Equilibrium. Quarterly Journal of Economics and Economic Policy
Volume 17 Issue 3 September 2022
p-ISSN 1689-765X, e-ISSN 2353-3293
www.economic-policy.pl

ORIGINAL ARTICLE

Citation: Kowalska, A., & Bieniek, M. (2022). Meeting the European green deal objective of expanding organic farming. *Equilibrium. Quarterly Journal of Economics and Economic Policy, 17*(3), 607–633. doi: 10.24136/eq.2022.021

Contact to corresponding author: Aleksandra Kowalska, aleksandra.kowalska@umcs.lublin.pl

Article history: Received: 6.11.2020; Accepted: 5.07.2022; Published online: 30.09.2022

Aleksandra Kowalska
Maria Curie-Skłodowska University in Lublin, Poland
orcid.org/0000-0003-3854-951X

Milena Bieniek
Maria Curie-Skłodowska University in Lublin, Poland
orcid.org/0000-0001-9686-7650

Meeting the European green deal objective of expanding organic farming

JEL Classification: *O13; Q15; Q18*

Keywords: *European Green Deal; green growth; organic farming; sustainable food system; green public procurement*

Abstract

Research background: Economic growth is unsustainable. However, a circular economy has the potential to lead to sustainable development, while decoupling economic growth from the negative consequences of resource depletion and environmental degradation. The EU's strategy of climate neutralization in 2050 developed, inter alia, into a European Green Deal action plan aiming at the efficient use of resources by moving to a cleaner, circular economy. More sustainable EU food system is a cornerstone of the European Green Deal. The European Commission's goal is 25% of agricultural land to be used for organic production in 2030. The question is if it is possible to reach the objective with the use of current incentives. What else may be done to encourage European farmers to convert to organic farming?
Purpose of the article: The aim of this research is to review the development of organic agriculture in Europe and the EU and to identify incentives for farmers to convert to organic farming.
Methods: First of all, the methodological approach is to iteratively review the existing literature to frame the problem. Secondly, the data on organic agriculture in Europe is to be analyzed to answer the research questions. The analysis is based on international statistics, mainly collected by FiBL, IFOAM, EC Agri-food data portal and Eurostat..Fitting the trend functions to the actual data has been made in three scenarios (pessimistic, realistic and optimistic). These trend functions were used for the long-term forecasts of the share of organic farmland in the EU.

Findings & value added: The long-run forecast might be treated as a goal, which can motivate to act more intensively to achieve the objective. The existing measures, including organic farming payments, are not sufficient to meet the goal of massive increase in the acreage under organic production. It is necessary to develop new incentives e.g. Green Public Procurement, innovative and effective media campaigns, development of a dynamic network of actors within the organic food supply chain with the use of blockchain technology.

Introduction

Economic growth is, by its very nature, unsustainable. Extensive scientific research shows that human activity, particularly related to the accelerating growth of production and consumption, is degrading the natural environment (Sandberg *et al.*, 2018, pp. 133–141; Steffen, 2015, p. 736). In response to increasingly serious warnings about climate change and ecological breakdown, the notion of green growth has emerged as a central theme in the European Union's (EU) economic policy. Green growth theory rests on the assumption that absolute decoupling of Gross Domestic Product (GDP) growth from resource use and carbon emissions is feasible. Green growth mainly relies on technological and market innovations to improve the efficiency of production and thus, to decouple the use of natural resources and environmental impacts from continued economic expansion measured by GDP (Hickel & Kallis, 2020, pp. 469–486; UNEP, 2011). Circular economy, a development strategy that provides for green growth, has the potential to lead to sustainable development while decoupling economic growth from the negative consequences of resource depletion and environmental degradation (Morseletto, 2020). Potting *et al.* (2017, p. 5) created a framework facilitating circular economy by organizing ten common circular economy strategies into three segments: (1) smarter product use and manufacture (refuse, rethink, reduce); (2) expand lifespan of products and its parts (reuse, repair, refurbish, remanufacture, repurpose); (3) useful application of materials (recycle, recovery). The EU's strategy of climate neutralization in 2050 has developed, inter alia, into the European Green Deal (EGD) action plan aiming at the efficient use of resources by moving to cleaner, circular economy.

