Carbon footprint of crops cultivated in the Mediterranean region

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Introduction

The Mediterranean countries are considered vulnerable to climate change and are expected to be more severely affected by climate change than the other Central and Northern European countries, whose agricultural sector could in some extent, be benefitted from temperature increase and rainfall decrease. The Mediterranean agricultural sector has to be prepared to address severe decrease in water resources availability, unfavorable temperatures for plant cultivation, decrease in yields and in farmers' incomes. Therefore, it is necessary to develop strategies for climate impacts mitigation and also practices for adapting to the new climatic conditions.

The first step for this is the recording and assessment of the current practices that are considered unsustainable and sources of Greenhouse Gas (GHG) emissions. Although these practices are known to policy makers and also to many farmers, their translation into CO_2 units may be a more valuable tool for identifying the major GHG emission sources and therefore, to prioritize the targets for emissions decrease; and also, a convincing method to make farmers understand what they do wrong.

This study, which was designed and implemented in the framework of the LIFE project ClimaMED "Innovative technologies for climate change mitigation by Mediterranean agricultural sector" (https://lifeclimamed. EU), aims to identify GHG emissions from five representative Mediterranean crops, the cultivation of which is very popular in the region.

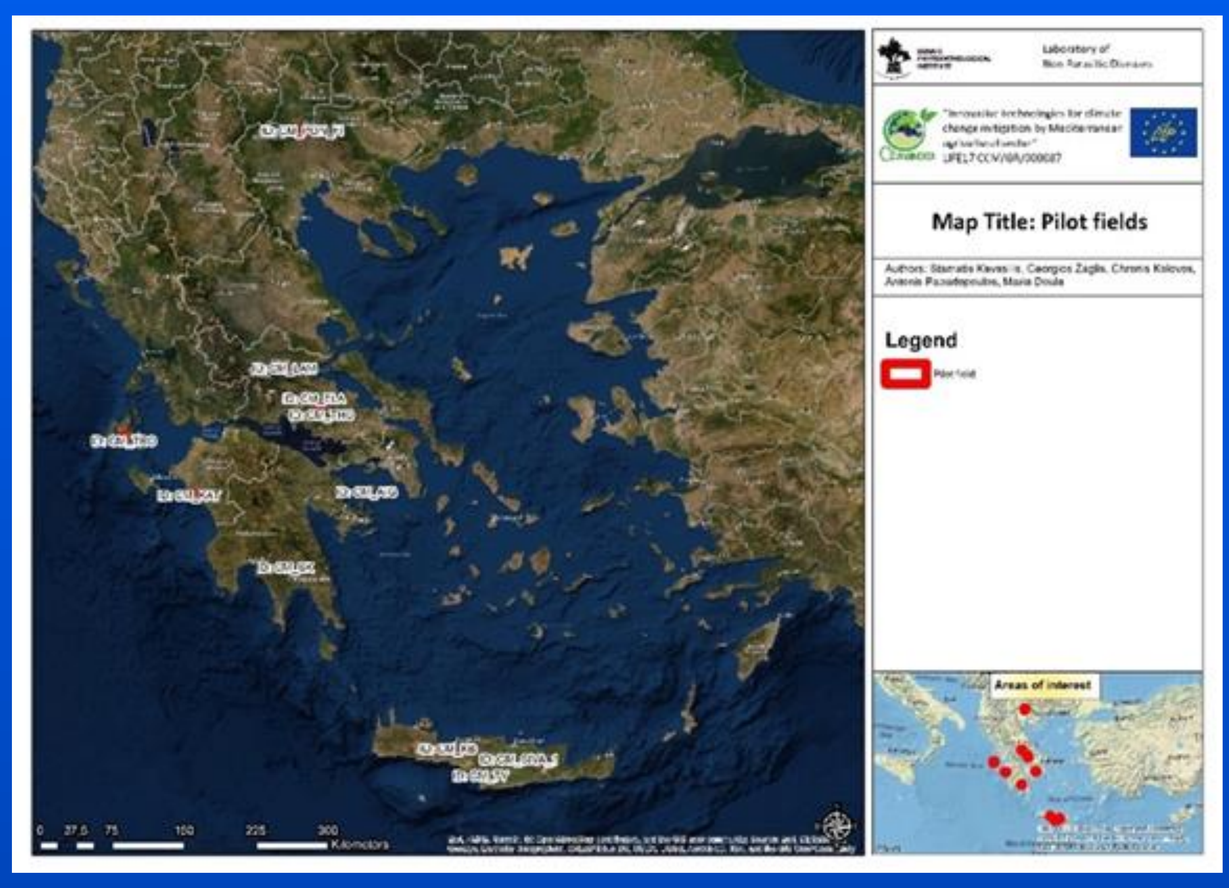
Study area and methodology

Fifteen pilot fields, in which olive trees, grapes, vegetables, cereals and pistachio trees are grown, were selected (Map 1) in a way that each crop to be studied in three different climatic conditions across north to south of Greece, while special attention was given to include different cases, as for example intensively cultivated crops (use of chemical fertilizers), organic farming, coexistence of livestock and agriculture. For the determination of GHGs emissions due to currently and past applied practices, a detailed recording of the practices applied in each pilot field during the last 20 years, has been made.

Carbon footprint was calculated by using IPCC (2006, 2019) guidelines as regard:

- fertilization (use of chemical fertilizers and organic materials);
- fuels use (diesel and gasoline) for the field machinery and irrigation;
- livestock farming;
- electricity consumption and
- burning agricultural residues.

