Comparative Economic Research. Central and Eastern Europe
Volume 28, Number 3, 2025
https://doi.org/10.18778/1508-2008.28.19

Organic Animal Products in the EU to Support Sustainable Consumption

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Abstract

A critical analysis of the research discourse on the development of organic farming is imperative if it is to contribute to the spread of sustainable consumption patterns, as indicated in the European Green Deal (EGD). However, there is a notable dearth of research from a macroeconomic perspective. What and how much we consume affects human health and the environment. Therefore, there is a need to increase consumer awareness of the consequences of food choices, as organic animal products can contribute to sustainable consumption and production. The study aims to determine the level of development of the production of organic animal products in European Union (EU) countries. Synthetic indicators of the development level of EU countries in 2016 and 2020 were constructed based on the Principal Components Approach (PCA) using Eurostat data. A survey and literature review shows that countries at the top of the ranking, such as Denmark, Sweden, Finland and Austria, have active policies to support the development of organic agriculture on both the supply and demand sides. On the other hand, a divergence in the factors that influence the development of organic agriculture was also observed in the top-ranked countries. Therefore, the development of organic agricultural production, including organic animal products, requires the diffusion of experiences across the EU to support the multifaceted OAFR (organic agriculture and food research) paradigm and the Sustainable Development Goals.

Keywords: organic animal products, organic farming, OAFR, level of development, sustainable consumption, European Green Deal, sustainable development goals

JEL: O11, O13, Q5, Q13, Q18

Received: 6.06.2024. Verified: 24.02.2025. Accepted: 27.06.2025

Introduction

Organic agriculture is a tool to support sustainable food systems, including the 12th Sustainable Development Goal[1]. Achieving this goal requires the implementation of sustainable consumption and production programmes, the sustainable management and efficient use of natural resources, the reduction of food waste, and the raising of consumer awareness of the possibilities of a lifestyle compatible with nature (UN 2022). Food consumption and production patterns are still unsustainable from both human health and environmental perspectives (Komisja Europejska 2020). Therefore, an informed consumer is an important link in creating a sustainable agri-food system that aligns with the development of organic agriculture and the achievement of the Sustainable Development Goals (SDGs) (Talwar et al. 2021).

The European Green Deal (EGD) strategy is designed to combat climate change and environmental degradation. Its overarching goal is to achieve a zero-emissions economy by 2050, and within that, at least 25% of agricultural land in the EU should be devoted to organic farming by 2030. Within the three priorities of the strategy, the development of organic farming has been identified as a key objective. A number of courses of action have been identified to stimulate demand for organic food products, nurture consumer confidence, and stimulate conversion along the entire agri-food system chain. Furthermore, specific actions and the importance of sustainable consumption have been outlined in the Farm to Fork strategy (European Commission 2022). The EC defines organic production as farm management that ensures best environmental practices, the maintenance of a high level of biodiversity, the maintenance of high animal welfare, the protection of natural resources, and respect for consumer preferences (COM 2014). This broad definition of organic agricultural production outlines the three basic functions that organic farming is expected to perform: to protect the environment, to meet food demand and to protect animal welfare. While it seems that these functions should work together, from the perspective of achieving SDGs, without ensuring stability in the social area – including the eradication of poverty – environmental issues will often be downplayed (Rawort 2021).

The challenge for organic farming is to ensure that the global population has access to sufficient food ("feeding the world"). In 2022, nearly 30 per cent of the world's population lacked consistent access to food, with 900 million experiencing severe food insecurity while about two billion people suffer from obesity (The Intergovernmental Panel on Climate Change 2022). Approximately one-third of the food produced annually (1.3 billion tonnes) is wasted in households, shops, transport, and as a consequence of suboptimal harvesting practices (United Nations n.d.). These statistics illustrate the unsustainability of the global agri-food system. Organic farming development could increase the availability of food locally and thus shorten supply chains, which would have a positive impact on reducing food waste. Nonetheless, this aspect needs to be analysed further. Studies show that, on the one hand, an increase in the availability of organic food products in supermarkets has a positive impact on the demand for organic food products. On the other hand, consumers are not interested in buying organic food products due to higher

1 The twelfth sustainable development objective refers to responsible consumption and production, and the article will use the nomenclature of sustainable consumption and production for the sake of uniformity.

prices or a lack of trust in certification methods (Gutkowska and Batóg 2016; Kaczorowska, Rejman, and Nosarzewska 2018; Bialik and Śmieja 2019; Maciejewski 2020; Talwar et al 2021; Malissiova et al. 2022).

Furthermore, the role of livestock in "feeding the world" context is of particular significance. On the one hand, animal husbandry is crucial for generating food, while on the other hand it has a negative impact on the environment and thus climate change. Livestock represents an important link in sustainable land use, and livestock production is an essential part of the entire agri-food system chain. The challenge of "feeding the world" requires a multidimensional approach that acknowledges the role of organic agriculture in food security. Research should focus on reducing the yield discrepancy between conventional and organic agriculture while simultaneously promoting sustainable consumption and production (Rahmann et al. 2017). Enhanced productivity in organic farming is contingent upon the provision of effective investment support and the development of requisite skills (Mei et al. 2022).

The discourse surrounding research into the development of organic agriculture requires a critical analysis of its characteristics, considering both its potential diffusion and an understanding of its limitations. An issue frequently encountered in the analysis of organic farming research is its diffuse nature, particularly its micro-economic aspect. Research is often based on a case study, which leads to a proposal for a systemic solution, and the conclusions relate to a specific farm or group of stakeholders. Therefore, it is not possible to generalise the results to the entire OAFR (organic agriculture and food research) system, as they are determined by the specific conditions of the farming system on a particular farm or in a particular region, for example (Freyer, Bingen, and Fiala 2019).

A macroeconomic analysis is required to determine the level of development of organic animal product production in the EU. This analysis is part of the process of satisfying consumer demand for food, including the challenge of "feeding the world". However, this study represents only a preliminary investigation into the potential for organic farming to contribute to the development of a sustainable food system. It aims to provide insights into the opportunities for organic farming to support sustainable consumption and production within the context of the SDGs.

