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Economic and Financial Comparison between Organic and Conventional Farming in Sicilian Lemon Orchards

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Academic Editor: Marc A. Rosen

Abstract: Sicily has a long tradition in citrus fruit cultivations that with vineyard and olive tree represent the main Mediterranean tree crops. In this paper we have evaluated the economic and financial sustainability of lemon production, both in organic farming and in conventional farming; the two systems differing just for inputs utilized in production process. Economic analysis has been carried out in a representative case study located in the Sicilian northwestern coast, considering an orchard economic life equal to 50 years. Results, which referred to one hectare area, showed both a higher economic and financial sustainability of organic farming respect to conventional farming. The higher profitability of organic farming was due to minor labor requirement and to greater market appreciation for organic products that granted a premium price respect to conventional prices. Moreover, greater profitability of organic farming and use of environmentally friendly inputs in production process make farms competitive and eco-friendly.

Keywords: agricultural practices; cost-benefit analysis; lemon; organic farming; profitability

1. Introduction

In 2012 global lemon area was equal to 980,949 hectares with a production amounted to 15.1 million of tons [1]. Global lemon area was equal to, while in Italy amounted to 25,703 hectares. In the Mediterranean area, where lemon represents a crop typical of landscape [2], cultivation affected an area equal to 113,000 hectares, with a production equal to 1.8 million tons. The main producer countries are Spain, Italy, Egypt, Greece, while other little Mediterranean producers are Syria, Morocco, Algeria, Tunisia, Lebanon, Israel, Cyprus, Albania, France, Croatia, Malta and Bosnia.

Italy, with a lemon area of 25,703 hectares and a production of 346,325 tons, represented the eighth world production area and the tenth country for harvested lemons. Italian lemon orchards are located mainly in Sicily, where 38,941 farms produced lemons [3] occupying an area equal to 23,952 hectares [4].

Nevertheless, in Sicily, an are very well suited area to citrus production, starting from the 80s, lemon cultivation has registered a crisis, due to trade policies and, subsequently, to lemon import from other countries being very competitive in the production and marketing phases [5]. In particular, even if during recent years, lemon orchards have been planted, in many cases we have attended to abandonment of agricultural activity, due to a lack of remuneration of production factors and of generational turnover.

From an economic point of view, in fact, Mediterranean countries are characterized by different production conditions (labor cost, land structure, *etc.*) that affected farm economic performances [6]. Commercial flows, also in European Union countries, determined in many cases drop of competitiveness for some countries to the advantage of others [7]. In territorial contexts where lemon cultivation has a history and a tradition such as in Sicily, these factors caused the abandonment of agricultural activity, lack of generational turnover, increasing unemployment and fall of incomes and consumptions. However, during recent years, lots of lemon orchards have been converted from conventional cultivation to organic cultivation [8].

The lemon tree, in fact, is well adapted to organic farming, being able to obtain high yield [9], especially for farms that implement all agricultural operations provided, such us increasing soil fertility with natural fertilizers and soil amendments, introduction of suitable monitoring systems with the aim of preventing or reducing possible phytophagous and fungus infestations by means of natural agents or suitable irrigations [10,11].

Nowadays, about 20 years after adopting Regulation (EC) No. 2092/91 [12], organic farming represents a successful reality in lots of European Union countries and the sector is still growing, also in a period of international economic recession [13].

During globalization, where everything appears conformed and standardized, this market segment is creating income opportunities and farm competitiveness. In many cases, consumers appreciate the return to the past and the tradition, which seems genuine and fresh: organic farming means developing a production method of fresh fruits and vegetables respecting natural resources, with the aim of safeguarding environment and consumer health [14]. Organic farming is greatly appreciated by consumers, who consider organic products of higher quality, principally for the lack of chemical products utilized during the production process or conservation phase, largely utilized and employed in conventional farming, allowing a more sustainable and environmentally friendly supply chain [15,16].

Organic farming is aimed at protecting a whole agricultural agro-ecosystem, promoting the agricultural practices that capitalize on natural soil fertility, the environmental biodiversity and limiting or excluding damaging chemical products [17,18].

