Emissions of greenhouse gases in rotation of crops with different crop management in Mediterranean climate

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Introduction

Climate Change and Agriculture is closely related. Mediterranean areas development, where the climate is arid or semiarid, are at high risk due to these changes in the climate patterns. This study, carried out by the Spanish Conservation Agriculture Association (AEACSV) and the European Conservation Agriculture Federation (ECAF) in collaboration with Syngenta under the framework of the Good Growth Plan, compares the differences, in terms of CO_2 emission among three different types of agricultural management.

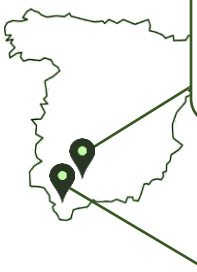
Methodology

To evaluate and compare the economical benefit of adopting Conservation Agriculture, this study has defined three types of agricultural systems in two fields located in the south of Spain.

GHG emissions have been evaluated by analysed CO_2 emissions (CO_2 equivalents) according to the operations of each crop (use of machinery) and supplies (inputs) that are applied during the crop cycle.

Table. Types of agricultural System used

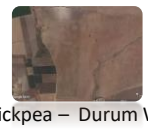
Sustainability ranking	System	Details
	Sustainable system 2 (S2)	No tillage, straw retained, adjusted Crop Protection , N and seed.
	Sustainable system 1 (S1)	Tillage - straw removed, adjusted adjusted Crop Protection , N and seed.
	Conventional system (CS)	Tillage - straw removed, standard adjusted Crop Protection , N and seed



Farm 1

Crop Rotation: Chickpea – Durum Wheat – Sunflower.
All plots cultivated every year: 9 plots.
Plot size: 5 ha / plot (45 ha per pilot farm).
Every year the full rotation is grown in the field.

Farm 2



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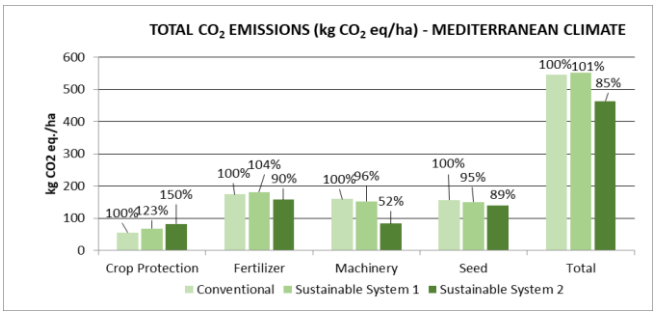
For the calculation of CO_2 emissions equivalent per ha, the associated energies and kg CO_2 eq/kg or litres have been taken into account from the literature.

- Inputs include the following: crop protection products, seeds and fertilizers used in each of the crops studied. To calculate the emissions generated, the following data has been taken into account:
  - Crop protection products: CO_2 is estimated by the energy associated (MJ/kg) to the active ingredients of each product applied to the crop.
  - Seeds: the associated energy (MJ/kg).
  - Fertilizer: energy (MJ/kg) of each essential macronutrient contained in the product applied.
- Fuel: energy of fuel used in each field operation (MJ/kg).

Results



TOTAL CO_2 EMISSIONS (kg CO_2 eq/ha). MEDITERRANEAN CLIMATE					
	Crop Protection	Fertilizer	Machinery	Seed	Total
Conventional	55.34	174.05	159.55	157.19	546.13
Sustainable S1	68.14	181.19	153.05	150.01	552.39
Sustainable S2	82.81	157.33	83.48	139.87	463.48

- The reduction of field operations, rationed and efficient fertilization in the S2 system largely offset the increase of emissions produced by the plant protection products application.
- The results obtained between the different management systems have contributed to CA practice (S2) reducing GHG emissions by 15% compared to the conventional system and by 16% compared to the S1 system.

Conclusions

Systems based on the three principles of Conservation agriculture offers the best solution to reduces GHG emissions in Agriculture. Mediterranean areas are under pressure. Soil degradation together with the high risk of desertification due to Climate Change makes Sustainable agricultural Managements based on Conservation Agriculture an opportunity to ensure the future of Agriculture and the Mediterranean rural areas.