Organic food products in the light of sustainable consumption

Achieving both the EDG and SDG goals necessitates the implementation of sustainable, responsible consumption practices. Thus, there is a continued need to educate consumers about the consequences of their purchasing choices, including food products, as the quantity and type of food consumed affects human health and the environment (Szubska-Włodarczyk 2022).

The demand for organic food products is strongly influenced by a number of factors. Wheeler (2006) demonstrated that the availability of organic products in supermarkets is a significant factor. Ladwein and Sánchez Romero (2021) highlighted the role of public institutions in financing activities for sustainable consumption and production, which is crucial for building trust between consumers and actors along the supply chain. Furthermore, Verburg, Verberne, and Negro

(2022) emphasised the need to support the demand side by promoting consumer awareness of organic farming.

Diagourtas, Kounetas, and Simaki (2022) analysed the purchasing motives of organic food consumers from two different European markets, Greece (a developing market) and Sweden (a developed market), were analysed. They found that consumer awareness was an important factor that influences the development of the organic food market. Swedish consumers were characterised by high environmental awareness and a demonstrated interest in sustainability. In contrast, Greek consumers were characterised by low environmental awareness and a lack of concern for animal welfare. However, they observed that health concerns play a significant role for them.

Stoica (2021) noted that low consumer awareness in Romania represents a significant barrier to the development of organic farming. However, there has been an increased interest in organic products due to the COVID-19 pandemic.

Table 1. Demand for organic food products in EU countries in 2016 and 2020

Country	2016			2020			2023		
	Organic consumption per capita [€/person]	Organic retail sales [€ million]	Organic retail sales share [%]	Organic consumption per capita [€/person]	Organic retail sales [€ million]	Organic retail sales share [%]	Organic consumption per capita [€/person]	Organic retail sales [€ million]	Organic retail sales share [%]
Austria	177.39	1541.6	8.2	253.63	2265	11.3	292.00	2657	11.00
Belgium	53	600	2.39	77.24	892	3.2	101.00	1153.00	4.0
Bulgaria	3.91	28.01	0.47	5	33.27	1	5.85	37.77	1
Croatia	23.5	99.3	2.2	24.18	99.3	2.2	24.18	99.3	2.2
Czech Republic	9.15	93.56	0.9	21.91	225.97	1.77	25.14	274.11	1.70
Denmark	243.9	1392	10.5	383.58	2240	13	362.00	2159	11.80
Estonia				57	76.5	4.3	81.27	111.00	4.60
Finland	49.75	273	2	73.9	409	2.6	63.26	352.00	1.90
France	100.89	6736	3.8	190.12	12831	6.57	176.00	12081	5.60
Germany	116.4	9478	4.97	180.25	14990	6.8	190.61	16080	6.30
Greece	5.6	66	0.32	5.6	66	0.31	5.92	60.00	–
Hungary	3.04	30	0.3	3.04	30	0.3	3.04	30	0.3
Ireland	33.85	160	1.94	47.33	235	2.73	32.65	165.15	2.73
Italy	43.58	2644	3	64.14	3872	3.5	65.80	3882	3.5
Latvia	2	4	0.2	6.32	51	1.5	6.32	51	1.5
Lithuania	2	6	0.2	17.8	50.5	1	17.8	50.5	1
Luxembourg	188	108	6.2	284.6	170.87	9.11	227.65	151.39	7.20
Netherlands	62.77	1070.9		78.19	1361.13	3.26	90.65	1614.60	4.59

Country	2016			2020			2023		
	Organic consumption per capita [€/person]	Organic retail sales [€ million]	Organic retail sales share [%]	Organic consumption per capita [€/person]	Organic retail sales [€ million]	Organic retail sales share [%]	Organic consumption per capita [€/person]	Organic retail sales [€ million]	Organic retail sales share [%]
Poland	4.39	167	0.39	8.28	314.12	0.62	8.23	310.00	0.57
Romania	2.06	40.65	0.15	2.06	40.65	0.15	2.06	40.65	0.15
Slovenia	26.6	48.6	1.8	26.6	48.6	1.8	26.6	48.6	1.8
Spain	36.33	1641	1.69	53.4	2528	2.48	57.14	2747.80	2.53
Sweden	224	2207	7.9	212.32	2192.8	8.7	219.55	2310.00	7.80

Source: FiBL Statistics n.d.

The largest market for organic food products in the EU is in Austria, Denmark, France, Germany, Italy, Portugal, and Sweden. The statistical consumer spends the most on organic food in Denmark, with an average expenditure of €362. This is followed by Austria (€292), Sweden (€219.55), France (€176), and Germany (€190.61). A comparison of the rate of retail sales of organic food products in both 2016 and 2020 reveals that Austria, Denmark, Finland, France, and Germany exhibited the highest levels of sales. Austria, Denmark, France, Germany, Luxembourg, and Sweden had the highest share of spending on organic food in general, with consumers spending between 6.57% and 13% of their expenditure on organic food in general. Comparing the data reveals that, in most leading countries, there was a decline in the rate of retail sales of organic products in 2016, 2020 and 2023, although the amount grew in absolute terms.

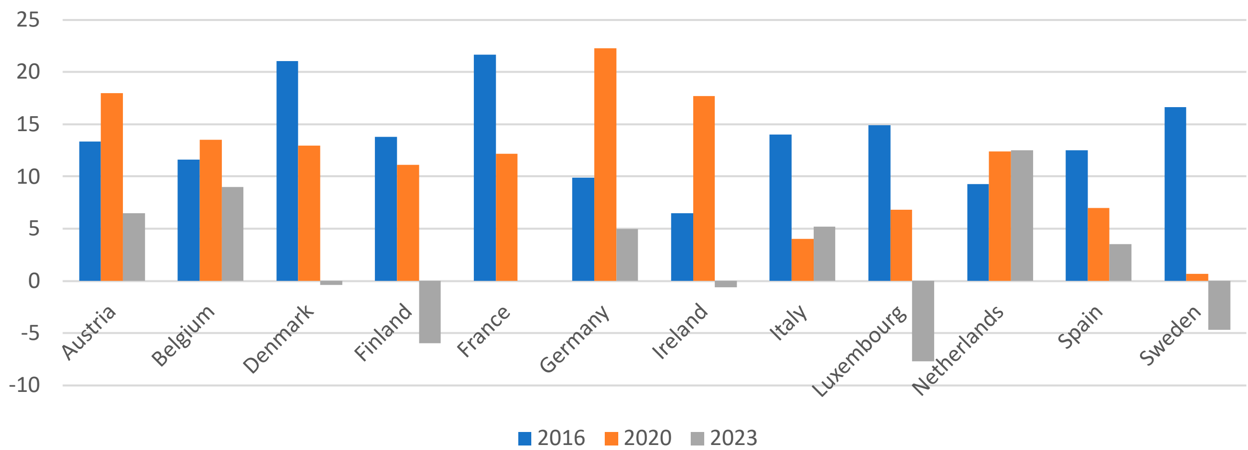

Figure 1. Organic retail sales growth (1 year) [%]

Source: FiBL Statistics n.d.

