Cooperative Research Programme: Sustainable Agricultural and Food Systems

Fellowship Summary Report

Name: Associate Professor Bradley Case

Title: Spatial modelling of nature-based solutions (NBS) in agricultural landscapes to enhance socio-ecological outcomes

Host Institution: Carleton University, Canada

Dates: 17 October 2022 to 12 December 2022

Consent: I consent to having this report posted on the CRP website

1. What were the objectives of the research project? Why is the research project important?

This research project aimed to develop a spatial modelling framework within which nature-based solutions (NbS) scenarios could be evaluated. Specifically, the objectives were: (1) to develop GIS-based approaches for modelling the impacts of typical (realistic) farm-scale NbS activities on possible landscape-scale socio-economic and ecological outcomes; (2) to evaluate these NbS scenarios in terms of the types of activities (e.g. restoration planting) and locations and spatial arrangements that provide the greatest synergistic benefits; and (2) to compare modelling results from the two countries to understand to what extent NBS approaches can be generalised in different agricultural contexts.

2. Were the objectives achieved?

Yes, the objectives were achieved in general. I had already created a draft working GIS simulation model to address the aim of the project and implement basic woody vegetation revegetation scenarios in New Zealand agricultural landscapes before I arrived in Canada. I was able to progress this model further during the fellowship time and to generate results for several agroecosystem case study areas in the New Zealand context that showed that the model was producing reasonable simulations outcomes. However, I was unable to implement the model for a Canadian case study area as it was not easy to obtain the necessary data and carry out the modelling in the short timeframe of the fellowship.

3. What were the major achievements of the fellowship?

The main achievement was the development of a working GIS-based simulation model for evaluating NbS restoration scenarios and their impacts in terms of carbon quantities, biodiversity indicators, and wildlife habitat for three New Zealand agroecosystems areas. This model was developed in the ArcGIS Pro software using a Python-based modelling environment. We, with one of my PhD student's help, have written a draft manuscript that describes the model and a set of simulation outputs from the model for the NZ landscapes. The aim will be to publish this manuscript sometime later in 2023.

4. Will the be any follow-up work?

The follow up work will mainly comprise further development of the model such that other, more complex, NbS scenarios could be simulated and tested.

5. How might the results be important for developing policies and or practices for society?

This type of NbS spatial modelling is extremely important for filling in gaps in our knowledge of how to best spatially plan agricultural landscapes to meet both production needs and environmental goals

(carbon, biodiversity, habitat, water quality, erosion) within a changing climate. The modelling carried out in this project feeds directly into my broader research in New Zealand that is connected with development of practices and policies related to the repurposing of agricultural landscape for multifunctional benefits and adaptation to climate change. The modelling framework enables the testing of a variety of real-world scenarios that are of interest to land managers in NZ.

6. How was the research relevant to the objectives and research theme of the CRP?

This type of Nature-based Solutions modelling work in New Zealand agroecosystems aligns directly with the "Managing Natural Capital for the Future" theme that formed the basis of my original proposal. The modelling work is directly underpinned by landscape ecology and management principles and the importance of these for evaluating how to best integrate multifunctionality into disturbed and intensively managed production lands. The outcomes from the modelling provide insights into how landscape configuration of existing agricultural production and vegetated areas, and less productive zones such as steep gully areas, can be used as a template for designing restoration interventions that can lead to better future outcomes for multifunctional objectives.

7. Personal experience and thoughts from the fellowship

On the whole, the fellowship was a useful and productive experience. It was useful to have time to focus on this work and to benefit from interaction with researchers in a different country and with different perspectives. Practically, my host and host department were still not "back on board" after the effects of Covid-19, and many staff and students were still working from home for a large part of the week. Thus, that part of the experience was not as interactive as what I had anticipated. This fellowship has been useful for my career progression as it increases my exposure internationally and my esteem within my institution.