Bioeconomic Approach to Hazelnut Crop's Assessment

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Abstract

The analysis regards the simulation of conversion of the durum wheat cultivation into hazelnut. This research is based on a case study in the province of Viterbo (Italy), where the durum wheat production and the hazelnuts represent the primary cultures adopted in this area. The purpose of this study is to analyse the number of people employed in the production of hazelnuts and durum wheat to understand if the intensification of hazelnut production has a positive impact on social sustainability and if the conversion process from durum wheat to hazelnuts is socially sustainable, in order to fill a gap in the existing literature. The social impact analysis shows that the hypothesis would be positive for the agricultural occupation of the Municipalities of the Province of Viterbo considered. The results showed as the conversion from the cultivation of durum wheat in hazelnut has brought to a considerable increase in agricultural occupation. Finally, I analysed the effects of the pandemic's crisis on the COVID-19 virus in the choices related to the conversion between durum wheat and hazelnuts.

Keywords Sustainability · Bioeconomics · Hazelnuts · Social sustainability · COVID-19

Introduction

Sustainability is the characteristic of a process or state that can be maintained at a certain level indefinitely. In the environmental, economic and social sphere, it is the process of change in which the exploitation of resources, the investment plan, the orientation of technological development and institutional changes are all in tune and enhance the current and future potential in order to meet human needs and aspirations. The guiding principle of sustainability is sustainable development, which concerns, in an interconnected way, the environmental, economic and social spheres. Interestingly,

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the term sustainable development was first introduced by the [1] Brundtland Report of the World Commission for Environment and Development (1987).

This article focuses on the dimensions of economic, environmental and social sustainability, particularly on this last dimension.

The primary goal of social sustainability is to pursue equity, which means striving towards eliminating poverty, the inequality of the benefits of development and the realisation of conditions of dignity for every man's life.

This analysis regards the simulation of conversion of the durum wheat cultivation into hazelnut. This research is based on a case study in the province of Viterbo (Italy), where the durum wheat production and the hazelnuts represent the primary cultures adopted in this area. It is essential to specify that the context analysed is a small one, even if an affluent area as regards the crops considered. Furthermore, the risk associated with using a monoculture was analysed from a social point of view. Finally, I investigated the effects of the pandemic's crisis on the COVID-19 virus in the choices related to the conversion between durum wheat and hazelnuts.

Economic, Environmental and Social Sustainability

Sustainability is, therefore, to be understood not as an immutable state or vision but rather as a continuous process, which recalls the need to combine the three fundamental dimensions. However, these dimensions are interdependent and cannot be analysed alone. If, when choosing a strategy, one of the three dimensions is lost along the way, there is no sustainable development.

According to [2] Spangenberg (2005), a sustainable economy must not undermine the sustainability of the systems it interacts with while defending its viability. Indeed, as an analysis of the macro-level system behaviour, it assesses the results of these actions and interactions but does not analyse the system elements, behaviour, or motivations at the micro-level. It helps to identify the characteristics of potentially sustainable systems but does not claim to define a unique sustainable system structure.

Economic sustainability is the basis of sustainable development; indeed, it is the ability of an economic system to generate continuing growth in economic indicators, particular wealth and employment. It can be defined as the ability of an economic system to create ongoing development of economic indicators, in particular, the ability to generate income and work for the livelihood of populations. Within a territorial system, economic sustainability means the ability to produce and maintain the maximum added value within the territory by effectively combining resources in order to enhance the specificity of local products and services. However, economic sustainability is only the basis of any concept of sustainability, even the broader one that concerns the safeguarding of economic, human/social, and natural capital.

The concept of sustainability is intrinsically linked to environmental protection, but it has undergone a profound evolution in recent years. Therefore, the meaning of environmental sustainability indicates one of the critical aspects of the broader concept of sustainable development, from which all the actions that institutions can implement, companies and individuals arise. Regarding, precisely, environmental sustainability [3], Scoones (2007) states that the ecologists had long been concerned with how ecosystems responded to shocks and stresses. Accordingly, it defines sustainability (particularly environmental sustainability) in these terms, i.e. the ability of a system to bounce back from such shocks and stresses and adopt stable states.

Table 1 Conventional average working time of agricultural activity (Central Italy)

Farming	Conventional average working time of agricultural activity (District: Central Italy)		
	Family worker	Salaried employees	Total
Durum wheat	44	4	48
Hazelnut	179	37	216

Source: [8]

Finally, as mentioned above, the primary objective of social sustainability is to pursue equity, which means striving towards eliminating poverty, the inequality of the benefits of development and the realisation of conditions of dignity for every man's life. Challenges to achieving social sustainability involve meeting the needs of the individual, established in the general principles of international human rights treaties. In particular, social sustainability means taking useful actions to affirm economic, social, political, cultural, gender and race equity among the people who inhabit the regions affected by those who intend to pursue these objectives. However, considering the analysed context, it is possible to affirm that it is not just a question of social sustainability in a general sense but more of local social sustainability. Therefore, the idea of social sustainability implies the right to live in a context that can express the potential of each individual, the possibility of citizens to act in decision-making processes. It also means supporting actions helpful in maintaining the traditions and rights of local communities concerning their territory.