The following countries were also included in the study: Belgium, Croatia, Estonia, Finland, Ireland, Italy, the Netherlands, and Spain. In these countries, the share of organic food in total food expenditure was between 2% and 5%. The last group comprises the Czech Republic, Greece, Hungary, Lithuania, Latvia, Poland, Romania, and Slovenia, where the share of organic food expenditure ranged between 0.15% and 2%. In 2023 there was an overall decrease in the share of organic food products in total food expenditure, excluding Belgium, Estonia, Netherlands and Spain, compared to 2020.

Organic farming alone cannot achieve both the SDGs and the EU's goal of a zero-emissions economy. Research shows that only a drastic change in diet, which would involve a 54–71% reduction in meat consumption and a 62–78% increase in local food consumption, would reduce EU greenhouse gas emissions by almost half. Without such changes, it will not be possible to achieve the SDGs and mitigate climate change. It has also been shown that to make changes in dietary patterns more realistic, it would be necessary to introduce a consumption tax on meat of over 70%, together with import duties and production taxes (Röös 2022). However, this is a highly contentious issue taking into account the goal of "feeding the word" and the widening of social inequalities in view of income disparities. Thus, organic farming could be one of the solutions to help achieve environmental SDG and climate change targets. For example, total energy consumption per unit of product is, on average, 15% lower in organic farming than in conventional farming (Rahmann et al. 2017). On the other hand, research shows that the benefits of developing additional/larger areas for organic crops would be offset by the greenhouse gas emissions generated by converting them (Purnhagen et al. 2021).

Furthermore, increasing the share of organic agricultural land may not always have positive results when considering the challenge of "feeding the world". Rasche and Steinhauser (2022) showed that increasing the share of organic land in Germany to 30% by 2030 could result in a calorie deficit of 7–80 kcal per capita per day, compared to the absence of 1,000–5,000 km^2 of arable land. It was estimated that the deficit would disappear by 2045, taking into account demographic and technological developments. However, the emergence of a calorie deficit would undoubtedly have a negative impact on the global food system and agri-food supply chains.

On the other hand, if crop productivity increases, there would be no need for additional agricultural land. Increasing the share of organic farming will only be possible if technological advances are made to minimise the unsustainable food system that could result. Kuosmanen et al. (2021) confirmed that the production efficiency of organic farms in Finland is lower than that of conventional farms. With the same amount of resources, organic farms produce less. However, they found that this difference is decreasing over the years.

Methodology

In the literature, most of studies analysed the level of development in regional terms while looking at the microeconomic aspects of organic farms (Jeločnik et al. 2015; Czyżewski, Matuszczak, and Muntean 2018; Antczak 2019; 2021; Smoluk-Sikorska, Malinowski, and Łuczak, 2020; Pépin, Morel, and van der Werf 2021; Smoluk-Sikorska and Malinowski 2021). The conducted research used the Hellwig method, TOPSIS, zeroed unitarisation, Factor Analysis of Mixed Data and agglomerative hierarchical clustering (AHC). Therefore, there is a need for a macroeconomic analysis of how organic agriculture is developing in the EU.

Synthetic indicators of organic animal products for EU countries were constructed using the Principal Component Analysis (PCA) method. The PCA method makes it possible to reduce the diagnostic characteristics to several main components, facilitating interpretation. The principal components do not lose their informative value (Panek 2009). The values of the eigenvectors are interpreted as correlation coefficients of individual principal components with the variables considered (Kwiatkowski and Roszkowska 2008). Using the value of the first principal component, it is possible to determine which diagnostic variable has a greater influence on the phenomenon under study (Kolasa-Więcek 2012). A detailed description of the principal component method can be found in, among others, Radhakrishna (1964), Morrison (1990), Ostasiewicz (1998), Aczel (2000), Krzyśko (2000), and Jolliffe (2002). This method can be found in Hellwig (1968), while Pluta (1974, p. 197; 1976) used the analysis of variance to construct a synthetic indicator. The PCA method was used by Kociszewski and Szubska-Włodarczyk (2023) to construct a synthetic indicator of the efficiency of ecological plant and livestock production[2]. This study is a continuation and extension of that work.

Synthetic indicators for organic animal products have been compiled for as many EU Member States as possible using data from Eurostat. However, the statistics on organic farming that were selected for the construction of the indicators are not complete for all EU countries such as Belgium, Finland, Germany, Greece, Portugal, Slovenia. Therefore, these countries have been omitted from further analysis. Considering the amount spent on organic food products per capita and the amount of animal products consumed per capita, the availability of data for Germany and Belgium might influence the ranking results. Synthetic indicators have been constructed for 2016 and 2020. The choice of years was determined by data availability. Where no data were available for a particular diagnostic variable in a given year, the average of two values from the previous and the following year was used where possible, or the previous year was used. This was done to keep as many countries as possible for further analysis.

The selection of variables was largely limited by the availability of data for individual countries, as well as focusing on variables that fit into animal products (mainly dairy products). The production of these types of food products has a significant impact on the environment. For example, the production of 1 kg of cheese consumes on average 5,605 litres of water and emits 23.88 kg of greenhouse gases (Ritchie, Rosado, and Roser 2022). The synthetic indicator for organic animal products was constructed with the following diagnostic variables:

- x_1 – raw milk (tonnes/dairy cows (head)),
- x_2 – cream (tonnes/dairy cows (head)),
- x_3 – butter (tonnes/dairy cows (head)),
- x_4 – cheese (tonnes/dairy cows (head)),
- x_5 – eggs for human consumption (thousand/hens),
- x_6 – acidified milk (yoghurts and others) (tonnes/dairy cows (head)).

