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How to ensure the sustainability of organic food system farms? Environmental protection and fair price

Selene Righi*, Elena Viganò**

Abstract

With the implementation of the Farm to Fork Strategy, the European Union aims to drastically reduce the use of synthetic chemical inputs and convert at least 25% of land to organic farming, which is the main alternative to the industrial/intensive production model, with many positive implications also in terms of reducing greenhouse gas emissions.

Currently, the agri-food system is facing market problems caused by the Covid-19 pandemic and the conflict between Russia and Ukraine, with increases in production costs, prices of agricultural products and their volatility, affecting the most vulnerable actors in the supply chain, namely farmers and consumers.

The objective of the paper is to analyse the effectiveness of organizational innovations in facilitating the process of converting agribusinesses to organic farming, with a focus on the supply chain, territorial coordination, and advisory services.

* Selene Righi, PhD student, Department of Economics, Society, Politics, University of Urbino Carlo Bo, via Saffi, 42 61029 Urbino (PU), Italy, e-mail: s.righi4@campus.uniurb.it.

** Elena Viganò, Full Professor, Department of Economics, Society, Politics, University of Urbino Carlo Bo, via Saffi, 42 61029 Urbino (PU), Italy, e-mail: elena.vigano@uniurb.it.

Con l'attuazione della Strategia Farm to Fork, l'Unione Europea punta a ridurre drasticamente l'impiego degli input chimici di sintesi e a convertire almeno il 25% dei terreni in agricoltura biologica, che rappresenta la principale alternativa al modello di produzione industriale/intensivo, con molte implicazioni positive anche in termini di riduzione delle emissioni di gas serra.

Attualmente, il sistema agroalimentare sta affrontando i problemi di mercato causati dalla pandemia di Covid-19 e dal conflitto tra Russia e Ucraina, con aumenti dei costi di produzione, dei prezzi dei prodotti agricoli e della loro volatilità, che si ripercuote sugli attori più vulnerabili della filiera, ovvero agricoltori e consumatori.

L'obiettivo del documento è analizzare l'efficacia delle innovazioni organizzative nel facilitare il processo di conversione delle aziende agroalimentari all'agricoltura biologica, con particolare attenzione alla filiera, al coordinamento territoriale e ai servizi di consulenza.

1. *Introduction*

The European food system has reached high levels of food safety by offering a wide range of different products to consumers, despite being still characterised by high unsustainability in environmental, social, and economic terms[1]. The industrial model applied to agriculture production and first proposed within the so-called green revolution has led to a substantial increase in productivity of land and labour, accompanied, however, by a multitude of negative externalities in terms of water and soil pollution, biodiversity loss and ecosystem destruction, greenhouse gas emissions as well as compromising the health of both producers and consumers[2]. These negative impacts are directly linked to the massive use of fossil fuels and synthetic chemical products, such as fertilisers and pesticides. Furthermore, the simplification of the production system, the reshaping of land use in the arable area around the 2000s induced by Common Agricultural Policy (CAP) reform, together with the reorganisation of the supply chain at a global scale, have also compromised the possibility of guaranteeing adequate profitability for many European farms working in rural areas[3].

The new European Green Deal, and in particular, the Farm to Fork Strategy, is one of those fundamental steps that must be taken to develop a sustainable, fair, healthy, and environmentally friendly food system[4]. By implementing this strategy, the European Union is aiming to drastically reduce pesticide and

[1] European Commission 2020.

[2] Mostafalou, Abdollahi 2017; European Court of Auditors 2020; Science Advice for Policy by European Academies 2020.

[3] De Olde *et al.* 2016; FAO 2018.

[4] European Commission 2020.

fertiliser employment and to convert at least 25% of European agricultural land into organic farming, which represents the main alternative to the industrial/intensive production model, with several positive implications in terms of sustainable management of common goods[5]. This productive model is based on principles of health, ecology, equity, and recovery[6], which are strictly ruled and certified at the global level. Its main features are the total abandonment of synthetic pesticide and fertilizer use as well as GMO, and the substantial reduction of external productive inputs, which help ease harvest and breeding conditions. Indeed, a great part of what cultures and breeding need may be found in the responsible and sensible use of natural resources locally sourced, together with the exaltation of natural cycles and positive interactions within the different living organisms, which coexist in the same agroecosystems, human beings included[7].

This process of conversion to organic farming also has important implications in terms of reducing greenhouse gas emissions, as emphasised by the latest IPCC report (2022), which pointed out that while the development of industrial farming systems are one of the main cause of climate change, the expansion of more sustainable systems could instead contribute to achieving global food security[8].