In the existing literature, various authors have studied sustainability in agriculture, also focusing on the social dimension of sustainability [4]. Janker et al. (2019), relying on Parsons' system approach, capture the components of a social system that encompasses agriculture and its embeddedness in society. This includes all major actors, their interactions and institutions. Further, they develop Maslow's hierarchy of needs and the rights approach into a sustainability scale, calling the conceptual framework the sustainable agricultural social system. This general framework can later be adapted to local cultural and social settings, serving as a more comprehensive and flexible sustainability framework. Instead [5], Janker et al. (2019) claim that the social dimension is largely neglected in the discourse on sustainability. The perception of it is also influenced by the media, political programs or the social environment. Consequently, they examined the discourse on the social sustainability of agriculture in the *Tages-Anzeiger*, the most widely read Swiss daily newspaper. Similarly [6], Anastasova-Chopeva (2019) affirms that social sustainability is linked to ensuring greater security of farm employment; indeed, it turns out to be necessary to undertake practical actions to ensure equal opportunities for individuals to develop in the field of agricultural labour and then providing

Table 2 Used agricultural area

Municipality	UAA	
	Durum wheat	Hazelnut
Viterbo	2727,91	267,8
Graffignano	141,17	11,4
Monterosi	76,24	1,7
Civita Castellana	714,54	219,13

Source: [9]

Table 3 Minimum working

Minimum working days of a direct farmer	104
Minimum daily working hours of a direct farmer	8
<i>Minimum annual working hours of a direct farmer</i>	<i>832</i>

education for the employees on the farm, fair distribution of income, strengthening the role of the right to work regardless of gender, etc. The author's purpose is a scientific study on the level of social sustainability in agriculture, which is part of the scientific project "Sustainability of Agriculture in Bulgaria" (2017–2018), using a methodical approach that takes into account the general concepts of social sustainability. The results obtained show that social sustainability in agriculture is linked to the satisfactory level of the prevailing party of its principles.

Based on [7] Nera's thesis (2019), which deals with the issue of resilience and studies aspects of sustainability (economic, environmental, legal and social), taking into account some indicators of social sustainability, in particular, his thesis focuses on the assessment of the resilience and sustainability of a hazelnut growing system in central Italy, as the economy of the area is highly specialised in raising hazelnuts. Still, the local hazelnut market is unstable and heavily dependent on Turkish production.

As for social sustainability, the basic concept is the quality of life and, in particular, improving the quality of life in farming areas by providing employment and offering decent working conditions. Consequently, the indicators that can be taken into consideration are:

- Number of employees (i.e. number of employed people)
- Percentage of women
- Health of agricultural workers

Method

As already stated above, the aim of this analysis is to answer the following research questions:

RQ1: Does the intensification of hazelnut production have a positive impact on social sustainability?

RQ2: Is the conversion process from durum wheat to hazelnuts socially sustainable?

Table 4 Working time of agricultural activity of durum wheat

Municipality	<i>Working time of agricultural activity: durum wheat</i>		
	Family worker	Salaried employees	<i>Total</i>
Viterbo	120028,04	10911,64	<i>130939,68</i>
Graffignano	6211,48	564,68	<i>6776,16</i>
Monterosi	3354,56	304,96	<i>3659,52</i>
Civita Castellana	31439,76	2858,16	<i>34297,92</i>

Source: Own elaboration

Table 5 Working time of agricultural activity of hazelnut

Municipality	<i>Working time of agricultural activity: hazelnut</i>		
	Family worker	Salaried employees	Total
Viterbo	47936,2	9908,6	57844,8
Graffignano	2040,6	421,8	2462,4
Monterosi	304,3	62,9	367,2
Civita Castellana	39224,27	8107,81	47332,08

Source: Own elaboration

The methodology used for this purpose is to analyse the number of people employed in hazelnuts and durum wheat production using data from the RICA 2007 Database (INEA) and ISTAT 2010 Census. Consequently, the measurement unit that will be taken into consideration is the number of people employed, specifying that in the agricultural sector, anyone who lends his manual work, for a fee, for the cultivation of land or livestock breeding and related activities in favour of a farming company or other person carrying out agricultural activities is an employee. Specifically, the employed persons will be divided into “Family worker” and “Salaried employees”: “Family worker” means those who belong to the family unit of the administrator of the farm, while “Salaried employees” persons outside the same family unit are represented.