Due to large amounts of missing data for individual EU countries for selected diagnostic variables, the study included several versions of indicators with different sets of diagnostic variables.

2 In this paper, we focused on determining synthetic indicators of organic animal products was undertaken. Consequently, organic food products such as meat were omitted from the selection of variables. This approach is similar to that used by Kociszewski and Szubska-Włodarczyk (2023), who also developed similar indicators.

In Variant I from 2016 and 2020, the synthetic indicator includes variables x_1, x_2, x_3, x_4, x_5, and x_6. Variant II included x_1, x_2, x_3, x_4, and x_6.

Results

Table 2 shows the vectors of eigenvalues of the first principal component for the variables analysed in each variant. When analysing Variants I and II for 2016, variables x_1 and x_2 had the greatest impact on the value of the first principal component, followed by variable x_3. The situation is different for 2020. In Variant I, variables x_1 and x_3 had the greatest influence on the value of the first principal component in this period. In Variant II, on the other hand, variables x_2, x_3 and x_4 had the greatest influence. Variable x_5 can be said to have quite a significant impact on the value of the first component. However, it has been removed from the construction of the synthetic indicator for Variant II in order to include Hungary in 2016 and Hungary, Greece, Italy and Slovakia in Variant II from 2020 onwards.

Table 2. Vectors of eigenvalues of the first principal component for diagnostic variables analysed

Variable	Eigenvalues of the first principal component			
	I 2016	II 2016	I 2020	II 2020
x_1	0.4938	0.5585	0.4942	0.3280
x_2	0.4642	0.5173	0.4377	0.5375
x_3	0.4434	0.4980	0.4749	0.5442
x_4	0.2169	0.2629	0.3211	0.5278
x_5	0.4193	–	0.4190	–
x_6	0.3482	0.3215	0.2449	0.1696

Source: own elaboration.

The average yield of organic animal[3] products included in the synthetic indicator increased between 2016 and 2020. The average production of organic milk increased from 4.9 tonnes/head –5.0 tonnes/head in the 2016 variants to 5.5 tonnes/head in 2020. Other products also show an increase in average production, although productivity remained low. For example, the average production of organic butter increased from 0.02 tonnes/head to 0.03 tonnes/head – 0.04 tonnes/head in 2020, depending on the variant. Elsewhere, the average production of organic eggs increased from 0.17 thousand/hens in 2016 to 0.20 thousand/hens in 2020. For Variant I, the average production of organic cheese decreased slightly from 0.23 tonnes/head in 2016 to 0.13 tonnes/head in 2020. For Variant II, the decrease is negligible. The average production of organic cheese was 0.22 tonnes/head in 2016 and 0.21 tonnes/head in 2020. Looking at organic acidified milk, it is also difficult to see an increase in the average efficiency. In 2016, it was 0.25 tonnes/head or 0.26 tonnes/head, depending on the variant. In 2020, however, it was

3 Tables with the average production efficiency of the individual organic animal products included in the synthetic indicators for each EU country are in the Appendix.

0.31 tonnes/head or 0.35 tonnes/head. The efficiency of organic cream production did not change and remained at 0.02 tonnes/head.

Below is the ranking of EU countries based on the value of the designated synthetic indicator for organic animal products.

Table 3. Ranking of EU countries according to designated synthetic indicators for organic animal products

I 2016		II 2016		I 2020		II 2020	
Country	Ranking	Country	Ranking	Country	Ranking	Country	Ranking
DK	1	DK	1	DK	1	IT	1
SE	2	EL	2	FR	2	DK	2
NL	3	SE	3	NL	3	FR	3
EL	4	NL	4	SE	4	CY	4
FR	5	FR	5	CY	5	NL	5
AT	6	AT	6	AT	6	AT	6
CY	7	CY	7	LT	7	SE	7
IE	8	IE	8	IE	8	EL	8
IT	9	EE	9	ES	9	IE	9
LT	10	LT	10	EE	10	LT	10
CZ	11	IT	11	BG	11	ES	11
EE	12	ES	12	CZ	12	EE	12
ES	13	HU	13	RO	13	HU	13
RO	14	CZ	14	LV	14	BG	14
LV	15	LV	15	HR	15	LV	15
HR	16	BG	16	PL	16	SK	16
PL	17	RO	17			CZ	17
BG	18	SK	18			HR	18
SK	19	HR	19			RO	19
		PL	20			PL	20

Source: own elaboration.

When analysing the ranking, Denmark was in first place in all variants, except for Variant II in 2020. In that case, Italy took first place due to its high production of organic cheese compared to Denmark (IT – 1.56 tonnes/head, DK – 0.2 tonnes/head). Italy also had the highest production of organic butter (0.4 tonnes/head) and organic cream (0.33 tonnes/head). In comparison, Denmark produced, on average, 0.1 tonnes/head organic cream and 0.16 tonnes/head organic butter. When analysing the average yields for this variant, Denmark produced the most organic milk (9.2 tonnes/head), followed by Sweden (8.4 tonnes/head), Cyprus (8.2 tonnes/head), the Netherlands (7.9 tonnes/head), France (7.2 tonnes/head) and Austria (5.6 tonnes/head). The lowest efficiency of organic milk production was found in Poland (2.4 tonnes/head).