In recent years, the greater sustainability of organic farming compared to industrial farming has also been recognized by consumers, who have shown increasing attention to issues of environmental protection, food safety and the health dimension of food[9]. This attention has been reflected in increased demand for organic foods, which are also considered healthier and tastier[10], and in higher average prices, even at the farm gate level[11].

In addition to environmental challenges, the agri-food system is facing new problems due to turbulent international contexts, caused first by the Covid-19 pandemic and then by the conflict between Russia and Ukraine. In Europe, there is an increase in both production costs and the agricultural product prices and their volatility, which affects the most vulnerable players in the supply chain, i.e. farmers and consumers[12].

In particular, the profitability of companies is heavily compromised, while

[5] Sturla *et al.* 2019; European Commission 2020.
[6] Willer *et al.* 2020.
[7] Rodale Institute 2011; Barberi 2015; Barberi *et al.* 2017.
[8] IPCC 2022.
[9] Gracia, De Magistris 2007; Viganò *et al.* 2015; Lee *et al.* 2016; Agovino *et al.* 2017; Willer *et al.* 2020.
[10] Aertsens *et al.* 2009; Shashi *et al.* 2015; Agovino *et al.* 2017; Liu *et al.* 2019.
[11] Lee *et al.* 2016; Issa, Hamm 2017; Dalmiyatun *et al.* 2018; Suwanmaneepong *et al.* 2020.
[12] Jagtap *et al.* 2022; Viganò *et al.* 2022.

the rise in global inflation, also driven by the increase in food prices, is severely reducing the purchasing power of consumers[13].

The aim of the paper is to analyse the effectiveness of organisational innovations in facilitating the process of agri-food companies' conversion to organic farming, with a focus on supply chain, territory coordination and consulting services.

The analysis refers to the cereal sector, in particular durum wheat, which is the basis of many food systems located in the Mediterranean area.

The paper is structured as follows. Section 2 presents the theoretical analysis of the problems associated with the adoption of organic farming and the volatility of agricultural commodity prices, while section 3 reports the sectoral data of organic durum wheat and the analysis of the price trends. The possible solutions that should be adopted to make the organic system more efficient and more widely implemented (vertical integration, the adoption of consulting services, and the possibility of implementing innovative systems) are illustrated in Section 4. Finally, Section 5 draws general implications for stakeholders and policy makers, suggesting directions for further research.

2. *Theoretical framework: factors influencing the conversion to organic farming*

The Covid-19 pandemic that has affected the entire population in recent years has had very negative effects and has also changed our habits. As far as food is concerned, consumers, for example, are increasingly careful about wanting quality products and pay more attention to the health effects of the food they consume. This has caused retail sales of organic products to grow steadily[14]. This positive trend in demand is also followed by a positive trend in production, from 11 million hectares certified as organic in 1999 to 75 million hectares in 2020 worldwide, an increase of 4.1% compared to 2018[15].

Although this growing attention to organic products and that organic farming is considered the most sustainable alternative to industrial agriculture, thanks to the many positive externalities associated with the implementation of innovative production processes[16] and also recognized by consumers, we must emphasise that the literature points to the existence of various factors that hinder conversion to this production model. Several studies, in fact, highlight that the adoption of this production model is conditioned by

[13] Zurek *et al.* 2022.
[14] Willer *et al.* 2022.
[15] Cook 2020; Willer *et al.* 2022.
[16] Bàrberi, Migliorini 2017.

multiple, sometimes interconnected, elements[17]. Over the years, several studies have highlighted the importance of multiple factors in the choice of organic production methods and the adoption of the innovations necessary to increase their competitiveness and profitability[18] (table 1).

In the European Union, the development of organic farming in the 1990s was supported by the definition of the regulatory framework (starting with Regulation (EC) 2092/1991) and the introduction of Regulation (EC) 2078/1992, and later with the introduction of agri-environmental payments. Subsequently, with the reform of the Common Agricultural Policy 2014-2020, new rules for agricultural entrepreneurs were defined, such as the maintenance of ecological focus areas and sustainability in order to be able to meet and satisfy the increasingly high expectations of consumers[19].

The adoption of organic certification can be driven by the values and lifestyle of the farmer, especially in terms of attention to the environment or awareness about the impact of his or her production activity on natural resources, and the personal and farm characteristics. Many studies report a greater propensity to convert to organic by individuals who are female, have medium to high educational qualifications and have lower risk aversion. With respect to age, on the other hand, some studies note a greater focus on organic farming by younger entrepreneurs while for other authors it would be older farmers who have a more favourable attitude toward this production system.

Similar considerations apply to farm size. Some research points to the difficulties of large enterprises in adopting the organic production model due to the use of intensive methods than small and medium-sized enterprises, while other research points to their greater chances of making this transition, due to the availability of more financial resources and the ability to access to technical assistance, contracts, production planning services.

