Insights from Cyprus, Greece, and North Macedonia towards the decarbonization of the agricultural sector: A Quadruple helix perspective on Carbon Farming-data derived from a Survey study

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ABSTRACT

Carbon Farming (CF) is an emerging method contributing to greenhouse gas (GHG) mitigation, mainly through soil carbon sequestration. CF consists of numerous agricultural practices (e.g., No-tillage, Cover cropping, Crop Rotation etc.) that help in the reduction of atmospheric Carbon Dioxide (CO_2) releases and enrich the below-ground biomassstorage in soil. To investigate how CF practices were aligned with stakeholders' needs, an in-depth questionnaire was designed under the frameworks of the CARBONICA project. Following the questionnaire, a second phase of face-to-face interviews was performed. Three Multi-Actor Platforms (MAPs) have been created in each of the three countries to facilitate the stakeholders' interaction, i.e., Cyprus (CY), Greece (GR), and North Macedonia (NMK). The questionnaire aimed to identify the current knowledge and existing gaps in the agricultural sector related to CF, and the willingness to adopt CF practices, focusing on the quadruple helix (QH). Participants in this survey were primarily farmers, with 44%, 31%, and 58% in CY, GR, and NMK, respectively. The data analysis indicated that the primary interest of the participants was toward potential financial benefits rather than environmental gains. 33% (CY), 41% (GR), and 47% (NMK) showed a high interest in CF, showing a willingness to embrace these approaches. Poor knowledge of CF was identified from this survey. Questions related to the European Union's policies were also included, illustrating different opinions from each country. A detailed country-based analysis will be included in the respective study for knowledge gained based on the QH needs to promote agricultural sustainability through CF practices.

Keywords: Carbon Farming, CO_2 reduction, Quadruple helix, Questionnaire, Multi-Actor Platforms

1. INTRODUCTION

CF is a viable approach to sustainably producing food and related products, reducing GHG as well as increase carbon sequestration in the soils. CF is seen differentely by stakeholders (QH). Policymakers primarily view CF through the lens of GHG emissions and their impact on climate change. But farmers prioritize factors that directly affect their operational efficiency, economic viability, and local environmental impacts, their primary concerns are usually centered around their benefits. CF aims to simultaneously produce a wide range of natural farming techniques and commercially viable products. According to the Food and Agricultural Organization (FAO), 24% of the global Greenhouse Gases (GHGs) are caused by emissions produced by agricultural practices, forestry, and other land-use practices. The annual livestock emissions worldwide are 7.1 gigatons of CO_2-equivalent, accounting for 14.5% of all anthropogenic greenhouse gas emissions [1].

Tenth International Conference on Remote Sensing and Geoinformation of the Environment (RSCy2024), edited by A. Christofe, S. Michaelides, D. Hadjimitsis, C. Danezis, K. Themistocleous, N. Kyriakides, G. Schreier, Proc. of SPIE Vol. 13212, 132120X · © 2024 SPIE · 0277-786X · doi: 10.1117/12.3037280

One-fourth of GHG emissions are estimated to be attributed to the global food chain. About 11% of the world's GHG emissions from agriculture come from Europe, 44% from Asia, 15% from Africa, 9% from North and South America, and 4% from Australia and Oceania [2].

New advances related to cropping systems, monitoring, and soil management have been developed, in order to deal with elevated amounts of CO_2 in the environment while enhancing soil quality and water use efficacy at the same time. Since variations in Soil Organic Carbon (SOC) can indicate whether a land use pattern enhances or degrades soil fertility, SOC serves as a critical indicator of soil fertility [3], [4]. Furthermore, SOC which is present in soil in the form of Soil Organic Matter (SOM), contributes to soil health, either directly or indirectly. The concentration of SOM is affected by different agricultural practices along with soil water holding capacity and soil composition. However, effective planning solutions depend on meeting human demands while safeguarding environmental resources [1], [4]. The goal of a soil quality study is to optimize soil management for its natural benefits, extending to farmers, consumers, ecosystems, and the environment. Consequently, it is crucial to understand the elements influencing soil health, among which SOM is one of the most important. To reduce atmospheric GHG, agricultural practices that enhance SOM to the soil are essential. However, agricultural sector cannot fully offset atmospheric GHG emissions. In order to balance their emissions with the ability of other land uses, such forests, to sequester carbon, the main emphasis of efforts is on emission mitigation. Although it cannot be completely accomplished, the method of carbon farming can help turn agricultural lands from sources of GHGs to sinks for carbon. Sustainable methods for lowering emissions from agricultural fields are crucial to achieving equilibrium in conjunction with the sequestration capacity of other land uses, such as forests.

Previous studies illustrated that soil management activities are highly important to conserving and restoring SOC. Nevertheless, a significant carbon shortage exists in many agricultural regions due to soil erosion and degradation. It is commonly acknowledged that different governments take all reasonable steps to encourage environmentally friendly farming practices in order to preserve soil carbon. Among these practices, agroforestry plays a crucial role, although it faces challenges in boosting crop output and supporting farmers in maintaining soil quality in low-input (e.g., minimal use of fertilizers, pesticides and irrigation management) environments [5]. Certain tree species in agroforest-management systems may be able to help with a number of agricultural problems when combined with crops. Enforcing environmental regulations to preserve a minimal carbon footprint is another government undertaking [3]. Farmers are advised to implement alternative agricultural practices, such as biofertilizers, no-till, and vegetal mulch, together with the systems operating under agroforestry, rather than the conventional tillage, terracing, and no-mulching systems [1]. Low-carbon agricultural practices consist of minimal soil disturbance management practices. Practises that can contribute to low soil distraction are crop rotation and cover crops [3]. Organic farming is an approach adopted by many farmers. Organic farming through research showed that can be beneficial regarding carbon footprint reduction. In addition, organic farming management showed significant benefits such as soil content enhancements, lower energy consumption and lowering nutrient performance [6]. No-tillage approach is another CF method [7] that can both reduce carbon footprint as well as increase and retain SOC by the minimization of soil disturbance [1].

