

## **INCREASING THE SUSTAINABILITY OF DURUM WHEAT CULTIVATION THROUGH A LIFE CYCLE ASSESSMENT APPROACH**

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### **ABSTRACT**

Durum wheat cultivation is responsible for most of the environmental impact of pasta production. Due to this reason, Barilla put forth a specific project aimed to increase widespread use of sustainable cropping systems. Such analysis was based on a holistic approach, taking into consideration economic, agronomic, and environmental indicators. The project focused on identifying potential improvements in the most diffused cropping systems for the cultivation of durum wheat in Italy, while maintaining high levels of quality and food safety. The project has demonstrated that the durum wheat cultivated according to the guidelines of sustainability developed by Barilla has a global warming potential significantly lower than that cultivated with conventional agricultural practices.

### **INTRODUCTION**

Barilla has released its study on the environmental impacts of pasta conducted with the life cycle assessment methodology through the publication of the Environmental Product Declaration (Barilla, 2010). Given that the home cooking phase does not fall under company dominion, and thus not factored into consideration, durum wheat cultivation is responsible for more than 80% of the ecological footprint, approximately 60% of the carbon footprint and for entirety of the water footprint. Due to this reason, Barilla put forth a specific project aimed to increase widespread use of sustainable cropping systems of durum wheat. Analysis was based on a holistic approach, taking into consideration economic, agronomic, food safety and environmental indicators. The project focused on identifying potential improvements of the most diffused cropping systems for the cultivation of durum wheat, while maintaining high levels of quality and health standards. Agricultural practices can in fact influence the environmental, economic and food safety performances of cultivation (Tilman et al, 2002). In

particular, this study contemplates the main practices of crop rotation, use of fertilizers, tillage, seeding, and weed and pest management.

Italy was the first cultivation area considered because it is the country where Barilla purchases approximately 70% of the durum wheat necessary to its entire pasta production.

The project started in 2010 and it has been developed in different phases. In the first year the company put in place theoretical studies on durum wheat cultivation in Italy and the evaluation of environmental impacts and of overall agriculture efficiency through the use of economic, social and environmental sustainability indicators.

In 2010/2011 Barilla analyzed a sample of farm to compare real data from farms with optimal values to obtain sustainable productions. The results shows that rotation of durum wheat with dicotyledons is more sustainable than rotations only with cereals and monoculture, and a reduction in production costs is possible with a better efficiency in the use of inputs. The results of this study were published in the *Handbook for sustainable cultivation of quality durum wheat in Italy*, which serves as source of practical suggestions for farmers.

Finally, in 2011/2012 the project was extended to demonstrate that an accurate planning of crop rotations and the use of a decision support system could help in being more sustainable, both environmentally and economically. In this part of the project a decision support system was given to the farmers to help them following the suggestions of the *Handbook for the sustainable cultivation of quality durum wheat in Italy*.

## **MATERIALS AND METHODS**

Two different durum wheat crop management were compared. The first one consists in farmer's usual crop management with only farmer crop choices and strategies, while in the second one the farmers were supported by the decision support system (DSS) *granoduro.net*<sup>TM</sup>, a web service that integrates information on weather patterns, soil conditions and varietal characteristics in order to give to the farmer the opportunity to optimize seeding, fertilization, weed control and disease management. The DSS provides also information on nowcasting and forecast weather conditions and crop growth and development.

The test was conducted in 13 farms, located in the most important areal for durum wheat cultivation in Italy (4 in Emilia-Romagna, 6 in Marche, 1 in Tuscany and 2 in Apulia). In order to verify the effectiveness and feasibility of the suggested practices, farmers have agreed to cultivate part of their land following the *Handbook* and *granoduro.net*<sup>TM</sup> and part following their routine practices.

The cultivation of durum wheat after several crops was tested to determine whether different crop rotations could aid in increasing sustainability of the whole process (Caporali et al., 1992). Such previous crops were divided into four groups: cereals (maize, sorghum, soft wheat, durum wheat), industrial crops (sunflower, rape seed, sugar beet), leguminous (faba bean, chickpea, proteic pea), vegetables (tomato). Previous crops were also divided into three groups according to their influence on durum wheat cultivation: favorable (faba bean, chickpea, rape seed, proteic pea, sugar beet), neutral (sunflower) and unfavorable (maize, sorghum, wheat). A comparison was made, for each type of previous crop, between the

cultivation of durum wheat with and without the use of the decision support system *granoduro.net*<sup>TM</sup>.

## RESULTS

The cultivation of durum wheat after a vegetable or a leguminous contributes in reducing significantly the greenhouse gas emissions compared to the cultivation after a cereal (Figure 1).

