Novel Approaches for Accounting and Monitoring Carbon Sequestration and the Socioeconomic Impacts of Tree Crops in Southern Europe

Kostas Bithas, Antonios Kolimenakis, and Angelos Mimis

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Novel approaches for accounting & monitoring carbon sequestration and the socioeconomic impacts of tree crops in Southern Europe

KOSTAS BITHAS[1], ANTONIOS KOLIMENAKIS[1a], ANGELOS MIMIS[1]

[1]INSTITUTE OF URBAN ENVIRONMENT & HUMAN RESOUCES, PANTEION UNIVERSITY;

29 Aristotelous St., Kallithea, 17671, Greece; Tel: +30 2109247450

[a]Email: akolimenakis@gmail.com

Abstract.

The purpose of this study is to investigate mitigation potential of tree-crop cultivations in the Mediterranean region and particularly in Spain, Italy and Greece. In that respect, a methodology is developed, built on top of different parameters affecting the sequestration in tree-crops and providing us with the vital compatibility to apply it in the Mediterranean region and set the framework up to generalize it for other regions in the future. The key parameters that were considered, are the tree-crop type, environmental conditions, the climatological conditions and the socioeconomic dimension of the cultivation. In that direction, field measurements for five representative tree-crops were made, and the relative management practices applied by the farmers were gathered with questionnaires. The current climatic conditions were collected as well as the future conditions were evaluated by projecting for the next 50 years with the use of a Global Climate Model. Based on these, an estimation algorithm was developed (CO2 Removal Capacity Algorithm) that captures the yearly CO2 balance in Biomass, Soil and the enclosed management practices and can be applied specifically at different regions of the study area. As a result, different cultivation practices are evaluated, and their mitigation potentials accordingly ranked. Our study identifies certain mitigation potentials of the agricultural sector and hence contributes to the development of climatic policies coupling agricultural, economic and climatic objectives.

Keywords: Climate Change Mitigation, Tree crops, Socioeconomic benefits of tree-crop practices, Carbon sequestration.

1 Introduction

The agricultural sector of Southern Europe may induce significant benefits both for climate change mitigation and food security which in many cases are largely neglected. The present study is based on the methods and outcomes of the LIFE CLIMATREE project (A novel approach for accounting & monitoring carbon sequestration of tree crops and their potential as carbon sink areas), which aims at identifying and evaluating the mitigation potentials arising from tree cultivations with emphasis on the ecosystems of South Europe.

Tree cultivations may result in significant climate mitigation actions once properly managed. However, this potential is seriously undermined by knowledge and information limitations over the link between tree cultivations and atmospheric CO_2. The present study aims at estimating the actual CO_2 balance of tree cultivations and therefore a novel methodology based on experiments and scientific evidence is developed. Different cultivation methods are evaluated and ranked according to their CO_2 removal and sequestration potentials. Furthermore, the CO_2 sequestration being a regulatory Ecosystem Service, is assigned with an economic value. In this respect, the climatic and economic effects of tree cultivations can be estimated. Our study can, then, substantially contribute to designing coupled climate – agricultural policies with positive climate, environmental policies and food security effects. Farmers, the main stakeholders can play a significant role once awarded and induced by "right" incentives.

2 Methodology

In order to check the hypothesis that the tree-crops cultivations could be used to sequester CO_2, a series of steps have been taken in that direction within the framework of the EU Life project CLIMATREE (LIFE14 CCM/GR/000635). In that respect, a methodology was needed, enabling us to capture all the different parameters affecting the sequestration in tree-crops and providing us with the vital compatibility to apply it in the Mediterranean region and set up the framework to generalize it for other regions in the future. The key parameters that were considered, are the tree-crop type, environmental conditions, the climatological conditions and the socioeconomic dimension of the cultivation.

So, a tree-crop categorization in the three Mediterranean counties of Spain, Italy and Greece was performed, resulting in four distinct tree crop clusters based on homogeneity in both cultivation and biological characteristics of the considered orchards. Further, for each category, a representative tree crop was chosen which in aggregate, represent in 8% of the three countries total land cover.

The representative tree-crops were the Orange, Olive, Apple, Peach and Almond trees and for these, field measurements were undertaken, to capture the carbon absorbed at the maturity phase in the trunk, roots, branches and leaves.