The European Commission defines innovation as the introduction of something new that can benefits rural practice in an economic, social, or environmental way [8],[9]. When solutions are co-created, innovation transforms into a nonlinear, iterative learning process involving close cooperation between various actors. Working together allows people to exchange ideas and transform study findings and current knowledge into creative solutions that are easier to implement [9]. This method, sometimes referred to as the Multi-Actor Approach (MAA), symbolizes the collaboration of the actors in all project-related activities, from ideation to project completion [10]. Many calls mandate that projects use the MAA. Such calls requires concentration on actual issues or opportunities that farmers, foresters, or other "end-users" in the wider framwork of EIP-AGRI network, who require a solution on problems that are encountering [10]. It also implies that partners with complementary knowledge such as scientific, practical, and otherwise must collaborate throughout the duration of the project [10]. Consequently, MAA projects are able to produce creative solutions that address actual demands and are more prepared for practical use. MAA can involves stakeholders representing the Quadruple Helix (QH). The QH innovation system comprises people from governmental bodies, academia, industry, and civil society [11]. The Multi-actor Platform (MAP) is the co-creation and knowledge exchange between various actor types with complementary specialties [12]. The flexibility provided by the platform and enabling ecosystems together promotes several competing and cooperative enterprises from various industries to produce rapid, affordable, and responsible innovation [13]. In general, the ecosystem's constituents follow the guidance of a central figure essential to the ecosystem's growth and maintenance. Innovation in business models and technology is linked to the MAA strategy , with MAP formulated and operating under its principle and objectives [13]. The key to fostering innovation in agriculture is for multiple stakeholders

with complementary expertise to collaborate on problem-solving and knowledge exchange. Such activities and MAP creation is one of the objectives of the CARBONICA project with the main goal lying in understanding current needs that farmers have and their issues in order to achieve problem solving ideas.

The aim of the current study is to (i) provide an insight from Cyprus (CY), Greece (GR), and North Macedonia (NMK) perspective on CF based on a survey analysis (ii) MAPs creation between the three innovation ecosystems (IES) and (iii) further finding through face-to-face interviews for need identification.

2. METHODOLOGY

A survey analysis was conducted as a research approach for this publication. A questionnaire was created and distributed to stakeholders representing the QH model in order to assess their perspectives on CF. The questionnaire was activated on 06/12/2023 until 02/02/2024. The objectives of the current survey is to assess the current carbon farming situation exist between the three ecosystmes in addition to participants opinion and willingness in carbon farming as well as their needs. A total of 313 respondents from each of the three ecosystems (CY, GR, and NMK) representing the QH completed the questionnaire. Specifically, 159 responses were from North Macedonia, 99 from Greece, and 55 from Cyprus.

In order to determine the needs of farmers and the existing gaps in the agricultural sector, a survey was carried out under the auspices of the CARBONICA project. The poll comprised 23 questions focused on CF, knowledge in particular fields, problems that farmers are currently facing, and potential interest in collaboration with the CARBONICA project. A few questions also centered on how EU funds and policy collectively impact them. One of the goals of the CARBONICA project is to educate farmers in the field and exchange knowledge in order to promote eco-friendly solutions and sustainability, which can positively affect soil health and productivity. According to the literature, encouraging CF in agriculture offers several advantages, including financial gain.

The paper comprising the present analysis strongly emphasizes CARBONICA's cooperation with members of the QH to achieve CF solutions and a zero-net outcome. The findings in this report illustrate how the selected participants responded to specific questions about CARBONICA's goals and the conversation during their one-on-one interviews. Each nation conducted interviews at the national level, which are examined in the current report. The process followed to achieve the collection of valuable insights from the agricultural sector along with the development of MAPs is presented in Figure 1.

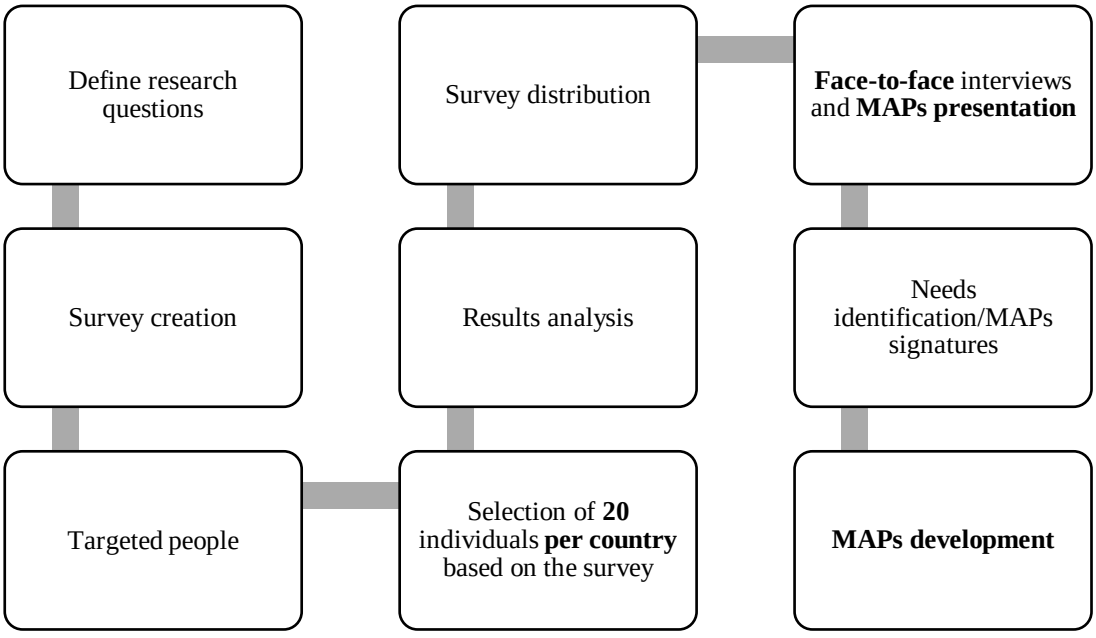

Figure 1. Process conducted for the current survey analysis and MAPs creation.

