Embracing Uncertainty in Complex Systems – Assessing Alternatives to Face Climate Change Impacts in Mediterranean Climate Orchards

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Abstract

Subtropical areas such as the major fruit production zone of Chile are among the most vulnerable environments to climate change. Increasing frequencies of unusual weather events, e.g. excessive rainfall or hail and frost episodes, during the growing season can cause severe fruit losses. This can threaten the viability of farm. and have implications for local and global food security. When deciding on which strategies to adopt in the face of these climatic events farmers are faced with major uncertainties about costs, benefits and risks. They find it difficult to predict the outcomes of implementing new management practices and technologies. Decision Analysis approaches offer methods that can embrace uncertainty and offer forecasts to support such complex decisions. We applied these tools for interventions to protect sweet cherry orchards in two production systems (i.e. orchards with and without covers) under two climatic conditions (i.e. northern-central and southern Chile). We gathered experts to help us build a causal impact pathway model which we implemented as a Monte Carlo simulation to estimate the Net Present Value (NPV). The model was parameterised with inputs provided by the experts. We computed the Expected Value of Perfect Information (EVPI) for each variable to determine where more information might be helpful in choosing the best management option. Our model suggests no major differences for decision options in northern-central Chile, whereas in southern Chile use of the covers increases the probability of achieving positive NPV outcomes. Across sites, EVPI analysis revealed that additional information on market price and yield could improve the decision support offered by model. Our model suggests that orchards in northern-central Chile are more likely to obtain positive outcomes in the long term, independent of the cover system. Farmers in the south risk major losses when growing sweet cherries without protection. We expect this work to inspire farmers in complex agricultural systems to adopt Decision Analysis approaches for choosing between climate change adaptation strategies.

Keywords: Cover systems, decision analysis, fruit cracking, orchard protection, pre-harvest rain, spring frost risk

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