Newsletter

March 2024

TECHNICAL FILE

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01

EDITORIAL #1

The CIEQV newsletter for the month of March is dedicated to the scientific area of Production and Food Technology / Food Behaviors. In this edition it is possible to see different works carried out by researchers and presented in different congresses, scientific articles, interviews with researchers and dissemination of projects. In this issue, it is also possible to check articles published by CIEQV researchers and publication of journals issues and projects.

The number now published reinforces the dynamics of the center's researchers, being a reason for satisfaction and motivation to continue our journey at a time of great challenges that are faced with us. The center is making its way and is currently in the FCT evaluation phase and building its strategic plan for the next cycle.

Good job everyone

Fernando Jorge Lourenço dos Santos [1,2,3]

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EDITORIAL #2

We return to present the March issue of our Newsletter, highlighting research results at the intersection of agricultural production, animal science, food technology and eating behaviors. In our research, we seek to study the impact of our sustainable choices on quality of life, and in this issue we reveal the contributions of integrated and collaborating members of the scientific line of investigation – "sustainable agri-food systems" - with two working groups: 1) Food and Nutrition; 2) Sustainable agrosystems, of the Life Quality Research Centre (LQRC-CIEQV) in order to solve the complexity that shapes agrifood systems and the broader implications with human health, sustainability, and well-being for all of us.

In the Food and Nutrition working group, researchers are focusing on the link between agricultural practices and human health outcomes. They are studying the nutritional value of food produced using sustainable methods, as well as the potential impact on reducing foodborne illnesses. By promoting the consumption of locally grown, organic food, they aim to improve overall health and well-being in communities. Advances in food technology are transforming the way we process, preserve, and distribute food. From new food formulations that improve nutritional content, to the valuing raw material losses and waste, our researchers are creating a more resilient and resource-efficient food industry. In addition to our research efforts, we are actively engaging with stakeholders in the agri-food industry, government, and civil society to ensure that our findings are translated into meaningful policy and practice. By working collaboratively with partners across sectors, we can create a more sustainable, equitable, and resilient food system for the benefit of all.

The sustainable agrosystems working group is exploring innovative farming techniques that minimize environmental impact while maximizing crop yields. Researchers are investigating the use of cover crops, crop rotation, and integrated pest management strategies to create resilient and productive agricultural systems. By reducing reliance on chemical inputs and promoting biodiversity in agri-food systems, they hope to create a more sustainable future for food production. Our researchers are also investigating the impact of agricultural practices on animal welfare and the quality of animal products. By studying the effects of different production methods on the well-being of animals, we aim to improve the sustainability and ethicality of animal agriculture.

Through collaboration and interdisciplinary research, the Life Quality Research Centre is contributing valuable insights to the field of sustainable agrifood systems. By considering the interconnectedness of agriculture, nutrition, and human health, researchers are working towards a more sustainable and equitable food system for all. We look forward to sharing more research findings and progress in future newsletters. Thank you for your continued support in our mission to promote sustainable agricultural practices and improve the quality of life for all. Our researchers have been seeking to make advances in the characterization and optimization of agroecological practices, promoting the sustainable use of soil, water, and biodiversity, to minimize environmental impact and to support the economic and social development of farmers and territories. At the same time, by embracing innovation, we are contributing to strengthening our ability to face both global challenges, in terms of access and the right to safe and healthy food, as well we make possible to offer solutions that meet the specific needs of different target populations. In this edition, we feature the launch of a new project aimed at promoting an innovative line of spreadable creams enriched with protein isolated from cricket powder.

The LQRC-CIEQV has been promoting the design of studies on the interactions of biological, psychological, and social factors that influence dietary behaviors and, in this context, the scientific line of investigation - sustainable agrifood systems - is working on a proposal for future research activities. We expect to gain a deeper understanding of the drivers behind our food preferences, and thereby be better prepared to design targeted interventions that promote healthier lifestyles and improve overall quality of life.

We invite you to explore the latest research findings and updates from the LQRC-CIEQV in this newsletter, and we welcome your feedback and input as we continue to advance our understanding of the complex interactions between agriculture, food technology, and eating behaviors.

At this moment I want to extend my sincere thanks to all the researchers and all the partners who contributed to this edition of the Newsletter and to the activities of the scientific area of Production and Food Technology / Food Behaviors.

Maria Gabriela Basto de Lima[1,2]
[1] ESAS – Santarém Polytechnic University
[2] Life Quality Research Centre
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INFORMATION

INFORMATION #1

— 2nd INTERNATIONAL CONFERENCE WATER RESOURCES MANAGEMENT SUSTAINABILITY: SOLUTIONS FOR ARID REGIONS. February 26-28, 2024, Dubai.

Water is vital for all types of life. Without water, life cannot be sustained. The lack of freshwater resources in arid and semi-arid regions constitutes the major deterrent to sustainable development. The rapid population growth, rising standards of living and per capita water consumption, expansion in urbanization, industrial and agricultural activities, and climate change pose considerable challenges on the use and management of water resources.

Oral comunnication: Low-Cost Solutions for Monitoring and Controlling Agro-Industrial Wastewater Treatment Systems

Presented by Artur Saraiva, Professor from Escola Superior Agrária de Santarém.

Team: Artur Saraiva[1,2], Joana Portugal Pereira[3]; José de Melo e Abreu4 & Margarida Oliveira[1,2,5].

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[1]Escola Superior Agrária de Santarém (ESAS); [2]LEAF Linking Landscape, Environment, Agriculture and Food Research Center; [3]Universidade Federal do Rio de Janeiro (UFRJ); [4]Instituto Superior de Agronomia – Universidade de Lisboa (ISA-UL); [5]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

Poster communication: Protecting Water Resources by Fertilizer Management - The Role of Nano fertilizers

Team: Raquel Saraiva[1,2], Gonçalo Rodrigues[2], Quirina Ferreira[3] & Margarida Oliveira[1,4].

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[1]Escola Superior Agrária de Santarém (ESAS); [2]LEAF Linking Landscape, Environment, Agriculture and Food Research Center; [3]iNOVA4Health, NOVA Medical School; [4]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://conferences.uaeu.ac.ae/warms2024/en/index.shtml

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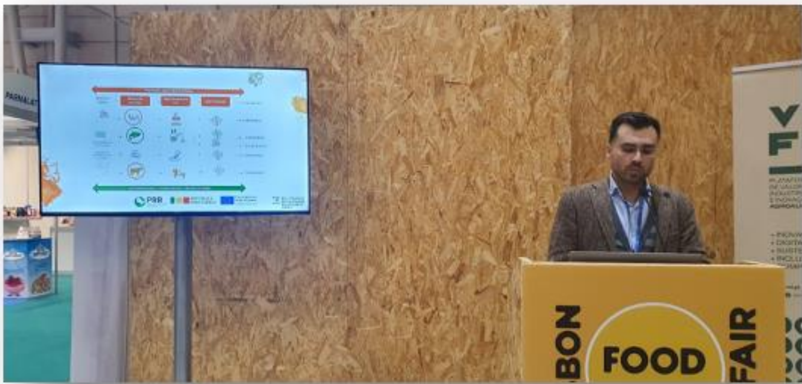
INFORMATION #2

— 2nd EDITION LISBON FOOD AFFAIR (LFA). February 04-06, 2024, FIL, Lisboa.

LISBON FOOD AFFAIR

Project SPIN

On 6th February, Professor Igor Dias, the project's coordinator, presented the SPIN project with a promotional poster at the event.



LFA stands as a distinguished and pioneering marketplace tailored to a perpetually evolving market, drawing together a myriad of international stakeholders from the food, HORECA (hotels, restaurants, and cafes), equipment, and technology sectors pertinent to the industry, research, and food distribution. It also serves as a hub for business transactions and the exchange of knowledge, delving into market trends, consumption patterns, emerging business landscapes, and the sector's future trajectory.

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The SPIN Project has been publicised with the purpose of promoting the consumption of sustainable and healthy food. Its mission is to stimulate economic, environmental, and social progress in rural areas by incorporating sustainable protein sources into the Mediterranean Diet. It includes new protein sources: insects; non-native fish species, such as the Silurus glanis (European catfish) in the Tagus River; leguminous protein such as Cicer arietinum (Grão-de-bico) and Lathyrus sativus (chícharo), and regeneratively produced bovine proteins. These sources of healthy and sustainable protein will serve as the basis for innovating new products in line with market trends, contributing to reducing greenhouse gas emissions, optimising the use of natural resources, and preserving biodiversity, thus reinforcing the sustainability of value chains. This project is funded by PRR - NextGenerationEU.

For more information: https://lisbonfoodaffair.fil.pt/

INFORMATION #3

— SPREADABLE HEALTHY CREAMS PROTEIN+, Vth LQRC-CIEQV MULTIDISCIPLINARY CONFERENCE

On 14th December 2023, researchers from the LQRC-CIEQV participated in the among the accomplished presenters, Gabriela Basto de Lima presented the short-term project, “Spreadable Healthy Creams Protein+”. This project has successfully brought together researchers from diverse scientific domains, united under the patronage of Life Quality Research Centre. The collaborative effort aims to explore and innovate in the realm of healthy and protein-enriched spreadable creams.

LQRC-CIEQV Team: Gabriela Basto de Lima (Coordinator), Adelaide Oliveira, Marília Henriques, Marisa Correia, Nair Cunha, Paula Pinto, Paula Ruivo, Pedro Oliveira, Regina Ferreira, Susana Alves, Vanda Andrade.

INFORMATION #4

— 12th IWACP - INTERNATIONAL WORKSHOP ON ADVANCES IN CLEANER PRODUCTION, Stellenbosch - South Africa, 23 and 24 November 2023

Oral communication: Strategies for carbon footprint reduction of wine production.

Presented by Artur Saraiva, Professor from Escola Superior Agrária de Santarém.
Team: Artur Saraiva[1,2], Joana Portugal Pereira[3]; José de Melo e Abreu[4] & Margarida Oliveira[1,2,5].
[1] Escola Superior Agrária de Santarém (ESAS); [2] LEAF Linking Landscape, Environment, Agriculture and Food Research Center; [3] Universidade Federal do Rio de Janeiro (UFRJ); [4] Instituto Superior de Agronomia – Universidade de Lisboa (ISA-UL); [5] Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: Proceedings of the 12th International Workshop, Stellenbosch, South Africa. November 23nd and 24nd, 2023, p.45.
http://www.advancesincleanerproduction.net/12th/files/proceedings_12th.pdf

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INFORMATION #5

— SCIENCE AND TECHNOLOGY WEEK - INSECTS THE PROTEIN OF THE FUTURE! ESAS 22 November 2023.

Oral communication: Insects and health.

Presented by Vanda Andrade, Professor from Escola Superior Agrária de Santarém.
Team: Vanda Andrade[1,2], Nair Cunha[1,2], Paula Ruivo[1,2] & Paula Pinto[1,2].