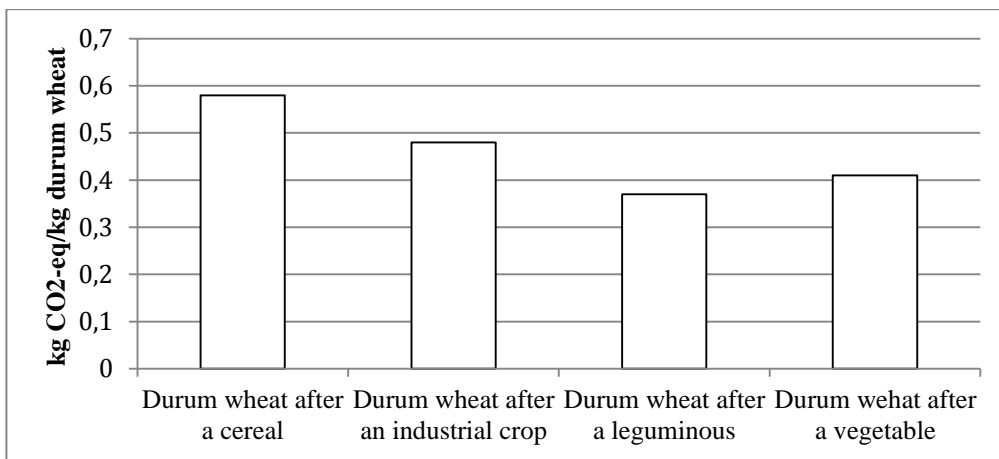


Figure 1. Carbon footprint of durum wheat cultivated after different crops

Concerning the expenses the cultivation of durum wheat after a leguminous or a vegetable contributes in reducing significantly production costs (Figure 2) compared for example to the cultivation after a cereal. To finish, a favorable previous crop contributes in obtaining a significantly higher yield (+20% equivalent to +1,3 t/ha) compared to an unfavorable one.

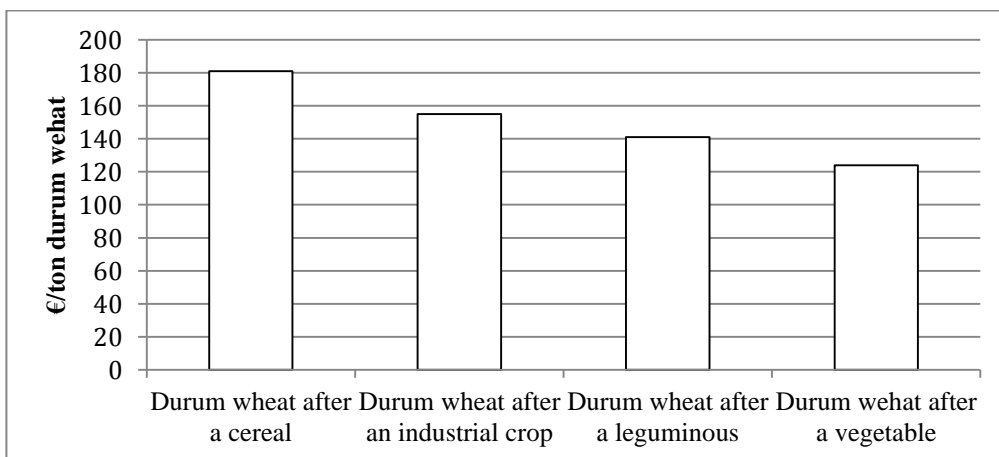


Figure 2. Production costs of durum wheat cultivated after different crops

Results show that the use of *granoduro.net*<sup>TM</sup> contribute in further reducing carbon footprint (Figure 32), supply to the reduction of production costs especially in case of favorable or neutral previous crop and contributes in reducing the costs of pesticides and fertilizers management.

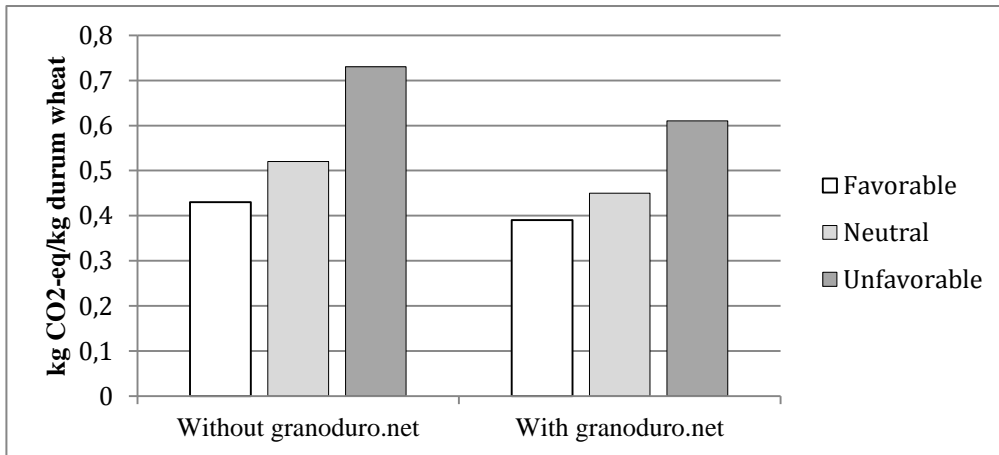


Figure 3. Carbon footprint of durum wheat cultivated with and without the DSS granoduro.net<sup>TM</sup>.

To sum up the use of the DSS contribute to a reduction in direct costs of production, a reduction in carbon footprint, an increasing in nitrogen use efficiency and to maintain high yields.

## DISCUSSION

The project has demonstrated the importance of an integrated approach to study the sustainability of a cropping system. It's important to bear in mind that agriculture is primarily an economic activity and there's the risk walking the line of counter-productivity when merely focusing on environmental and food safety issues. However, the study shows that environmentally friendly practices are also often economically advantageous because they greatly increase the efficiency of technical tool usage and the yield.

## CONCLUSIONS

The project has highlighted the importance of technical instruments such as the DSS granoduro.net to help the farmers in their decisions. With this kind of support the agriculture would be less costly and at the same time the environmental impacts linked to its activities could be reduced. The project's ultimate goal is to take "sustainable agriculture" to a large scale by signing contracts with farmers that encompass sustainable practices.

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