Social Impact Analysis

As for social sustainability, the basic concept is the quality of life and, in particular, improving the quality of life in farming areas by providing employment and offering decent working conditions. Consequently, the indicators that can be taken into consideration are:

- Number of employees (i.e. number of employed people)
- Percentage of women
- Health of agricultural workers

In order to calculate the indicator of *the number of employed people* (for durum wheat and the kernel), I used the data relating to the average conventional working time of agricultural activity (as per Table 1) in hours/hectare/ year, noting that the hours work for the hazelnut are more than four times those for durum wheat:

Table 6 Working days of agricultural activity of durum wheat

Municipality	<i>Working days of agricultural activity: durum wheat</i>		
	Family worker	Salaried employees	Total
Viterbo	144,2644712	13,11495192	157,3794231
Graffignano	7,465721154	0,678701923	8,144423077
Monterosi	4,031923077	0,366538462	4,398461538
Civita Castellana	37,78817308	3,435288462	41,22346154

Source: Own elaboration

Table 7 Working days of agricultural activity of hazelnut

Municipality	Working days of agricultural activity: hazelnut		
	Family worker	Salaried employees	Total
Viterbo	57,615625	11,909375	69,525
Graffignano	2,452644231	0,506971154	2,959615385
Monterosi	0,365745192	0,075600962	0,441346154
Civita Castellana	47,14455529	9,744963942	56,88951923

Source: Own elaboration

I also used the used agricultural area (UAA) (for durum wheat and hazelnut) in hectares of the municipalities of Viterbo, Graffignano, Monterosi and Civita Castellana, part of the Province of Viterbo (Table 2).

And I used the minimum number of working days (during the year) of direct farmers (Table 3):

The next step was to calculate the working time of the annual agricultural activity, based on the UAA, so I multiplied the average conventional working time of the farming activity by the hectares for each Municipality considered, both for durum wheat and for the hazelnut (Tables 4 and 5):

Subsequently, I divided the values obtained by the minimum annual working hours of a direct farmer (832 h), thus finding the yearly average working days (Tables 6 and 7):

After making these calculations, I hypothesised the enlargement of the cultivated area of the hazelnut, considering the elimination of 70% of the cultivated area of the durum wheat. I have redone the same calculations in order to conclude the differences that derive from agricultural employment, before and after the hypothesis (Tables 8, 9, 10 and 11):

Just as regards the differences between the annual working days with the area used and the annual working days, eliminating 70% of the durum wheat cultivated area to replace it in hazelnut, the results were the following:

It is possible to note that the employment differences for durum wheat are negative, while the employment differences for the hazelnut are positive (Table 13).

At this point, the calculated differences were then added up to understand if the impact of this hypothesis was positive from the point of view of agricultural employment, and, as can be seen from the table, the differences are all positive:

Table 8 Working time of agricultural activity of durum wheat

Municipality	Working time of agricultural activity: durum wheat		
	Family worker	Salaried employees	Total
Viterbo	36008,412	3273,492	39281,904
Graffignano	1863,444	169,404	2032,848
Monterosi	1006,368	91,488	1097,856
Civita Castellana	9431,928	857,448	10289,376

Source: Own elaboration

Table 9 Working time of agricultural activity of hazelnut

Municipality	Working time of agricultural activity: hazelnut		
	Family worker	Salaried employees	Total
Viterbo	389743,323	80561,469	470304,792
Graffignano	19729,201	4078,103	23807,304
Monterosi	9857,172	2037,516	11894,688
Civita Castellana	128756,132	26614,396	155370,528
Source: Own elaboration			

Source: Own elaboration

Results

Based on the analysis carried out, it is possible to highlight that the employment differences for durum wheat are negative; this means that by eliminating 70% of the cultivated area, the annual working days have decreased; on the other hand, the employment differences for the hazelnut are positive (with a very high value in the Municipality of Viterbo); this means that by replacing 70% of the durum wheat cultivated area with the hazelnut, agricultural employment would increase. This is a positive result with regard to social sustainability.

There is the need, however, to make a note, already made in Table 1, about the average hours/hectare/year of work for the agricultural activity of durum wheat and the hazelnut, i.e. the conventional hours foreseen for the hazelnut are more than four times that expected for durum wheat. This leads to a positive conclusion regarding employment from the beginning, especially considering some of the municipalities in the Province of Viterbo with the highest used agricultural area of durum wheat.

In conclusion, this means that the impact of my hypothesis would be positive for the agricultural occupation of the Municipalities of the Province of Viterbo considered.