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[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://www.ipsantarem.pt/esas-semana-da-ciencia-e-tecnologia/

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INFORMATION #6

— IMPACT SCIENCE'23 CONFERENCE 1-2 OCTOBER 2023, RESEARCHERS FROM ESA-IPSANTARÉM

On 1st and 2nd of October of 2023, occurred the IMPACT SCIENCE 23 International Conference, in the Polytechnic University of Santarem. This multidisciplinary conference was organized by the Research Unit of Polytechnic University of Santarem and the aimed to promote:

a) Exchange of knowledge and cooperation between 4 scientific domains: Life and Health Sciences, Natural Sciences and Environment, Social and Human Sciences, Exact Sciences and Engineering.
b) Integration of students in scientific events and their training for presenting research results.
c) Dissemination and exploration of the European Project PREDICT - jobs of the future with AI 4 VET inclusion.

Integrated members and collaborators of the LQRC-CIEQV scientific area of Food production and technology / Food behavior" were authors and co-authors in 6 oral communications and 21 poster communication, in three main areas:

- Sustainability – short agri-food circuits, agricultural practices, water management, nano fertilizers.
- Consumers' behaviors, including food waste, consumption of alternative protein sources such as insects, labelling, and Mediterranean Diet.
- Development of novel foods.

The abstracts are available at Proceedings of the International Conference IMPACT SCIENCE'23 Revista UIIPS, Vol. 11 No. 3

For more information: https://revistas.rcaap.pt/uiips/issue/view/1716

Oral communication at Impact Science'23 Conference:

1. **Allergenicity risk of edible insects, a systematic review of human studies.** Presented by Vanda Andrade, Professor from Escola Superior Agrária de Santarém. Team: Vanda Andrade[1,2], Nair Cunha[3], Paula Ruivo[1,2] & Paula Pinto[1,2].

   [1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]Master's student in Food Techonology - Escola Superior Agrária de Santarém.

   For more information: https://doi.org/10.25746/ruiips.v11.i3.32027

2. **Preliminary study of the biochemical composition of the muscle of European catfish (*Silurus glanis*) caught in the Tagus River, Portugal.** Presented by Ana Teresa Ribeiro, Professor from Escola Superior Agrária de Santarém.

   For more information: https://doi.org/10.25746/ruiips.v11.i3.32441

3. **Development of pitaya jelly for industrial and gastronomic applications.** Presented by Tânia Canais, Master student in Food Techonology. This work was performed as part of her master thesis entitled "Development of pitaya jelly for industrial and gastronomic applications". This study was carried out in collaboration with the Escola Superior de Hotelaria e Turismo do Estoril, where a dark chocolate bonbon was developed with the pitaya jelly mentioned above. Team: Tânia Canais[1], Ana Neves[2], Manuela Guerra[3], Marília Henriques[2,4] & Gabriela Basto de Lima[2,4].

   [1]Master student in Tecnologia Alimentar - Escola Superior Agrária de Santarém; [2]Escola Superior Agrária de Santarém (ESAS); [3]Escola Superior de Hotelaria e Turismo do Estoril (ESHTE); [4]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

   For more information https://doi.org/10.25746/ruiips.v11.i3.32470

4. **Study of cultural and oenological adaptation of Croatian grape varieties to the territory of the Municipality of Alenquer.** Presented by Ana Isabel Marques, Agronomy graduate student at the Escola Superior Agrária de Santarém.Team: Ana Marques[1], Paulo Franco[2], Jorge Cunha[3], José Eira-Dias[3], Ricardo Noronha[4], João Inácio[4], Ana Figueiredo[5], Miguel Policarpo[5], Paulo Marques[2], Helena Mira[1,6].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Câmara Municipal de Alenquer; [3]Instituto Nacional de Investigação Agrária e Veterinária – Polo de Dois Portos; [4]Adega Cooperativa da Labrugeira; [5]Associação dos Viticultores de Alenquer; [6]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32509

5. **Precision management in water resources - practical demonstration cases.** Presented by Artur Saraiva, Professor from Escola Superior Agrária de Santarém. Team: Artur Saraiva[1,2], Raquel Saraiva[1,2], Anabela Grifo[1,3], Albertina Ferreira[1,3], Mafalda Ferreira[1,3], Samuel Guerreiro[1,3], Nuno Barba[1], Ana Paulo[1] & Margarida Oliveira[1,4].

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[1]Escola Superior Agrária de Santarém (ESAS); [2]LEAF Linking Landscape, Environment, Agriculture and Food Research Center; [3]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [4]CERNAS – Centro de Recursos Naturais, Ambiente e Sociedade.

For more information: https://doi.org/10.25746/ruiips.v11.i3.32547

6. **Low-cost systems for monitoring and control of agro-industrial wastewater treatment.** Presented by Artur Saraiva, Professor from Escola Superior Agrária de Santarém. Team: Artur Saraiva[1,2], Joana Portugal Pereira[3]; José de Melo e Abreu[4] & Margarida Oliveira[1,2,5].

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[1]Escola Superior Agrária de Santarém (ESAS); [2]LEAF Linking Landscape, Environment, Agriculture and Food Research Center; [3]Universidade Federal do Rio de Janeiro (UFRJ); [4]Instituto Superior de Agronomia – Universidade de Lisboa (ISA-UL); [5]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32548

Poster communication at Impact Science'23 Conference:

1. **Criteria, Concerns, and Rewards: Towards Sustainable Consumer Behavior in Portugal**. Team: Paula Pinto[1,2], Maria Figueiredo[3], Inês Ferrão[3] & Renata Narciso[3].

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[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]Graduate student in Qualidade Alimentar e Nutrição Humana in Escola Superior Agrária de Santarém.

For more information: https://doi.org/10.25746/ruiips.v11.i3.31940

2. **Exploring Factors and Attitudes Towards Household Food Waste: A Study on Consumer Concerns and Practices.** Team: Paula Pinto[1,2], Jandira Valente[3], Leonor Pessoa[3], Vanessa Fazeres[3] & Julia Otlowska[3].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]Graduate student in Qualidade Alimentar e Nutrição Humana in Escola Superior Agrária de Santarém.

For more information: https://doi.org/10.25746/ruiips.v11.i3.32140

3. **Novel Foods – exploratory study about their acceptance in a sample of young adults.** Team: Paula Pinto[1,2], Beatriz Agostinho[3], Rafael Barros[3], Telma Esteves[3] & Wilson Lopes[3].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]Graduate student in Qualidade Alimentar e Nutrição Humana in Escola Superior Agrária de Santarém.

For more information: https://doi.org/10.25746/ruiips.v11.i3.32140

4. **Maize crop cycle: vegetation cover analysis using Sentinel-2 derived vegetation indices.** Team: Anabela Grifo[1,2], António Palminha[1] & Albertina Ferreira[1,2].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32349

5. **Adaptation of broccoli varieties (Brassica oleracea L. var. italica Plenck) to mechanical harvesting.** Team: Artur Amaral[1,2] & Tiago Reis Madeira[1].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32373

6. **Chitosan as a biostimulant component in nanofertilizers.** Team: Raquel Saraiva[1,2], Quirina Ferreira[3]; Gonçalo Rodrigues[2] & Margarida Oliveira[1,4].

[1]Escola Superior Agrária de Santarém (ESAS); [2]LEAF Linking Landscape, Environment, Agriculture and Food Research Center; [3]iNOVA4Health, NOVA Medical School; [4]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32436

7. **The impact of Mediterranean Diet in Cancer: a narrative review.** Team: Paula Pinto[1,2], Vanessa Roque[3] & Rui Jorge[4,5].

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[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]Master's student in Tecnologia Alimentar - Escola Superior Agrária de Santarém; [4] Instituto Politécnico de Leiria - Escola Superior de Saúde; [5]Polo de Literacia Digital e Inclusão Social (CIAC).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32448

8. **Consumer behavior and labeling: narrative review of the literature.** Team: Paula Pinto[1,2], Catarina Conceição[3], & Rui Jorge[4,5].

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[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]Master student in Tecnologia Alimentar - Escola Superior Agrária de Santarém; [4]Instituto Politécnico de Leiria - Escola Superior de Saúde; [5]Polo de Literacia Digital e Inclusão Social (CIAC).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32468

9. **Iron deficiency and iron deficiency anemia in children up to 5 years of age in African countries: A review of the literature.** Team: Paula Pinto[1,2], Celisa Sanches[3] & Rui Jorge[4,5].

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[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]Master student in Tecnologia Alimentar - Escola Superior Agrária de Santarém; [4]Instituto Politécnico de Leiria - Escola Superior de Saúde; [5]Polo de Literacia Digital e Inclusão Social (CIAC).

For more information: https://doi.org/10.25746/ruiips.v11.i3.i3.32471

10. **Qualitative evaluation of a sample of preschool menus in the region of Alenquer.** Team: Paula Pinto[1,2], Maria Paula Alves[3] & Rui Jorge[4,5].

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[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]Master student in Tecnologia Alimentar - Escola Superior Agrária de Santarém; [4]Instituto Politécnico de Leiria - Escola Superior de Saúde; [5]Polo de Literacia Digital e Inclusão Social (CIAC).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32472

11. **On the way to sustainability: OASIS framework for assessing agroecological transition.** Team: Paula Ruivo[1,2], Maria do Céu Godinho[1,2], Mafalda Ferreira[1,2], Rosa Coelho[1,2] & Ana Nunes[3].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]Centro Operativo e Tecnológico Hortofrutícola Nacional (COTHN-CC).

For more information: https://doi.org/10.25746/ruiips.v11.i3. i3.32497

12. **Contribution to the Study of Nature Tourism in the Paul do Boquilobo Natural Reserve.** Team: Márcia Queiroz[1], Fernando Pereira[2], Paula Ruivo[3,4] & Ana Paulo[3].

[1]Graduate student in Educação Ambiental e Turismo de Natureza – Escola Superior de Educação de Santarém (ESES); [2]Instituto da Conservação da Natureza e das Florestas (ICNF); [3]Escola Superior Agrária de Santarém (ESAS); [4]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32504

13. **Short Agri-Food Circuits: Challenges and Interventions for a Resilient and Sustainable Economy.** Team: José Carvalho[1] & Paula Ruivo[1,2].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32505

14. **Effect of direct coverage on melon with thermal blanket.** Team: Artur Amaral[1,2], Ana Carolina Marques[3], João Bernardo[3], Maria João Jorge[3] & Samuel Sequeira[3].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3] Graduate students in Agronomia.

For more information: https://doi.org/10.25746/ruiips.v11.i3.32510

15. **Digital Elevation Model: comparative study of data from different sources.** Team: Albertina Ferreira[1,2], Anabela Grifo[1,2] & Ana Cláudia Charana[1].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://doi.org/10.25746/ruiips.v11.i3.32513

16. **Effect of cultural precedent on a cover culture.** Team: Artur Amaral[1,2], Tiago Reis[1], Ângela Prazeres[1] & Mama Baldé[3].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]Master student in Agronomia.

For more information: https://doi.org/10.25746/ruiips.v11.i3.32526

17. **SPIN Project – Sustainable ProteIN.** The SPIN Project approved under the PRR addresses four opportunities, spread over four rows, focused on obtaining healthy and sustainable protein, which allows contributing to the development of new products and following new consumption trends. Team: Igor Dias[1,2,3] (Coordinator), Ana Ribeiro[1,3], António Raimundo[1,3], Ana Neves[1], Artur Amaral[1,3], Helena Mira[1,3], João Gago[1,4], Paula Ruivo[1,3,5], Nuno Alvarenga[6], Maria Lima[1,3], Paula Pinto[1,3,5] & Margarida Oliveira[1,5,7].

