support and present scientific information for decision makers. The imperatives for new modes of science and knowledge management are driven strongly by a changing climate, with forest and natural resource managers facing future conditions that will be markedly different. The focus of the proposed research is novel and will provide valuable evidence and information to support policy makers in promoting the sustainable use of natural resources. The proposal also aims at facilitating international co-operation among research scientists and institutions as well as strengthening the connection between scientific knowledge and innovation. The results of the proposed research will help the ongoing efforts of governments and other institutions to collectively improve the equity, sustainability and efficiency of sustainable natural resource management under increasing uncertainty	Canada	McGill University	Australia	The University of Melbourne	16

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through systemic innovation processes that can enhance resilience and adaptive capacity.					
Determining the relationship among soil health, soil microbial community functions, and tomato plant stress in organic and conventional agroecosystems Soils are one of our most valuable resources and are fundamental natural capitals at the basis of all trophic chains. In agricultural systems, management practices that ensure high production often have negative repercussions on soil health, quality and fertility. To ensure the long-term sustainability of cropping systems, both the status of soil microorganisms and crops need to be taken into account. In this study, specific biological indicators of soil health will be combined with the soil physicochemical parameters. The core assumption of the proposed research is that healthy soils provide an optimal environment for soil microorganisms that, in turn, stimulates plant physiological and biochemical responses to stress. Microbial and plant stress indicators will be studied in a long-term experiment on tomato that includes two agricultural systems (organic and conventional). The project results will facilitate the inclusion of soil health, quality and fertility in management decisions made by farmers, land managers, and crop advisers working in tomato production chain.	Italy	University of Basilicata	United States	University of California - Davis	26
Evidence-based policy and husbandry interventions for protecting livestock and biodiversity The fellow and host propose a new collaboration for research and training workshops for Lower Saxony's livestock owners and government agencies responsible for the agri-environment sector. The goals are conservation of native wolves and protection of livestock and farm livelihoods. An OECD fellowship would support any participatory, field experiment designed as a randomized, controlled trial of a non-lethal method of predator control in grazing areas. Two workshops on lessons learned from recent, systematic reviews of global predator control science and on implementation hurdles are planned with phase 1 results, and the reversal of treatment or cross-over in phase 2. Strong inference is vital given the many controversies about carnivore protections mandated by EU policy.	USA	University of Wisconsin–Madison	Germany	Alfred Toepfer Academy for Nature Conservation	6

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Global virtual water trade: unravelling complexity in the international food-water nexus The goal of this research project is to investigate how much water could be saved by adapting water saving strategies worldwide. It will investigate the sustainability of the amount of water embedded in global economic production and trade. The project will focus on the entire global supply chain, with the objectives of: identifying which countries and sectors are the most water-intensive; calculating the sensitivity of the water demand to temperature and precipitation patterns in order to extrapolate the impact of future climate conditions on worldwide production and trade and comparing these figures with the reduction in global trade and water use due to COVID-19; suggesting several water-saving scenarios and identifies the most efficient one for each country. These results should help define strategies to adapt to climate change, population growth and food security risk.	USA	University of Illinois at Urbana-Champaign	Spain	University of Zaragoza	26
Managing semi-natural habitats for sustainable agricultural production in France - lessons from Sweden This research project will be important for implementing and managing biodiversity in agricultural systems across Europe. It aims to draw attention to social, ecological and economic constraints within sustainable agriculture production through the well-studied and effective farmland biodiversity initiative of grassy and flowering strips. The correct management of grassy and flowering strips improves pollination and insect diversity. This research project will not only promote grassy and flowering strips in mainstream agriculture management, but it will also explore their limitations. The perspectives and practices of Swedish and French farmers obtained from this research will give an insight into how policies should be implemented in order to progress sustainable agriculture initiatives.	Canada	Centre national de la recherche scientifique	Sweden	Swedish University of Agricultural Sciences	10