Organic farming adopts environmentally friendly production processes, especially in the long-term. In fact, farming methods, above all the intensive ones, have always had heavy repercussions on structure and functionality of natural ecosystems, causing different impacts that represent a damage both for environment and for public health [19,20]. Environmental impacts of agricultural production processes, in fact, are influenced by the climate, the soil typology, the agricultural practices and many other factors that make impacts extremely variable and, subsequently, hard to control and reduce [21–24]. Simply the deep awareness of all the stakeholders involved in the production and consumption processes (farm, processing industry and, in particular, the consumer), basing it on environmental respect, healthcare and eco-sustainability, can control and limit environmental damaging impacts [25].

In this context, organic farming aims at being climate friendly with respect to conventional farming, by granting a lower carbon footprint and reduced environmental impacts, as well as renewable sources [26–32]. Today, the cultivation of organic citrus in Italy covers an area of 25,340 hectares, of which 12,341 ha is in Sicily, which is the mainly Italian production area for organic citrus [33].

So, since profitability is the most important factor for a farmer [34–36], in this paper we analyzed the economic and financial sustainability of organic lemon tree in order to evaluate if nowadays, in a so dynamic and complex economic context, organic lemon investment could be convenient. In particular, it has been considered a representative organic lemon farm in which techno-economical parameters, related to production processes, have been determined. Moreover, in order to better evaluate the economic results, as well as in other studies [37–39], we have carried out a comparison with conventional lemon, by hypothesizing that the case study was managed by a conventional method.

2. Materials and Methods

2.1. Case Study

The case study is an organic lemon farm located in the north-western Sicilian coastline, within Trapani and Palermo provinces. In this area, 22% of Sicilian lemon farm are localized. The surveyed farm was chosen in function of work objectives, as well as in other studies [40,41], and it is representative of organic farms present in the area. Data have been collected by means of a face-to-face questionnaire directly administered to the farmer [42,43].

The surveyed farm is associated to a Producer Organization to which it allocates all its production. This grants a higher sales price to a farmer with respect to competitors that allocate their product to local market and to processing industry [44,45].

Farm area, divided in two parties, is equal about to 23.5 hectares, of which 22.0 hectares are organic lemon cultivated. *Femminello comune* is the lemon variety present, planted in 1975, with a globular tree form aimed at facilitating the fruit production of the lowest branches, a planting distance of 5 × 7 m (286 trees per hectares) and an average yield of 180.54 quintals per hectare. The human labor required by production process during the crop year is equal to 293 h/ha.

2.2. Economic Analysis

Economic analysis is referred to a 50-year period, equal to citrus average economic life in Sicily. In the production cycle of lemon orchard, four phases have been distinguished:

- planting phase, from the 1st to the 5th year, in which plant is modeling and possible revenues do not exceed costs;
- increasing production phase, from the 6th to the 9th year, in which revenues exceed costs and the plant continues its growth;
- maturity phase, from the 10th to the 42nd year, in which plant completes its growth and guarantees a constant production during all the period;
- decreasing production phase, from the 43rd to the 50th year, in which average yield decreases.

Economic evaluations are referred to an area of 1 hectare, as in other studies [46,47]. With the aim of estimating revenues, both production and additional incomes have been considered. Lemon production has been calculated considering the average production of the last four years (2011–2014), with the purpose of limiting possible variations due to weather trend or reclamation diseases. The same period has been taken into account for sale prices.

Additional incomes (AI) are represented by community integration provided by fruit and vegetables common market organization (Regulation (EC) No. 1182/2007) [48] and by Measure 214/1B for organic farming of the 2007–2013 Sicilian Rural Development Plan (Regulation (EC) No. 1698/05) [49].

Production cost has been calculated for each year, taking into account expenditures occurred during all lemon production cycle and related to materials and services, labor, quotas and other attributions [50].

Materials and services include all costs of circulating capital (fertilizers, pesticides, herbicides, gasoline, irrigation water and other items); labor includes worker cost involved in agricultural production; quotas and other attributions considered quotas on durable capitals, interest on current costs and durable capitals and on land value [51]. In this study taxes have been excluded.

With regards to benefits and costs referred to the different period of production cycle with respect to maturity phase, in increasing the production phase we considered a lemon production reduction of 30%, while in the decreasing phase we considered a reduction of 20%.

Economic analysis has been carried out following these hypothesis:

- all the costs have been determined considering present hourly earnings of workers for manual and mechanical operations;
- farm machines and equipment have been calculated considering fixed and operational costs. Fixed costs have been estimated basing on replacement value of farm machines (depreciation) and on interest and insurance costs. Operational costs included repair, maintenance, lubricant and gasoline costs;
- irrigation cost has been determined considering installation, management and maintenance costs of the irrigation system.