[1]Escola Superior Agrária de Santarém (ESAS); [2]MED - Instituto Mediterrâneo para a Agricultura, Ambiente e Desenvolvimento & CHANGE - Global Change & Sustainability Institute; [3]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [4]MARE, Centro de Ciências do Mar e do Ambiente, Faculdade de Ciências da Universidade de Lisboa; [5]CERNAS – Centro de Recursos Naturais, Ambiente e Sociedade; [6]UTI, Unidade de Tecnologia e Inovação, Instituto Nacional de Investigação Agrária e Veterinária; [7]LEAF Linking Landscape, Environment, Agriculture and Food Research Center.

For more information: https://doi.org/10.25746/ruiips.v11.i3.32546

18. **Impact of peas (*Pisum sativum L.*) in crop rotation with maize (*Zea mays L.*).** Team: Artur Amaral[1,2], António Palminha[1], Maria do Céu Godinho[1,2], Artur Saraiva[1,3], Albertina Ferreira[1,2], Anabela Grifo[1,2] & Margarida Oliveira[1,3,4].

[1]Escola Superior Agrária de Santarém (ESAS); [2]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [3]CERNAS – Centro de Recursos Naturais, Ambiente e Sociedade; [4]LEAF Linking Landscape, Environment, Agriculture and Food Research Center.

For more information: https://doi.org/10.25746/ruiips.v11.i3.32551

19. **Biorefinery for the production of a Biofungicide.** Team: Jéssica Torrão[1], Mónica Contente[1], Tomás Carraço[1], João Reis[2], Ana Neves[2], & Margarida Oliveira[2,3,4].

[1]Graduate Student in Biologia e Biotecnologia Alimentar; [2]Escola Superior Agrária de Santarém (ESAS); [3]CERNAS – Centro de Recursos Naturais, Ambiente e Sociedade; [4]LEAF Linking Landscape, Environment, Agriculture and Food Research Center.

For more information: https://doi.org/10.25746/ruiips.v11.i3.32552

20. **Extraction and Separation of Photosynthetic Pigments.** Team: Ana Carmo[1], Catarina Martins[1], Sara Gusmão[1], João Reis[2], Maria Gabriela Lima[2,3], & Margarida Oliveira[2,4,5].

[1]Graduate Student in Biologia e Biotecnologia Alimentar; [2]Escola Superior Agrária de Santarém (ESAS); [3]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV); [4]CERNAS – Centro de Recursos Naturais, Ambiente e Sociedade; [5]LEAF Linking Landscape, Environment, Agriculture and Food Research Center.

For more information: https://doi.org/10.25746/ruiips.v11.i3.32554

21. **Water use efficiency in maize crop under 4 irrigation systems.** Team: Margarida Oliveira[1,2], Artur Amaral[1,3], Diogo Cascareja[1] & Gonçalo Rodrigues[1].

[1]Escola Superior Agrária de Santarém (ESAS); [2]LEAF Linking Landscape, Environment, Agriculture and Food Research Center; [3]Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

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INFORMATION #7

— 2nd NETWORK OF HIGHER EDUCATION INSTITUTIONS FOR THE SAFEGUARDING OF THE MEDITERRANEAN DIET CONGRESS

2nd MEDITERRANEAN DIET AND GASTRONOMY INTERNATIONAL CONFERENCE - MULTIDISCIPLINARITY AT THE TABLE

On 28 and 29 of September was held at Évora University the 2nd Congress of the Network of Higher Education Institutions for the Safeguarding of the Mediterranean Diet;

2nd International Conference on the Mediterranean Diet and Gastronomy - Multidisciplinarity at the Table.

Margarida Oliveira1,2, Paula Ruivo1,2 & Igor Dias1,2 were Members of the Scientific Committee.

Igor Dias attended on Round Table discussion Territorial Cohesion - Territory and Sustainable Development.

1Escola Superior Agrária de Santarém (ESAS); 2LEAF Linking Landscape, Environment, Agriculture and Food Research Center; 3Life Quality Research Center – Centro de Investigação para a Qualidade de Vida (LQRC-CIEQV).

For more information: https://www.mediterraneanconference2023.com/

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03

INTERVIEW #1

— Entrevista a Elsa de Jesus Centeio Valério

Elsa de Jesus Centeio Valério [1,2]
[1] ESA – Santarém Polytechnic University
[2] Life Quality Research Centre
Ciência ID 1015-BC9B-0FB7

Brief curricular presentation

Elsa de Jesus Centeio Valério has a PhD in Agronomy (University of Évora, 2010) and is a professor and researcher at the Polytechnic Institute of Santarém - School of Agriculture (IPSantarém-ESA). She has been responsible for Curricular Units in Agricultural Sciences with a special focus on horticulture. She is an integrated member of the Life Quality Research Centre (CIEQV-LQRC), with a focus on the Agricultural Scientific Area. She works in the fields of Horticulture, soil sciences, agroecology, organic farming, and preservation of natural resources. Currently, the determination of soil biological quality through arthropods and annelids bioindicators is the focus of her research. She specializes in soil arthropod biodiversity in intensive horticultural systems. She has published more than 50 scientific papers and abstracts, served as the first author of

2 books, author, and co-author of several book chapters, over 25 oral communications, and over 40 poster presentations. Elsa has participated in the revision of articles for journals and conferences and Organization/Scientific Committees of Technical-Scientific Events. Participated in over 50 training actions. Participated as a member of over 18 national projects with a focus on horto-industrial crops, soil sciences, and agroecology.

What are your goals as a CIEQV member?

My main goal is to contribute to the achievement of enhanced production in the global domain of LQRC-CIEQV – the Quality of Life – and in the specific scientific area of agriculture, specially in healthy and sustainable food.

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What are your most important research projects? Develop one of the indicated projects.

There are several projects I have been involved. Since 2017, through an important and winning project on various occasions (MaisSolo project), we formed a support team that has been working to this day on improving soil quality and consequently, the conservation of natural resources and human health. This project propelled the development of other projects such as Soilife 1st, currently ongoing, with Polytechnic Institute of Santarém - School of Agriculture, as the promoter. The 2030 Agenda for Sustainable Development has integrated several goals in the field of soils, including those related to soil recovery. It focuses on implementing sustainable management practices that progressively improve soil quality and minimize contamination, contributing to climate change adaptation, mitigation of its effects, combating desertification, and promoting biodiversity. In this context, our project was developed with the aim of soil preservation which is essential for food production and safety, nutrient cycling, filtration, and purification of thousands of km3 of water every year, which is fundamental for climate regulation. This project aims to recover horticultural systems in the Lezíria do Tejo, Oeste, and coastal Alentejo, where intensive monoculture systems predominate, with high levels of agronomic intervention, that lead to biodiversity loss, fertility loss, progressive soil degradation, water quality degradation in the soil, and storage difficulty. In these systems, there is an emergence of phytosanitary problems that tend to worsen in the current context of climate change. The introduction of cover crops based on legume and grass intercropping in the technical itinerary of intensive monocultures promotes improvements in the physical-chemical conditions of the soil, increased production of main crops, along with soil and biodiversity, conserving water quality and its management are of extreme importance, with special attention to groundwater, whose protection is considered a strategic territorial objective of the utmost importance, within the framework of balanced and sustainable development.

Knowing that knowledge must be transferred to society, how can the area of scientific research and professional intervention in which you are involved contribute to uniting theory with practice?

Sustainable agri-ecosystems are a decisive area if a better quality of life is to be achieved. The biggest part of the research conducted in this scientific area comes from challenges that emerge from real situations. Most of our projects have been designed to solve production problems, in which all the agents involved in the process act as direct partners, from farmers, and researchers, to the consumers themselves. Researchers in this area always try to overcome the boundaries between theory and practice with a lot of operative proposals.

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Considering that the LQRC-CIEQV promotes research on the quality of life, what are the practical implications of the research it develops?

As I mentioned in the previous response, sustainable agri-ecosystems are farming systems that aim to meet the needs of current and future generations while minimizing negative impacts on the environment. The importance of these ecosystem services, particularly carbon sequestration, water quality maintenance, and biodiversity conservation, cannot be overstated in their contribution to human quality of life. Recognizing and valuing these services is crucial for promoting sustainable development practices, fostering resilience to environmental changes, and ensuring the long-term well-being of both humans and the planet. Therefore, efforts to conserve and restore ecosystems must be prioritized to safeguard these invaluable services for current and future generations.

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INTERVIEW #2

— Entrevista a Maria do Céu Godinho

Maria do Céu Godinho[1,2]
[1] ESA – Santarém Polytechnic University
[2] Life Quality Research Centre
Ciência ID E51B-5B36-02BA

Brief curricular presentation

Maria do Céu Godinho holds a degree in Agronomic Engineering and a master's degree in integrated Pest Management from the Instituto Superior de Agronomia, University of Lisbon. She has been a professor at Santarém Polytechnic University where she is responsible for the curricular units in the area of plant protection. Member of the IPSantarem Research Unit (UIIPS) and the Quality of Life Research Centre (CIEQV).She has completed postgraduate training courses in Plant Protection at institutions such as Wageningen University (Netherlands), Imperial College (Univ. London) and CAB-Institute of Entomology (London). Participates in several national and European projects with special focus on the coordination of PRR - Soilife1st. Participates as a trainer to agents of the sector in integrated protection. Assumes orientation and co-orientation of Bachelor and Master thesis. She has been Chairman of the Board of the COTHN General Assembly since 2015 and a member of the APH Board. Author and co-author of technical and scientific papers and book chapters in the field of plant protection.

What are your goals as a CIEQV member?

As a member of the LQRC-CIEQV, I am committed to advancing knowledge in the field of agroecology by fostering collaboration and innovation, and by effectively communicating our findings to both the scientific community and farmers. I actively engage in research projects within our group, contributing through the design of experiments and providing valuable insights. By collaborating with other members, I leverage diverse expertise and perspectives, leading to more comprehensive and impactful research outcomes. I prioritize continuous learning, acquiring new skills, techniques, and knowledge relevant to sustainable food systems, thereby enhancing my contributions to our group's research efforts. Furthermore, I prioritize building relationships with researchers from other institutions to broaden our collaborative network and explore new research opportunities. I am actively involved in the continuous process of writing and submitting grant proposals to secure funding for our research projects, ensuring the sustainability and growth of our endeavors in agroecology.

What are your most important research projects? Develop one of the indicated projects.