After completing the survey, 60 individuals—20 per country—were selected to participate in in-person interviews to gain a deeper knowledge of the state of CF and the requirements of farmers. During the face-to-face (F2F) interviews, the creation of MAPs was discussed, resulting in the registration of 15 individuals per country to their respective regional MAP.
This survey was originally intended for use within the context of the CARBONICA project and was designed to be completed by participants from North Macedonia (NMK), Greece (GR), and Cyprus (CY). This survey aims to determine the problems facing the agriculture industry and how CARBONICA may address them to promote sustainability and CF.

3. RESULTS AND ANALYSIS

3.1 Categories and Participation Motivation

The questionnaire was distributed to participants who represented the QH model. Figure 3 below illustrates the group of participants per country. It is worth highlighting that the highest participation was observed from farmers since are the most interested stakeholders and most affected by climate crisis. Nevertheless, high participation was observed from academic communities, as CF can offer high-impact research opportunities and drive knowledge and innovation at the national level.

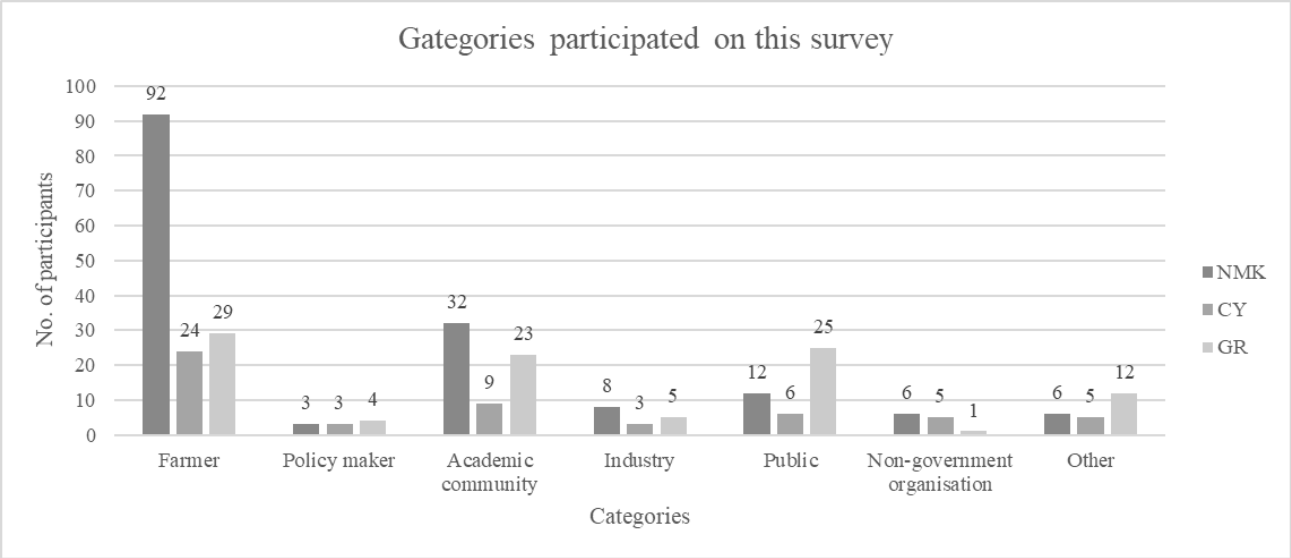

Figure 2. Categories participation

During this survey a question was posed regarding the primary motivation for participation (Figure 4). In the CY ecosystem, 40% of respondents indicated that their primary motivation was the promotion of sustainability in the agricultural sector, while 29% highlighted the development of innovative agricultural solutions as the second most common motivation. In the GR ecosystem, 26% of respondents shared the primary motivation of promoting sustainability, similar to CY, with the second most common motivation being the exchange of knowledge and experience with other stakeholders (25%). Notably, 24% of GR respondents cited the exploitation of business opportunities as their primary motivation, while another 24% supported the development of innovative agricultural solutions, indicating no significant numerical deviation among the responses due to the diverse interests of different occupations. In the NMK ecosystem, 36% of respondents identified the development of innovative agricultural solutions as their primary motivation, followed by 34% who emphasized the exchange of knowledge and experience with other stakeholders.

Overall, GR and CY shared a common view related to the motivation for participation, while the NMK ecosystem prioritized the development of innovative agricultural solutions. This highlights the regional differences in needs and priorities.

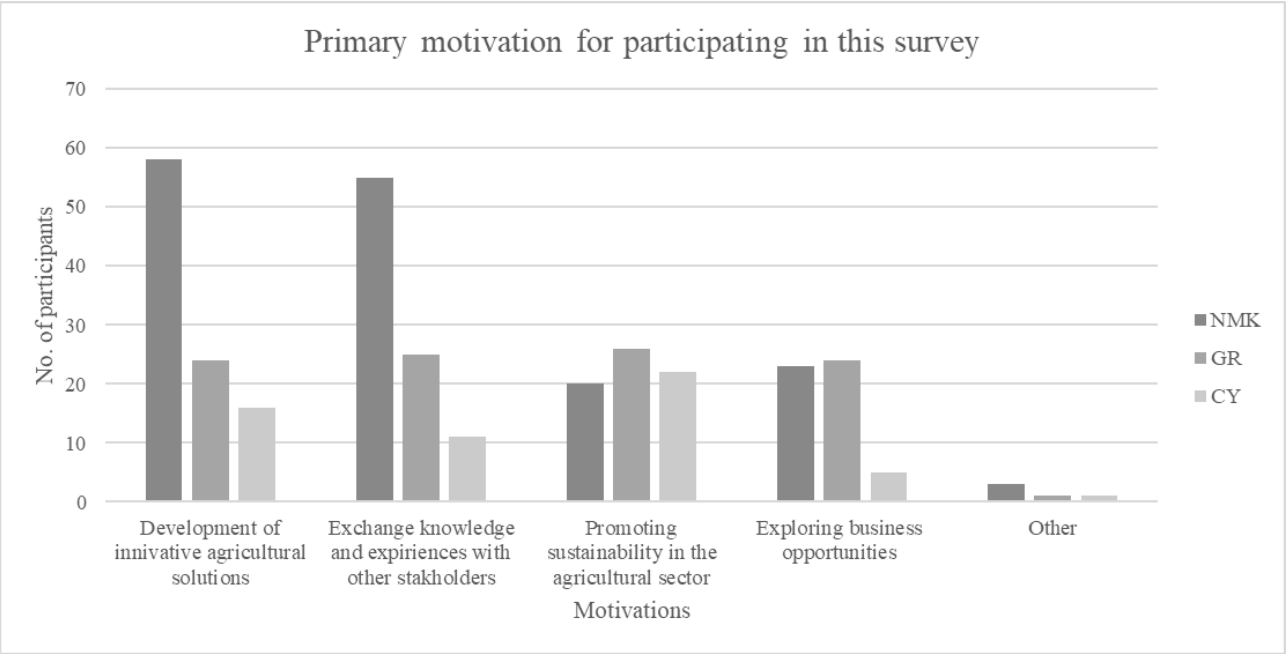

Figure 3. Participation motivation per country.