Among the factors that affect the choice of farmers to convert to organic farming, in addition to the positive ones, we also highlight some obstacles related to bureaucratic aspects and the management of the certification system. Moreover, the insufficiency of public measures in favour of this production system, in terms of contributions, publicity and food education to consumers, is often underlined in the literature, but above all the need for greater support for the acquisition of new knowledge and technologies.

[17] Ferreira *et al*. 2020; Sapbamrer, Thammachai 2021; Canavari *et al*. 2022.
[18] Canavari *et al*. 2022.
[19] Menozzi *et al*. 2015.

Factors	*Authors*
Ethical values	Dettori et al. 2010; Herath and Wijekoon 2013; Läpple and Kelley 2013; Alavoine-Mornas and Madelrieux 2014; Menozzi et al. 2015; Lee et al. 2016; Riar et al. 2017; Issa and Hamm 2017; Baudry et al. 2018; Bouttes et al. 2019; Ferreira et al. 2020
Personal characteristic	Rana et al. 2012; Malá and Malý 2013; Soltani et al. 2014; Azam and Banumathi 2015; Menozzi et al. 2015; Xie et al. 2015; Lee et al. 2016; Riar et al. 2017; Dalmiyatun et al. 2018; Métouolé Méda et al. 2018; Liu et al. 2019; Ferreira et al. 2020
Farm characteristic	Rana et al. 2012; Soltani et al. 2014; Groeneveld et al. 2016; Xu et al. 2020
Production: - availability of raw materials and fear of lower production yields	Herath and Wijekoon 2013; Moumouni et al. 2013; Menozzi et al. 2015; Riar et al. 2017; Liu et al. 2019; Ferreira et al. 2020
Economic-organizational: - higher level of production costs; - price uncertainty and commercial channels; - inadequacy of public subsidies;	Gardebroek 2006; Rodriguez et al. 2009; Dettori et al. 2010; Rana et al. 2012; Moumouni et al. 2013; Herath and Wijekoon 2013; Läpple and Kelley 2013; Soltani et al. 2014; Menozzi et al. 2015; Lee et al. 2016; Riar et al. 2017; Issa and Hamm 2017; Liu et al. 2019; Bouttes et al. 2019; Ferreira et al. 2020
Difficulties linked to bureaucratic requirements and controls of certification system	Läpple and Kelley 2013; Soltani et al. 2014; Issa and Hamm 2017; Liu et al. 2019
Socio-cultural: - lack of adequate technical support for training and updates	Moumouni et al. 2013; Ferreira et al. 2020

Tab. 1. Factors influencing the propensity of farmers to convert to organic farming

An essential element in conditioning the conversion process is certainly the expected level of profitability, which is primarily conditioned by the price level and its volatility. The agricultural commodity sector is characterized by high price volatility, brought about by the joint effect of multiple causes[20], that can be classified into structural and conjunctural (Table 2).

Structural factors directly influence price volatility and are responsible for gradual changes that determine a specific trend over an extended time frame, and are related to the supply side, with a direct effect on production levels, or to the demand side. Conjunctural factors are sudden and unexpected events that directly affect the price level, such as weather conditions, the international trade regulation and the financial markets, as well as the price trends of inputs, particularly energy and fossil fuels.

[20] Brümmer *et al*. 2016; Tadasse *et al*. 2016; Santeramo *et al*. 2018; Viganò *et al*. 2022.

Factors	*Drivers*	*Authors*
Structural factors	Trends and changes in the demand of agricultural commodities	Fisher et al. 2012; Haile et al. 2016
	Changes in the levels of productions, exchange and stock of the agricultural commodities	Balcombe 2011; Brümmer et al. 2016; Haile et al. 2016
		Tadasse et al. 2016
Conjunctural factors	Climate conditions	Wright 2011; Fisher et al. 2012; Brümmer et al. 2016; Tadasse et al. 2016
	International trade regulation	Götz et al. 2015; Tadasse et al. 2016
	Financial markets	Götz et al. 2015; Brümmer et al. 2016; Tadasse et al. 2016
	Purchase prices of production input	Serra and Gil 2013; Brümmer et al. 2016; Tadasse et al. 2016.

Tab. 2. Structural and conjunctural factors that affect the prices dynamics

The increasingly high and volatile prices of agricultural commodities and products are a problem especially for the most vulnerable actors in the supply chain (consumers and producers) [21], also due to asymmetric price adjustments. Indeed, agrifood supply chains are characterized by the presence of a great diversity of market structures, with varying degrees of vertical and/or horizontal integration, and a wide range of economic actors, from small and medium-sized enterprises to multinational corporations. In particular, larger firms (generally operating in the industrial processing and distribution stages) can: impose special contractual conditions on smaller ones (belonging to the agricultural sector), resulting in problems of unequal distribution of added value among the different actors and low profitability[22]; adopt opportunistic behaviour in a situation of low prices, not adjusting the retail price so that consumers cannot benefit from falling prices[23], remaining exposed to the effects of steadily rising global inflation, with strong implications for food security and increasing rates of hunger and malnutrition.