Currently, our team is actively engaged in two significant projects: SoiLife1st and RedeSusterra. The SoiLife1st project, accessible at https://soilife1st.webnode.pt/, focuses on adapting production systems within the context of climate change. This initiative has received approval under the Plano de Recuperação e Resiliência (PRR) and the Agenda de Inovação para a Agricultura 2030. Coordinated by IPSantarém, the Consortium includes INIAV, COTHN, AIHO, CAMPOTEC, FERTIPRADO, as well as various small and medium-sized companies. With a regional focus on Ribatejo, Oeste, and Alentejo Litoral, the project aims to promote soil conservation tailored to agricultural systems, foster innovation in water management, and facilitate knowledge sharing through co-creation. The project's objectives are designed to ensure: i) Increased area under cover crops, ii) Enhanced crop diversity, soil health, and biodiversity, iii) Promotion of natural-based solutions, iv) Improved water management practices, v) Enhanced engagement of farm managers in adopting recommended techniques, and vi) Greater availability of solutions for integration into organic production and low-carbon agriculture. The SoiLife1st project received funding following PDR MaisSolo project. This pivotal phase has been instrumental in establishing a network involving various stakeholders crucial for agroecological and climatic transitions. The primary goal of this project was to facilitate knowledge transfer and demonstrate the efficacy of agricultural practices that promote system sustainability. Consequently, the project has been recognised and selected as a nominee for the EIP-AGRI Innovation Awards 2024.

Knowing that knowledge must be transferred to society, how can the area of scientific research and professional intervention in which you are involved contribute to uniting theory with practice?

Research on agroecology has significant potential to contribute to the union of theory and practice by addressing the challenges faced by agricultural systems while promoting sustainability, biodiversity, and social equity. Firstly, the promotion of the more sustainable farming practices by studying ecological principles and traditional farming practices, we can identify innovative techniques that enhance soil health, water conservation, and biodiversity while maintaining or increasing crop yields and integrating traditional knowledge, since agroecological research often involves working closely with farmers and communities to incorporate traditional knowledge into modern agricultural systems. Another aspect is

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the ecosystem services issues. Agroecology promotes the interactions between crops and natural ecosystems. Empowering farmers and scaling up agroecological practices conducting on-farm trials, demonstrations, and extension programs, we can facilitate the widespread adoption of agroecological principles and practices among farmers, policymakers, and agricultural stakeholders. In addition, advocating for policy decisions, engaging with policymakers and civil society organizations, our work can influence agricultural policies. Agroecology plays a crucial role in bridging the gap between theory and practice by generating knowledge that is relevant, accessible, and actionable for farmers, policymakers, and society. Through interdisciplinary collaboration, community engagement, and a commitment to sustainability, agroecological research can contribute to building more resilient, equitable, and environmentally friendly food systems.

Considering that the LQRC-CIEQV promotes research on the quality of life, what are the practical implications of the research it develops?

Agroecology research can improve food security. Agroecological practices promote diverse cropping systems, which can enhance resilience to climate change by increasing agricultural productivity and promoting local food production. Agroecology contributes to food security, ensuring that communities have access to nutritious and affordable food. Additionally, agroecological practices prioritize environmental conservation, including soil health, water conservation, and biodiversity conservation, reducing synthetic inputs such as pesticides and fertilizers and can create opportunities for rural livelihoods and economic development. Overall, agroecology research has the potential to contribute significantly to improving the quality of life for individuals and communities by promoting sustainable food systems, enhancing environmental quality parameters, fostering social equity, and building resilience to global challenges such as climate change and food insecurity.

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04
ARTICLES

ARTICLE #1

– Sustainable farming practices: adapting land cover to land use[1]


Anabela Grifo[1,2,3] & Albertina Ferreira[1,2,3]
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3 UI_IPSantarém, Unidade de Investigação do Instituto Politécnico de Santarém
Ciência ID E71C-28EF-9505 & 251A-9EAD-6A57

Abstract

Land use management is important for preserving the environment. To achieve more sustainable agriculture, capable of producing better quality products with less environmental impact, it is necessary to know the soil, its occupation, and the most appropriate occupation. The main of this study was to identify and classify areas of land use and land cover conflicts in an agricultural field, occupied with maize crop and located in the district of Santarém (8.637453W; 39.320977N). To accomplish this goal, we used the soil map, the land use and land cover cartography, the land use capacity map, at scale 1:50000, sheet 27-C, digitalized and georeferenced, the digital elevation model and data from Google Earth Pro, developed in ArcGISTM. Performing a spatial analysis of land use using data from different sources it was possible to identify two conflict zones - overuse (approximately 72%) and suitable (approximately 28%) - which allowed the conclusion that the existent crop is not, for the largest of the field, the most suitable.This work made it possible to delimit conflict zones regarding land

[1] This is an adapted version of the work entitled "Adapting Land Cover to Land Use Capacity: Safe Food Production" presented at the II International Congress CIEQV

use, as well as to have a better perception in spatial terms of the areas that should be explored. Adapting the crop to the type of soil promotes better soil conservation and safer production, contributing to a healthier food system for people and the planet.

Keywords: land cover conflict; land use; mapping; sustainable management.

Introduction

The adequate use of natural resources is fundamental for the preservation of the environment. World population growth puts significant pressure on agriculture, requiring more efficient, sustainable, and socially responsible food production.

Knowing the soil, what its current occupation is and what occupation would be appropriate, is a valuable contribution to a more sustainable agriculture, capable of producing better quality products with less environmental impact.

In this context, Geographic Information Systems (GIS) play a crucial role by being integrated into the agricultural production process. GIS, together with other technologies such as Global Navigation Satellite Systems, remote sensors, data acquisition systems and sensors, computer science and diverse agricultural machinery allow us to reduce the costs of monitoring crops, soil, and the environment, and convert this data into useful and relevant information (Bilotta et al., 2023; Javaid et al., 2022; Kumhálová et al., 2014; Schellberg et al., 2008). GIS are relevant in promoting sustainability as because they make it possible to collect of spatial and temporal data and thus identify critical areas and monitor changes in land use, leading to more efficient management of natural resources and more conscious decision-making (AbdelRahman, 2023).

Mandal et al. (2020) used GIS to assess land suitability and suggest which cultural sequences are most suitable. In this study, they found that the adoption of soil recovery measures can transform areas that are unsuitable for the cultivation of certain crops into areas that can be used. Blakeney (2022) also used GIS to determine the most suitable land for peach cultivation and develop a detailed management plan with the aim of eliminating the pollutant load present in the soil. These two studies use GIS to assess the suitability of the land, but these systems can be used in the most diverse areas, namely in the study of climatic characteristics, accessibility parameters, protected areas (Chaudhary et al., 2022), or even in more concrete situations such as the definition and classification of agricultural terraces (Gökçe et al., 2023).

The different occupations of land use and their evaluation promote the development of a great diversity of studies. In Portugal, some of them, use the Soil Use Capacity Chart (SROA) of 1960. This chart had as reference the wheat crop and not the characteristic cultures of the Mediterranean landscape, such as olive groves, vineyards, and orchards. After joining the European Union, some technicians even argue that this type of interpretative maps that aim to assess the suitability of soils no longer makes sense. However, this map, which was based on the characteristics and qualities of the soils described in the Soil Chart (Cardoso, 1965) and the main determinants of limitations or risks of use (SROA, 1972), continues to be one of those used to the management and planning of rural space, provided that, in each situation, it is analyzed with critical capacity. Together with other types of information, such as soil attributes, meteorological data, production factors and soil properties, this map could, through spatial analysis techniques, contribute to differentiating areas with different agricultural potential (Aimrun et al., 2009).

The main of this study was to identify and classify areas of land use and land cover conflicts in an agricultural field, occupied with maize crop. Land use conflict occurs when the land occupation is at odds with its suitability, causing changes that can cause problems in environmental terms, especially about regard to soil conservation. A parcel is considered to have adequate land use when it conforms to its suitability and an overuse situation occurs when the land is being used above its potential.

Material and Methods

The study area (38.5 ha) is located 10 km northwest of Santarém (8.637453W; 39.320977N), close to Vale Figueira. This is a parcel of a farm that is owned by the Escola Superior Agrária de Santarém (ESAS), known as Quinta do Quinto.

The climate of this area is typically Mediterranean (Csa climate according to the Koppen classification). Average annual precipitation is 600 to 700 mm, with a dry season from June to September in which maximum temperatures can exceed 40 °C. Winters are mild, with minimum temperatures that are rarely below 0 °C. The average annual temperature ranges between 16 and 17.5 °C (climatological normal 1931-1960).

The soil maps (1:25000), in digital format, were obtained from the website of the “Direção Geral de Agricultura e Desenvolvimento Rural” (DGADR). The land use capacity map at scale 1:50000, sheet 27-C, was digitized and georeferenced using four points, with known coordinates, in the ETRS89 system (Figure 1a) and 1b)).

The soils in the study area (Figure 1b)) are classified from a pedological point of view as Sbc and Pcs. According to SROA, Sbc soils are classified as “Solos Incipientes – Solos de Baixa (Coluviosolos), Calcários (Para-solos Calcários)”, of medium texture and Pcs soils, “Solos Calcários, Pardos dos Climas de Regime Xérico, Normais, de margas ou materiais afins” (Cardoso, 1965).

The altimetry maps were obtained from the ASTER global digital elevation model which provides a global digital elevation model of Earth's land areas.

To construct the conflict maps, four types of possible results were considered: adequate, moderately adequate, overuse and underuse. A parcel is considered to have adequate land cover when it is in accordance with its suitability. An occupation was considered moderately suitable whenever it is in line with your aptitude but requires greater attention. An overuse situation occurs when the soil is being used above its potential or in such a way that its preservation is not ensured. If land occupation falls short of its potential, there is an occurrence of underuse.

The software used to develop this work was ArcGISTM (ESRI, 2019). We highlight the tools for data editing, geoprocessing, coordinate projection and transformation, and spatial analysis tools.

Results and Discussion

Land use conflict occurs when land occupation disagrees with its suitability, causing changes that can lead to consequential damage to the environment. These conflict situations can cause problems for the environment, especially about to soil conservation. According to the Portuguese soil classification, the existence of "Solos Incipientes" stands out from the use capacity map and the farm's soil map, in a strip that crosses the parcel. Although these soils are genetically little evolved and have a thin surface horizon, they often present an accumulation of organic matter in this horizon. These soils are classified as use class B, that is, as soils with a high capacity for agricultural use, with moderate erosion limitations and risks, susceptible to moderately intensive agricultural use (SROA, 1972). In this case, some soil limitations may occur in the root zone (Class B, subclass s). It was considered that this entire area has adequate cultivation, as it is usually occupied with corn irrigated by a pivot ramp. The remaining area is made up of limestone soils. Regarding land use capacity, the use capacity classes found in this study area essentially correspond to class C. This class considers soils with a moderate use capacity, severe limitations, and high erosion risks (subclass e), being susceptible to low-intensive agricultural use (SROA, 1972), (Figure 1). This area is overused, as it is also occupied by corn, a demanding crop, irrigated by a pivot ramp. The mobilizations necessary for all cultural operations up to the maize “kneeling” stage and/or the occurrence of periods of intense rain will, most likely, cause soil erosion problems.

