Quantifying damages from wildfires: A case study in Crete

[1]Haleema Misal, [2] Dr. Ionnis Kountouris, [3] Professor. Apostolos Voulgarakis

[1]Centre for Environmental Policy; [2] Leverhulme centre for wildfires, society and the environment, [3] Technical University Crete

1. Introduction

Crete is the largest and most populous island in Greece, spanning around 833,600 hectares. It has a unique heterogeneous landscape shaped by anthropogenic and natural processes over time resulting in a rich biodiversity with many endemic species (Siebert, 2004). The Island of Crete experiences many wildfires due to its fire-prone climate and the prevalence of human-caused fires. Global models suggest that wildfires in Crete will become more frequent and severe in the coming years as the climate changes as illustrated in Figure 1. Human activities including land abandonment, neglect of agriculture and ineffective fire management jeopardise the island's ecological integrity and allow for increasingly unpredictable wildfires.
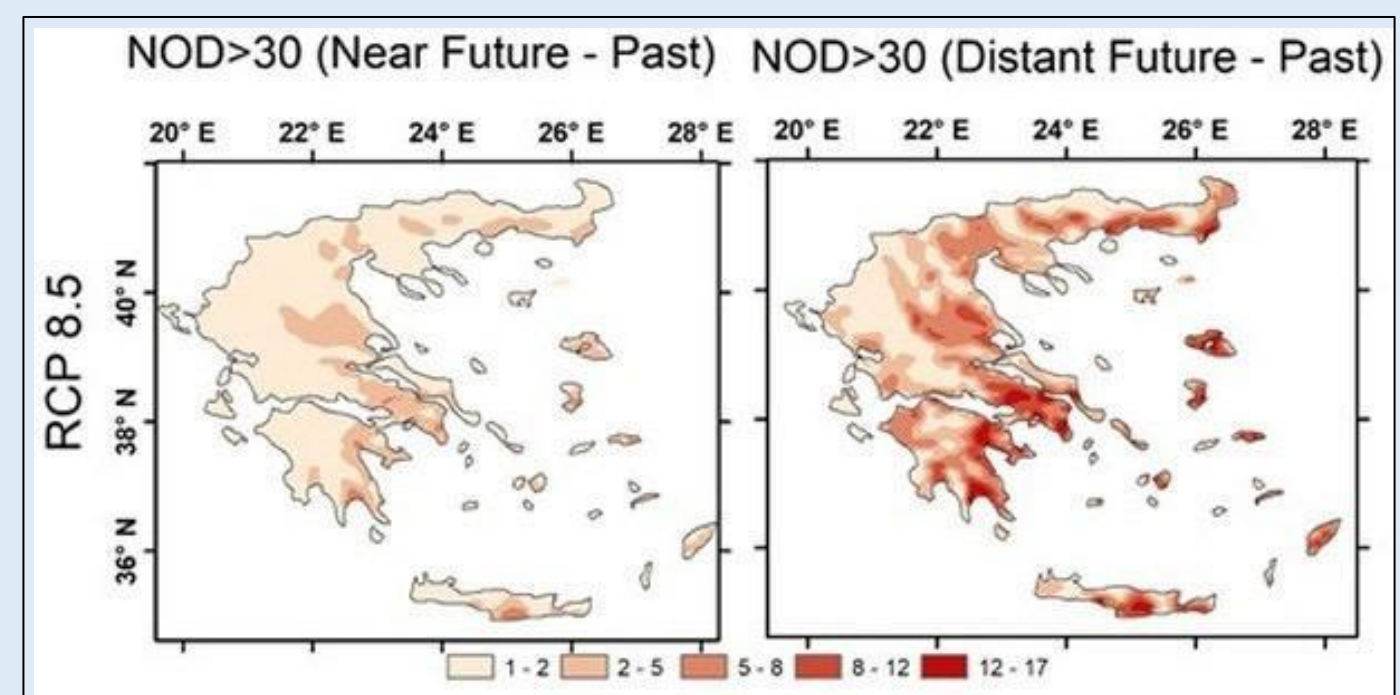

Fig 1: Difference in the annual average number of days (NOD) with FWI>30 between the future periods and the present.

However, to fight and enforce correct practices on the island, it is necessary to have proper metrics and valuation processes to inform policy makers and show in real terms what the cost of wildfires are.

2. Aims and Objectives:

This thesis aims to improve the understanding of the human-wildfire relationship. Specifically, the impacts of wildfires on the wellbeing of rural and urban populations in the Mediterranean. I will develop a conceptual framework for assessing wildfire effects on humans and apply this in a series of case studies. The thesis will:

1. Identify the impacts wildfires have on humans.

   a) Undertake a review of the impacts of wildfires on ecosystem services, recreation, human health, and infrastructure, how these relate to individual's risk perception, and what valuation methods are used to assess them.