In the past, these dynamics mainly characterized agricultural commodities, but the recent transformations of agri-food systems and the economic crisis related to the current pandemic and war emergencies are also affecting the organic farming sector. Therefore, it becomes important to analyse the situation

[21] They are exposed to the effects of steadily rising global inflation with strong food security implications and ever-higher rates of hunger and malnutrition. In 2020, 161 million more people experienced hunger due to the pandemic (FAO *et al.* 2021).

[22] European Commission 2009; Mariani *et al.* 2013.

[23] Ricci *et al.* 2019.

of the sector and market trends in order to identify effective tools to strengthen the organic system, ensuring its competitiveness and profitability.

However, for this shift to organic farming to take place and for this system to be strengthened, innovation is needed. When we talk about agricultural system innovation (AIS), we do not only mean digital innovation but also organisational innovation, which is defined as increased interaction between the different actors in the supply chain[24]. Through more cooperation between different actors (such as farmers, researchers and intermediaries)[25] there will be more knowledge sharing[26] which can be crucial in overcoming the obstacle highlighted in the literature, of the lack of support for farmers and information transfer for the transition to sustainability.

In this context, consulting services, which are actually interventions to support enterprises in making the changes necessary for their development, should be studied and favoured as they could be the key tool to facilitate a fair and equitable transition towards sustainability. They can offer tailor-made services that would allow for a more adequate response to the current global challenges as well as allow for the modernisation of productive activity especially of small-medium enterprises and would bring about a revitalisation of rural areas[27].

3. *The cereal sector (industrial and organic durum wheat) and price dynamics*

3.1. *Organic sector data*

3.1.1. Worldwide trends

As we have already mentioned in recent years, people have changed their habits. In the way they eat, for example, we see that they are increasingly concerned about their health and well-being. This has therefore led to a rise in demand for organic products that are considered by consumers to be healthier and of higher quality[28]. According to the latest FiBl report on organic farming[29], retail sales of organic products continue to grow[30].

The latest available data are those to 2020 and of the 75 million hectares we know that Oceania alone occupies almost half of the world's organic ag-

[24] Lema *et al*. 2021.
[25] Fieldsend *et al*., 2020; Lundvall 2016.
[26] Ingram *et al*. 2020.
[27] Cristiano *et al*. 2015; Ivanova 2017.
[28] Baudry *et al*. 2017; Willer *et al*. 2022.
[29] Willer *et al*. 2022.
[30] Eurostat 2020; Willer *et al*. 2022.

ricultural area (with 36 million hectares), followed by Europe (17.1 million hectares, 23%), Latin America (9 million hectares, 13.3%), Asia (6.1 million hectares, 8.2%), North America (3.7 million hectares, 5%) and Africa (2.1 million hectares, 2.8%)[31].

Of the total, only a quarter, i.e. 18.4 million hectares, is devoted to cultivated land, which is divided between arable crops (13.1 ha) and permanent crops (5.2 ha), while the rest is devoted to grassland/grazing (over 50 million hectares). Over 60% of the arable land is in Europe, followed by Asia (21%) and North America (9%). Of these, most are dedicated to arable crops, particularly cereals, which occupy 5.1 million ha.

3.1.2. European contest

European Union (EU) is one of the continents with the largest share of agricultural land dedicated to organic farming (8.5 % in 2020, a growth rate of 62 % over the last 10 years)[32]. At the end of 2020, 17 million hectares of agricultural land in Europe were managed organically by almost 420,000 producers, of which 13 million from the EU. Organic farmland increased by more than 0.7 million hectares compared to 2019. The countries with the largest organic agricultural areas were France (2.5 million ha), Spain (2.4 million hectares) and Italy (2.1 million ha)[33]. Like 2020, 2021, with the continuation of the COVID-19 crisis, was a favourable year for the European organic sector. Consolidated data for 2020 show particularly strong double-digit retail sales growth in several countries. Retail sales of organic products reached EUR 52 billion in 2020, an increase of 15 % compared to 2019[34].

Although the growth of the European area as a whole is evident, the variations in individual countries are uneven. Some states are reaching or have even surpassed the target of 25% organic area, such as Austria, but in some cases, we are also faced with decreases, generally slight, such as the Eastern European countries[35].