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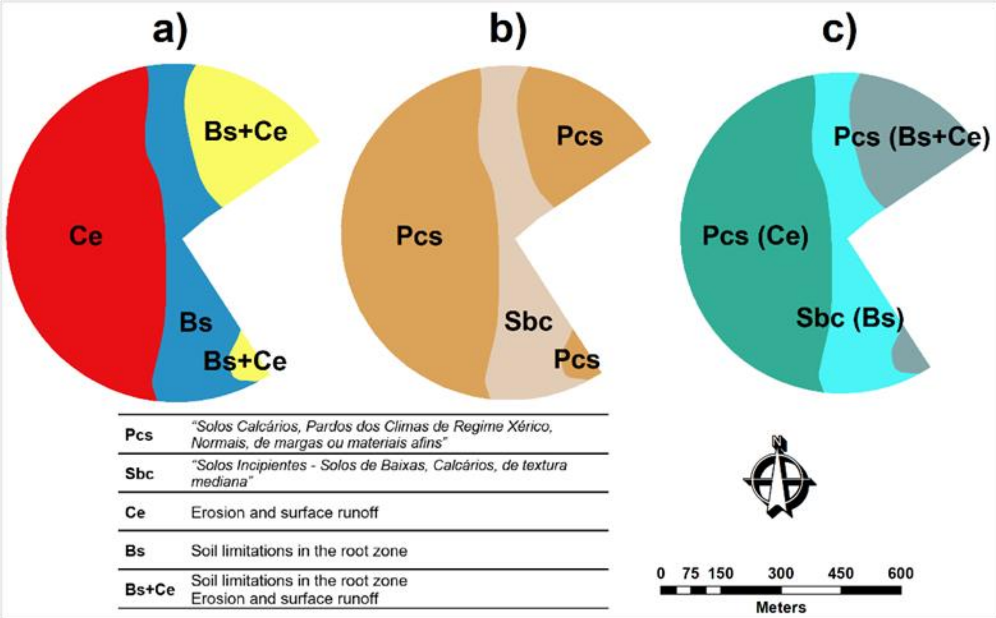

Figure 1: a) land use capacity; b) types of soil; c) land use capacity + types of soil.

It was also found that the area of overuse coincides mostly with the altitude zones above 50 m and the suitable area is mainly located in the lower altitude zones (Figure 2).

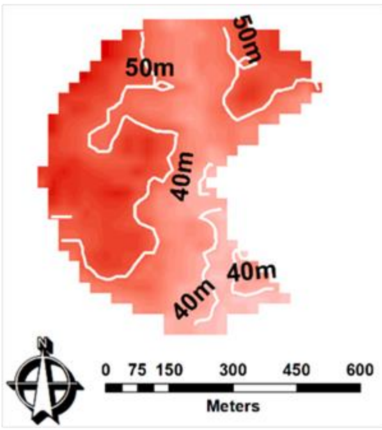

Figure 2: Elevation map.

Thus, the spatial analysis of land use allowed us to identify two zones - overuse (approximately 72%) and suitable (approximately 28%) - which allowed the conclusion that the existent crop is not, for the largest of the field, the most suitable. Therefore, with this parcel being under the influence of the rotary ramp it is suggested to choose soil conservation farming practices and to opt for crop rotations that protect the soil (Figure 3).

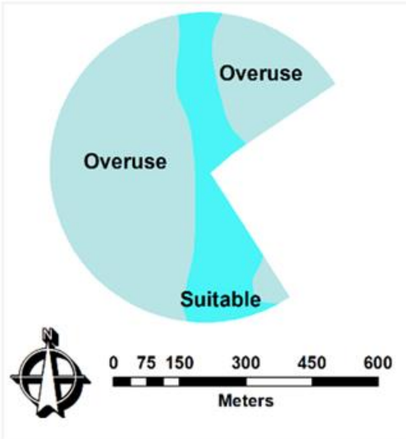

Figure 3: Adapting land use.

Conclusion

The results show that it was possible to identify two distinct zones on the agricultural field: one overused, which should be rethought in terms of culture and farming practices, and another where the crop is suitable for the soil characteristics.

The installation of a crop more suited to the type of soil promotes better soil conservation, promotes biodiversity, guarantees safer food production, contributes to environmental sustainability, and provides an improvement in the lives of consumers.

GIS has proven to be a useful technology, whose potential has made it possible to cross-reference and analyze data, free of charge, from various data sources.

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ARTICLE #2

– Effect of cover crops in soil carbon storage: A Case Study in Ribatejo, Portugal






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[4]LEAF – Linking Environment and Food

Abstract

It is widely believed that the inclusion of cover crops in traditional crop rotation practices can significantly influence soil organic carbon storage, playing a crucial role in climate change mitigation and adaptation strategies. The present study, aimed to assess the potential of cover crops for soil organic carbon storage in monoculture systems in the Ribatejo region of Portugal.Carbon content in aboveground biomass, belowground biomass, and soil was quantified in two monoculture fields in Ribatejo, Portugal

(Carregueira and Chamusca) during 2021/22 and 2022/23 agricultural years. Carbon quantification was conducted following the GSOC MRV protocol (FAO, 2020) and IPCC (2008) guidelines. Experimental modalities in each site were: (CG) Control group maintaining traditional monoculture practices with natural vegetation as a reference and (GL) Introduction of site-specific grass-legume intercropping. In Carregueira, the carbon stored in aboveground biomass was approximately five times higher in grass-legume intercropping (2.26 t ha-1) compared to natural vegetation (0.4 t ha-1). Belowground biomass carbon remained consistent at 1.9 t ha-1. The introduction of grass-legume intercropping increased soil carbon storage. In Carregueira, it reached 28.6 t ha-1 with grass-legume intercropping and 20.6 t/ha with natural vegetation intercropping. In Chamusca, the values were 15.8 t/ha and 12.6 t/ha, respectively. Soil stored the highest carbon content, accounting for 78% to 93% of the total. Root/above ground biomass ratio was similar for the grass-legume cover crop (0.50) in both sites, but different between sites for the natural vegetation (2.68 in Carregueira and 1.11 in Chamusca). Total carbon content ranged from 22.1 t/ha to 31.8 t/ha.This study advances our understanding of cover crop integration and underscores the key contribution of grass-legume cover crops in improving soil carbon storage and promoting sustainable soil management for climate change mitigation. Furthermore, the research persists in a follow up project.

Keywords: carbon sequestration, climate change, horticultural monoculture, soil management, soil quality.

Introduction

The predominant horticultural crop systems in the Portuguese Ribatejo region are widely acknowledged for their high productivity and significant contribution to the national economy. However, these monoculture systems face challenges related with phytosanitary issues, low organic matter content and soil health concerns (Belete & Yadete, 2023; Faye & Braun., 2022). In response to these challenges, the integration of cover crops into monoculture systems has emerged as a promising strategy to enhance soil health and resilience. Specifically, this approach can contribute to increase soil organic carbon (SOC) stocks, which is a fundamental component in mitigating global climate change (Quintarelli, et al., 2022, Lal, 2004) and beneficial for soil fertility. It's well known that SOC provides a crucial carbon reservoir, helping in the reduction of greenhouse gas emissions by sequestering atmospheric carbon dioxide (CO_2) in the soil. Demonstrating the ability to reinforce SOC content, cover crops contribute to carbon sequestration from the atmosphere into the soil (Angers and Eriksen-Hamel, 2008). On the other hand, the amount of soil organic matter influences soil aggregation and structure, preventing erosion and improving water holding capacity and infiltration (Venati et al., 2020, Weil & Brady, 2017). Additionally, soil organic matter serves as a crucial reservoir for nutrients, playing a pivotal role in sustaining soil fertility and ensuring the sustainability of food production (Abad Chabbi et al., 2022 et al, Six et al., 2004; Lal, 2021).

The knowledge regarding soil carbon sequestration in Portuguese horticultural monoculture systems remains limited. To date, only a few studies have investigated potential changes in soil carbon content attributed to sustainable agricultural practices in these specific areas. Therefore, the need for experimental development is crucial to better understand the potential impact of cover crops on SOC levels and their role in soil fertility and climate change mitigation. It's important to note that even a modest rise in the quantity of carbon stored in soils, potentially achieved through changes in agricultural management techniques, can contribute to mitigating climate change if implemented on a large scale (Abad Chabbi et al, 2022).

The demonstration of sustainable agricultural practices, particularly cover cropping, crop diversity, and reduce tillage, on promoting increased SOC stocks is well documented (Jordahl et al., 2023; Restovich et al., 2022; Adetunji et al, 2020; Angers and Eriksen-Hamel, 2008). Recent studies (Rosinger et al., 2023) show that soil characteristics, such as texture, or initial soil carbon content before implementing the improvement practice, are also significantly important. While some soil carbon simulation models (Garsia et al, 2023) already consider these effects to estimate recent and future trends in SOC in agricultural soils at local and regional scale, further studies are necessary to better understand how these factors may impact carbon storage in diverse crops and environments. Additionally, there is a need to adapt these models to different regions beyond their initial development context. The accuracy of model results for a specific region must be validated, ensuring its capability to represent recent and current management practices, demanding minimal input data that aligns with information provided by services and land users.

Additionally, cover crop roots also play a crucial role in the provision of soil ecosystem services by directly interacting with the soil. Their impact on soil processes and properties as highlighted in studies like those of Six et al. (2002), Wilhelm et al. (2004), and Ogilvie et al. (2021), include enhancements in wet-aggregate stability, improved water infiltration, and a reduced risk of soil compaction. Despite the crucial role played by roots and their significant contribution to soil carbon content, as indicated by Mazzilli et al. (2015), most studies examining the benefits of cover crop practices, tend to focus just on the yield of aboveground biomass. To gain a more comprehensive understanding, it is therefore important to explore how different aspects of cover crop management, influence root biomass.

Exploring the use of cover crops in different monoculture systems is therefore crucial for optimizing agricultural practices and for identify suitable cover crop species and their optimal management strategies (Allevato et al., 2022) and important to provide data for validate carbon simulation models.

The present study, conducted under the HortiCover project: Improvement of monoculture agricultural systems using cover crops, aimed to assess the potential of cover crops for soil organic carbon storage in monoculture plantations in the Ribatejo region of Portugal.

Materials & Methods

The field experiments were conducted at two experimental sites: Carregueira (39.3°N; 8.2°W) and Chamusca (39.3°N; 8.5°W), located in Ribatejo, Portugal, during the 2021/22 and 2022/23 agricultural years. In this region, climate type is C_2 B'_2 s2 b'_1 (Thornthwaite, 1948) with hot summers, and most rainfall concentrated between late autumn and spring. In Carregueira, the soil has been classified as *Eutric Fluvisols* (FAO,1974) with coarse texture and in Chamusca as *Calcaric Fluvisols* (FAO,1974) with medium texture.

Experimental modalities in each site were: (CG) Control group maintaining traditional monoculture practices with spontaneous flora, as a reference and (GL) Introduction of site-specific grass-legume intercropping in fall-winter season on tomato (*Solanum lycopersicum*) crop. Each plot was around 1 ha.

Prior to the installation of field plots (November 2021), soil samples were collected to perform physical and chemical characterization. The following measurements were conducted: pH (H_2O), organic matter, available phosphorus and potassium, extractable micronutrients, bulk density, percentage of coarse elements, sand, silt, and clay content.