Comparing the statistics above with Variant II from 2016, in which organic eggs were removed from the set of variables to keep as many countries as possible in the ranking, Denmark is also in first place, followed by Greece, Sweden, the Netherlands, France and Austria. Poland came last. Comparing the ranking with the average production efficiency of the individual variables, the most organic milk was produced by Greece (10.4 tonnes/head), Denmark (8.9 tonnes/head), the Netherlands (7.7 tonnes/head), and Sweden (7.6 tonnes/head). This was followed by Italy (5.2 tonnes/head), Austria (5.2 tonnes/head), and France (5.0 tonnes/head). The highest average production of organic cream was recorded in Sweden and Denmark (0.1 tonnes/head each). Denmark (0.1 tonnes/head), the Netherlands (0.09 tonnes/head), and France (0.08 tonnes/head) are among the leaders in the efficiency of organic butter production. Greece leads in the average efficiency of organic cheese production (2.0 tonnes/head), followed by Cyprus (0.4 tonnes/head) and Austria (0.3 tonnes/head). The highest average production of acidified milk was in Ireland (1.0 tonnes/head), the Netherlands (0.7 tonnes/head), Cyprus (0.6 tonnes/head), and Sweden (0.5 tonnes/head). In Variant I of 2016 and 2020, all variables were used to construct the indicator. The average efficiency of organic egg production was 0.17 thousand/hens in 2016 and 0.20 thousand/hens in 2020. In 2016, the leading countries in terms of efficient organic egg production were Sweden, France, the Netherlands, Italy and Ireland. In 2020, it was Denmark, Sweden, the Netherlands, Ireland, and France.

The development of organic animal production in the context of promoting sustainable consumption

The article attempts to determine the level of development of organic animal production in the EU. Organic animal products have been treated as "the lesser of two evils" on the way to sustainable, responsible consumption due to the lower energy consumption per unit of product and the concept of organic agricultural production itself. However, scientific research confirms that it will be impossible to achieve the EU's environmental targets and the SDGs without reducing the consumption of meat and animal products (Rahmann et al. 2017; Purnhagen et al. 2021; Talwar et al. 2021; Röös 2022).

The implementation of SDG 12 through organic farming seems justified, considering the principles of this type of production. Organic agricultural production means avoiding the use of artificial fertilisers, pesticides, antibiotics, animal growth hormones and GMOs while maintaining biodiversity and natural biological cycles and ensuring a high standard of animal welfare (European Union 2007; 2008). Additionally, organic food is less harmful to health (Taghikhah et al. 2020). For example, organic milk is richer in omega-3 polyunsaturated fatty acids, carotenoids, and vitamins E, B2, and B9 than conventionally produced milk, while organic meat contains more bioactive compounds than meat produced using conventional methods (Duru et al. 2017).

Organic farming in the EU is developing at different rates in different countries, taking into account, for example, the share of organic land in the total agricultural area. For example, it is 25.7% in Austria, 22.4% in Estonia, 20.3% in Sweden, 16% in Italy, 15.3% in the Czech Republic, 14.8% in Latvia, 13.9% in Finland, 11.7% in Slovakia, 11.45% in Denmark, 10.1% in Greece, 8.7% in France, 7.25% in Belgium and 3.9% in the Netherlands. Analysing the results of the study, it can be concluded that the level of development is not solely dependent on the share of organic agricultural area. The countries at the top of the ranking, such as Denmark, the Netherlands, and France, do not exhibit a unique share of organic agricultural area in the EU. On the other hand, Sweden, which is at the top of the ranking, has the third highest share of organic agricultural area. A similar example is Italy, which moved from ninth and eleventh place in the 2016 variants of the indicator to first place in Variant II in 2020. Austria, which has the highest share of organic agricultural area, ranks sixth in each variant.

Therefore, it seems that the level of development of organic farming should be identified with more than just the share of organic agricultural area in general. Going a step further, Purnhagen et al. (2021) raised concerns about the EU's targets for organic farming, which shows an increase in carbon dioxide emissions as a result of additional land conversions.

What then influences the level of organic farming development in the EU? Daugbjerg (2023) showed that the introduction of public procurement programmes for organic food in public institutions in Denmark and Sweden helped the organic food and agriculture sector expand. Palšová et al. (2014) showed that after the introduction of policy changes in Slovakia, the development of organic agriculture was noticed through the obligation to increase the area of organic crops in Slovakia and the possibility for farmers to receive subsidies for establishing organic agricultural production. However, organic livestock production dominated organic crop production.

On the other hand, when analysing Slovakia's ranking, which was in 19th or 18th place in 2016, depending on the variant, and in 16th place in 2020 in Variant II, it is evident that the policy contributed to the development of organic agriculture, which is visible in the ranking classification and in the share of organic agricultural area (11.7%). However, it also confirms the observation that the increased share of organic agricultural area should not be the only measure/determinant of organic agriculture development in terms of the implementation of sustainable consumption. Countries with a lower share of organic areas, such as the Netherlands, Denmark, France, and Belgium, were higher in the ranking.

Kujala, Hakala, and Viitaharju (2022) demonstrated that many factors contribute to regional differences in the share of organic land in Finland. However, the key factor for areas with the highest shares is the long tradition of organic heritage. In some Finnish regions, initiatives to support the development of organic farming were established as early as the 1980s, such as extension services (the Mikkeli eco-county and the Partala Rural Development Centre for research on organic farming).

In Sweden, policies to limit the use of pesticides and artificial fertilisers in agriculture began to be implemented as early as the 1980s, and the main Swedish certification body for organic products (KRAV) was established. In addition, a tax was levied on the prices of pesticides and fertilisers, with the revenues used for research into eliminating the use of chemicals in agriculture and to spread awareness and education in this area (Lohr and Salomonsson 2000). In addition to production targets (i.e., increasing the area under organic farming to 30% by 2030), Sweden also set consumption targets to increase demand for organic food, introducing a law that requires a 60% share of organic food in public procurement (Basnet et al. 2023).

The current food system includes large amounts of animal products and processed foods. Increasing food self-sufficiency and reducing the negative impact of consumption on the natural environment can be achieved by reducing consumption of mainly animal products while increasing domestic production of cereals, pulses, and potatoes (Basnet et al. 2023).