With regard to arable land, equal to 6.5 million hectares (occupying 45% of the total), Eurostat data confirm the prevalence of cereals (over 36%) although root crops, vegetables, green fodder and industrial crops are also well represented[36].

As far as the cereal sector is concerned, the EU is one of the world's largest producers and traders and around 20% of wheat crops, which account for more than half of the cereals grown in the EU, are exported annually, while

[31] Willer *et al.* 2022.
[32] Eurostat 2020.
[33] Ursu and Petre 2022.
[34] SINAB 2021; Willer *et al.* 2022.
[35] SINAB 2021; Gismondi *et al.* 2022.
[36] Eurostat 2020.

seeds, feed and rice are imported in large quantities. The use of these is mainly for animal feed (two thirds); one third is for human consumption and 3% is used to produce biofuels[37].

3.1.3. Italian contest

Italy is one of the most virtuous countries in Europe, with area dedicated to organic farming reaching 2,186,570 hectares in 2021, i.e. an increase of 4.4% compared to 2020. The percentage of organic on the total UAA has grown to 17.4% from 16% in 2020, shortening the distance from the 25% target, and is second only to the aforementioned Austria (25.2%) and with France (with a UAA of 2,776,799 ha) and Spain (with a UAA of 2,437,891 ha) is among the top three EU countries in terms of surface area[38].

The analysis of the geographical distribution confirms that even at the national level we have a fairly differentiated situation between the different regions. As far as the national organic UAA is concerned, over 50% of it is located in five regions, which are Sicily (316,147 ha), Apulia (286,808 ha), Tuscany (225,295 ha), Calabria (197,165 ha) and Emilia-Romagna (183,578 ha)[39].

Also, in terms of operators we have a 5.4.% growth in 2021 to 4,413 and again the majority (52%) are concentrated in five regions: Sicily, Calabria, Apulia, Campania and Tuscany. Italy is the first country in Europe for organic farms and the size of organic farms is also on the rise at 28.8 ha compared to 11.1 ha for the overall national average[40].

Almost half of Italy's organic area is cultivated with arable crops (49%, over 900,000 hectares), mainly cereals (9.7%) driven mainly by increased investments in durum wheat and soft wheat, while the remainder is divided between meadows/grazing land (28%, about 551,000 hectares) and permanent crops (24%, over 480,000 hectares), the latter showing an increase of +3.5% overall[41].

The production of organic durum wheat, concentrated mainly in the central-southern regions of Italy (table 3), is fundamental for the production of pasta, a strategic product and, at the same time, a symbol and expression of Made in Italy.

[37] <https://agriculture.ec.europa.eu/farming/crop-productions-and-plant-based-products/cereals_it>, 25.05.2023.

[38] Gasparri 2022; Ismea, Ciheam-Bari 2022.

[39] Ismea, Ciheam-Bari 2022.

[40] Ismea, Ciheam-Bari 2022.

[41] Gasparri 2022; Ismea, Ciheam-Bari 2022.

	Area (ha)	
Region	*Industrial durum wheat*	*Organic durum wheat*
Piemonte	1.840	360
Valle d'Aosta	-	-
Liguria	-	3
Lombardia	10.930	387
Trentino A. A.	8	-
Veneto	14.474	910
Friuli-Venezia Giulia	45	6
Emilia-Romagna	64.677	6.395
Toscana	57.546	13.522
Umbria	22.600	1335
Marche	100.103	9.846
Lazio	40.260	7.448
Abruzzo	34.290	2.098
Molise	60.900	1.892
Campania	53.847	5.992
Puglia	343.500	40.391
Basilicata	115.160	31.734
Calabria	23.092	5.202
Sicilia	264.075	32.998
Sardegna	264.075	931
Italy	**1.228.503**	**161.456**

Tab 3. Industrial and organic durum wheat area by region, 2021 (Source: elaboration on ISTAT and SINAB data, available at: <http://dati.istat.it/, www.sinab.itcontent>, 23.04.2022)

3.2. *The price trends of commodities*

Agriculture plays a crucial role in climate change. Firstly, agriculture contributes to climate change, but at the same time it is a possible solution because it is able to contain negative environmental externalities related to production and can therefore be a tool for mitigation and adaptation, as demonstrated by a large body of scientific literature[42].

The strengthening of this production model requires the achievement of

[42] Tuck *et al*. 2014; Skinner *et al*. 2019.

adequate levels of profitability for farms, which depends on commodity price trends that have risen dramatically and are characterised by excessive volatility, mainly due to rising fertiliser and energy prices, but also due to many other factors that we reported in the literature review.