The EGD, published by the European Commission (EC) in December 2019, is divided into several policy areas relating to: protecting biodiversity, ensuring more sustainable agricultural and food systems, clean energy, sustainable industry, cleaner construction sector, sustainable mobility, eliminating pollution, making Europe a climate-neutral continent by 2050 (EC, 2020a). Furthermore, Becchetti *et al.* (2021) recognized the EGD as a 'social vaccine' to overcome COVID-19 health and economic crisis since the commitment towards zero emissions is to involve all sectors, whereas no individual and no place will be left behind.

More sustainable EU food system is a cornerstone of the EGD. This is understandable, since agriculture and food production have tremendous negative impacts on the environment which can be measured in terms of greenhouse gas (GHG) emissions, land use, freshwater use, eutrophication, and biodiversity (Ritchie & Roser, 2021). It cannot be failed to point out that the agricultural sector has also positive effects on environment through the production of oxygen, provision of natural life, maintenance of rural landscapes and the provision of environmental and other public goods (Ali *et al*., 2022; Kowalska, 2019, p. 44–46). Furthermore, if agricultural sector takes the right course, it will meet nutritional needs of people and will be a good source of income, as well as contribute to the sustainable development of rural areas. While livestock, fisheries and crop production account for 58% of food's total emissions, transportation of food accounts for only 6% of food emissions (Ritchie & Roser, 2021). Thus, promoting the consumption of local food and seasonal products that are in-season is definitely not enough to significantly cut the emissions. There is a concern that organic farming is not the paradigm for sustainable agriculture and global food security, but also there are reasoned suggestions to reduce environmental impact of food consumption through minimizing meat intake, refusing air-transported products, and purchasing organic food (Kowalska *et al.*, 2021, 13022). One thing is certain: the goal of environmental sustainability can be achieved only if a sustainable pattern of production (sources) and consumption (sinks) is maintained (Goodland, 1995, pp. 1–24).

Given that food industry has significant effects on the environment and organic food production is commonly perceived as a sustainable management system, one of the EC's goal set within the EGD is 25% of agricultural land to be used for organic production in 2030. The research questions that this study seeks to answer are as follows: (RQ1) Is it possible to reach the goal of expanding organic farming with the use of current incentives? (RQ2) What else may be done to encourage European farmers to convert to organic farming?

The aim of this research is to review the development of organic agriculture in Europe and the EU and to identify incentives for farmers to convert to organic farming and boost the growth of the organic food sector. The methodological approach is to, first, review the existing literature to frame the problem, and then to analyse the data on organic agriculture in Europe and to establish reasonable forecasts for the long-term development of organic farming in the EU.

The paper is structured as follows. Section 1 provides a brief overview of the concept of organic agriculture and its role in meeting the EGD targets. Section 2 outlines the approach employed to analyse the data used in the study. Section 3 highlights the findings, synthesizes secondary data to review the development of organic farming in Europe and the EU and seeks to assess if the EGD objective of expanding organic agriculture is achievable. Section 4 discusses the results and puts forward proposals concerning actions that may be taken to boost the growth of organic food sector. Section 5 provides conclusions from the study and recommendations for future research.

Literature review

The development of a more sustainable food system is at the heart of the EGD plan. As part of this policy, ‘from farm to fork’ strategy is now being implemented to protect people’s health and well-being, and at the same time, to increase the EU’s competitiveness and resilience. The following 2030 targets have been set within this strategy (EC, 2020a): (a) to reduce the use of chemical and more hazardous pesticides in agriculture by 50%; (b) to reduce nutrient losses by at least 50%, while ensuring no deterioration of soil fertility, and reduce fertilizer use by at least 20%; (c) to reduce the sale of antimicrobials for farmed animals and in aquaculture by 50%; (d) to foster the growth of the EU organic agricultural sector, with the goal of 25% of total farmland being used for organic farming by 2030.

Organic production is described in Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No. 834/2007 as

> “a sustainable management system consisting of the production of a wide variety of high-quality food and other agricultural and aquaculture products that respond to consumers’ demand for goods that are produced by the use of processes that do not harm the environment, human health, plant health or animal health and welfare.”

The International Federation of Organic Agriculture Movements (IFOAM – Organics International) proves that the development of organic agriculture contributes to meeting the following sustainable development goals: (a) achieve food and nutrition security, and promote sustainable agriculture; (b) ensure healthy lives and promote well-being for all by reducing negative effects of chemicals on people and the planet; (c) ensure availability and sustainable management of water and sanitation for all by hindering pesticide runoff into waterways; (d) ensure responsible consumption and production patterns; (e) take urgent action to address climate change and mitigate its effects by focusing on best soil management practices (organic farming can sequester more carbon than is currently emitted); (f) protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, reverse land degradation and halt biodiversity loss by enhancing biological diversity (IFOAM, 2020).