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
New approaches to improving food security in a post-COVID world This research proposes using the four pillars of food security as a framework to examine the impacts of COVID-19 on the current food supply system, using the fisheries and aquaculture sectors as a pilot. The research will evaluate alternative approaches that would improve future food security, making it more resilient to future shocks, and will conclude with policy recommendations to support this alternative. All four pillars of food security: availability, access, utilisation and stability, have been shaken by COVID-19, exposing the cracks in our current food supply system. Given the multitude of long-term threats to food security, COVID-19 presents an opportunity to examine an alternative model that can accommodate future shocks and build more resilient systems. Restructuring food production and trade to focus on resilience and wellbeing rather than efficiency and economic growth will be necessary to achieve future food security. The challenge of improving food security post-COVID is not to implement less of the same, but to examine egalitarian alternatives where appropriation, extraction, production, distribution, consumption and waste are organised differently. This proposed research lies at the dissecting line between economic policy linked to natural resource use and food security. The methodology is based on a mixed methods approach to answer the following three research questions: i) how has global food security been impacted by COVID-19? ii) What are the important elements of a post-COVID system that will contribute to improved food security? iii) What is required to support this alternative?	United Kingdom	Heriot-Watt University	United States	University of Washington	8

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Theme 2: Managing Risks in a Connected World					
Biological control of invasive pests: implications for biodiversity and ecological stability This research project plans a risk-benefit analysis of the ecological role of the vedalia beetle in the control of the invasive cottony cushion scale in Catania. The results will be used to identify and contextualise the indirect benefits of a biological control introduction and thus aid the process of risk-benefit analysis that lies at the core of biological control decision-making and policy. The deliberate release of living organisms to control invasive pests and weeds – biological control – has led to the control of hundreds of pest and weed species in dozens of countries over the past century. As a prime example, biological control of an insect pest called the cottony cushion scale by the Australian vedalia beetle (*Rodolia cardinalis*) saved citrus industries in many countries from ruin. However, this insect is not only a citrus pest, but feeds on numerous other plants as well, including many endemics species. The project will research whether the vedalia beetle protects these plants from cottony cushion scale as well, thus providing a benefit to native biodiversity on top of its benefit to agriculture. Sicily is an ideal place to test this hypothesis because the vedalia beetle has been controlling cottony cushion scale there for over 100 years.	USA	University of Minnesota	Italy	University of Catania	12
Incorporating disease intensity and pathogen genetics in network analysis of long-distance dispersal and spread of plant disease epidemics This research project will look at the long-distance pathogen dispersal in plants with an ultimate aim of minimising risks from invasive species. Pathogen dispersal is key in development of plant disease epidemics at different spatial scales, ranging from a field to the landscape level. Currently, inferred networks are used to determine the risk of transmission and disease spread for aerially dispersed pathogens. However, these network models do not account for either disease intensity or strains of the pathogen at the source. The fellow and his host propose an analytical framework to account for disease incidence and severity using a probability of infection at a node. They will also construct bipartite networks of host and pathogen strains where separate nodes from hosts are connected with nodes of pathogen strains to generate a unipartite network. This modelling approach should provide a general framework to better assess the risk of long-distance spread of invasive species in agricultural and forest systems. Few models attempt to model dispersal at multiple scales that result from multiple sources of aerial inoculum (e.g. mildews and rusts). Predicting the risk associated with such long-distance pathogen dispersal is the first step to develop and implement measures to minimise the risk.	USA	North Carolina State University	United Kingdom	NIAB East Malling Research	26

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
New approach methods to assess risks of nanomaterials in the food supply chain Engineered nanomaterials are being widely utilised across food systems (for example, as nanopesticides and pigments in food) though the toxic risks and environmental implications associated with the use of these chemicals is not known. Further, traditional assessments do not consider functional performance and economic costs alongside toxicity. The goal of this research project is to bring together a group of diverse scholars and stakeholders to enable dialogue and networking so that more comprehensive and holistic, as well as predictive and precautionary, approaches in the identification and evaluation of potentially hazardous chemicals in our food systems can be realised. The activities will centre on a case study in which the alternatives assessment framework is adapted for use in studying chemicals in food systems. The results will be presented to regulatory bodies in Canada, Australia (the countries of the research fellow and host), and internationally. The resulting framework will be designed so that it can be fit for purpose in a range of food and agricultural settings to allow quick and tangible chemical assessments that compare and contrast risks and benefits spanning human health, environmental, economic, and social considerations, while also identifying safer options.	Canada	McGill University	Australia	The University of Sydney	16
Rethinking resilient agriculture: from climate-smart agriculture to climate-functional farming Climate change is having real effects on farming systems in dry jurisdictions and the impacts cannot be fully predicted. It also has a big influence on livelihoods, especially the livelihoods that are mostly natural resource oriented. It is believed that Climate Smart Agriculture (CSA) has the potential to be resilient to climate change. This project uses social science to understand farmers' willingness to adapt. The project will look at the triple challenge of: i) ensuring food security, ii) adapting to the critical incidents caused by climate change and/or farming activities, and iii) contributing to climate change mitigation but also explicitly focusing on farm, farmers and their livelihoods. Starting from the assumption that CSA objectives are rarely met and the whole farming system still remains highly vulnerable, this research study will look at Climate-Functional Farming (CFF), which not only addresses food security and climate change, but also explicitly focuses on farm, farmers and their livelihoods. Therefore, the main aim of this study is to understand whether and why rethinking resilient agriculture from CSA to CFF is needed and "how" CFF should be practised.	Belgium	Ghent University	United States	University of California, Santa Barbara	26