In this paragraph we will analyse these trends and in particular in Figures 1 and 2 we report the analysis of two indicators which are the intra-annual volatility and the inter-annual volatility of organic and industrial durum wheat prices and afterwards we also report the results of the global indicator. All three indicators are calculated in the Italian national context using data from the year 2014 to the year 2022 (due to data availability) available at the Bologna Commodity Exchange - AGER for organic and industrial durum wheat, which is an evolution of the work reported in Viganò *et al.* (2022).

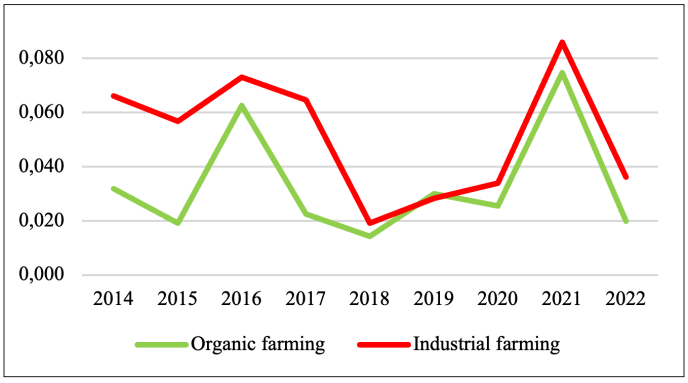

Fig. 1. Intra-annual volatility of industrial and organic durum wheat prices (from 2014 to 2022) (Source: Elaboration on Ager data)

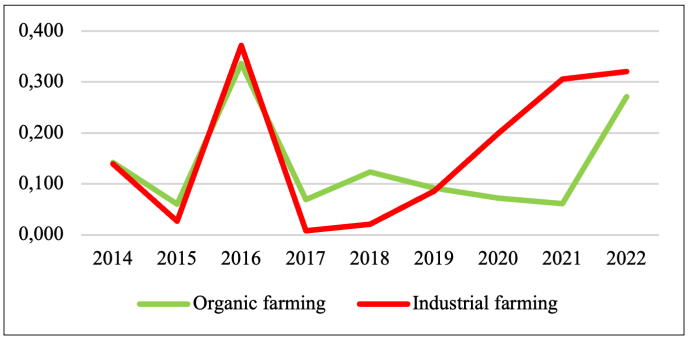

Fig. 2. Inter-annual volatility of industrial and organic durum wheat prices (from 2014 to 2022) (Source: Elaboration on Ager data)

Considering intra-year volatility, the price of industrial durum wheat has been significantly more volatile and almost always with higher values. In-

ter-annual volatility, with similar trends for both production methods, is higher over the period. This means that medium- to long-term decisions tend to be riskier because of the larger time frame that makes reliable decision-making impossible.

The global volatility of durum wheat prices for the period 2014-2022 is 0.041 for the organic system and 0.058 for the industrial one. The global indicator of the price of organic durum wheat is lower compared to the industrial one. Overall, conventional durum wheat has an intrinsic risk that is not compensated by higher purchase prices than organic durum wheat. In any case, this does not mean that organic crops suffer from less risk, but it can be interpreted as another reason to switch to more sustainable production models.

This instability resulted from the post-pandemic crisis and then worsened with the Russia-Ukraine conflict. In addition to this, these trends are also driven by the increasing competition brought about by a strong development of intensive production models and aggressive marketing strategies implemented by international traders.

We think it is also important, however, to focus on commodity price data of durum wheat, in terms of the trend of average annual prices (Figure 3) and of monthly prices (Figure 4).

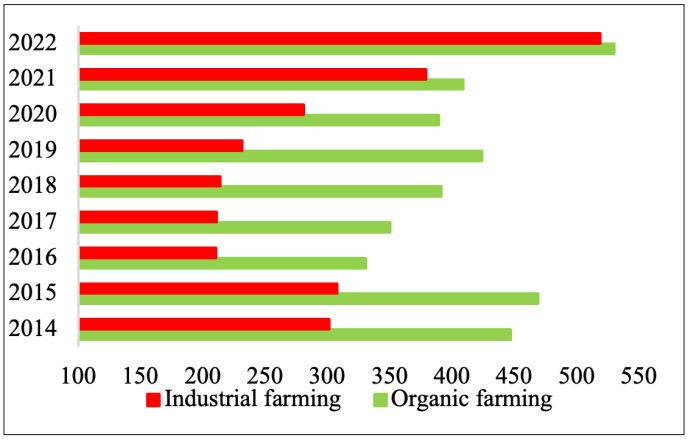

Fig. 3. Average annual prices (from 2014 to 2022; eur/ton)) (Source: Elaboration on Ager data)