Carbon storage was accounted for in three pools: aboveground biomass, belowground biomass and soil. In 2021/2022 agricultural year, site-specific grass-legume cover crops were sown, in both experimental sites, on November 15, 2021, and harvesting of aboveground and belowground biomass were carried out on March 23, 2022. On May 10, 2022, processing tomato was planted in Chamusca field plot. Unfortunately, due to water deficit and producer economic constrains, it was not possible to plant in Carregueira experimental field. Harvesting of aboveground and belowground biomass of tomato residues were done on September 26, 2022.

In 2022/2023 agricultural year, excessive precipitation in the fall-winter season made seeding impractical due to soil saturation in Carregueira site. In Chamusca, intense precipitation after the sowing (November 29, 2022) imposed severe limitations on the development and growth of the cover crops. Consequently, harvesting and biomass quantification became impossible.

Carbon content in aboveground biomass, belowground biomass, and soil was quantified following the GSOC MRV protocol (FAO, 2020) and IPCC (2008) guidelines.

For biomass harvesting, a 0.24 m^2 frame was randomly thrown within each plot. Five repetitions were made. All the material that remained within the frame was cut, weighed, and dried at 60°C until constant weight. The relationship between fresh and dry matter and the quantity of carbon was determined. Subterranean biomass retained in a 2 mm mesh sieve (mostly composed of roots, rhizomes, and bulbs) was collected to a depth of 20 cm using 8.5 cm diameter cylinders. The biomass retained in the sieve was cleaned, dried at 65°C to a constant weight, and weighed. The carbon content in the organic matter was estimated using a conversion factor of 0.58 (IPCC, 2008).

The carbon storage in the coarse fraction of subterranean biomass (Root C, tC ha^{-1}) was determined using the equation (FAO, 2019):

$$C\ roots_i = Root\ OC_i \times Root\ M_i \times t_i / V_i \times 0.1 \qquad \text{(eq. 1)}$$

where $C\ roots_i$ is the carbon storage in roots (Mg C/ha) up to depth i; $Root\ OC_i$ is the carbon content (mg C/g) of dried roots, up to depth i; $Root\ M_i$ is the dry weight of dried roots (g) up to depth i; t_i is the considered depth (cm); V_i is the volume of the soil sample from which the roots were extracted (cm^3), and 0.1 is the conversion factor from mg C/cm^2 to Mg C/ha.

To assess soil carbon content, samples were collected from each plot 2-4 weeks before main crop planting. Soil Carbon content was determined, using Tinsley method (acid dichromate oxidation method). Soil organic carbon storage (SOC_i stock), in tons per hectare, was determined following the IPCC equation (FAO, 2020):

$$SOC_i\ stock\ (t\ C\ ha^{-1}) = OC_i \times BDfine_i \times (1 - vG_i) \times t_i \times 0.1 \qquad \text{(eq. 2)}$$

where: $SOC_i\ stock\ (t\ C\ ha^{-1})$ is the amount of carbon stored up to depth i; OC_i is the organic carbon content in the soil (mg C/g of fine soil); $BDfine_i$ is the mass of fine soil (g) per volume of fine soil (cm^3); vG_i is the volumetric fraction of coarse elements (cm^3 of coarse elements/cm^3 of soil); t_i is the soil thickness (cm), and 0.1 is the conversion factor from mg C/cm^2 to Mg C/ha.

Results

Soil characterization

The soils in the study plots had very similar characteristics, with low or very low values for organic matter and extractable zinc, medium values for assimilable potassium, copper and extractable boron and high or very high values for assimilable phosphorus and extractable iron and manganese. Both soils are medium-textured, with less than 0.5 % total limestone and a slightly alkaline pH (Table 1)

Table 1. Physical-chemical characterization of the soils in Carregueira and Chamusca experimental plots.

Soil parameters	**Experimental plots**	
	Carregueira	**Chamusca**
pH (H_2O)	7.9	8.1
O.M. (%)	1.3	0.8
P_2O_5 ass. (mg kg^{-1})	211	226
K_2O ass. (mg kg^{-1})	82	90
Limestone (%)	0	0.5
Fe ext. (mg kg^{-1})	94	89
Cu ext. (mg kg^{-1})	2.6	1.3
Mn ext. (mg kg^{-1})	105	68.8
Zn ext. (mg kg^{-1})	0,7	1.1
B ext. (mg kg^{-1})	0.53	0.69
Bulk density	1.37	1.36
Sand (%)	62	78
Silt (%)	23	10
Clay (%)	15	12
Texture	Loam	Sandy loam
Coarse elements (%)	0.47	0.39

Carbon storage in above-ground biomass

The results of the above-ground green and dry biomass and carbon storage in the cover crops in 2022 are shown in Table 2. As mentioned in material and methods, several constrains during the agricultural year of 2023 prevented the collection of data.

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Table 2. Geen and dry biomass production and organic carbon of above-ground cover crops in the Carregueira and Chamusca experimental fields in the year 2022. (CG) Control group, natural vegetation; (GL) Grass-legume cover crop. Mean values and respective standard deviations.

	Carregueira CG	Carregueira GL	Chamusca CG	Chamusca GL
Green biomass	9.06 ± 3.20^{a}	19.68 ± 7,50^{b}	12.05 ± 3.41^{a}	26.67 ±
Dry biomass (t	0.69 ± 0.17^{a}	3.74 ± 0,66^{b}	1.87 ± 0.86^{a}	5.03 ± 2.30^{b}
Organic carbon	0.40 ± 0,10^{a}	2.17 ± 0,38^{b}	1.23 ± 0,72^{a}	2.92 ± 1.34^{b}

Means with the same lowercase letter between cover crop type and site are not significantly different at $p < 0.05$.

To test for significant differences between above ground biomass of the four plots, an analysis of variance with a significance level of 0.05 was performed. The results indicated significant differences in above-ground biomass production (green and dry) between the CG and GL at both sites. In Carregueira, the GL plot produced around twice as much green biomass and approximately five times as much dry biomass compared to the CG plot. In Chamusca, there was a similar difference in green biomass, which was around twice as high, and in dry biomass, around three times as high. The visible differences in above-ground biomass production between plots with cover crops and those featuring natural vegetation underscore the beneficial influence of cover crops on biomass yield.

When comparing the GL plots between Carregueira and Chamusca, there were no significant differences in biomass production between them. The average value of above-ground green biomass was 23.18 t ha^{-1} and dry biomass was 4.38 t ha^{-2}.

The differences in above-ground biomass were reflected in carbon storage. In Carregueira e Chamusca GL plots, carbon storage was similar, with an average value of 2.26 t C/ha. Carbon storage in the control plots (0.40 t C/ha in Carregueira and 1.23 t C/ha in Chamusca) was around 5 and 2 times lower than carbon storage in the GLI plots in Carregueira and Chamusca, respectively.

The results of the above-ground green and dry biomass and carbon storage in the stubble of the main crop (tomatoe) are shown in Table 3.

Table 3. Geen and dry biomass production and organic carbon of above-ground of tomato crop stubble in Chamusca experimental field in 2022. (CG) Control group, natural vegetation; (GL) Grass-legume cover crop. Mean values and respective standard deviations.

	Chamusca CG	**Chamusca GL**
Green biomass (t	6.19 ± 3.91a	3.50 ± 2.76[a]
Dry biomass (t ha^{-1})	3.78 ± 1.59[a]	2.94 ± 2.42[a]
Organic carbon (t	2.19 ± 0.92[a]	1.70 ± 1.40[a]

Means with the same lowercase letter between cover crop type are not significantly different at $p < 0.05$.

Although data suggests an apparent decrease in biomass and carbon in tomato residue under the GL condition, ANOVA showed that there were no significant differences between plots.

Carbon storage in below-ground biomass

Table 4 shows the results for the below ground biomass and carbon content of cover crops in 2022. Contrary to what happened with above ground biomass, the average production of below ground biomass and carbon storage in the roots of cover crops did not differ significantly between CG and GL, but they did differ between sites (p<0.05). On average, below ground biomass production in the Carregueira plots was 1.87 t ha^{-1} and in Chamusca 2.41 t ha^{-1}. Carbon storage was 1.1 t ha^{-1} in the Carregueira plots and 1.4 t ha^{-1} in Chamusca plots.

Table 4. Dry biomass production and carbon stored in cover crops roots to a depth of 20 cm in Carregueira and Chamusca experimental fields in 2022. (CG) Control group, natural vegetation; (GL) Grass-legume cover crop. Mean values and respective standard deviations.

	Carregueira CG	**Carregueira GL**	**Chamusca CG**	**Chamusca GL**
Dry biomass (t ha^{-1})	1.84 ± 0.07 [a]	1.91 ± 0.17 [a]	2.37 ± 0.51[b]	2.44 ± 0,46 [b]
Organic carbon (t ha-	1.07 ± 0,04 [a]	1.11 ± 0.10 [a]	1.37 ± 0,30 [b]	1.42 ± 0.27 [b]

Means with the same lowercase letter between cover crop type and site are not significantly different at $p < 0.05$.

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Regarding the root biomass of the tomato crop (Table 5), analysis of variance showed that there were no significant differences (*p* = 0.05) in both root dry biomass and carbon storage between the two experimental plots.

Table 5. Dry Root biomass and organic carbon of tomato crop stubble in Chamusca experimental field in 2022. (CG) Control group, natural vegetation; (GL) Grass-legume cover crop. Mean values and respective standard deviations.

	Chamusca CG	**Chamusca GL**
Dry biomass (t ha^{-1})	$1,75 \pm 1,15^{a}$	$0,48 \pm 0,30^{a}$
Organic carbon (t ha^{-1})	$1,02 \pm 0,67^{a}$	$0,28 \pm 0,18^{a}$

Means with the same lowercase letter between cover crop type are not significantly different at $p < 0.05$.

Carbon storage in soil

The results, presented in Table 6, shows the SOC in the two experimental plots before cover crop seedling. Data collected in 2021 represents the initial SOC in each plot (baseline). Although cover crop was not sown in winter fall season of 2022 for reasons already explained, soil samples were also collected in Chamusca field.

Table 6. Soil organic carbon (SOC) to a depth of 20 cm in the plots under study (CG) Control group, natural vegetation; (GL) Grass-legume cover crop.

	year	**Carregueira CG**	**Carregueira GLI**	**Chamusca CG**	**Chamusca GLI**
SOC (t ha^{-1})	baseline, year 1 (october 2021)	20.62		12.69	
	March, 2022	20.62	28.55	12,61	15.76
	Feburary, 2023	-	-	17.45	19.35

The results shows that right after the termination of the cover crop, there appears to be an increase in SOC in the plots where grass-legume cover crops were used. In contrast, no such increase was observed in the control plots with spontaneous flora cover cropping. In 2023, there was a continued increase in SOC levels. Despite the compromised development of the cover crop due to heavy rainfall occurring after its seeding, it is possible that it still had positive effects on soil carbon storage. However, due to the absence of biomass quantification, we cannot definitively state that this was the actual outcome. The observed increase in SOC in plot CG is also challenging to explain, likely attributed to tomato crop residues sown in spring/summer season of 2022.

Total Carbon storage

Figure 1 shows carbon storage in the various compartments considered (above ground biomass, below ground biomass and soil) in the four experimental plots in 2022.