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Manuscript: Azadi H. et al. (2021), Rethinking resilient agriculture: From climate smart agriculture to vulnerable-smart agriculture, Journal of Cleaner Production, 319, 128602 (IF: 11.072); https://doi.org/10.1016/j.jclepro.2021.128602					
Wildland fire management during COVID-19 The coincidence of COVID-19 and the 2020 wildland fire season created significant challenges for effective wildland fire management across the globe. At the same time, in response to climatic changes, wildfires across the world are becoming more frequent, intense, and are lasting longer durations. In March of 2020, the United States and northwestern Europe began preparing for the complexities involved in managing the wildland fire season under COVID-19. Research studies were undertaken at the institutes of the CRP research fellow and host on challenges and risk mitigations for managing wildland fire during a global pandemic. This CRP research fellowship will combine these studies to create the most robust data set on wildland fire management during COVID-19. In 2020, the pandemic had significant implications for wildland fire risk management due to strict restrictions of physical distancing and hygiene requirements, and fire management procedures, standards, and approaches were adapted to reduce the risk of spreading the virus. By combining the evidence from the two studies already undertaken, the researchers will be able to assess the efficacy of prescribed wildfire management risk mitigation strategies during COVID-19, with the aim of improving the wildland fire management community's capacity to adapt. The results will help inform official policy and guidance which are fundamental to informing how wildland fire management is practiced on the landscape. The increasing frequency and complexity of mega-fires due to climate change, years of fire suppression, urbanization in forested land, and, now, managing fire under COVID-19, requires a complete rethinking of existing policy and guidance.	USA	USDA Forest Service	Netherlands	Wageningen University & Research	20

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Theme 3: Transformational Technologies and Innovation					
A framework for integrating forest foods and medicines into a bioeconomy Global efforts to understand how forest food, medicines and other possible products can be integrated into bio-economy are increasing. This fellowship provides the opportunity to capitalise on various initiatives and to clarify pathways for further transitioning. The aim of the study is to develop a framework for integrating forests foods and medicines into the concept of a bioeconomy. Food and medicine foraged from forests support the livelihoods, food security and nutritional needs of billions of people, and provide raw materials for a multi-billion dollar industry, yet they are seldom included in forest resource policies and management. The bioeconomy concept is emerging as a critical strategic economic movement in this century. Global efforts to understand how forest food, medicines and other non-timber products can be integrated into bioeconomies are increasing, and this fellowship provides an opportunity to bring these together into a framework to support future efforts. The approach and methods will develop knowledge needed to support research and policies relative to these products and the bioeconomy.	USA	USDA Forest Service	Denmark	University of Copenhagen, Department of Food and Resource Economics	6
Curcumin-nanospheres as a feed additive to improve the pig's growth performances and health This research project will investigate enhancing the biological and pharmacological properties of curcumin to overcome its drawbacks by efficient delivery systems, particularly nanoencapsulation. The researchers aim to develop a nanomaterial, curcumin nanospheres, which will increase the biological and pharmacological properties. They will also evaluate the cytotoxicity and bioavailability of curcumin nanospheres, for their use particularly in pig farming to improve the quality of animal nutrition, important for animal health, reducing antimicrobial use, increasing livestock production and therefore farmers' income. Pig farming can be seen globally under diverse management and environmental conditions. Due to a higher demand for pork meat, the pig industry is becoming an attractive activity in order to diversify agricultural production. However, several factors including reduced growth performance and various diseases can compromise productivity, profitability, and affect meat quality. Thus, suitable management and quality nutrition are required to keep their reproductive competence in order to favour animal growth and to reduce mortality rates. Recently, plant-derived antioxidants	India	Jeju National University, Korea	United States	Massachusetts General Hospital and Harvard Medical School	6