2. Contribute to the methodology of assessing wildfire impacts using stated preference valuation methods

   a) Undertake a discrete choice experiment in a rural setting (Crete)

   b) Undertake a choice experiment in an urban setting in another Mediterranean region

3. Produce outputs that allow scientists and policy makers to better understand the relationship between wildfires and society

3. Methodology:

Environmental goods and services are not directly traded in markets, we cannot assign economic value to them, making it difficult to understand the value of goods provided by the environment. We can attempt to quantify the damages from wildfire using non-market valuation. In this case study we use stated preference methods (SP). Common SP methods include the contingent valuation method (CVM) and the discrete choice experiment (DCE). DCE's are based on the random utility model (RUM) by McFadden (1973) which states that individuals make choices that maximises their utility.

a. Discrete choice experiments:

Discrete choice experiments are part of attribute-based **survey** methods under stated preference valuation approaches. The core premise of the method is that environmental goods/services can be broken down into its respective attributes which individuals derive utility from.

The flowchart in Figure 2, adapted from Hanley et al., 2001, illustrates the steps in completing a choice experiment, these methods are particularly useful in supporting policy makers in decision processes as it allows policy makers to create targeted and relevant decisions. Typically, a cost as an attribute will be implemented in the design to indirectly derive the marginal willingness to pay.
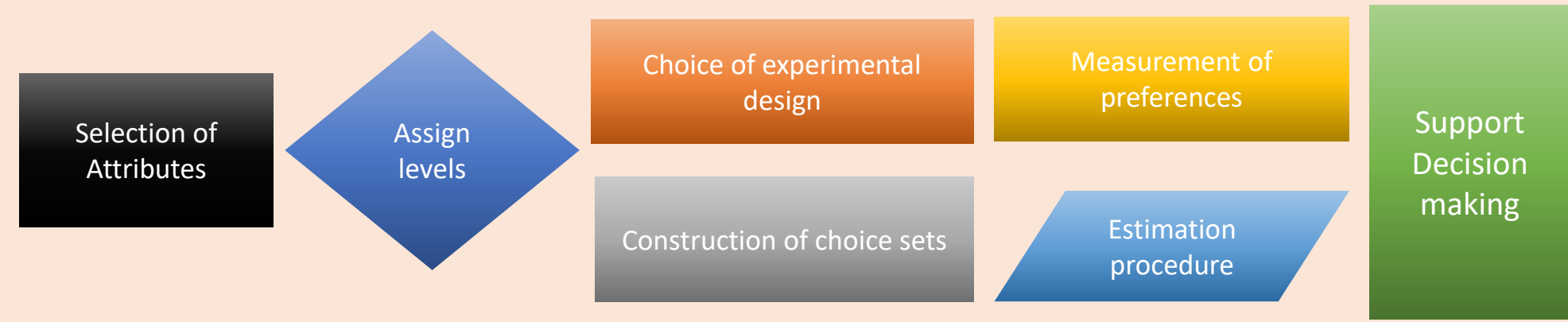

Fig 2: Steps in completing a choice experiment

b. Rationale of chosen attributes

The survey's attributes were chosen following a review of the literature and focused interviews with academics and professionals in Crete and ensure that the survey focuses on the effects of wildfires that are most relevant to Crete specifically.

1. Reduction of fire frequency: Over the past 20 years, on average 623 non-agricultural fires happen every year in Crete (Figure 3). This frequency will be reduced by interventions such as prescribed fires.
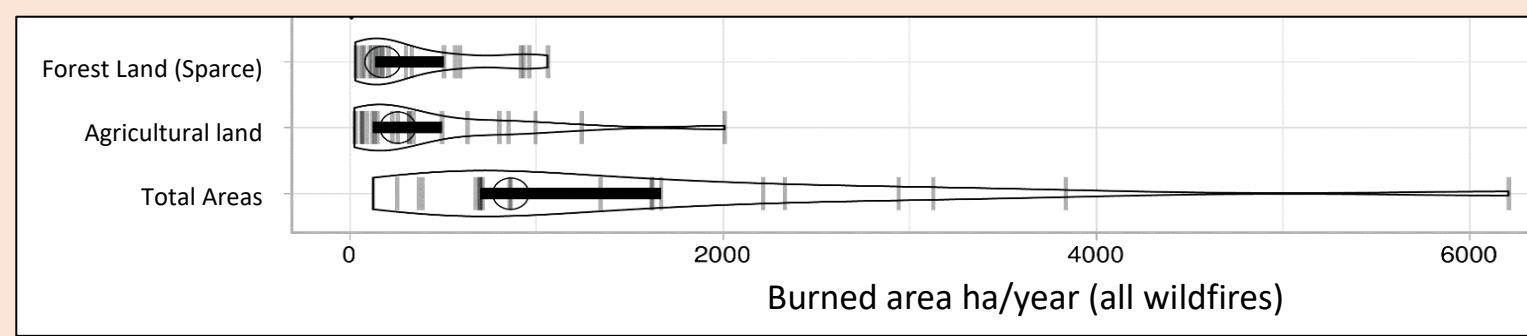

Fig 3: Total burnt area due to wildfire in Crete (2000-2020)

