



# Designing Innovative Crops According to the Needs of Climate Change and Green Deal

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## RESEARCH ARTICLE

### Abstract

Climate change and environmental degradation pose an actual threat to Europe and the rest of the world. Innovative or retrovative crops could be components of alternative redesigned agro-ecosystems, meeting the EU Green Deal targets for reduced use of chemical inputs by 2030. The present study aimed to evaluate: a) the adaptation of production to the stormy effects of climate change, b) the detection of the receptivity of the producers to the application of the design of innovative and retro-innovative crops in the field, and c) the in-depth detection of inhibiting factors (natural resources, economic, social and anthropogenic factors) for producers. A quantitative research was performed using structured interviews (face to face - a set of questions) and open-ended questions. The selected sample was composed of 41 farmers and the study area was the Mani Peninsula, Southern Greece. The statistical processing of the answers showed a significant correlation of change receptivity with age, educational level and the main profession. Younger people, those with higher education and non-mainstream farmers are more receptive to change and switch to innovative crops. The environment, climatic and economic, requires adaptation and change in order to maintain sustainability. Producers are receptive to reforms and shifts to innovative and retro-innovative crops. However, there is a lack of coherent policies in the direction of building infrastructure, solving structural problems, training and transferring know-how, and finally, providing incentives and opportunities by creating and utilizing the appropriate tools.

**Keywords:** Climate change, innovative crops, retro-innovative crops, restrictive factors, sustainability

## INTRODUCTION

Undoubtedly, climate change poses a major threat to agriculture (Engonopoulos et al., 2021). The rising temperatures, frequent droughts, and the degradation of soils forced the European Union (EU) to act. In 2019-2020 the EU Commission presented the European Green Deal (EGD) and the Farm to Fork strategy (F2F), a set of initiatives that amongst others aim to neutralize climate by 2030 (EU Commission, 2019a; EU Commission, 2020). Within their objectives, the EGD and the F2F aspire to reduce the emissions of greenhouse gasses (GHGs), reduce the use of agrochemical inputs, and enhance food security (EU Commission, 2019a; EU Commission, 2020). A promising solution that meets these requirements and benefits both the environment, and man, is the adoption of alternative crops (ACs). An AC is a crop that is introduced into a new area of adaptation and is usually characterized by tolerance to biotic and abiotic stress (e.g. drought tolerance) (Hirich et al., 2020). In Greece, the ministry of agriculture recently


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proposed the provision of subsidies to farmers that are willing to adopt one of seven ACs: Quinoa (*Chenopodium quinoa* Willd.), Teff (*Eragrostis tef* (Zucc.) Trotter), Triticordeum (x *Triticordeum martinii* A. Pujadas), Camelina (*Camelina sativa* L. Crantz), Chia (*Salvia hispanica* L.), Nigella (*Nigella sativa* L.), and Sweet potato (*Ipomoea batatas* L. Lam.). According to a study by Kakabouki et al. (2021), these seven ACs could acclimatized in the Mediterranean Basin and satisfy the goals of EGD.

However, the introduction of ACs and their incorporation to local food systems is a timely task. In a study by Andreotti et al. (2022), the authors stated that once the ACs introduction processes is usually divided in phases. The initial phase is the promotion of the ACs. The literature regarding the attitude of farmers towards ACs in Greece, therefore the progress of the “promotion” phase is next to non-existent. The current study aimed to evaluate: a) the adaptation of farming to the stormy effects of climate change, b) the detection and the receptivity of the farmers to adoption of innovative and retro-innovative crops, and c) the in-depth detection of factors that hinder the adoption of ACs (natural resources, economic, social and anthropogenic factors) by farmers.

## MATERIALS AND METHODS

A series of structured interviews took place in the Mani Peninsula, Southern Greece. In these interviews 41 farmers/participants answered in a survey consisting of 12 questions Table 1. The survey was divided into three sections. On section 1 the participants provided their personal information (age, sex, educational level, and main occupation). Section 2 included questions regarding the agricultural profile of the study area, and Section 3 consisted of questions regarding the adoption of alternative crops. The data gathered from the surveys were subjected to Spearman’s Rank correlation. Cronbach's alpha coefficient was also used to estimate the credibility of the participants answers.