Ultimately, at the aim of comparing profitability of an organic farm with a conventional farm, it has been hypothesized that case study was managed with a conventional method. Thus, determining economic indicators, technical data have been collected by means of interviews of lemon conventional farmers and the existing literature [52]. In particular, the human labor required by the production process during the crop year is equal to 338 h/ha, denoting an increase of 13.3% with respect to the conventional lemon orchard. This is due essentially to the higher annual yield (228.72 quintals/ha) of conventional lemon.

2.3. Financial Analysis

In order to better understand the sustainability of organic lemon in Sicily, it is necessary to assess not only the profitability of the lemon orchard but also the financial sustainability of the business cycle, applying appropriate indexes [53,54]. Financial analysis has been carried out determining the Net Present Value (NPV), the Internal Rate of Return (IRR), the Discounted Cost-Benefit Rate (DCBR) and the Discounted Pay-Back Time (DPBT).

NPV included the diversity of perspective according to which economic convenience is analyzed in investment context, with respect to long-term theoretical analysis [55,56]. In fact, NPV does not base its judgment on maximizing incomes, but on maximizing wealth, represented by the difference between discounted gross income values generated during the investment life and the corresponding fixed costs (FC) [57].

NPV has been calculated with the following formula:

$$NPV = \sum_{i=0}^{n} \frac{GI_i - FC_i}{(1+r)^i} \tag{1}$$

where GI is the gross income (that is equal to the difference between gross production value and variable costs), FC represents the fixed costs, n corresponds to the lifetime of the investment (equals to 50 years), i represents the year considered and r is the discount rate (in our case equal to 5%, considering market conditions). The considered investment is convenient if NPV is positive. Thus, choosing between two investments, the one with higher NPV value is more convenient [58].

The IRR is the discount rate at which the discounted benefits are equal to the discounted costs, determining a NPV equal to zero. Mathematically, the IRR represents the discount rate for which the following equation is satisfied:

$$\sum_{i=0}^{n} \frac{GI_i - FC_i}{(1+r)^i} = 0 \tag{2}$$

According to IRR, an investment is convenient if its IRR is higher than chosen discount rate [59].

DCBR is defined as the ratio between the discounted gross income values generated during the investment life and the corresponding fixed costs. It has been calculated with the following formula:

$$DCBR = \frac{\sum_{i=0}^{n} \frac{GI_i}{(1+r)^i}}{\sum_{i=0}^{n} \frac{FC_i}{(1+r)^i}} \tag{3}$$

In this case, the investment will be convenient if the ratio it is higher than one [60].

The DPBT is a financial indicator that corresponds to the number of years occurred equating initial investment and it is not a measure of the economic convenience of the investment. DPBT corresponds to the year in which the sum of discounted GI exceeds the FCs [61].

3. Results and Discussion

Economic and financial indicators show a clear convenience for organic lemon orchard.

Gross production value of organic farm is equal to 6138.28 €/ha, exceeding the 648.98 €/ha conventional farm, even if the latter is able to obtain greater yield (+21% respect to organic farming). The difference is mainly attributable to the sale price of organic lemon (0.34 €/kg) that is higher than the conventional one (0.24 €/kg) and to entrepreneurial ability organizing farm inputs and marketing strategies [62–64]. This higher sales price is guaranteed by organic certification and by the Association of Producers Organization, which sells the product to the Large Organized Distribution, passing from a competitive to oligopolistic market [65,66], because farmers who are involved in local sales achieve lower earnings [67,68]. Moreover, consumers have a greater willingness to pay for organic products with respect to conventional ones, driven by a perception that organic farming results in fewer negative environmental impacts and greater benefits for human health than conventional systems, recognizing them a premium price [69,70].

Production cost value (Table 1) of an organic farm is equal to 6525.39 €/ha, lower than 743.02 €/ha with respect to a conventional farm. Considering production cost relative to product unity, registered values equal to 36.14 €/q (organic) and to 31.78 €/q (conventional) have been recorded.

Table 1. Production cost of organic and conventional lemon orchards.