2. Reduction of agricultural fires: The island has a huge agricultural presence with intermixing land mosaics which creates an increased risk of fires (Figure 4, 5).
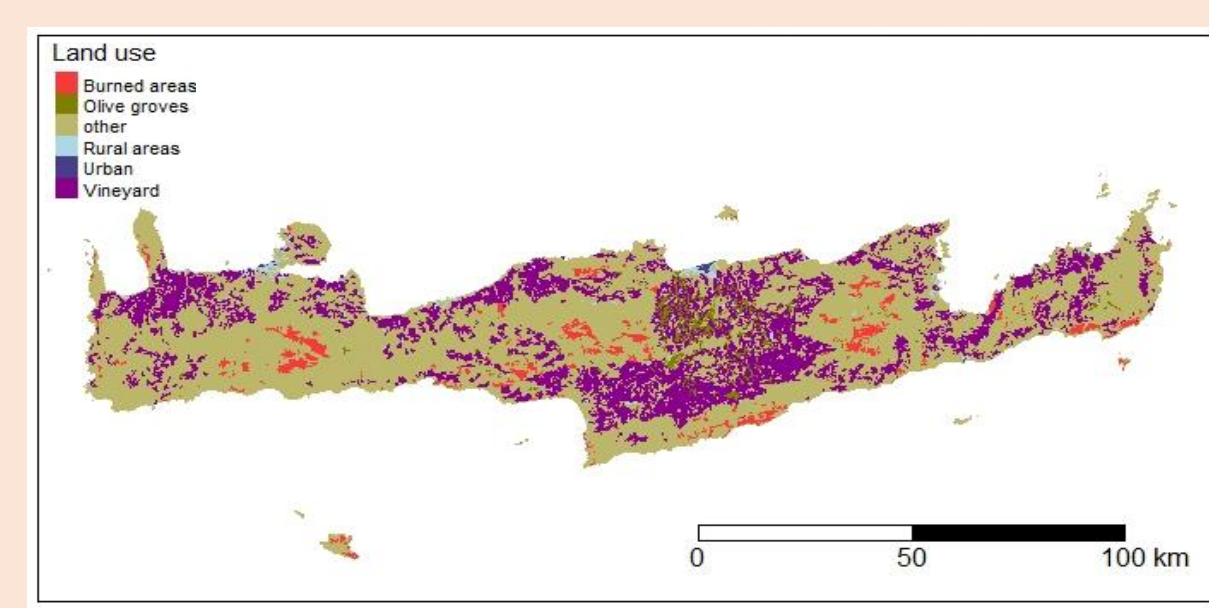

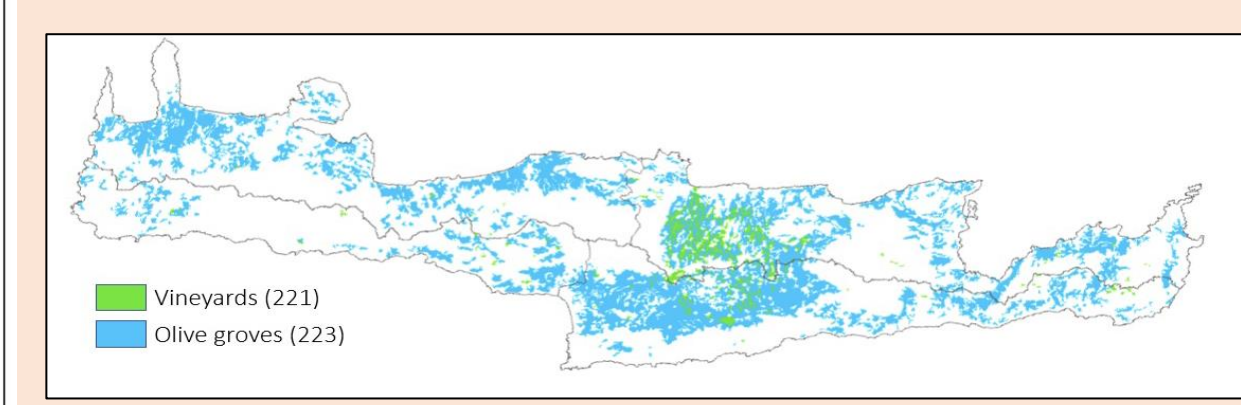Fig 4: Different land cover types in Crete showing intermixing land types with burnt areas superimposed

Fig 5: regions covered by olive groves and vineyards

3. Physical interventions to maintain the traditional landscape quality: Physical interventions include practices such as fire walls and fuel breaks which will be engineered to respect the local landscape.

4. Protection against post-wildfire damages: For example, increased monitoring with the use of drones across the island to detect smoke and prevent fires and dredging of rivers to prevent flooding.

c. Survey

Respondents will be provided with 6 choice cards and asked to choose amongst a set of 3 alternatives (one of which is an opt-out option) (Figure 6). A tax is included as an attribute to indirectly inform willingness to pay for the fire mitigation program.

Fig 6: Public survey

4. Conclusions

This case study aims to understand public preferences for a wildfire mitigation programme in Crete using environmental valuation methods. It will allow a quantification of the damages from wildfires which is an instrumental component of successful policy making.

5. References

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