For further insights, analysis based on motivation was performed based on each category per ecosystem. The highest number of farmers participants' primary motivation to participate in this survey is to exchange knowledge and experience with other stakeholders while the second highest number suggest the promotion od sustainability in agricultural sector. No significant differences observed between the participants derived from academia where equally in number suggest that their primary motivation are the knowledge exchange and experience with other stakeholders and promotion of sustainability in agricultural sector. Industry primary motivation with equal number of participants is the promotion of sustainability in agricultural sector, exploitation of business opportunities and exchange of knowledge and experiences with other stakeholders. As it can be seen in the figure 4 most of the participants motivation is the knowledge exchange and experiences sharing with other stakeholders.

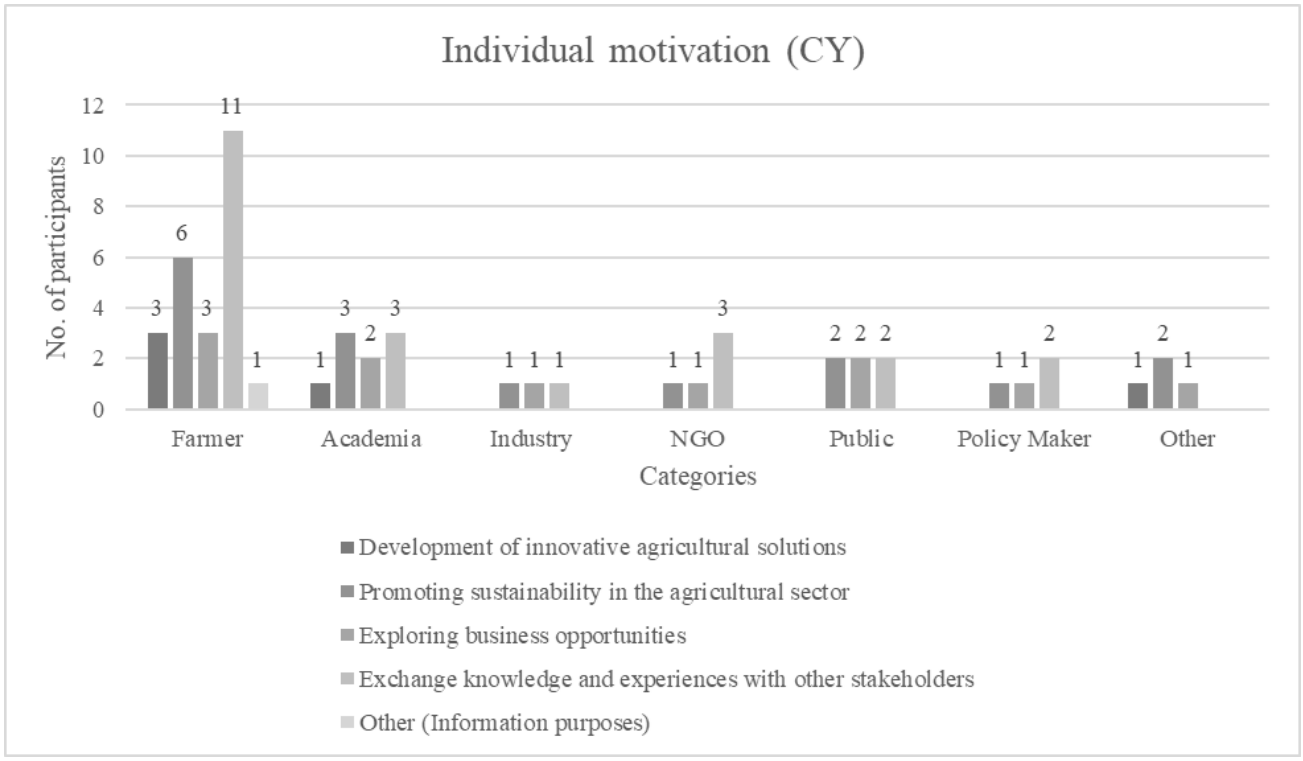

Figure 4. CY individual motovation to participate on this survey

The highest number of farmers from GR ecosystem (13 individuals) primary motivation is to promote sustainability in the agricultural sector. However, academia on a reasonable perspective their primary motivation is the development of innovative agricultural solutions (9 participants). Three participants from industry primary motivation are to explore business opportunities while 1 participant is to exchange knowledge and experiences with other stakeholders. NGOs with equal numbers of participants (2) suggest that their primary motivation is to promote sustainability in the agricultural sector while the other 2 is to explore business opportunities. Public highest in number (11) motivation to participate in this survey is to exchange knowledge and experiences with other stakeholders while the second most voted answer with 6 participants is to explore business opportunities. This showed us the great interest of the public to be part of the agricultural sector activities. No significant differences in number observed for policy makers with their primary motivation to be the development of innovative agricultural solutions with 2 votes and business exploitation opportunities with 2 votes (Figure 5).