Muller *et al.* (2017) have stated that organic agriculture is a controversial suggestion for improving the sustainability of food systems. Several authors claim that ecological benefits of organic farming, due to lower pesticide use and the exclusion of chemical fertilizers, are partly compensated as organic agriculture tends to have lower yields, which means that more land is required to produce the same amount of food (Jungbluth *et al.*, 2000, pp. 134–142; Hansmann *et al.*, 2020; Lorenz & Lal, 2016, pp. 99–152; Muller *et al.*, 2017; Treu *et al.*, 2017, pp. 127–142; Tuomisto *et al.*, 2012, pp. 309–320). Therefore, environmental benefits of organic agriculture might be smaller or even absent if measured per unit of product rather than per unit of area (Meier *et al.*, 2015, pp. 193–208; Seufert *et al.*, 2012, pp. 229–232). However, there emerge new propositions on how to produce a certain total amount of food, in terms of protein and calories, with organic agriculture with no increase in the cropped area, and to make organic agriculture more environmentally friendly. For example, Muller *at al.* (2017) have suggested making certain changes to the food system to feed the world more sustainably with organic agriculture, namely (a) reductions of livestock feed from arable land (i.e. food-competing feed) with corresponding reductions in animal production (and thus human consumption of animal products) and in related natural resource use and environmental impacts; and (b) reductions of food wastage, with correspondingly reduced production levels and impacts. Recent studies have shown that people with high civic consciousness and with high environmental concern waste less food (Barr, 2007, pp. 435–473; Melbye *et al.*, 2016, pp. 416–429; Parfitt *et al.*, 2010, pp. 3065–3081). Unfortunately, current research does not provide clear evidence that organic food consumers waste less food in order to avoid the monetary loss associated with wasting quality food or for other reasons (McCarthy & Liu, 2017, pp. 2519–2531).

Globally, only 1.5% of total agricultural land is organic (Willer *et al.* (Eds.), 2020, p. 20), but organic farming is one of the fastest growing sectors of global agriculture (Seufert *et al.*, 2017, pp. 10–20). In 2018, the share of organic farming area in total Utilized Agricultural Area (UAA) in the EU was 7.7% (Agri-food data portal: European Commission, 2020; FiBL Statistics, 2020a). The question is what may be done to increase this rate more than threefold to the level of 25%. There is a non-exhaustive list of driving forces that have been identified for organic agriculture which include conscious consumers, efficient market structures, subsidies, expertise and knowledge transfer etc. (FAO, 2022). Even if framework conditions for operating in the (organic) food market have remained more or less unchanged in Europe for the past dozen years, the COVID-19 pandemic has influenced both the supply and the demand side of the food market (Janssen *et al.*, 2021; Laborde *et al.*, 2020, pp. 500–502; Prosser *et al.*, 2022). One of the factors which contribute to the growth of organic market in European countries is an increase in health awareness during COVID-19 pandemic. Health awareness is a critical factor in choosing organic food which is commonly perceived as a healthier option. Many believe that organic food production is chemicals-free and organic products are of high nutritional value. Over the pandemic, consumers have also become more concerned about the environmental issues, which translated into higher demand for organic food products (see more Wojciechowska-Solis *et al.*, 2022). Since the COVID-19 pandemic there has been a significant shift to online food shopping across many European countries which might be particularly important for the development of organic food market in countries, like Poland, where this market is still immature and where the supply-demand relationship and distribution channels are developing (EIT Food, 2021, p. 7; Łuczka & Kalinowski, 2020). Finally, it has to be mentioned that the ongoing war in Ukraine and the related sanctions imposed on Russia by the United States of America (USA), Canada, Japan, Australia, Western European countries and so on will influence global food supply and result in further increase of food prices.

Research methods

The review of existing literature led to certain key research questions:

RQ1. *Is it possible to reach the EGD goal of expanding organic farming with the use of current incentives?*

RQ2. *What else may be done to encourage European farmers to convert to organic farming?*

The methodological approach is to, first, iteratively review existing literature to frame the problem, and then to analyze the 2000–2018 data on organic agriculture in Europe and the EU to consider the research questions. The analysis is based on international statistics, mainly collected by the Research Institute of Organic Agriculture (FiBL), IFOAM, EC Agri-food data portal and Eurostat. Policy makers both on the domestic and pan-European level widely use econometric models to develop and implement successful policies. Long-term forecasting appears crucial when shaping the common agricultural policy. However, still more studies are needed on the relative success of casual models for long-term forecast in agriculture. A long-run prediction may set ambitious aims and significantly change the agricultural policy (Allen, 1994, pp. 81–135).