Items	Organic		Conventional	
	€/ha	%	€/ha	%
Materials and services	1344.72	20.6%	1709.55	23.5%
Fertilizers	399.00	6.1%	593.45	8.2%
Irrigation water	261.92	4.0%	269.05	3.7%
Pesticides	142.50	2.2%	310.38	4.3%
Services	356.50	5.5%	338.67	4.7%
Fuel and lubricant	184.80	2.8%	198.00	2.7%
Labor	2773.92	42.5%	3178.43	43.7%
Farmer's family labor	2219.14	34.0%	2542.74	35.0%
Outside the farmer's family labor	554.78	8.5%	635.69	8.7%
Quotas and other attributions	2406.75	36.9%	2380.44	32.8%
Quotas on durable capitals	997.05	15.3%	997.05	13.7%
Intellectual work	306.91	4.7%	274.46	3.8%
Interest	192.22	2.9%	198.2	2.7%
Interest on land value	912.49	14.0%	912.49	12.6%
Total	6525.39	100.0%	7268.42	100.0%

The higher production cost of conventional farm, as well as in other studies [71,72], is mainly attributable to labor and material and services costs, that have greater incidence respect to organic farm because of higher lemon yield and different utilized products (fertilizers, pesticides, herbicides). In addition,

organic production appears to use more renewable resources and less purchased energy and materials, obtaining a more sustainable production [73,74]. Quotas and other attributions have similar values.

In particular, labor cost in organic farm accounts for 42.5% (2773.92 €/ha) of total cost while in a conventional farm for 43.7% (3178.43 €/ha). The difference is due to the higher yield of conventional orchard, which is directly related to the time required for harvesting.

Materials and services account for 20.6% in organic farm and to 23.5% in a conventional farm, due to different fertilizers, pesticides, herbicides, services, fuel and lubricant cost.

Quotas and other attributions (including quota on durable capitals, taxes, intellectual work, interests) represent 36.9% (2639.81 €/ha) of production cost in an organic farm and 32.8% (2594.07 €/ha) in a conventional farm.

This small difference to the advantage of conventional farms is attributable to the specific production process, which involves less agricultural mechanical operations.

In fact, manual operations such as harvest and pruning have had minor impacts on lemon cultivation in terms of costs and labor and their incidence is very similar in both farming methods. Moreover, pruning in lemon cultivation has a great utility with the aim of preventing plant-health risks and reducing the use of chemical products for disease control [75].

With regards to financial indicators (Table 2), the results show higher convenience for organic farming, highlighting a NPV equal to 52,675.57 €/ha, an IRR to 28.5%, a DCBR to 5.16 and a DPBT to 7 years. Conversely, a conventional farm presents an NPV equal to 34,960.60 €/ha, an IRR to 19.0%, a DCBR to 3.76 and a DPBT to 10 years.

Table 2. Financial indicators.

Lemon Orchard	NPV		IRR		DCBR		DPBT	
	Without AI	With AI	Without AI	With AI	Without AI	With AI	Without AI	With AI
Organic	27,612.09	52,675.57	13.3%	28.5%	3.18	5.16	14	7
Conventional	13,144.22	34,960.60	9.5%	19.0%	2.04	3.76	19	10

This better profitability is also shown when not considering additional incomes (AI), provided by fruit and vegetables common market organization and by Measure 214/1B for organic farming of the 2007–2013 Sicilian Rural Development Plan.

Thus, results show how organic farming is twice as sustainable, both for minor use of process inputs (especially labor and chemical products) and for subsequent reduction of total cost, as shown by other studies [76–78]. This allows us to obtain a more sustainable and environmentally friendly lemon supply chain, that grants higher income for farmers and lower carbon footprint with regard to conventional farming [79–83]. Organic farming, in fact, is very suitable for Southern European countries such as Italy, where improved environmental benefits and conditions respect to conventional farming, as shown by several studies [84–87].

4. Sensitivity Analysis

Finally, as the financial parameters vary with changes in market conditions, we carried out a sensitivity analysis, by increasing the production cost and decreasing sales price by 10%, 20% and 30% (Table 3).

This variation has been chosen taking into account the volatility of prices and productive factors that could happen in the market as function of the current economic conditions, as well as in other studies [88,89].

