Climate Change Adaptation Research Grants Program
- Primary Industries Projects

Project title:
EverFarm® - Design of climate adapted perennial-based farming systems for dryland agriculture in southern Australia.

Principal investigators: Dr Amir Abadi
Lead organisation: Future Farm Industries CRC (FFI CRC)

Objectives:
Evaluate whether and the extent to which the use of perennial plant technologies can improve the capacity for dryland agricultural systems to adapt to climate change. This will be done by modelling the impacts of currently achievable innovation and testing their economic feasibility for large scale adoption under predicted future climate scenarios.

Project design and methods:
Objective: To evaluate the extent to which dryland agriculture incorporating new perennial plant technologies and farming systems can adapt to climate change by modelling currently achievable innovation and its economic feasibility for large scale adoption under predicted future climate scenarios for southern Australia. The project will build on the bio-economic modelling and risk analysis capability of the FFI CRC, and its partners to test the capacity of alternative novel perennial based farming systems to provide climate resilience to the southern Australian agricultural sector.

Our Null Hypothesis is that under predicted climate change, incorporating a higher proportion of the farm into perennials results in similar profitability and is no less variable in net revenues than existing systems, which assesses the alternative hypothesis (H1) that incorporating a higher proportion of perennials into farming systems will increase profitability and decrease the variability in farm incomes.

EverFarm® will differentiate the biological and economic impacts of adapting to climate change across four key regions broadly representative of conditions across southern Australia. This recognises that there are important regional and industry balance aspects to adapting to climate change and that adaptive responses will be regionally specific. In recognition of the strong regional climatic, edaphic and infrastructure differences across Australia, the FFI CRC has calibrated its bio-economic models for regional application, and can support them with its region-specific technical data.

The design has two sites in south-eastern Australia and two in south-western Australia. These locations have been selected as they are applicable to large areas of southern Australia. The bioeconomic models and data to drive the models are available in these selected regions. The additional modelling to assess the capacity of systems that incorporate perennials to adapt to climate change will rely on the use of economic models already available and calibrated for the selected regions by the FFI CRC.

The project will test two main effects: The impact of climate change (current climate vs. predicted future climate) and the effect of additional perennials in farming systems (annual based farming system vs. farming system with additional perennials). This will be done by modelling three scenarios in each of the selected regions. The first two scenarios are essentially base cases against which the effectiveness of new perennial system will be assessed; all scenarios will be forward looking. The selection of the climate scenarios (magnitude and timing of change) in the selected regions will be determined in consultation with climate scientists who have knowledge of the regions (see Section se 4) and will be of sufficient magnitude to test the resilience of the farming systems. The use of downscaled data will provide the capacity to examine the impact of changes in both the predicted magnitude and variability of climate.

Scenarios to be used in each region to test the impact of novel perennials on the adaptive capacity of agricultural systems are:

1. Current climate and perennial based farming systems (Control for base climatic conditions)
2. Predicted climate and annual farming systems (Control for base annual farming system)
3. Predicted climate and perennial based farming systems (New farming system and new climate)

FFI CRC has access to whole-farm and paddock-level bio-economic models (including MIDAS and IMAGINE) to examine the impact of changes in farming systems on farm profitability. These models will use the outputs from plant growth models like APSIM and 3PG2 (based at CSIRO) which simulate growth and yield of annual and perennial crops and pastures from agro-climatic and physiological parameters.

The inputs to the economic models (system productivity) will be estimated using outputs from the plant growth models based on predicted climate scenarios. The bio-economic models will be used to assess land use sequences under variable conditions and evaluate the profitability of alternative farming systems under different climatic scenarios.

To assess these scenarios the project will have two parts:

1. Preparation of technical (biological) specifications for the novel perennial plant technologies, matched to key regional settings so they can transform the nature and productivity of dryland agricultural systems; and prediction of the productivity for the integrated systems to be used in the economic analyses for the range of selected climate scenarios. The productivity predictions will be based on climate data downscaled from GCM's.
2. Economic analysis to simulate and optimise the performance of farms that utilize the new perennial and existing annual crop/pasture components. It will also include an assessment of risk associated with each farming system. This will define the likely scale of application and critical constraints for each key technology defined by region.

In the first stage of the project the technical options for climate change adaptation will be defined. Experts from each of the EverFarm component technologies (New Woody Crops, EverGraze, Enrich and EverCrop) will specify the extent to which key elements of their technologies are capable of accommodating climate change risk and farm managers will be consulted to ensure that the analyses are realistic and applicable. The EverFarm technologies are:

- New Woody crops, the use of integrated mallee eucalypts in farming systems to produce biomass and provide environmental benefits through the control of groundwater recharge and the direct benefit from trees in the landscape
- EverGraze®, a high performance grazing system based on perennial pasture plants, including new cultivars that are more drought tolerant than the existing suite
- Enrich, an initiative based on screening Australian native and introduced fodder shrubs for their production and persistence. Potentially they could be the basis of new grazing enterprises in areas where cropping profitability is in decline, due to a drying climate
- EverCrop®, the use of perennial plants in the non-crop phase of cereal production systems, aimed at producing benefits in terms of better soil and water management and drought resilience, lower cost organic nitrogen delivery and weed and disease control

This information will then be used to assemble conceptual designs of whole farm systems demonstrating how singly and in combination these new technologies will transform the capacity of dryland agriculture to adapt to climate change, while also maintaining farm viability.

In the second stage of the project economic analysis will be used to assess the benefits in projected long term performance of the transformed systems under predicted climate change scenarios.