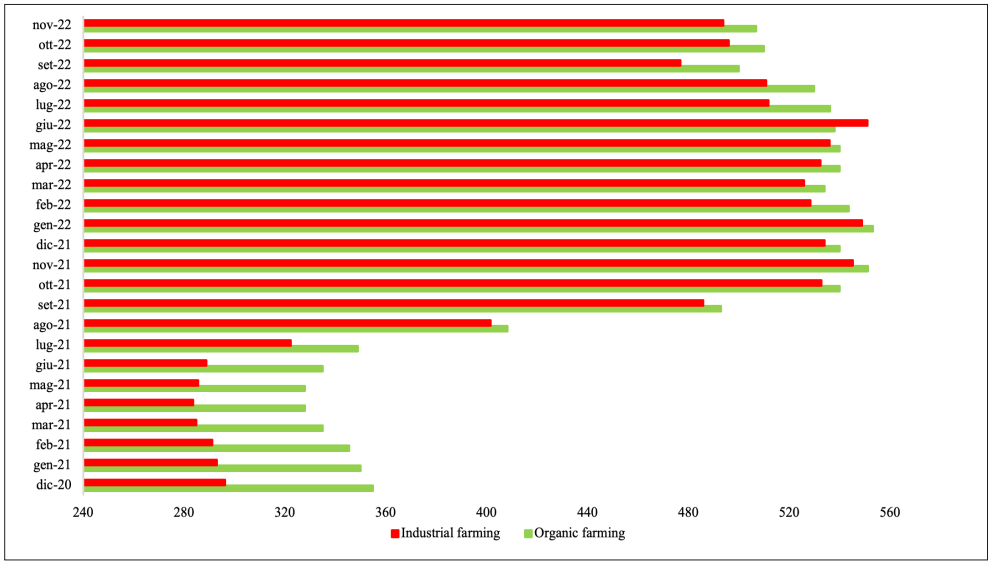

Fig. 4. Monthly prices (from Dec 2020 to Nov 2022; eur/t) (Source: Elaboration on Ager data)

Analysing the trends of the last few years and especially focusing on what is happening in the last few months we can see that the prices of organic and conventional durum wheat are getting closer and closer. This is an issue that should be taken into consideration by policy makers as it could prove the exit from the organic system of farmers not considering it adequately profitable and as for the increasing volatility, which characterises especially the industrial system, it should be analysed to make sure that a solution is found as it can lead to higher rates of hunger and malnutrition and financial speculation in commodity markets.

4. *Organisational innovations: knowledge dissemination and supply chain contracts*

The analysis of factors hindering farmers' conversion to the organic system highlights the importance of the absence of both agencies for the transfer of knowledge from research institutes to farms[43], and of market risk management tools, conditioned by market dynamics, which are particularly disincentivising at this time for new farms to remain or enter the organic farming system[44].

[43] Läpple, Kelley 2013; Liu *et al.* 2019.
[44] Canavari *et al.* 2022; Viganò *et al.* 2022.

Therefore, it is important to study what the problems are and to understand what the possible solutions might be to strengthen organic supply chains and the agri-food system in general.

The innovation system and research certainly play a strategic role in identifying production and organisational solutions that allow adaptation to the new climatic-environmental conditions and, at the same time, the reduction of greenhouse gas emissions and allow for organisational improvement and situations of fair redistribution of value along the supply chain.

As far as organisational solutions are concerned, there is a need for greater coordination between the various actors in the supply chain and the dissemination of knowledge, which, however, can only be effective if the level of training and professionalisation of farmers is adequate to be able to benefit from it[45]. In this context, we understand the importance of adopting multiple institutional interventions and how collaboration between the university and research system, the agricultural consulting system, agricultural enterprises and the world of education (agricultural technical institutes) and professional training should be encouraged by exploiting all synergies.

This is why there is a growing realisation at national and policy level of the importance of the role of consulting services in facilitating the diffusion of innovation.

These tools could be important knowledge-sharing vehicles and thus innovation that would benefit both the farmers themselves and the environment in which they operate by providing support for territorial, social and economic cohesion (e.g. rural areas)[46]. The fact of being followed by expert advisors could bring an increase in skills and greater professionalisation in agriculture thanks to their technical-organisational support. This, however, will also require a strengthening of chains and relations between the different stakeholders that will have to be increasingly fair and stable[47] and it will be important that farmers are able to understand the benefits so as to reduce the perceived complexity of the adoption process.

At the European level, the "Agricultural Innovation System" was already being talked about in 2011 as a system that would be able to improve agricultural productivity and sustainability[48] and those who are in charge of addressing the obstacles to the European research and innovation system and facilitating coordination between the various actors involved to date are the European Innovation Partnerships (EIP-Agri)[49].

[45] Bàrberi, Migliorini 2017.

[46] <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52017DC0713>, 23.05.2023.

[47] Vecchio *et al.* 2020.

[48] FAO 2018; FAO *et al.* 2021.