In first case have obtained NPV values between 39,027.73 and 47,953.61 €/ha for organic lemon and between 19,474.27 and 29,625.81 €/ha in the case of conventional conduction; IRR values ranged from 22.3% to 26.3% in an organic farm and between 13.1% and 19.6% in a conventional farm; DCBR values ranged from 3.32 to 4.37 (organic lemon) and between 2.16 and 3.08 (conventional lemon), while DPBT values for organic lemon were between 8 and 10 years and for conventional lemon ranged from 11 to 14 years.

Considering a reduction of the market price of lemons, the organic lemon orchard NPV showed values between 28,133.06 and 43,791.14 €/ha, IRR ranged from 21.4 and 26.3%, DCBR was between 3.22 and 4.45 and DPBT values ranged from 8 to 10 years. In a conventional lemon orchard, instead, NPV ranged from 13,424.73 and 27,545.00 €/ha, IRR was between 12.0 and 16.9%, and DCBR values ranged from 2.06 and 3.17, while DPBT was between 11 and 15 years.

Finally, financial parameters showed a lower profitability without additional incomes, but the organic lemon orchard always denoted the best economic performance. In particular, in conventional lemon production, investment is not convenient with an increase by 30% of production cost or with a decrease of sales price by 20%. These results denote a lower risk management and higher farmer's income in biological farms with respect to conventional ones, that are key factors in an ever more globalized market [90–96].

5. Conclusions

From the results obtained, in the present study, it is clear that the organic lemon orchard is the investment with higher profitability with respect to conventional one, because the entrepreneur can obtain a higher price in the market, guaranteed by certification. In the conventional lemon, despite a higher yield per hectare compared to the organic lemon (+21%), the sales price of the product on the market is lower, because in most cases the farms address the product to local market and to processing industry. The lower sales price of conventional lemon, related to a higher production cost, allows us to affirm that organic lemon production grants a higher profitability for the farmer.

Therefore, considering the results obtained in the present study, we can affirm that in a long period, the profitability of the organic lemon orchard is higher respect to conventional one, also hypothesizing a decrease of sales price or an increase of production cost.

All this promotes a more sustainable development of lemon supply chain from an economic and environmental point of view, granting higher incomes for farmers, thus avoiding rural exodus phenomena and reducing the environmental impacts.

Hence, organic farming could be a positive factor for the revival of citrus production in Sicily, but a concentration of lemon supply by means of association of producers appears necessary, as does a generational turnover that grants new entrepreneurial strategies.

Table 3. Sensitivity analysis.

Lemon orchard	NPV		IRR		DCBR		DPBT	
Production Cost + 10%								
	Without AI	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**
Organic	22,890.13	47,953.61	11.9%	26.3%	2.61	4.37	15	8
Conventional	7809.43	29,625.81	7.8%	16.9%	1.55	3.08	23	11
Production Cost + 20%								
	Without AI	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**
Organic	18,427.19	43,490.67	10.6%	24.2%	2.19	3.80	17	9
Conventional	2733.66	24,550.04	6.03%	15.0%	1.18	2.58	33	12
Production Cost + 30%								
	Without AI	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**
Organic	13,964.25	39,027.73	9.4%	22.3%	1.83	3.32	19	10
Conventional	−2342.11	19,474.27	4.0%	13.1%	0.86	2.16	-	14
Sales Price − 10%								
	Without AI	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**
Organic	18,727.66	43,791.14	11.1%	26.3%	2.48	4.45	16	8
Conventional	5728.63	27,545.00	7.2%	16.9%	1.45	3.17	26	11
Sales Price − 20%								
	Without AI	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**
Organic	10,898.61	35,962.10	8.9%	23.9%	1.86	3.84	20	9
Conventional	−1331.51	20,484.87	4.4%	14.6%	0.89	2.62	-	12
Sales Price − 30%								
	Without AI	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**	**Without AI**	**With AI**
Organic	3069.57	28,133.06	6.2%	21.4%	1.24	3.22	31	10
Conventional	−8391.65	13,424.73	−1.2%	12.0%	0.34	2.06	-	15

Author Contributions

This study is a result of the full collaboration of all the authors. However, Filippo Sgroi elaborated Introduction, Matteo Candela wrote Results and Discussion, Anna Maria Di Trapani elaborated Case study, Mario Foderà wrote Sensitivity analysis, Riccardo Squatrito elaborated Economic analysis, Riccardo Testa wrote Financial Analysis, while Salvatore Tudisca elaborated Conclusions.

Conflicts of Interest

The authors declare no conflict of interest.

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