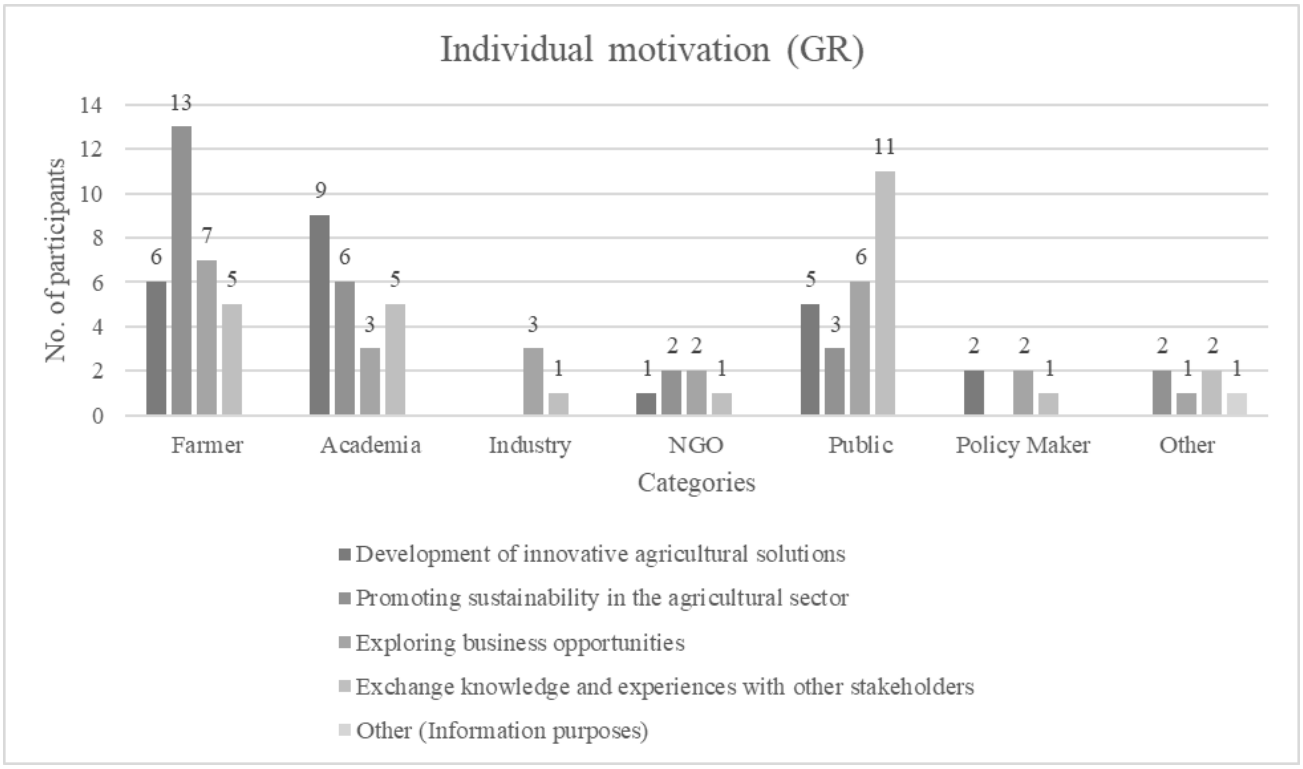

Figure 5. GR individual motivation to participate on this survey

36 farmers form NMK ecosystem primary motivation to participate on this survey is to exchange knowledge and experience with other stakeholders while the second highest in number motivation is the development of innovative agricultural solutions. The highest source of motivation for academia with 14 individuals is the development of innovative agricultural solutions while 11 participants primary motivation is to exchange knowledge and experience with other stakeholders. Industry like the other above mentioned categories primary motivation is the development of innovative agricultural solutions and exchange knowledge and experiences with other stakeholders (Figure 6). NGOs primary motivation with the highest number (4) is to promote sustainability in the agricultural sector.