[49] European Commission 2022.

At the national level, following European policies, the "Strategic Plan for Innovation and Research in Agriculture, Food and Forestry" was presented in 2014 with the aim of modernising the sector by promoting and sharing knowledge, innovation and digitalisation in rural areas. In order to be able to activate information exchanges and improve knowledge and innovation flows, the actors of the system will have to be directed to favour the strengthening of the Agricultural Knowledge and Innovation System (AKIS), which is "a set of organisations and/or persons, including the links and interactions between them, operating in the generation transformation, transmission, storage, retrieval, integration, dissemination and utilisation of knowledge and information, with the aim of working synergistically to support decision-making, problem-solving and innovation in agriculture with the objective of mitigating/adapting change and achieving economic, social and environmental sustainability of agricultural enterprises"[50]. This system in Italy is promoted by national rural networks[51].

The innovative system is important, but as we have already mentioned above, it is crucial that agricultural entrepreneurs are also able to implement all the insights that can be derived from it. In general, more efficient governance systems and supply chains require greater coordination. We are therefore going to analyse what, through the study of literature, we believe could be an effective solution to the problems listed above, supply chain contracts.

The economic sustainability of food systems is closely linked to guaranteeing fair prices and adequate profitability margins for the various actors in the food chain. Supply chain contracts, being agreements whereby parties sign up to objectives, strategies, obligations, roles and responsibilities in order to better coordinate and thus reduce market risk, make it possible to receive guaranteed "fair prices"[52]. This is possible through the advance definition of the guaranteed minimum price, the specification of the qualitative characteristics of the delivered product in order to receive a premium price, and the assurance of seeing all the product that was pre-established through the contract placed[53].

In the previous paragraph, however, we have seen that with recent price dynamics, the price factor can no longer be the only element to consider when deciding to enter into a supply chain contract. Therefore, in addition to this, the ancillary services that a farmer can take advantage of becoming very important. These are, for example, the product purchase guarantee, which is particularly important in the event of oversupply, because otherwise farmers would not even be able to sell their product or would be forced to do so at unprofitable and below-market prices; pre-financing or the certainty of payment

[50] OECD 2013.
[51] <https://www.reterurale.it/PAC_2023_27/PianoStrategicoNazionale>, 23.05.2023.
[52] Righi *et al*. 2022.
[53] Carillo *et al*. 2017; Viganò *et al*. 2022.

times. They also offer a number of advantages at the level of territorial systems. Efficient and sustainable supply chains are fundamental, in fact, for improving logistics and, therefore, the connection between the production system and the final demand for organic products. Other services that we consider significant in terms of risk reduction are the provision of technical assistance and consultancy services for the management of the production process[54].

Integration forms and the presence of supply chain contracts, therefore, are crucial because they support farmers and provide them with the necessary knowledge to remain in the organic system and also increase their competitiveness. Efficient supply chains can also allow for improved logistics and, thus, easier access to the end demand market for organic products. A particularly interesting example is the one reported in Blasi *et al*., 2016 relation to public procurement for sustainable public (school and hospital) canteens, which is often hampered by the lack of an adequate organisational level of agri-food companies. In addition, agricultural education and improving the skills and innovative capacity of farmers is important to ensure that there are more and more well-qualified operators who are able to recognise the advantages of the sector and seize the opportunities that can help solve the current challenges. These seem to be the ways forward to respond to the changing scenarios, triggered by climate change and exacerbated by the COVID 19 pandemic and the Russia-Ukraine war[55].

5. *Conclusion*

In the post-pandemic context and with rising commodity prices, consumers are increasingly attracted to local or organic products, considering them to be of higher quality and healthier. This growing attention means that the entire system, in order to meet consumer demands, is moving towards the production of healthier and more sustainable food.

In order for the agri-food system, and in particular the organic sector, which as we have seen has a lower market risk, to be able to respond to the current challenges, however, adequate and effective responses are needed.

In particular, it is necessary to increase professionalisation and improve the current organisation of agricultural enterprises in order to improve their efficiency, market competitiveness and profitability.

To do this, the organisational innovation and the innovative and knowledge dissemination system seems to be a way forward, as does joining a supply chain or other form of integration, considering the multiple advantages for ag-

[54] Righi *et al*. 2022; Viganò *et al*. 2022.
[55] OECD 2013; Righi *et al*. 2022.

ricultural entrepreneurs. However, as we have also emphasised in our analysis, another tool that seems crucial at this time are consulting services that would make it possible to make the most of all the opportunities that will come from the new policies guiding the transition. Creating a "knowledge chain" could improve the qualification, skills and knowledge of agricultural entrepreneurs to guide the transition to a more sustainable agrifood system.

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