**Table 1.** The questions asked to the participants of the survey, and the section they belong

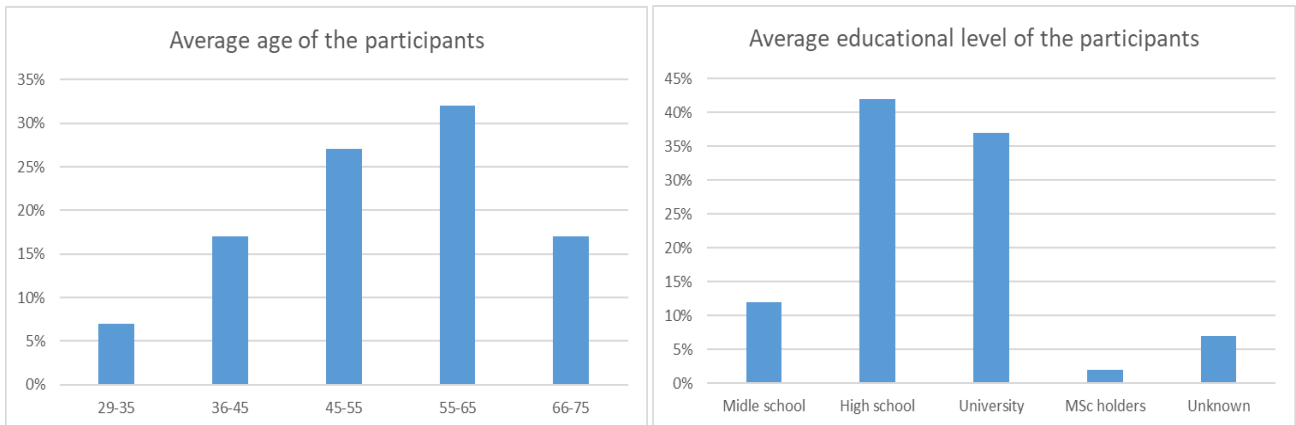
Section	Question No.	Question
1	Personal information	What is your age, sex, educational level, and main occupation?
2	Q1	What is, in your opinion, the major limiting factor to agricultural development in your area?
2	Q2	Would you adopt a new crop?
3	Q3	Would you adopt an alternative crop instead of a traditional one?
3	Q4	If yes, are there any requirements for you to do so?
3	Q5	Had you considered cultivating an alternative crop prior to this questionnaire?
3	Q6	If yes, what led you to this consideration?
3	Q7	Do farmers cultivate any alternative crops in your area?
3	Q8	If yes, are you aware of their income and returns?
3	Q9	Are you familiar with any of the following crops (Aloe Vera, agave, carob, lupin, teff, quinoa, chia, nigella, camelina, tritordeum, flax, black mustard, borage, sweet potato, and hop)?
3	Q10	Would you cultivate any of these crops?
3	Q11	What stops you from doing so?
3	Q12	Are you aware of the Common Agricultural Policy (CAP), the European Green Deal (EGD), and the Farm to Fork (F2F) strategy?

## RESULTS AND DISCUSSIONS

### Section 1

In this section of the study the personal information of the participants facilitated the profiling of the average farmer in the study area. Based on our results, the majority of farmers were over the age of 45 (66%). In particular, 32% of the farmers were 55-65 years of age Figure 1. This finding is in accordance with the EU statistics regarding the average age of farmers within the EU (Eurostat, 2019). Similarly, the overwhelming majority of farmers were male as only 12% of the participants were female. Previous reports regarding the reduction of fertilizers and pesticides within the EU had reported similar findings (United Nations, 2020). Almost half of the farmers that participated in the surveys were high school graduates (42%), while 39% of them have Bachelors’ or Masters’