Table 4. Total per capita consumption of selected animal products in the EU

	Per capita milk consumption [kg]			Per capita egg consumption [kg]		
	2016	2020	Relative change [%]	2016	2020	Relative change [%]
Austria	185.65	188.23	1	13.95	13.99	0
Belgium	107.64	133.38	24	7.42	13.84	86
Bulgaria	140.03	127.06	– 9	8.19	4.98	– 39
Croatia	211.95	161.04	– 24	9.62	8.32	– 14
Cyprus	116.86	157.01	34	7.62	6.49	– 15
Czech Republic	143.75	157.14	9	8.94	10.27	15
Denmark	234.57	241.16	3	15.95	15.02	– 6
Estonia	270.62	279.54	3	12.94	12.41	– 4
Finland	358.18	258.80	– 28	10.74	11.37	6
France	183.19	200.90	10	11.64	14.11	21
Germany	164.54	209.63	27	13.02	15.38	18
Greece	224.95	200.32	– 11	8.75	8.67	– 1
Hungary	165.69	175.05	6	13.70	14.55	6
Ireland	203.66	238.47	17	8.77	9.06	3
Italy	181.32	184.09	2	11.76	11.49	– 2
Latvia	165.71	197.29	19	11.21	13.41	20
Lithuania	102.65	223.99	118	15.46	11.83	– 23
Luxembourg	102.53	93.84	– 8	15.38	16.26	6
Malta	98.42	93.03	– 5	10.14	9.61	– 5
Netherlands	311.44	256.24	– 18	22.24	21.86	– 2
Poland	164.81	173.06	5	7.25	8.63	19
Portugal	133.51	138.99	4	9.04	10.09	12
Romania	234.12	211.04	– 10	14.15	12.84	– 9
Slovakia	172.99	144.82	– 16	11.88	9.46	– 20
Slovenia	135.03	168.61	25	9.63	9.52	– 1
Spain	160.80	154.56	– 4	14.74	14.65	– 1
Sweden	176.59	210.76	19	13.83	13.27	– 4

Source: own elaboration based on Ritchie, Rosado, and Roser 2017.

Milk and egg consumption varies between EU countries. The highest per capita consumption of milk, of 200 kg or more, is found in Sweden, Romania, the Netherlands, Lithuania, Ireland, Greece, Germany, France, Finland, Estonia, and Denmark. The per capita consumption of eggs is highest in the Netherlands, with an average of 21.86 kg per inhabitant in 2020. Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Luxembourg, Portugal and Romania also have egg consumption per capita ranging from 10 to more than 16 kg.

In 2020, 154 million tonnes of milk was produced in the EU. The largest milk producers are Germany (32.5 million tonnes), France (24.8 million tonnes), Poland (14.9 million tonnes), the Netherlands (14.2 million tonnes) and Italy (13.2 million tonnes). In the EU alone, 10.3 million tonnes of cheese were produced in 2021. The largest producers were Germany (2.4 million tonnes), France (1.9 million tonnes), Italy (1.4 million tonnes), Poland (993,000 tonnes) and the Netherlands (984,000 tonnes) (Krajowy Ośrodek Wsparcia Rolnictwa 2023, pp. 5–12). For example, research conducted in France shows that dairy farmers believe that organic farming increases their adaptability to changing market conditions. It can increase their adaptability by reducing risk, stimulating learning, increasing job satisfaction and allowing them to maintain a family farm. This is due to the belief that organic milk prices are higher, prices are more stable, and feed autonomy is increased, thus limiting the risk of increasing production costs (Bouttes, Darnhofer, and Martin 2019).

The differences in organic milk production methods across the EU are the result of topography, land availability and legislation. The development of this form of organic farming requires the exchange of knowledge, experience and advice between farms across the continent. Research in seven EU countries showed that the lowest levels of organic milk production and the smallest herd sizes were found on Polish and Austrian farms, while the highest levels were found in Denmark, Sweden, and northern Germany. Farms in the Netherlands, Germany, Denmark, and Sweden were characterised by high intensity.

The greatest diversity was observed in Austria and Germany due to the different dairy systems, i.e., lowland and mountain. The diversity included the size of the herd and the area of arable land used for fodder production and pastures. The automated milking system was predominant in Germany, Denmark and Sweden, i.e., countries where the culture of automated milking systems also prevails in conventional production. There were also differences in the proportion of animals slaughtered due to, among other things, differences between breeds. A lower rate of organic milk production was found in Lithuania. However, the rate is higher on highly efficient dairy farms in Sweden and Germany. High production intensity is associated with shorter animal life and reduced fertility (Wallenbeck et al. 2019).

Looking at the top countries in the ranking, strong growth in organic dairy cattle can be seen in Austria and Denmark. In the Netherlands, however, this type of production has developed more slowly due to the lack of government support in the early 1990s. The focus was on supporting conventional agriculture to increase the competitiveness of the sector and develop exports of conventional agricultural products. Additionally, organic farms were not considered when it came to reducing emissions from natural fertilisers. Organic farmers produce animal products at lower densities, but the rules have not been relaxed for them. In addition, the belief that organic farming should develop through market mechanisms, the non-application of CAP (Common Agricultural Policy) payments and the high price of agricultural land were identified as barriers to the development of organic farming in the Netherlands. As research has shown, the different pace of development is the result of inappropriate support, or a lack thereof, at the very beginning of formal guidelines for organic farming.

By comparison, Denmark and Austria have long supported organic dairy farming. In Denmark, the use of pesticides was taxed, and the revenue from these taxes was used to support organic farming. In addition, in both countries, the large distribution of organic dairy products in supermarkets is a very important factor in the popularisation of organic food products, helping to reduce the differences in retail prices between these products. These countries have also implemented health and marketing campaigns to promote the consumption of regional products (Verburg Verberne, and Negro 2022).

Taking into account the applied policies to develop organic farming in different EU countries, as well as the results of the ranking, it seems that demand-stimulating instruments can have a positive impact on organic farming development, e.g., the implementation of public procurement programmes in Denmark and Sweden. Such solutions seem crucial for increasing interest in organic food consumption in EU countries such as Bulgaria, Greece, Hungary, Lithuania, Poland, and Romania, where consumption of these products is relatively low (see Tables 1). Positive confirmation can be found in the campaigns promoting the health benefits of consuming regional organic food products, carried out in Denmark and Austria, where organic consumption per capita is high (see Tables 1). The use of only supply-side instruments aimed at increasing organic agricultural land may not have a satisfactory effect in terms of promoting organic farming supporting sustainable consumption, as exemplified by Slovakia, which is at the bottom of the ranking.