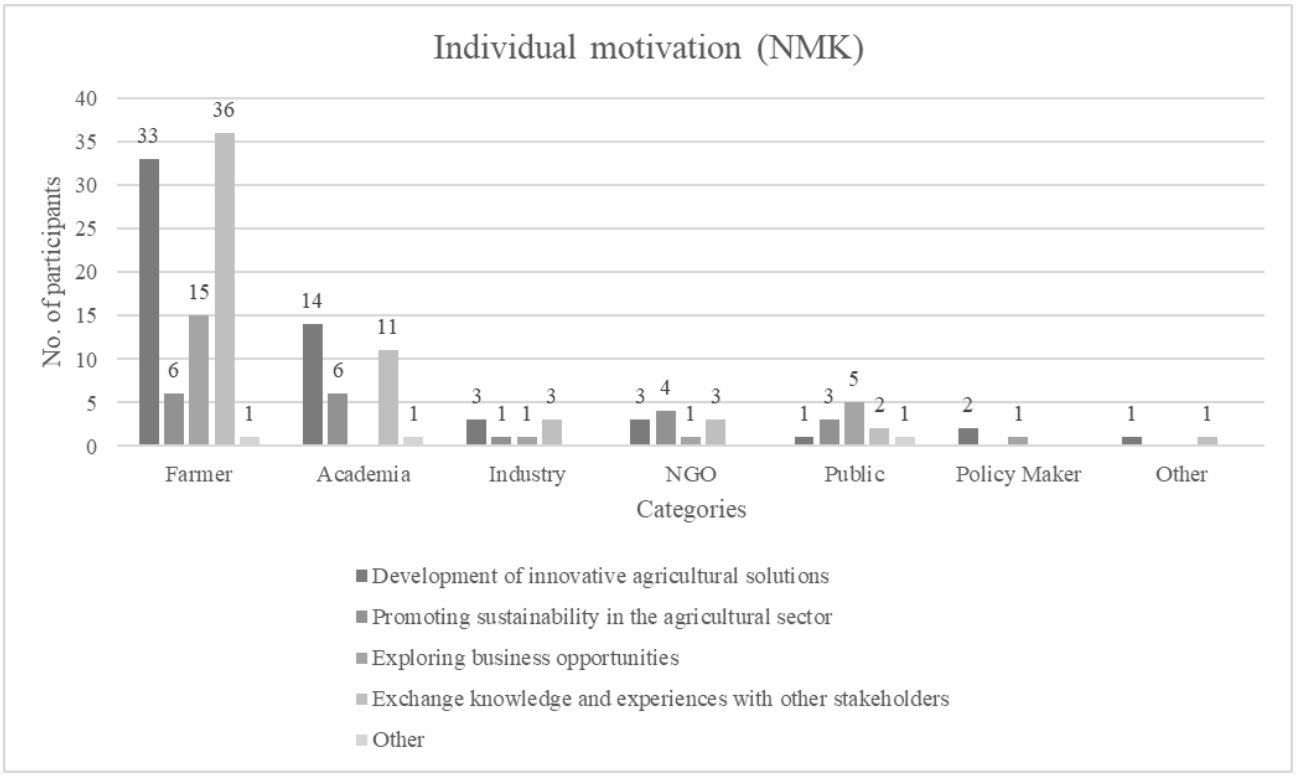

Figure 6. NMK individual motivation to participate on this survey

3.2 Needs identification

The subject of the objectives that ought to be accomplished in the agriculture sector according to ranking led to the identification of divergent viewpoints and requirements among the three IES. We set answers related to water conservation, profits, productivity, product improvements, development of innovative technologies, sustainability promotion, as well as environmental protection, soil health enhancements, and carbon sequestration, to achieve a broader understanding of the current needs, farmers require. It is worth mentioning that the analysis performed is based on all category's goals participated in this survey according to what will benefit farmers and what they believe are their current needs. Financial profits and market expansion emerged as the most important parameter commonly identified from the three countries. Specifically, this answer received 15, 32, and 64 votes from CY, GR, and NMK, respectively, placing it at the top of the importance ranking. This finding is logical, considering that the agriculture industry is the primary provider of food while often being viewed as a minority when it comes to policies. The second most significant factor in the agricultural sector, however, varies per nation, indicating the unique requirements of each at the national level.

In the CY ecosystem, the second most important goal that needs to be addressed is the development and application of innovative technologies in the agricultural sector so as to help them to find solutions to current issues and develop management schemes for better results on their farmlands. Equal in votes related to the second most important goal is soil health enhancements and carbon sequestration highlighting farmers' needs for alternative solutions and modernization in the agricultural sector. The third most important goal, voted by the majority, is the promotion of sustainability and environmental protection, which illustrates the conscientiousness towards an eco-friendly agricultural practice. Remarkably, the fourth and fifth most important goals that emerged from this inquiry were the conservation of water for irrigation, since it is a significant concern in CY and the increase in production, since it can be regarded as the most significant metric that requires improvements.

In GR, as somewhat expected, the second most important goal to be achieved with a significant numerical was the increase in production. This likely reflects the country's annual yield losses, possibly due to climatic conditions. In recent years, GR has experienced severe heavy winters [14] and floods [15] that destroyed agricultural lands and consequently reduced production rates, causing financial loses. GR and the Mediterranean region are among the most at risk from the recent

climate change, with extreme weather disasters already threatening the agriculture sector. As agriculture is the economic sector most directly impacted by climatic extremes, it is considered highly susceptible to climate change [14]. The third most important goal to be achieved is water conservation for irrigation purposes in the agricultural sector. Extreme weather events significantly impact GR's water resources, with droughts, floods, and soil erosion being the most severe effects. GR's agriculture sector uses most of the country's accessible water resources. Additionally, there is ample evidence of a water scarcity and the poor chemical state in some water bodies, primarily due to intensive farming practices and saltwater intrusion in coastal agricultural areas [16]. It is worth mentioning that the fourth most important goal set by the GR ecosystem, which received a high number of votes, was the development and application of innovative technologies in agriculture. As a fifth most important goal set by participants from GR was soil health enhancements and environmental protection while the sixth in rank was the improvement of production and efficiency in the agricultural sector.

Similar to CY, the second most important goal for NMK is developing and applying innovative technologies in the agricultural sector, highlighting the need for advancements in this domain for overall improvement. The third most important parameter that needs to be addressed is the promotion of sustainability and environmental protection, illustrating that most participants have concerns about the environmental impact. The fourth set by NMK ecosystem was production enhancement, while the firth most important goal was soil health enhancement and carbon sequestration. Equal in votes for fourth place and seventh most important goal was water conservation for irrigation purposes, possibly influenced by the analysis of all categories for this question.

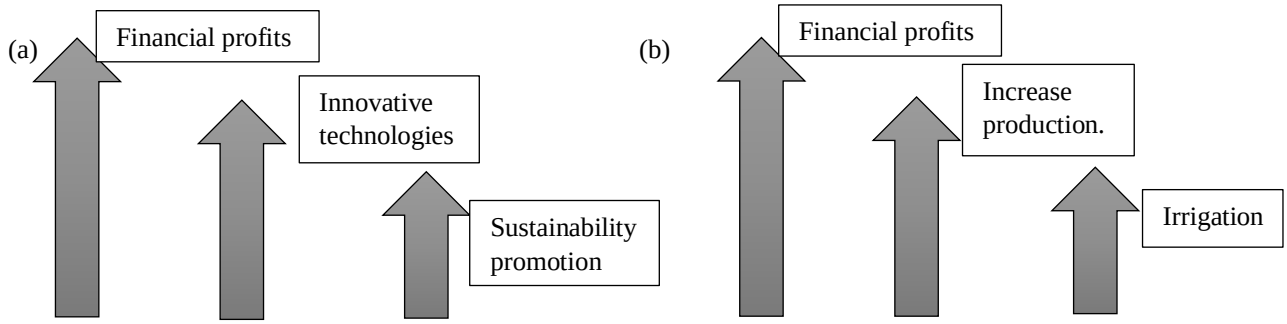

Figure 7.(a) Common view about 1st-3rd most important goals from CY and NMK, (b) GR 1st -3rd most important goals

3.3 Collaboration with CARBONICA and Carbon Farming Interest

The Greek and Cypriot communities regarded the creation of shared objectives and cooperation as the most significant barriers to collaboration among diverse stakeholders, with 29% and 34%, respectively. The majority of participants from NMK (33%) indicated that communication and information exchange are the main barriers to stakeholder collaboration. Regarding collaboration within the CARBONICA project's MAP, a high priority for collaboration was expressed by participants from CY (43%), GR (48%), and NMK (49%) as a means of enhancing ideas and experiences. However, a small number of participants (8 participants) suggested that while collaboration is desirable, it is not necessary, and some had no opinion on the matter.