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were widely used as feed additives to enhance body function and alleviate stress damage. Curcumin, a plant-derived substance, with the effect of scavenging oxidative free radicals due to its phenolic structure, can be used as an antioxidant in a daily dietary supplement. Diet curcumin improves performance and enhances antioxidants and the immune system of animals. However, curcumin's low water solubility, poor bioavailability, and rapid metabolism reduced its efficacy as well as restricted the applications.					
Development of high-quality forage sorghum for a sustainable and climate-resilient future livestock industry The aim of this collaborative project is to develop the next-generation forage sorghum crop for livestock. The researchers will look into increasing the energy density of sorghum biomass by elevating the lipid content while improving the lignin composition to optimise digestibility. To this end, the Fellow and host will bring together complementary skills in lignin and lipid metabolic engineering, respectively, and combine their experience with sorghum. Developed high quality forage will contribute to more efficient livestock production through higher feed conversion efficiency, improved live-weight gains, and reduced water requirement. There is also the expectation that the high lipid content of sorghum will decrease the environmental impacts of livestock production through a reduction of enteric methane production.	Australia	CSIRO	United States	Oklahoma State University	16

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Genetically engineering *Toxoplasma gondii* as a novel vaccine delivery system This research project will evaluate the potential of *Toxoplasma gondii* – the parasite that causes toxoplasmosis – as a novel vaccine delivery system. Advances in molecular genetics have enabled the possibility of creating stains of *T. gondii* that will not persist in the host and that can also be used to express foreign antigens of other pathogens. The research project will create and test this system to determine whether *T. gondii* could be an effective vaccine delivery platform. This will lead to the development of a game-changing multivalent, customisable and self-adjuvanting veterinary vaccine system that induces cell mediated and humoral immune responses against specific antigen targets. The researchers will use CRISPR-Cas9 gene editing technology to generate a modified strain that is unable to persist within the host that can be developed into a broad spectrum, highly adaptable, self-adjuvanting vaccine delivery system. The prevention of infectious diseases with improved vaccines is of huge, and efficient use of better vaccines will prevent economic losses, benefit livestock welfare and also can reduce antimicrobial usage.	United Kingdom	Moredun Research Institute	Italy	Università degli Studi di Perugia	12
How do maternal reproductive biofluids affect the epigenome of developing embryos? Assisted reproductive procedures are increasingly being incorporated into livestock breeding programs and the CRISPR/Cas9 genome editing technology promises to further accelerate improvements in production traits. There are still significant concerns regarding the impacts of these techniques on early embryos, with evidence indicating they cause aberrant gene expression and abnormal epigenetic reprogramming, an essential developmental process involving DNA methylation. Using a porcine embryo in vitro production system, this project will examine the effects that in vitro conditions and CRISPR/Cas9 manipulations have on early embryo development and DNA methylation levels. We hypothesize that supplementing the system with reproductive biofluids to more closely mimic the sow's natural maternal tract environment will reduce the detrimental effects of the in vitro conditions on epigenetic reprogramming.	Australia	The University of Sydney	Spain	The University of Murcia	19

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Proposed Studies	Research Fellow's Nationality	Home Institution	Destination Country	Host Laboratory	Duration of Fellowship (weeks)
Merging engineering and plant breeding: Bendable electronics and sensing technologies to improve plant productivity This fellowship will be a study on techniques for pH sensing in plants, in relation to oxalic acid production by the plant pathogenic fungus *Sclerotina sclerotiorum*. *Sclerotinia sclerotiorum* is the pathogen responsible for white mould in 408 different plant species including the common bean. This necrotrophic fungus causes extensive crop damage and yield loss each year. It is estimated that dry bean yield losses as a result of white mould in North Dakota alone have been up to MUSD 1.9. Oxalic acid is associated with increased pathogenicity during infection of the common bean, coinciding with a reduction of the pH in the plant tissue and suppression of production of reactive oxygen intermediates, which are involved in plant defence against pathogens. The host laboratory has developed a potentiometric sensor that will be used to monitor pH. Using bendable electronics to monitor pH changes due to infection in host plants would enable increased resolution on host plant resistance that will widen the applicability of this principle. The approach has the potential to improve efficiency and speed of plant breeding towards disease resistance, and could also be used as a tool for early warning of plant disease in field conditions with the impact in reducing the use of plant pesticides.	Colombia	McGill University, Canada	United Kingdom	University of Glasgow	12