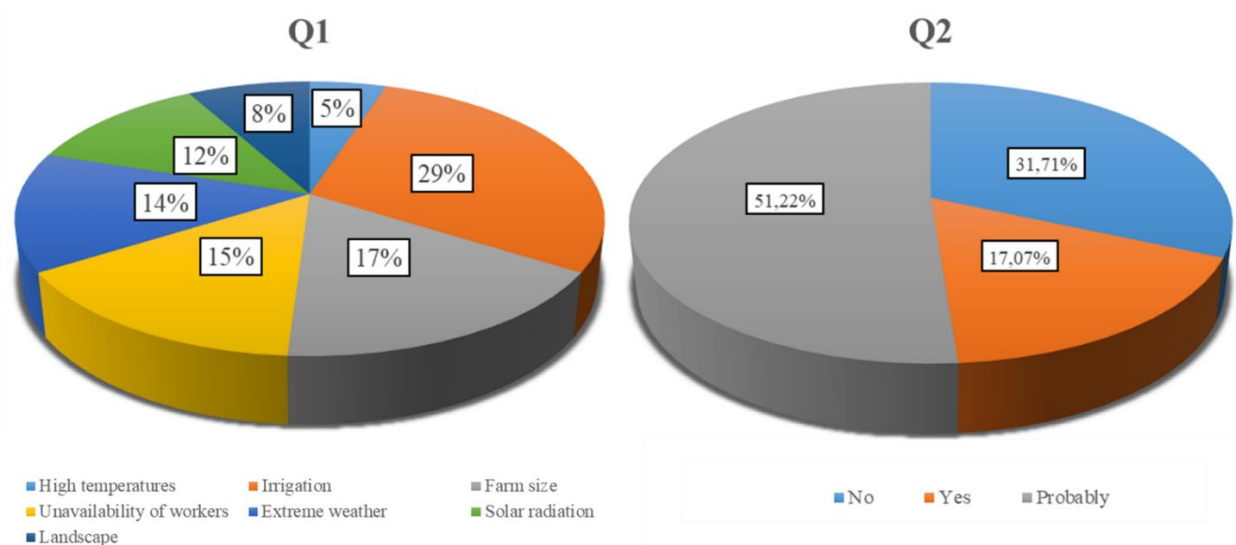
degrees. Lastly, only 41% of the participants stated that their occupation is “farmer”, indicating that most of them have other sources of income and treat farming as a part time preoccupation.



**Figure 1.** Average age and educational level of the participants.

## Section 2

In the second section of the study the responses of the farmers to Q1 and Q2 Figure 2, facilitated the profiling of the study area. Most of the participants consider that the major limiting factor to agricultural development in the study area are the irrigation needs of the crops (29%), followed by the average size of farms (17%), and the unavailability of workers (15%). These answers on the Q1 were partially anticipated. The irrigation needs are closely correlated with water scarcity that has been observed not only in Greece, but throughout the Mediterranean Basin, due to the adverse effects of climate change (Tramblay et al., 2020). Concurrently, the Covid 19 pandemic has reportedly reduced the availability of workers on a farm level (Okolie and Ogundeji, 2022). The answers of the participants validate the literature, as several recent studies highlighted the severity of the shock that the climate change and the Covid 19 pandemic would induce on the agricultural sector (Laborde et al., 2020; Pokhrel et al., 2021). The results of the questionnaires also dictate that farmers acknowledge this shock and are willing to adopt an AC (68% of them), provided that adopting the AC would help them to overcome the aforementioned limiting factors to agricultural development.