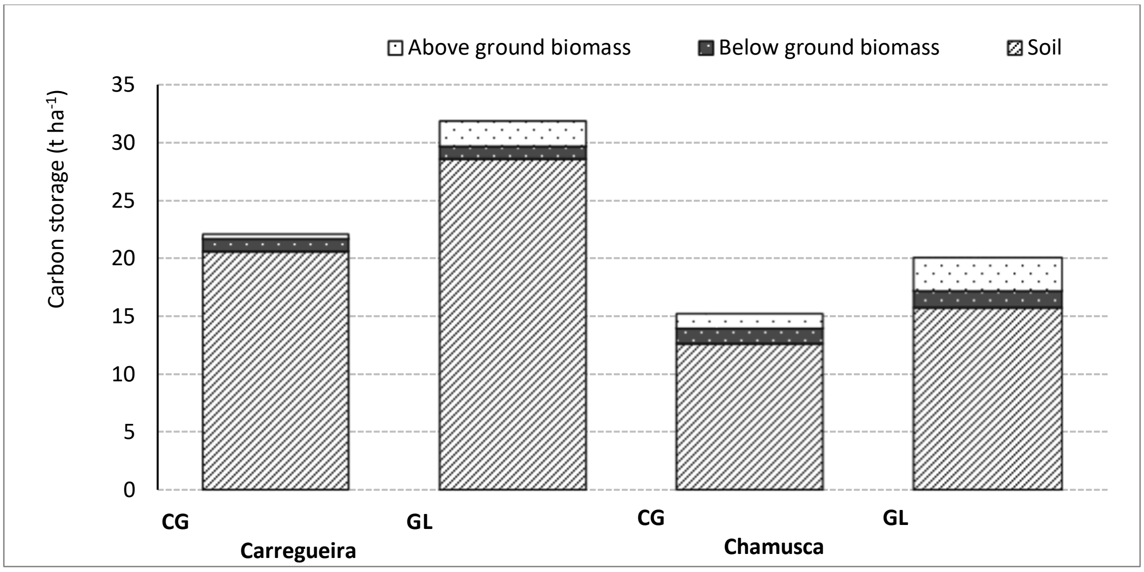

Figure 1. Carbon storage in above ground biomass, below ground biomass and soil in the experimental plots in 2022. (CG) Control group, natural vegetation; (GL) Grass-legume cover crop.

Regardless of the type of cover vegetation (natural or site-specific grass-legume), it was observed that roots stored a significantly higher amount of carbon compared to the above-ground portion of the plants. The biomass distribution between root:above-ground in the grass legume cover crop (GL) remained consistent at both test locations, with an average of 0.5. Regarding natural vegetation, the variation was more pronounced, ranging from 2.7 in Carregueira to 1.1 in Chamusca. These results indicate that in the grass-legume cover crop, a smaller proportion of carbon was allocated to the roots (approximately 33%) compared to natural vegetation (73% - 56%).

The total carbon content varied among the experimental plots, ranging from 31.8 t ha^{-1} (Carregueira GL) to 15.21 t ha^{-1} (Chamusca CG). The compartment that exhibited the highest carbon concentration was the soil, accounting for between 78% and 93% of the total stored.

Discussion

The visible differences in above-ground biomass production between seeded grass-legume and spontaneous flora cover crops, observed in the present study, highlight the considerable potential of a seeded cover crop mixture, to significantly enhance soil quality (Adetunji et al., 2020; Scavo et al. 2022). In fact, the increase in biomass not only promotes better soil cover, reducing erosion (Blanco-Canqui et al., 2015), but also can promote greater addition of organic matter to the soil (Decker et al., 2022). In a 3-year study conducted by Nyabami et al. (2023), to evaluate the effect of different cover crops, on soil organic carbon pools in a subtropical vegetable agroecosystem, it was shown that the incorporation of cover crops increased concentrations of soil organic matter, permanganate oxidizable carbon, and mineralizable carbon, relative to their baseline values in year 1. In that study, concentration of soil organic matter increased after 3 years of cover crop management.

The increase of SOC observed in the present study, indicates rapid organic matter accumulation, after the inclusion of winter grass-legume cover crop into tomato monoculture. After only one year of cover crop management, SOC increase was detected. Other studies also report soil organic matter accumulation in 1 or 2 years after cover crop use. This rapid increase may be associated with the fact that the soil sampling took place shortly after the end of cover crops, which could be prone to transient soil carbon dynamics due to the large carbon inputs from cover crop residues (Castellano-Hinojosa et al., 2022; Freidenreich et al., 2022).

While acknowledging that the evaluation period was very short to measure significant changes, we have observed a clear inclination toward an increase in soil organic matter, particularly noticeable in plots where grass-legume cover crops were sown. It's true that more extended periods are required for an accurate assessment of changes in soil carbon stocks. Indeed, although cover crop cultivation reduces bare fallow periods and losses of organic carbon in the soil, making it an effective strategy for mitigating climate change in agriculture, it is essential to note that cover crops alone cannot transform cultivated areas into carbon sinks (Seitz et al., 2023). In fact, works such as those of Anuo et al. (2023), that studied the effect of cover cropping on soil organic matter characteristics in Nebraska, suggests an overall slow response to cover cropping over a period of five years due to no increase in carbon losses from the topsoil (0–10 cm) and no increase in topsoil SOC storage. They suggest that a period of more than five years is needed for track changes in cover crop biomass production and input into the soil.

Furthermore, the mean values of green biomass (23.18 t ha^{-1}) and dry biomass (4.38 t ha^{-2}) observed in grass-legume cover crops, underscore the substantial potential for carbon sequestration. (Poeplau & Don, 2015; Chahal, 2020; Joshi et al., 2023).

Interestingly, when comparing seeded grass-legume cover crops plots between Carregueira and Chamusca, the absence of significant differences in biomass production and in root:above-ground ratio, suggests a consistent performance of site-specific seeded cover crop mixture in different locations within the region. Biomass stability is a complementary indicator of the productivity of cover crop mixtures, and it indicates the mixture's capacity to perform uniformly under different pedo-climatic conditions (Lavergne et al., 2021). It can serve as an indicator of how a cover crop mixture could consistently offer ecological benefits over different periods and location (Wendling et al., 2019). Besides the target of high biomass production, stability is also a key element of cover crop success. Cover crops are generally grown in a short period and need to achieve high biomass very quickly. However, growing conditions, can be highly variable. It is thus crucial to identify species or mixtures that are adapted to a wide range of pedoclimatic conditions to ensure a good performance (Wendling et al., 2019).

On average, the below-ground biomass production of cover crops ranged from 1.87 t ha^{-1} (Carregueira) to 2.41 t ha^{-1} (Chamusca). These values align with the range reported in Ruis et al. (2020), which indicates that among the limited studies providing results for cover crop root biomass, the root biomass yield values (encompassing both cover crop and main crop) vary from 0.4 to 5.0 t ha^{-1}, with an average of 1.89 ± 1.3 t ha^{-1} for an average soil depth of 0–32 cm. However, it would have been expected that different species would have produced different root biomass values, as observed in other studies (Ruis, et al., 2020; Ogilvie, et al. 2021), but this was not the case. For the same location, root biomass was similar in both modalities.

These outcomes do not appear to be attributed to variations in weather conditions during the study period, as the two locations were proximate and precipitation patterns and amount were comparable between sites. Additionally, the soil characteristics, as evidenced in Table 1, were akin and thus do not provide a justifiable basis for the observed disparities in root biomass between the sites. A more plausible explanation lies in the type and yield of the main crop in the year preceding the start of the project. Residues from the preceding crop, particularly the roots, are likely contributors to the heightened root biomass observed in the Chamusca plots. The research carried out by Hirte et al. (2017), which one of its objectives was to determine the proportion of current crop root biomass carbon compared to the total carbon in root samples obtained from an agricultural field, revealed that only 60% of the root mass extracted from field soil cores constituted the actual crop root biomass from the ongoing season. The study identified a significant source of error in quantifying root biomass for agricultural crops in field conditions, which stems from the presence of extraneous organic matter in the soil. This includes factors such as remnants of dead roots from previous crops, weed roots, incorporation of above-ground plant residues, and organic soil amendments, as well as remnants of soil fauna.

Conclusion

In general, this study evaluating the effect of spontaneous flora and site-specific grass-legume cover cropping in monoculture systems on soil organic carbon storage, concludes with compelling insights into the dynamic interactions between cover crop choices and their impact on soil quality. The differences in above-ground biomass production between seeded grass-legume and spontaneous flora cover, highlight the potential of a tailored cover crop mixture in enhancing soil quality. The observed rise in soil organic carbon content following the inclusion of a winter grass-legume cover crop into tomato monoculture, underscores the rapid organic matter accumulation, detectable after just one year of cover crop management. Moreover, it appears that main crop residues also have a beneficial effect on SOC increase.

In addition, the consistency in biomass production and root:above-ground ratio across different locations within the region suggests the robust performance of site-specific seeded cover crop mixtures, which is essential to recognize plant species or combinations that are well-suited to different growing conditions, to guarantee optimal performance and optimize ecological benefits.

Despite the short evaluation period limiting the assessment of significant changes, the study indicates a clear trend towards increased soil organic matter, particularly in plots where grass-legume cover crops were sown. The mean values of green and dry biomass further emphasize the substantial potential for carbon sequestration within grass-legume cover crops and main crop residues are likely contributors to SOC storage. Overall, this research provides valuable insights into the ongoing discourse on sustainable agricultural practices and their impact on soil organic carbon dynamics. It underscores the importance of nuanced understanding of cover crop interactions to optimize ecological benefits. Furthermore, the research continues through a follow-up project, extending and building upon the initial research findings.

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05

NEWS – PROJECTS UNDER DEVELOPMENT

Project #1

— SPIN – SUSTAINABLE PROTEIN

Igor Dias[1,2]

[1] ESAS – Santarém Polytechnic University

[2] Life Quality Research Centre

Ciência ID 3913-EE5F-8399

Investment RE-C05-i03 - Research and innovation agenda for the sustainability of agriculture, food, and agro-industry No. 15/C05-i03/2021 - PRR-C05-i03-I-000192 Research and Innovation Projects - Promotion of Portuguese Agri-Food Products

Two master students in food technology are performing research under the SPIN project:

- Catarina Conceição is currently carrying out research into the incorporation of *Cicer arietinum* (Grão-de-bico) and *Lathyrus sativus* (chícharo), in the development of new patisserie and pastry products. Her master thesis in Food Technology is entitled - Physico-chemical, microbiological, rheological, nutritional, and sensorial characterization of products supplemented with *Cicer arietinum* (Grão-de-bico) and *Lathyrus sativus* (chícharo).

Supervisors: Ana Teresa Ribeiro[1,2] & Gabriela Basto de Lima[1,2]

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[1]ESAS - Santarém Polytechnic University; [2]Life Quality Research Centre

- Pedro Cláudio, is currently carrying out research into the incorporation of cricket protein in the development of new bakery and beverage products. His master thesis in Food Technology is entitled - Physico-chemical, microbiological, rheological, nutritional, and sensorial characterization of products supplemented with protein from *Acheta domesticus* (domestic cricket).