Kahn and Wiener (1967) have stated that long-range forecasting is difficult, but not impossible. They say that the main reason for the fact that the simple statistical long-term forecasts are of poor quality is the occurrence of future major disruptions. However, the predictions might sometimes be satisfactory. The simple methods of long-run forecasting may be successful after one considers the uncertainty. The authors also pointed out that the long-term forecast might be treated as a goal, which subsequently can motivate to act more intensively in order for the objective to be achieved.

Long-run forecasting is dominated by trend curves, particularly by the simple linear and exponential trends (Granger & Jeon, 2007, pp. 539–551). We use these methods of long-term forecasting and check if they can be successful. We base forecasts on three kinds of trends: linear, exponential and parabolic. We evaluate and compare the fit of those curves to the data using the adjusted determination coefficient and the mean absolute percentage error (MAPE).

The coefficient of determination increases when extra-explanatory variables are added to the model. Therefore, the adjusted determination coefficient is sometimes more appropriate to describe the model's fit. It is defined by

$$adj\,R^2 = 1 - \frac{(1-R^2)(n-1)}{n-k-1},$$

where R^2 is the coefficient of determination, k is the total number of explanatory variables in the model not including the constant term, and n is the sample size. The adjusted determination coefficient is more relevant than the simple coefficient in comparing alternative nonlinear trend models (Aczel & Sounderpandian, 2008, p. 479).

MAPE, being a statistical measure of the accuracy of the prediction method, is also used in the comparison of the trend models. It is given by

$$MAPE = \frac{1}{n}\sum_{t=1}^{n}\frac{|y_t - y_{tp}|}{y_t}$$

with y_t being the actual value and y_{tp} the predicted value, and works best if there are no extremes to the data.

We also examine the accuracy of the 2030 forecasts by calculating ex-ante errors based on the investigated trend models. The ex-ante error in period T is defined by

$$\frac{V_T}{y_{Tp}} * 100\%,$$

where

$$V_T = s_e \sqrt{\frac{(T-\bar{t})^2}{\sum_{t=1}^{n}(t-\bar{t})^2} + \frac{1}{n} + 1}, \qquad \bar{t} = \frac{n+1}{2},$$

and s_e^2 is the mean squared error (Moore & McCabe, 2006, pp. 640, 667).

Results

Europe is a region that has had a very constant growth of organic land over the years (Figure 1) and that covered approximately 22% of the world's organic agricultural land in 2018 (Willer *et al.* (Eds.), 2020, p. 37). The compound annual growth rate (CAGR) of organic farmland in Europe within the studied period 2000–2018 is approximately 7.06%. The vast majority of land in Europe used for organic agriculture is located in the EU (Figure 1).

In the EU, 7.7% of the agricultural area was organic in 2018 (FiBL Statistics, 2020a). We present the baseline (linear) projection of the future share of organic farmland in total agricultural area in the EU (Figure 2). Assuming a linear trend over the period 2000–2030, the share of organic farmland in UAA in the EU–27 is predicted to reach 10.6% in 2030. Thus, when we look at Figure 2, we doubt that the goal of 25% of agricultural land to be used for organic production in 2030 is realistic and attainable (RQ1).

This is in line with the study by Mowlds (2020, pp. 17–30) who showed that if we stick to the business as usual approach (BAU), merely 10.3% of EU agricultural land would be under organic production by 2030. Adopting the BAU means an assumption is made that there will be no major change in people's attitudes and behaviors, or no considerable changes in technology, economics, or policies, so that the circumstances remain unchanged. The author stated that the EU Member States (MSs) should double the speed of annual growth from 5% between 2005 and 2018 to 11% annual growth rate between present and 2030, to reach the 25% target.

Let us precisely look at the EU data regarding the share of organic farmland and examine the accuracy of predictions obtained from the simple trend functions. We present the forecasts of the share of organic farmland by using a linear, parabolic and exponential trend function (see Figure 2). The linear trend is hereinafter called the pessimistic trend, the parabolic one — the realistic trend, and the exponential one — the optimistic trend.

In each scenario, we calculate the statistical measures of the goodness of fit, namely, the MAPE and the adjusted coefficient of determination. We also determine the 2030 forecasts obtained from the relevant trends and verify the forecasts' accuracy (Table 1).