In the CY ecosystem, 33% of respondents indicated that are very interested in CF, while 29% are extremely interested. This shows the need to adopt new and promising approaches in the agricultural sector to benefit and contribute to the zero-net goal of the EU. Conversely, a very small percentage of 3% responded that they are not interested at all in CF. This might be derived from the fact that all categories included in the analysis of this question or due to insufficient information or lack of awareness, highlighting a need for informative activities to address this gap. At the same time, 47% of NMK participants responded that are somewhat interested in CF, while 35% are very interested. Similar to CY, 4% of participants expressed that are not interested at all in CF. GR ecosystem with 41% said that are somewhat interested in CF while the 21% and 18% are extremely interested or very interested, respectively.

3.4 Opinion on EU policies

This subsection concerns the questions about European Union (EU) challenges and actions and the participants' opinions. Participants were asked about their opinions regarding the current challenges that the EU faces in the agricultural sector. A broad range of answers to this question indicated that more than one challenge is faced. Promoting sustainability in agriculture and climate change adaptation had the largest percentage of responses (44%) among the challenges drawn from GR. The absence of a sustainable income guarantee for farmers, as well as the promotion of rural employment and the enhancement of rural development, account for an equal 21% of the answers provided. Food safety, product quality, and competitiveness promotion were ranked as the EU's least challenging issues by voters, with 12% and 2% of the vote, respectively. These responses highlight that individuals face significant challenges in adjusting to climate change due to insufficient procedures and structures, along with concerns about stability and income.

Nearly half (47%) of the participants in CY responded that the main issue facing the EU is providing farmers with a sustainable income. Every year, this puts their firm in grave danger and jeopardizes the proprietors' stability. The second most popular response was the absence of support for rural employment and growth (29%). With 18% of the vote, sustainable agriculture, and climate change adaptation came in third. Similar to GR, participants from CY believe that promoting competitiveness and ensuring food security pose the least number of challenges to the EU, at 2% and 4%, respectively.

According to the responses from NMK, the primary challenges the EU faces are sustainability and climate change adaptation in the agriculture sector, receiving the most votes (33%). Stability of sustainable income for farmers received 24% of votes, making it the second most popular choice. The insufficient support and encouragement of rural development is the third most mentioned issue, accounting for 20% of the comments. Similar to GR and CY, attendees at NMK believe that promoting competitiveness, food safety, and production quality presents less of a challenge, with 5% and 16%, respectively.

A second question related to the EU Common Agricultural Policy (CAP) was asked. The majority of participants from NMK believe that CAP is necessary to support farmers and ensure their sustainable development. However, CY and GR ecosystem suggest with high numerical value that CAP needs revision to be fairer and sustainable to all. Notably, a small number of respondents expressed that they do not have an opinion about CAP, while some are not familiar with CAP, possibly due to the fact that analysis was performed for all categories from the QH (Figure 5).

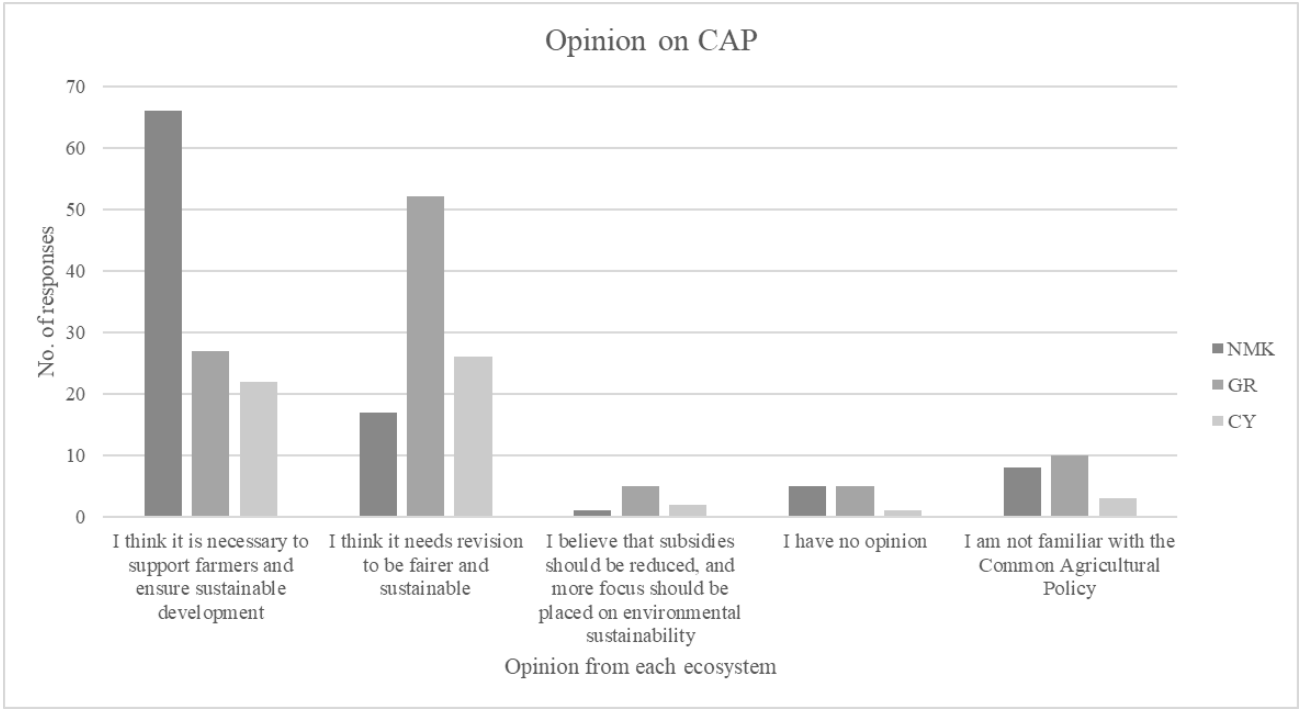

Figure 8. Opinion on CAP

More specific questions about challenges that the agricultural sector faces due to EU and CAP policies were included in this survey, allowing participants to select multiple answers. The provided information outlines the various challenges that farmers encounter as a result of agricultural policies. It enumerates the particular concerns brought forth by the interviewees, including rising production costs and import competition, unstable markets, financial limitations for investment and innovation, challenges in putting environmentally friendly practices into practice, and the administrative burden caused by rules and regulations.