The environmental conditions are of equal importance with the type of the orchard. The carbon sink potential is affected by plantation density, soil tillage, irrigation requirements, and fertilization, herbicides and pesticides usage. So, the trees under study were matched with cultivation practiced by collecting behavioral data from the farmers with the use of questionnaires.

The main climatic parameters which are related to tree crops are the temperature, precipitation and humidity. For the purpose these parameters were collected for Greece, Italy and Spain using daily data from the European Climate Assessment and Dataset (ECA&D) project in order to capture the current status. For the future climatic conditions, a Global Climate Model was employed, over the area of interest, the parameters were projected in 50 years' time and changes were recorded.

The socioeconomic dimension and its interconnection with tree crops under study was focused on production, employment and trade as well as the role of Common Agricultural Policy (CAP) affecting the European agricultural sector.

Having build on the basis of the factors of the removal potential of tree-crop cultivations, a tool (CO2 Removal Capacity Algorithm) was developed to give the opportunity to both the policy makers as well as to farmers to examine the current status and perform scenarios for the future (Spanos et al., 2019). The prescribed algorithm is evaluating, yearly, the removal potential of tree-crops on multiple scales. It is consisting by calculations on biomass, soil, applied agricultural practices (in terms of energy consumption) based on tree-crop type (life-span of the tree, field density, crop yield), soil characteristics and climatic conditions. The scale of calculation is either the country and regional level or a custom scale that the farmer can use to examine their status. The tool is under test and will be delivered to the public in the form of a web page tool.

3 Results

The current research is under way and three main outcomes are delivered. The first one is the field measurements for the tree-crops in the study which provide us with the rate of growth of the various part of the tree during maturity. That can contribute to official reporting of CO2 by replacing the default values described currently in the IPCC framework (IPCC, 2018) with our measurements, avoiding the high uncertainty present in the calculations.

The second outcome is the development of a methodology of calculating the CO2 balance in the tree-crops present in the Mediterranean region by taking into consideration the most important parameters affecting the sequestration of CO2. This provides a tool for policy makers to examine the current status and evaluate possible future scenarios and at the same time engage farmers in exploring how different management practices affects CO2 balance.

The third result is related to the best available cultivation practices which were concluded with the use of the algorithm. Those practices include intermediate to high plantation density, pruning manipulation allowing for low intensity and wood recovery, grinding techniques for fallen leaves and crop loss management and no tillage.

Lastly, the implementation of the relevant LULUCF framework and the inclusion of the agricultural sector on the framework of the Decision 529/2013 (EC, 2013), which targeted reduction of GHG

emissions (i.e. 20% below the 1990 emissions by 2020), is investigated through the exploitation of the project's key outcomes.

4 Discussion

Overall, we are aiming, with the use of our study, to contribute to an integrated analysis of the role of EU's agricultural sector in the climate and food security nexus. In addition, the potential to contribute towards more accurate estimates of the LULUCF sector and land-use based climate policies is also investigated. Official CO2 estimations resemble the function of tree crops with those of forests and therefore result in a ≈70 uncertainty (IPCC, 2018). This undermines the mitigation potentials of tree cultivations. We develop a methodology for estimating CO2 removals from tree cultivations. We apply this methodology in the Mediterranean where tree cultivation occupies a relatively high percentage of land use. Different cultivation methods are evaluated and ranked according to their CO2 sequestration potentials. As a result, we estimate the mitigation potentials of tree cultivations and we compare them with the current official accounts which underestimate them. Furthermore, based on standard economic methods, we are planning to assign a monetary value to CO2 sequestration in the agricultural sector. In this context, we attempt an essential step towards the definition of coupled agricultural and climatic policies in the Mediterranean.

References

1. European Parliament and Council (2015) http://www.europarl.europa.eu/RegData/etudes/ATAG/2015/564362/EPRS_ATA%282015%29564362_EN.pdf
2. IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.
3. LIFE CLIMATREE PROJECT: https://www.lifeclimatree.eu/
4. Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0841&from=EN
5. Spanos, I., Sotiropoulos, A., Evergetis, E., Roussos, P., Haroutounian, S., Mimis, A., 2019, Algorithm for the calculation of tree crops' CO2 Removal Capacity, 12th EFITA International Conference, June 27-29 Rhodes, Greece