Conclusion

When trying to outline a unified framework for systemic solutions for organic farming, it remains difficult to clearly state what influences its development in the EU. However, there is no doubt that organic farming, based on its principles and guidelines, is a tool that can support the implementation of SDG 12. The issues outlined in the article point to an area of research that requires the identification and definition of opportunities and threats and, perhaps most importantly, barriers to development from a macroeconomic perspective. The study examined the complex interplay between organic farming, the promotion of sustainable consumption, and the EU's environmental objectives based on the EGD.

However, there remains a need to thoroughly examine the validity of the subsequent conversion of agricultural land to organic use from the perspective of greenhouse gas emissions. Research shows that environmental goals do not always go hand in hand with the goals of sustainable consumption development of organic food. Thus, more research is needed on the balance of greenhouse gas emissions, as well as the benefits and costs for the entire food system from a global perspective in light of the mission to "feed the world" (Rahmann et al. 2017; Rasche and Steinhauser 2017; Purnhagen et al. 2021; Röös et al. 2022; Basnet et al. 2023).

When analysing the results of the study and the literature presented, a similarity can be observed between the position of a country's position in the ranking and the observations presented in the literature on the subject. Countries at the top of the ranking, such as Denmark, Sweden, Finland, and Austria, had active policies to support the development of organic agriculture from both the supply and demand sides. Their policy included public procurement aimed at purchasing organic food, early support for organic farming as far back as the 1980s, revenues from the taxation of pesticides and fertilisers were allocated to support organic farming, and consumers were given easier access to organic animal products through supermarket distribution (Wallenbeck et al. 2019; Lohr and Salomonsson 2000; Kujala, Hakala, and Viitaharju 2022; Verburg, Verberne, and Negro 2022; Basnet et al. 2023; Daugbjerg 2023).

The factors that influence the development of organic farming vary considerably across the countries at the top of the ranking. For example, in France, organic dairy farming is seen to have adapted to changing market conditions through higher and more stable prices. This contrasts with the lack of knowledge of Belgian farmers about the real economic potential of organic farming, which has a negative impact on decisions related to the transition to organic production (Kerselaers et al. 2007; Bouttes, Darnhofer, and Martin 2019). Meanwhile, the slower development of organic animal production in the Netherlands has been attributed to, among other things, the lack of differentiation between organic farming guidelines and general agricultural production regulations and the inconsistency of regulations on stocking density (Stubenrauch et al. 2021; Ambrosius et al. 2022; Verburg, Verberne, and Negro 2022). Therefore, the development of organic agricultural production, including organic animal products, requires the dissemination of experiences across the whole of the EU (Wallenbeck et al. 2019; Nikolić, Knežević, and Paraušić 2021).

In conclusion, there remains a need to analyse the factors that influence the development of organic agriculture in the EU and to find common development directions to support the macroeconomic concept of organic agriculture. This may entail adjusting policy instruments or differentiating and specifying the guidelines for organic agriculture in general regulations on agricultural production. The research underscores the importance of prioritising efforts to increase the efficiency of the production of organic animal products through the exchange of experiences, practices, and policy tools used between countries.

Therefore, in the light of our research, it seems that policy support instruments for organic farming development should allow for the dissemination of innovation and the implementation of technological advances in the production process, rather than focusing solely on increasing the share of organic land in total. Moreover, it seems crucial to intensify the use of instruments that influence the demand side of the market by increasing the availability of organic food products, promoting broader consumer awareness and knowledge, and introducing public procurement programmes for organic products. This aligns with the principle that "change starts at the top".

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Appendix

Table 5. Average production yields for diagnostic variables for Variant I 2016

	X_1	X_2	X_3	X_4	X_5	X_6
Austria	5.18	0.044	0.0336	0.29	0.13	0.28
Bulgaria	2.97	0.002	0.0048	0.05	0.00	0.08
Croatia	2.83	0.000	0.0000	0.00	0.10	0.00
Cyprus	6.04	0.000	0.0000	0.45	0.18	0.60
Czechia	4.76	0.006	0.0003	0.02	0.21	0.01
Denmark	8.88	0.108	0.1256	0.12	0.18	0.38
Estonia	5.87	0.007	0.0011	0.08	0.13	0.04
France	5.03	0.040	0.0794	0.19	0.29	0.44
Greece	10.42	0.033	0.0128	1.99	0.19	0.15
Ireland	2.52	0.006	0.0000	0.09	0.25	1.05
Italy	5.23	0.000	0.0000	0.22	0.27	0.00
Latvia	5.05	0.000	0.0000	0.00	0.07	0.00
Lithuania	4.36	0.000	0.0000	0.10	0.18	0.27
Netherlands	7.69	0.009	0.0942	0.25	0.27	0.75
Poland	2.16	0.000	0.0000	0.00	0.11	0.00
Romania	2.31	0.000	0.0028	0.26	0.20	0.00
Slovakia	2.60	0.000	0.0017	0.10	0.04	0.02
Spain	3.55	0.001	0.0014	0.09	0.15	0.39
Sweden	7.56	0.114	0.0147	0.02	0.31	0.56
Mean	5.00	0.019	0.020	0.23	0.17	0.26
Standard deviation	2.34	0.035	0.037	0.44	0.09	0.31

Source: own elaboration.

Table 6. Average production yields for diagnostic variables for Variant II 2016

	X_1	X_2	X_3	X_4	X_6
Austria	5.2	0.044	0.034	0.29	0.277
Bulgaria	3.0	0.002	0.005	0.05	0.083
Croatia	2.8	0.000	0.000	0.00	0.000
Cyprus	6.0	0.000	0.000	0.45	0.605
Czechia	4.8	0.006	0.000	0.02	0.013
Denmark	8.9	0.108	0.126	0.12	0.377
Estonia	5.9	0.007	0.001	0.08	0.040

	X_1	X_2	X_3	X_4	X_6
France	5.0	0.040	0.079	0.19	0.436
Greece	10.4	0.033	0.013	1.99	0.153
Hungary	4.1	0.004	0.007	0.16	0.052
Ireland	2.5	0.006	0.000	0.09	1.051
Italy	5.2	0.000	0.000	0.22	0.000
Latvia	5.0	0.000	0.000	0.00	0.000
Lithuania	4.4	0.000	0.000	0.10	0.270
Netherlands	7.7	0.009	0.094	0.25	0.748
Poland	2.2	0.000	0.000	0.00	0.000
Romania	2.3	0.000	0.003	0.26	0.003
Slovakia	2.6	0.000	0.002	0.10	0.015
Spain	3.5	0.001	0.001	0.09	0.392
Sweden	7.6	0.114	0.015	0.02	0.558
Mean	4.96	0.019	0.019	0.22	0.25
Standard deviation	2.29	0.034	0.037	0.43	0.30

Source: own elaboration.