The pessimistic trend gives relatively poor fit to the data while the realistic trend gives the best fit. However, the accuracy of the 2030 forecast is the highest in the optimistic scenario because the ex-ante error (0.32%) is the smallest in this case comparing to the 1.51% ex-ante error in the realistic scenario and 2.44% ex-ante error in the pessimistic one. Even though the trend function increases rapidly in the optimistic scenario, the forecast for the share of organic farmland in 2030 (16.5%) is much lower than the 25% goal (RQ1). Therefore, there is a need to introduce new incentives for farmers to encourage them to convert to organic farming and to implement actions to stimulate the demand for organic food.

To address the two research questions, the secondary data are used to gain insight into the efficiency of rural development programmes in the EU MSs and the size of the organic market in these countries.

The expansion of organic farming in the EU has been supported financially since the early 1990s. Since 1992, the EU rural development policy has provided the Common Agricultural Policy (CAP) specific support for farmers' conversion to organic production and/or the maintenance of farmers producing organically (Kowalska, 2013, pp. 218–223). Furthermore, in the first pillar, organic farms have benefited from the green direct payment without the need to fulfil any further obligations because of their overall significant contribution to environmental objectives. The Green Deal reiterates that 'at least 40% of the CAP's overall budget […] would contribute to climate action' (EC, 2020d). The problem is to provide sufficient support for effective climate change mitigation, for efficient instruments to maintain biodiversity and ecosystems, etc. So far, the CAP programmes that have supported a variety of practices contributing to wide-scale biodiversity loss, climate change, soil erosion and land degradation have been assessed as insufficient and/or underfunded (Pe'er *et al.*, 2019, pp. 305–316; Pe'er *et al.*, 2020, pp. 305–316). However, Poland is a case in point where introducing financial support under the CAP agri-environmental program for organic farming encouraged farmers to convert to organic farming practices during the initial years following Poland's accession to the EU. Organic agricultural holdings have almost doubled in number (from 3760 in 2004 to 7182 in 2005) (Kowalska, 2013, pp. 218–233). Lindström *et al.* (2020, p. 106622) proved that direct organic subsidies in Sweden had a significant positive impact on the share of organic farmland. Kriščiukaitienė *et al.* (2013, p. 43) found out that subsidies had the strongest impact on farmers' decisions on switching to organic agriculture in Lithuania; and indicated the precise amount of effective green payment.

In 2018, the levels of the area payments financed by EU funding programmes and their national co-financing elements differed among the MSs (Figure 3). It is worth noting that there are several outlying observations identified (the so-called outliers) (Aczel & Sounderpandian, 2008, p. 12) in Figure 3 and Figure 4, i.e. the Republic of Cyprus (CY) with relatively high organic area payment equal to 723 EUR/ha, and relatively low organic share of total agricultural land equal to 5.4%; and Luxemburg (LU) with a relatively high organic area payment equal to 1441 EUR/ha, and relatively low organic share of total agricultural land equal to 4.4% (see Figure 4; marked in black). Moreover, when we analyze the share of organic area in UAA by NUTS2 regions, it can be observed that this share was considerably high in 2016 in the following regions (Eurostat, 2020):

- Salzburg (AT32) in Austria – 51.5%;
- Severozápad (CZ04) in Czechia – 29.62%;
- Calabria (ITF6) in Italy – 29.31%;
- Norra Mellansverige (SE31) in Sweden – 29.39%.

A regional concentration of certified organic farms and areas of organic land in the EU might be influenced, inter alia, by: location of customers, level of farmer training, the organization of collection of organic agricultural produce, as well as the mimicking of other agricultural producers who stand out as a result of their high profitability (Kowalska, 2010, pp. 188–197; Zuba-Ciszewska *et al.* 2019, pp. 3396–3412).

In order to answer the RQ2, a mention may be made of three major driving forces identified for the development of organic agriculture: (1) consumers and market (conscious consumers have had a strong influence over organic production; both general retailers (Denmark, Austria, Sweden, Switzerland, the United Kingdom) and specialized retailers (France and Italy) have been successfully involved in the organic market growth in Europe); (2) service (the EU subsidies for organic farming have been available to provide environmental goods and services); (3) farmers (they have converted to organic farming to improve health of their families, profitability of agricultural production and/or self-reliance) (FAO, 2022; Willer *et al*., 2021, p. 255).

