

## **Mitigating climate change and cutting fossil energy use in Spanish food production: Synergies between organic farming, renewable energies and dietary shifts.**

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Latest reports suggest that anthropogenic greenhouse gas emissions (GHGe) have to be radically cut if global temperatures are to be held within safe limits. Food production accounts for a significant part of GHGe, including not only direct agricultural emissions but also those associated to the related industrial processes and land use changes. GHGe in the Spanish food production system are dominated by fossil energy use and livestock related emissions. In this work, we have modelled the impact on energy consumption and GHGe of a complete transition to actual and “best management” organic farming, including estimations of the potential of renewables for substituting fossil energy use and of the impact of dietary shifts.

Data on baseline direct emissions from crop and livestock production were obtained from the National Inventory of atmospheric emissions, with modifications to account for the particularities of Mediterranean climate. All significant life cycle emissions were included in the assessment, using activity data from Spanish statistics and emission factors from LCA databases. Emissions embodied in the international trade of feed products were also assessed. Modelled scenarios include extensive application of soil-improving organic techniques such as cover crops and soil incorporation of residues, renewable technologies such as solar-powered irrigation and biofuels for self-consumption, and dietary shifts such as reduced meat and increased legume consumption.

According to our preliminary results, drastic reductions in GHGe and fossil energy consumption could be achieved through the transition to the proposed scenario. The elimination of industrial inputs such as chemical fertilizers, pesticides and diesel fuel would reduce GHGe to levels that could be offset by increased soil carbon sequestration, potentially achieving carbon neutral crop production. In addition, livestock emissions would be greatly reduced through the elimination of imported feed products. Nonetheless, this transition to a largely self-sustained, low-carbon food production system in Spain would require a significant shift in dietary patterns due to reduced agricultural output. The consumption of animal products, and particularly of pig meat and poultry products (meat and eggs), would need to be substantially reduced to achieve the proposed goals. At the same time, legume cultivation for human and animal consumption would need to be boosted to maintain both soil fertility and dietary protein levels. These changes, however, would not threaten human health but, on the contrary, would lead to an improved health status of the Spanish population, according to WHO dietary recommendations.