Supervisors: Igor Dias[1,2] & Gabriela Basto de Lima[1,2]

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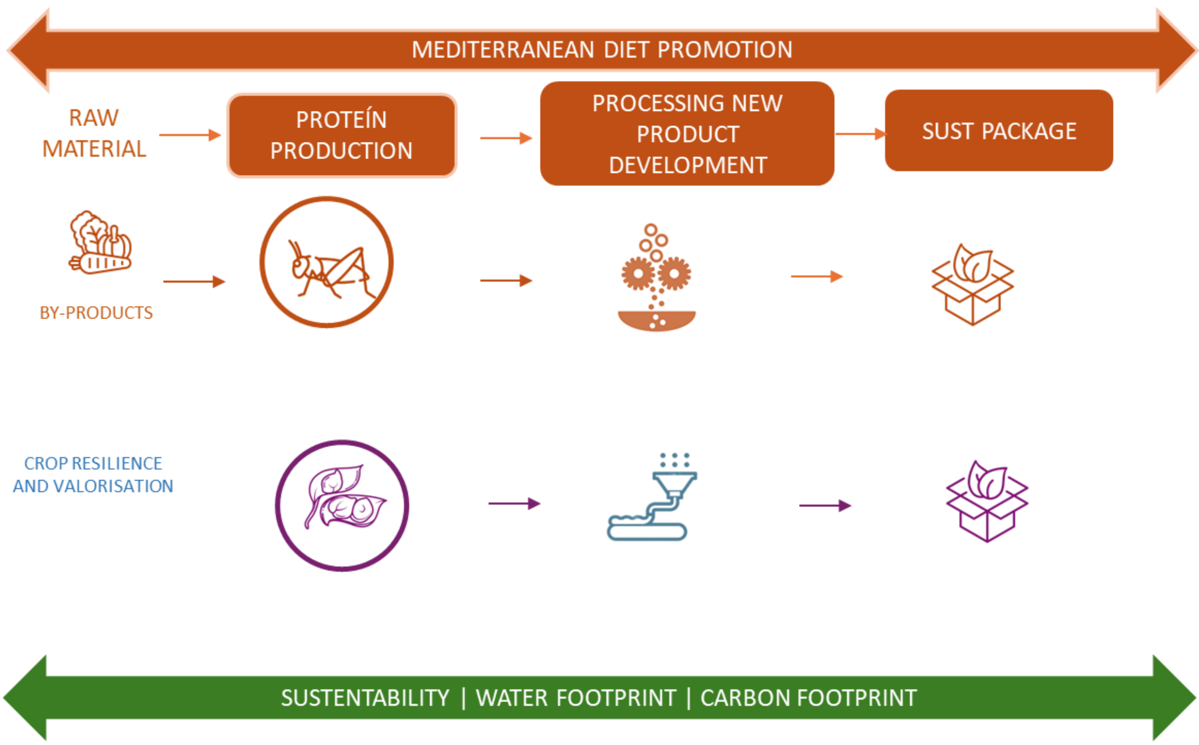
[1]ESAS - Santarém Polytechnic University; [2]Life Quality Research Centre



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Project #2
— SPREADABLE HEALTHY CREAMS PROTEIN+

Maria Gabriela Basto de Lima[1,2]
[1] ESAS – Santarém Polytechnic University
[2] Life Quality Research Centre
Ciência ID A117-6A3B-3265

This project received an honorable mention in its participation in the 4th Multidisciplinary Scientific Research Competition, by LQRC-CIEQV, in 2023. The multidisciplinary is guaranteed bringing together the skills and know-how of LQRC-CIEQV members from all scientific areas.
A master's student in food technology is developing research under the Spreadable healthy creams protein$^+$ project:

Vanessa Roque, is currently carrying out research into the incorporation of cricket protein extracted from cricket powder. In this context, it was proposed to innovate in the creation of prototype(s) of spreads enriched with cricket protein. These water in oil emulsions with protein enrichment in the aqueous phase, are different from what is already produced industrially. It will thus expect to provide a stable, safe, and healthy, supplemented product that satisfies target audiences with specific protein needs. The use of cricket protein isolate allows the formulation of foodstuffs enriched in quality protein and presents very interesting advantages over the use of other alternative protein sources from plants (e.g., soy, milk derivatives…). Her master's thesis in Food Technology is entitled - Development of a New Spreadable Cream Protein$^+$.

Supervisors: Gabriela Basto de Lima[1,2], Paula Ruivo[1,2] & Paulo Bispo[1].

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[1]ESAS - Santarém Polytechnic University; [2]Life Quality Research Centre

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Project #3
— ALIMENTAÇÃO SUSTENTÁVEL.LT (APRODER / CIMLT / DRAP LVT)

Technical-scientific support from ESAS

In January and February 2024, a team of students and teachers from the Escola Superior Agrária de Santarém supported the project Alimentação Sustentável.LT, promoted by GAL APRODER - Associação para a Promoção do Desenvolvimento Rural do Ribatejo (Association for the Promotion of Rural Development in Ribatejo), and its partners CIMLT - Comunidade Intermunicipal da Lezíria do Tejo and DRAPLVT - Direção Regional de Agricultura e Pescas de Lisboa e Vale do Tejo, funded by the PDR2020. Within this framework, activities were developed with the aim of promoting healthy eating behavior and making students aware of the importance of a healthy, balanced, and sustainable diet. Minimizing waste was also considered by teaching the practical activity of composting. The teaching team prepared teaching material to support the activities performed, favoring the consumption of national, regional, and local products in balance with the principles of the Mediterranean Diet. At the same time, the team is collecting information to assess adherence to the Mediterranean Food Pattern in the 21 schools visited in the 11 municipalities of Lezíria do Tejo.

ESAS Team: Paula Ruivo[1,2], Vanda Andrade[1,2], Rute Vitor[1,2], Maria Figueiredo[3], Inês Ferrão[3], Rafael Barros[3], Laura Mendes[4].

[1]ESAS - Santarém Polytechnic University; [2]Life Quality Research Centre; [3]Food Quality and Human Nutrition graduate student; [4]Zootechnics graduate student.

06
PUBLICATIONS

Published Book Chapter:

Saraiva R., Dias I., Grego J., Oliveira, M. 2023. Greenhouse tomato technologies and their influence in Mediterranean region. In: Lops F. (ed.) Tomato Cultivation and Consumption - Innovation, Sustainability and Health, pp. 1-26, IntechOpen Book Series, DOI: 10.5772/intechopen.112273.

Published articles:

Andrade V.L., Ribeiro I., dos Santos A.P.M., Aschner M.,& Mateus M.L.(2023). Metals in Cow Milk and Soy Beverages: Is There a Concern? *Toxics*, *11* (12), 1013. https://doi.org/10.3390/toxics11121013

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Oliveira, R., Brito, J.P., Fernandes, R., Morgans, R., Alves, S., Santos, F.J., Pinto, P., Espada, M.C. (2023). The Effects of Pre-Season and Relationships with Physical, Physiological, Body Composition, and Load Markers: A Case Study Comparing Starters versus Non-Starters from an Elite Female Professional Soccer Team. *Medicina*, 59, 2156. https://doi.org/10.3390/medicina59122156

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Saraiva, R., Saraiva, A., Rodrigues, G.C, Ferreira, Q., Oliveira, M. (2023). Otimização de imagens térmicas de baixo custo para a deteção de stress em plantas, *Agrotec* 49, pp 64-67, 4º trimestre 2023.

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Saraiva, R., Ferreira, Q., Rodrigues, G.C.,& Oliveira, M. (2023). Nanofertilizer Use for Adaptation and Mitigation of the Agriculture/Climate Change Dichotomy Effects. *Climate*, 11 (6), 129. https://doi.org/10.3390/cli11060129

07
R&D ACTIVITIES

- **Invitation for publication in Healthcare journal**
  The researcher Prof. Dra. Ana Pereira is the guest editor of a special issue with the topic: Active Brain and Body with Lifetime Physical Exercise for a Healthier Aging. Deadline for manuscript submissions: 31 May 2024. For more information **CLICK HERE**

- **Invitation for publication in Healthcare journal**
  The researcher Prof. Dr. Raul Antunes, Prof. Dr. Miguel Jacinto and Prof. Dr. Diogo Monteiro are the guest editors of a special issue with the topic: Physical Activity, Exercise, and Sport in People with Disabilities: Strategies for Health Promotion. Deadline for manuscript submissions: 30 November 2024. For more information **CLICK HERE**

- **I&D projects in the scientific areas of CIEQV:** For more information **CLICK HERE**.

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08

CALLS AND FUNDING

- ***FCT CALLS***. For more information **CLICK HERE**

- **2024 CALL FOR PHD STUDENTSHIPS – REGULAR LINE OF APPLICATION:** PhD studentships aim at financing research activities that lead to obtaining the academic degree of doctor. Deadline: 18 April 2024. For more information **CLICK HERE**

- **2024 CALL FOR PHD STUDENTSHIPS – SPECIFIC LINE OF APPLICATION IN A NON-ACADEMIC ENVIRONMENT:** PhD studentships to be awarded in the Specific Line of Application, aim at financing research activities that lead to obtaining the academic degree of doctor and carried out in close articulation with non-academic institutions. Deadline: 18 April 2024. For more information **CLICK HERE**

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SCHEDULE

- ***H_2OEFFICIENT***, April 2nd 2024, Alcobaça, Portugal. For more information **CLICK HERE**

- ***XIX CONGRESO DELA SOCIEDADE ESPAÑOLA DE MALHERBOLOGIA (SEMH) / VI SIMPÓSIO NACIONAL DE HERBOLOGIA***, 17-19 April 2024, Instituto Politécnico de Beja, Portugal. For more information **CLICK HERE**

- ***SDEWES2024 - 19TH CONFERENCE ON SUSTAINABLE DEVELOPMENT OF ENERGY, WATER AND ENVIRONMENT SYSTEMS*****,** 8-12 September 2024, Rome, Italy. For more information **CLICK HERE**

- ***XVIIº ENCONTRO DE QUÍMICA DOS ALIMENTOS***, 9-11 October, UTAD, Vila Real. For more information **CLICK HERE**

- ***XXVIIIº ENCONTRO GALEGO-PORTUGUÉS DE QUÍMICA*****,** November 2024, Galicia, Spain. For more information **CLICK HERE**

- ***4TH EDITION OF THE SEMINAR "COMMUNICATION FOR HEALTHY AND SAFE EATING"***, under the theme "Food communication: from promoting literacy to excess messages", 23 May 2024, Instituto Nacional de Saúde Doutor Ricardo Jorge, I.P. (INSA, I.P.), Lisbon, and online, broadcast on the ZOOM platform through the Department of Food and Nutrition with free registration Link to pre-register for the event: https://formamais-insa.min-saude.pt/

- ***7TH SYMPOSIUM "FOOD PRODUCTION AND PROCESSING IN A SUSTAINABLE ENVIRONMENT"***, 29th may of 2024, INIAV Oeiras.

  For more in information **CLICK HERE**