Conclusions and COVID-19 Impact

Having considered some of the municipalities in the Province of Viterbo with the highest used agricultural area of durum wheat, a general conclusion regarding the hypothesis formulated is that the impact of conversion of the durum wheat cultivation into hazelnut would be positive

Table 10 Working days of agricultural activity of Durum wheat

Municipality	Working days of agricultural activity: durum wheat		
	Family worker	Salaried employees	Total
Viterbo	43,27934135	3,934485577	47,21382692
Graffignano	2,239716346	0,203610577	2,443326923
Monterosi	1,209576923	0,109961538	1,319538462
Civita Castellana	11,33645192	1,030586538	12,36703846
Source: Own elaboration			

Source: Own elaboration

Table 11 Working days of agricultural activity of hazelnut

Municipality	Working days of agricultural activity: hazelnut		
	Family worker	Salaried employees	Total
Viterbo	468,441,494	96,828,6887	565,2701827
Graffignano	23,712,981,97	4,901,566,106	28,614,548,08
Monterosi	11,847,5625	2,448,9375	14,2965
Civita Castellana	154,754,9663	31,988,45673	186,743,4231
Source: Own elaboration			

Source: Own elaboration

for the agricultural occupation of the Municipalities of the Province of Viterbo considered. In order to answer the two research questions formulated, it is possible to affirm:

- About the RQ1, the intensification of hazelnut production has a positive impact on social sustainability
- About the RQ2, the conversion process from durum wheat to hazelnuts socially sustainable

The COVID-19 pandemic has, in a few weeks, cracked the paradigm of globalisation in every economic sector, including the primary one of agriculture. Here the impact of the virus is on two fronts: the first is the structural non-self-sufficiency of Italian agricultural production (in particular in the strategic wheat sector) and the consequent difficulty in procuring raw materials for the production of essential goods (bread, pasta) following the reduction in world trade. The second concerns the sudden shortage of labour, mainly seasonal, due to the global lockdown and the closure of borders. The first challenge is quantitative and qualitative: to produce more and with higher quality on ever-smaller land (more with less). The other essential aspect is the use of the so-called precision agriculture with the help of high technology, from the detection of biochemical data of the land to close weather forecasts. Here too, cooperation between companies, universities and institutions is essential, leading to the creation of certified supply chains also through the blockchain. It is necessary to extend the

Table 12 Differences between the annual working days with the area used and the yearly working days, eliminating 70% of the durum wheat cultivated area to replace it in hazelnut

Differences (UAA70%-UAA)			
Municipality	Working days of agricultural activity: durum wheat		
	Family worker	Salaried employees	Total
Viterbo	– 100,9851298	– 9,180466346	– 110,1655962
Graffigna	– 5,226004808	– 0,475091346	– 5,701096154
Monterosi	– 2,822346154	– 0,256576923	– 3,078923077
Civita Castellana	– 26,45172115	– 2,404701923	– 28,85642308
Viterbo	410,825869	84,9193137	495,7451827
Graffignano	21,26033774	4,394594952	25,65493269
Monterosi	11,48181731	2,373336538	13,85515385
Civita Castellana	107,6104111	22,24349279	129,8539038

Source: Own elaboration

Table 13 Sum of the differences in Table 12

Sum of the differences (UAA70%-UAA)

Municipality	Working time of agricultural activity		
	Family worker	Salaried employees	Total
Viterbo	309,8407392	75,73884736	385,5795865
Graffignano	16,03433293	3,919503606	19,95383654
Monterosi	8,659471154	2,116759615	10,77623077
Civita Castellana	81,1586899	19,83879087	100,9974808

Source: Own elaboration

already existing best practices: supply chain contracts with which, on the one hand, local productions are encouraged through the provision of specific premiums to farmers based on the quality of the product and, on the other hand, there is coverage of the supply risk for the food industry. An example is the supply chain project launched by Loacker for the production of 100% made in Italy hazelnuts.

Considering the results and the COVID-19 scenario, it is possible to state that, at least for the Municipalities of the Province of Viterbo taken into consideration, the intensification of hazelnut production and the conversion process from durum wheat to hazelnuts could have a positive impact at least from the point of view of the social dimension of sustainability.

It is crucial to consider the limits of research, especially of the small area considered; a possible line to follow for future research could concern the enlargement (e.g. at a national level) of the cultivated areas. Another limitation is having considered only the cultivation of hazelnuts and the cultivation of durum wheat; consequently, future research could focus on other types of crops or expand the types of crops to be analysed.

The weakness of this study is undoubtedly the scarcity of the sources used, as there are not many studies on this topic in the existing literature. This aspect highlights, at the same time, the originality of the research.

Availability of Data and Materials The data will be made available on demand.

Author Contribution ER was involved in data generation, manuscript preparation and editing.

Declarations

Ethics Approval and Consent to Participate Not applicable

Consent for Publication ER provides the consent to publish this manuscript.

Conflict of Interest The author declares no competing interests.

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