The rise of external imports and cost production was the most familiar answer from NMK, with 30%. Close behind, 26% of participants expressed concerns about future market and price uncertainties, indicating insecurity regarding their future and income stability. Additionally, 19% of NMK respondents highlighted the bureaucratic burden of rules and regulations as a significant issue. Raising capital for investments and innovation and the difficulties in implementing green practices received the lowest percentage of votes, at 13% and 10%, respectively. Similarly, in GR, 34% of participants concurred that rising production costs and import competitiveness are the biggest policy concerns. Concerns regarding the market's future and prices, which have increased this year and are clearly visible to the public, came in second with 22% of the votes. The adoption of green practices to reduce GHG emissions and contribute to climate change, the funding challenges for investments and innovation, and the bureaucratic weight of rules and regulations received similar percentages of votes (18%, 13%, and 13%, respectively). For each response, similar percentages come from GR and NMK, indicating that both nations view current policies as not particularly promising for their business. Similar to the other two nations, with the greatest percentage (38%), CY concurs that there is a problem with rising manufacturing costs and import-related competitiveness. However, the second-most popular response differs from NMK and GR because 20% of voters responded that bureaucratic rules and procedures burden them. Comparable percentages of 16%, 14%, and 12% for each response address the following issues: the unpredictability of the market and product prices in the future, the challenges associated with sustainable practices, and the difficulty of obtaining funding for innovation and investment, respectively.

3.5 Face-to-Face interviews

In-person interviews revealed shared economic perspectives among farmers in all three ecosystems (NMK, GR, and CY). Farmers emphasized the need for new business ventures to meet their needs and increase their profits. Barriers also emerged concerning knowledge of CF, as none of the three ecosystems had much understanding of CF and associated opportunities. Farmers have expressed mutual concern due to the economic uncertainty they are experiencing, making it more difficult for them to alter their current methods. For all three ecosystems to receive all the opportunities and pertinent knowledge from this subject, they need to attend educational events and receive training in the CF domain.

There are also issues with the current system, where Monitoring, Reporting and Verification (MRV) is hampered by the numerous documentation procedures that need to be completed. Academic circles widely recognize the importance of soil variances and crop type suitability for applying CF methods. Explaining MRV to participants during the F2F interviews seemed to motivate them for CF adoption. However, some participants noted that consumers should also attend informative events since they have a primary role in the market. Participants stressed the need for new policies to motivate farmers to adopt CF. These policies should include funding opportunities to alleviate farmers' fears of potential negative impacts on their lands, as farmers are hesitant to embrace new changes without financial security.

Most of the participants in the F2F interviews suggested that field activities should take place to promote CF, allowing farmers to observe the outcomes of such practices in real-life environments. Alongside field activities, participants recommended that informative activities should be implemented to explain CF principles, its application, and the financial opportunities. People are convinced that if there are no financial prospects for these activities farmers will never adopt this kind of practice.

3.6 MAPs development

One of the CARBONICA project’s aims is the creation of MAPs among the three IES. The mobilization of three national MAPs will bring together stakeholders representing the QH, engaging them to exchange ideas, experiences, and knowledge in the field of CF. Through knowledge sharing and mutual learning among participants, active involvement from regional IES actors within the QH, and the development of strong, interconnected regional IES based on mutual respect and trust, the goal of MAPs is to create an interdisciplinary process of collaboration. The project's collaborative efforts will involve MAP stakeholders in developing, verifying, tracking, and updating the joint R&I strategy of the CARBONICA Hub. During the F2F interviews, MAPs created by the CARBONICA project were presented. The aims and objectives were presented as well. Participants showed an extreme interest in participating in the activities of the CARBONICA project.

The main goal of the MAPs creation between the three ecosystmes is to engage participants that will be able to participate in CARBONICAs' activities. Activities such as field trainings, info days and roundtable discussions will provide to MAPs members with the opportunity to act as a passing information persons to others. In addition, participants will have the opportunity to share agricultural sector concerns were discussions will be held in order to achieve problem solving ideas. Each ecosystem managed to register 15 participants to the regional MAP. The MAPs consist of stakeholders representing the QH model and will facilitate the stakeholder's interaction.

4. CONCLUSIONS

The creation and analysis of this survey provided valuable insights into the needs of CY, GR, and NMK. Agicultural domain experiences certain threads derive from climate crisis. However, carbon farming is an approach that can be adapted by farmers in order to reduce environmental impact of CO_2 as well as improve production rates and financial state. The main outcome of the survey analysis is that participants are interested in CF and ready to start implementing new agricultural practices. In addition, we identified that financial gain is the primary concern of the three ecosystems, and we need to find alternative solutions that will provide more sustainable and stable income. Moreovore, farmers experience insecurity regarding income and the advancement of rural development. Through the participants' responses, we can conclude that EU policies might need revision in relation to the agricultural sector to be fairer to all, making farmers feel less vulnerable and more sustainable. Through the F2F interviews, we gained a deeper understanding of the issues and potential solutions. Consumers seem to have an essential role regarding products; thus, informative events should be designed for them. MRV opens an acceptance pathway for farmers to adopt CF practices since it can provide them with extra income. Aligning with stakeholders can provide better and more targeted solutions based on the agricultural sector's needs. Thus, MAPs creation is an important asset that will lead to better outcomes towards regional innovations.

ACKNOWLEDGMENTS

The present work was carried out in the framework of CARBONICA project that has received funding from the Horizon Europe HORIZON-WIDERA-2022-ACCESS-04-01 - Excellence Hubs programme under Grant Agreement No. 101087233. The authors would also like to acknowledge the 'EXCELSIOR': ERATOSTHENES: Excellence Research Centre for Earth Surveillance and Space-Based Monitoring of the Environment H2020 Widespread Teaming project (www.excelsior2020.eu). The 'EXCELSIOR' project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 857510, from the Government of the Republic of Cyprus through the Directorate General for the European Programmes, Coordination and Development and the Cyprus University of Technology.

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