Table 7. Average production yields for diagnostic variables for Variant I 2020

	X_1	X_2	X_3	X_4	X_5	X_6
Austria	5.6	0.065	0.0414	0.2734	0.13	0.321
Bulgaria	4.3	0.009	0.0000	0.0539	0.18	0.201
Croatia	3.7	0.000	0.0000	0.0079	0.13	0.000
Cyprus	8.2	0.000	0.0000	0.6530	0.19	0.821
Czechia	4.4	0.001	0.0004	0.0171	0.21	0.015
Denmark	9.2	0.099	0.1561	0.1992	0.31	0.398
Estonia	4.9	0.007	0.0022	0.1824	0.18	0.069
France	7.2	0.059	0.1082	0.2651	0.24	0.413
Ireland	2.8	0.005	0.0000	0.0377	0.24	1.623
Latvia	5.0	0.000	0.0001	0.0001	0.09	0.000
Lithuania	5.4	0.000	0.0144	0.1100	0.24	0.242
Netherlands	7.9	0.010	0.0967	0.2545	0.28	0.768
Poland	2.4	0.000	0.0009	0.0052	0.07	0.001
Romania	2.8	0.003	0.0001	0.0014	0.21	0.002
Spain	6.0	0.001	0.0017	0.0660	0.19	0.284
Sweden	8.4	0.047	0.0126	0.0250	0.31	0.474

	X_1	X_2	X_3	X_4	X_5	X_6
Mean	5.5	0.02	0.03	0.13	0.20	0.35
Standard deviation	2.1	0.03	0.05	0.17	0.071	0.43

Source: own elaboration.

Table 8. Average production yields for diagnostic variables for Variant II 2020

	X_1	X_2	X_3	X_4	X_6
Austria	5.6	0.065	0.0414	0.273	0.32
Bulgaria	4.3	0.009	0.0000	0.054	0.20
Croatia	3.7	0.000	0.0000	0.008	0.00
Cyprus	8.2	0.000	0.0000	0.653	0.82
Czechia	4.4	0.001	0.0004	0.017	0.02
Denmark	9.2	0.099	0.1561	0.199	0.40
Estonia	4.9	0.007	0.0022	0.182	0.07
France	7.2	0.059	0.1082	0.265	0.41
Greece	7.0	0.005	0.0022	0.392	0.04
Hungary	4.2	0.005	0.0078	0.151	0.08
Ireland	2.8	0.005	0.0000	0.038	1.62
Italy	6.9	0.340	0.4251	1.585	0.47
Latvia	5.0	0.000	0.0001	0.000	0.00
Lithuania	5.4	0.000	0.0144	0.110	0.24
Netherlands	7.9	0.010	0.0967	0.255	0.77
Poland	2.4	0.000	0.0009	0.005	0.00
Romania	2.8	0.003	0.0001	0.001	0.00
Slovakia	4.2	0.000	0.0059	0.034	0.01
Spain	6.0	0.001	0.0017	0.066	0.28
Sweden	8.4	0.047	0.0126	0.025	0.47
Mean	5.5	0.033	0.04	0.22	0.31
Standard deviation	2.0	0.078	0.10	0.36	0.40

Source: own elaboration.

Ekologiczne produkty pochodzenia zwierzęcego w UE jako wsparcie zrównoważonej konsumpcji

Istnieje potrzeba krytycznej analizy dyskursu badań nad rozwojem rolnictwa ekologicznego, jeśli – tak jak wskazano w Europejskim Zielonym Ładzie (EZŁ) – ma ono przyczynić się do upowszechniania zrównoważonych wzorców konsumpcji. Widoczny jest niedosyt badań w ujęciu makroekonomicznym. Ekologiczne produkty pochodzenia zwierzęcego mogą przyczynić się do realizacji zrównoważonej konsumpcji i produkcji. To, co konsumujemy i w jakich ilościach, wpływa na nasze zdrowie i środowisko naturalne. Niezbędne jest poszerzanie świadomości konsumentów w kontekście konsekwencji, jakie wynikają z podjętych decyzji zakupowych dotyczących produktów żywnościowych. Celem artykułu jest określenie poziomu rozwoju produkcji ekologicznych produktów pochodzenia zwierzęcego w krajach UE. Syntetyczne wskaźniki poziomu rozwoju krajów UE w latach 2016 i 2020 zbudowano na podstawie metody głównych składowych (PCA). Wykorzystano dane pochodzące z Eurostatu. Na podstawie przeprowadzonego badania, jak również studiów literatury można stwierdzić, że państwa będące w czołówce rankingowej, takie jak Dania, Szwecja, Finlandia, Austria, prowadziły aktywną politykę wspierającą rozwój rolnictwa ekologicznego zarówno od strony podażowej, jak i popytowej. Z drugiej zaś strony w krajach sklasyfikowanych w czołówce rankingowej zauważono również rozbieżność co do czynników wpływających na rozwój rolnictwa ekologicznego. Dlatego rozwój ekologicznej produkcji rolnej, a w tym ekologicznych produktów pochodzenia zwierzęcego, wymaga dyfuzji doświadczeń w krajach UE w celu wsparcia wieloaspektowego paradygmatu OAFR (*organic agriculture and food research*) i celów zrównoważonego rozwoju.

Słowa kluczowe: ekologiczne produkty pochodzenia zwierzęcego, rolnictwo ekologiczne, OAFR, poziom rozwoju, zrównoważona konsumpcja, Europejski Zielony Ład, cele zrównoważonego rozwoju