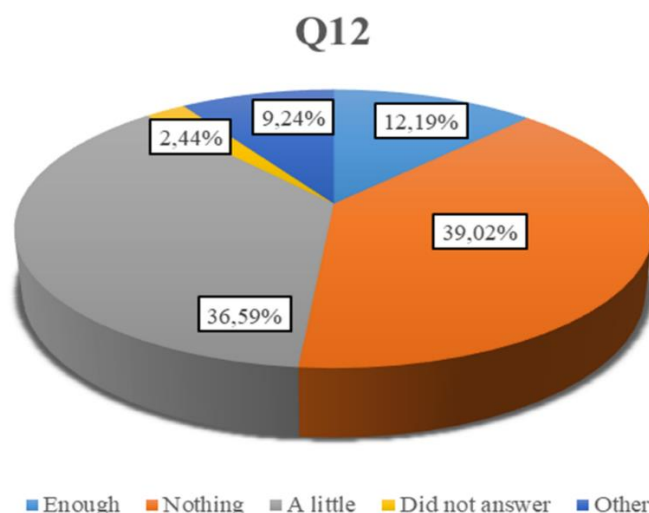


**Figure 2.** Major limiting factors to agricultural development (Q1) and willingness to adopt ACs (Q2) in the study area

### Section 3

The vast majority of farmers (>90%) would consider sifting from traditional to alternative crops only under certain conditions (Q3 & Q5). When asked to name those conditions, the most common answers were the provision of extension services (18.52%), the provision of subsidies (17.28%), and the investments on fitting infrastructures (16.05%) (Q4). It is worth noting that most farmers prioritized the provision of extension services, as literature emphasizes their importance in sustainable agricultural practices (Wuepper et al., 2021). Previous studies have reported that financial motivations (e.g. subsidies) are usually the driving force that shape farmers' attitudes (EIP-AGRI, 2022). Similarly, more than 50% of the participants in the present study stated that they would cultivate an alternative crop if it would return higher profits (Q6), and more than half of them stated that it is uncommon to cultivate alternative crops in their area (Q7) and that they do not know if these crops are profitable (Q8).

Amongst the ACs of Q9, Lupin (18.48%), carob (18.01%), and aloe vera (17.54%) were the three most well-known crops, probably due to the fact that they are considered retrovative crops that have been cultivated in Greece at some point in the past (Batlle, 1997; Abraham et al. (2019; Kaparakou et al. (2021). On the contrary tritordeum (1.42%), camelina (0.95%), and borage (0.95%) were the three least-known crops. Similarly to Q2, 75.61% of the participants would adopt one of the Q9 crops under certain circumstances (Q10). When asked what stops them from cultivating alternative crops, the most common answer (30%) was the "inconsistencies in the value chain of alternative crops" (Q11). Admittedly, when ACs are introduced to a new area of adoption, they are often characterized by poor market presence (Padulosi et al., 2021). Finally, when asked how familiarized they were with the CAP, the EGD, and the F2F, the majority of the farmers had none-to-little knowledge of these strategies (Figure 3). This has also been the case in several studies conducted within the EU regarding the use of pesticides, soil preservation, and the importance of biodiversity (European Commission, 2018; European Commission, 2019b; Schismenos et al., 2022). Based on these observations, perhaps the efforts to raise awareness regarding the "green strategies" of EU are not effective and should be intensified.



**Figure 3.** Levels of farmers' awareness regarding the CAP, EGD, and F2F

#### *Correlation analysis*

The data gathered from the participants were also subjected to Spearman's Rank correlation. The results of the analysis concluded that the gender of the participants did not significantly affect the findings of the survey. On the contrary, the age and the level of education were significant factors. In particular, the participants that were of older age or lower education were less likely to adopt an ACs. This observation verifies the importance of the "Generational Renewal" that has been proposed in many EU initiatives (European Network for Rural Development, 2019).

### CONCLUSIONS

The environmental and economic status quo calls for "adaptation" and "change" in order to maintain agricultural sustainability. Farmers could be receptive to reforms and shifts to innovative and retro-innovative crops. However, there is a lack of coherent policies in the direction of building infrastructure, solving structural problems, training and transferring technical know-how, and finally, providing incentives and opportunities by creating and utilizing the appropriate tools

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### Conflicts of Interest

The authors declare that they do not have any conflict of interest.

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