For the calculation, Tier 2 emission factors were used for the main emission categories, as these were defined by the Greek State (Annual Inventory of Greece, 2019), while emission factors of Tier 1 of IPCC (2016, 2019) guidelines were used for the other categories. Emission of Scope 3 category, i.e., fuels from rented machinery, are not considered in this study All pilot fields belong to the Cropland remaining Cropland category.



Map 1. Location of the fifteen pilot fields in Greece

Results & Discussion

From the information gathered, it was found that there is a significant heterogeneity in the practices that the farmers apply even for the same type of cultivation. This is largely due to the lack of strategic planning in agriculture, both by climate area and type of cultivation. The result is the overuse of natural resources and energy and also soil and environment degradation, as producers apply practices based on their experience and knowledge, which, however, lack scientific basis.

The results firstly were grouped regarding the emissions per crop type Fig 1, where it can be seen that GHGs emissions are reduced by the order pistachios, olive trees, vines, vegetables and finally cereals.

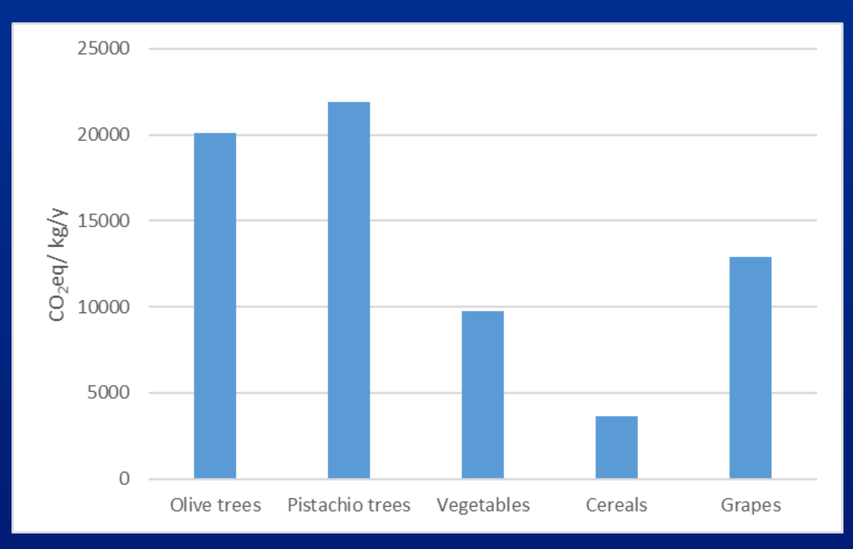


Figure 1. Total emissions per crop type

Then the emissions were grouped by different climatic zones in Greece (Papamanolis, 2015) in order to comprehend the diversity of the agricultural practices that applied leading to differential GHGs emissions, Fig 3, where can be noticed that the average emissions are higher in climatic zone C that includes pilot fields in northern Greece and the lowest average emissions are found in climatic zone A where are located pilot fields in southern Greece..

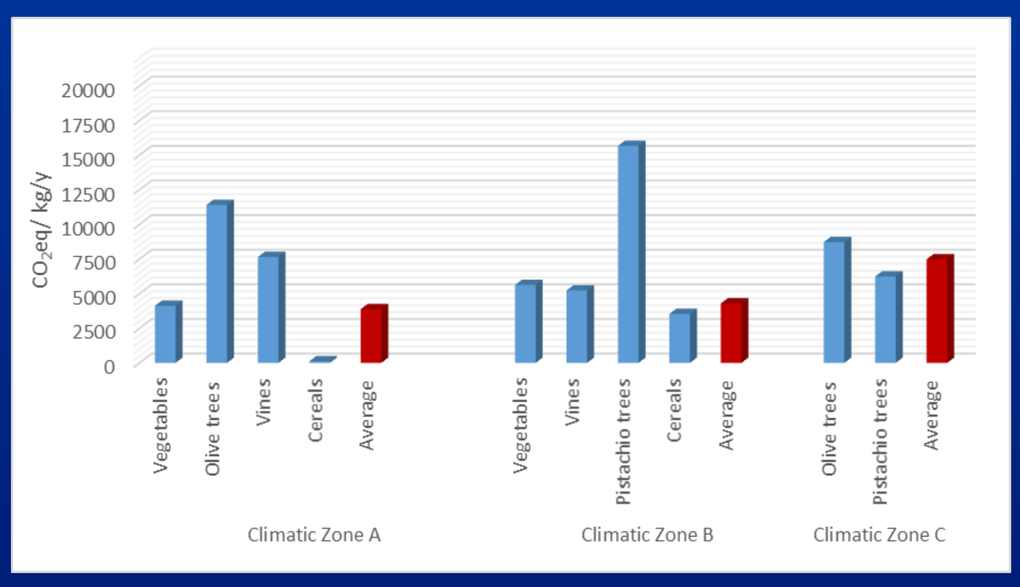


Figure 2 Emissions per Climatic Zone

References

- Annual Inventory of Greece under the convention Kyoto Protocol for Greenhouse and other gases for the years 1990-2017.
- IPCC (2006) Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture, Forestry and Other Land Use
- Refinement to the 2006 IPCC (2019) Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture, Forestry and Other Land Use.

Conclusions

The results of this study considered the practices recorded for 2018. However, as it was pointed out, the heterogeneity of the practices applied by the farmers was significant and therefore, more accurate results are anticipating by monitoring the cultivations and estimating the emissions for more years, which will be done during the lifetime of the ClimaMED project.