The question is if we can describe a relationship between the two variables: (1) organic area payments; (2) organic share of total agricultural land. The scatter plot suggests that these two variables are uncorrelated (Figure 4). Given quite steady but slow growth of organic land in 27 EU MSs over the past dozen years (see Figure 1), it is questionable if green direct payments are the most effective instruments to promote organic farming. In view of the EGD objectives, it is proposed to review the existing support structures and develop new incentives for farmers to convert to organic farming.

Organic agriculture is a strongly consumer-driven sector (Fromartz, 2007; Seufert *et al.*, 2017, pp. 10–20). The global market for organic foods has expanded over fivefold between 1999 and 2014. It has been still growing over the past few years. As of the end of 2018, organic food and drink sales reached 96.7 billion euros (Lernoud & Willer (Eds.), 2016, p. 26; FiBL Statistics, 2020b; Willer *et al*. (Eds.), 2020, p. 19). Over the past twenty years, the demand for organic foods has remained concentrated in North America and Europe (Kowalska, 2013, pp. 218–223; Willer *et al.* (Eds.), 2020, p. 37; Zuba-Ciszewska *et al.*, 2019, pp. 3396–3412). In 2018, the two regions comprised a large part of global sales (87.3%). At that time, organic retail sales in Europe were valued at 40.1 billion euros, which comprised 41.5% of global sales (37.4 billion euros in the EU, which comprised 38.7% of global sales) (Willer *et al.* (Eds.), 2020, p. 228). Globally, European countries account for the highest share of organic food sales as a percentage of their respective markets (Willer *et al.* (Eds.), 2020, p. 228). In 2018, Denmark, Switzerland and Sweden had the highest organic market share in Europe (DK — 11.5%, CH — 9.9%, SE — 9.1%) (Willer *et al.* (Eds.), 2020, p. 251). At that time, the EU countries with the largest organic markets were Germany (10.9 billion euros) and France (9.1 billion euros) (see Figure 5). The countries have been recognized as outliers because they have a relatively high organic retail sale and low organic share of total farmland (Figure 6; marked in black). The level of development of the organic food market and the market size vary from one country to another

(Figure 5). If we assume that consumers across countries are becoming more similar over time in terms of their spending across the types of products, we should try to answer the question concerning the antecedents and consequences of convergence in consumption (Ozturk *et al.*, 2021, p. 105). It is important with regard to the introduction of new instruments to accompany the future growth of organic sector in the EU.

The question is if a relationship exists between the two variables: (1) organic retail sales; (2) organic share of total agricultural land. The scatter plot suggests that these two variables are not correlated (Figure 6). It should be noted that for years organic production has been concentrated in southern regions, which have been export-oriented, while the largest markets for organic agricultural produce have been located in northern countries (the USA, the EU MSs) (Kowalska, 2013, p. 222; Zuba-Ciszewska *et al.,* 2019, pp. 3396–3412).

Discussion

The results of our research seem to confirm that it is very unlikely that the goal of 25% of total farmland in the EU being used for organic farming by 2030 will be reached without additional encouragement to increase the supply of organic agri-food products (RQ1). The CAP will continue to support the further development of organic farming in the EU. In September 2020, the EC launched a public consultation on its action plan on organic farming that includes measures to be applied to boost the growth of the sector, i.e. (1) the introduction of new organic legislation designed to guarantee fair competition for farmers while preventing fraud and maintaining consumer trust; (2) the development of new agri-food promotion policy which provides promotion actions and information campaigns on the EU organic sector (EC, 2020c). This is particularly important to minimise fraud vulnerability in the organic food supply chain since organic products are credence products and consumer trust is a prerequisite for a dynamic development of the organic food market (Manning & Kowalska, 2021, 1879). It is a great challenge to put in place universal instruments capable of making organic market and the production sector grow at a rapid pace in every MS. For example, the most important barriers to the development of organic food market in Poland are high price, insufficient consumer knowledge and low availability of organic products (Bryła, 2016, pp. 737–746) which is very different from the situation in several EU countries, where consumers can purchase basic organic certified foods in nearly all supermarkets. When analysing the development of organic farming and organic market in the EU MSs, there is a need for an innovative approach to promoting organic food system and encouraging farmers to convert to organic farming. Generally speaking, high organic price premiums for organic food makes it difficult to promote the products (Liang & Lim, 2020).

In the present era of progressive globalisation, the results of research carried out in different EU and non-EU countries have social and practical implications for several parts of the world. We can mention the study by Aghasafari *et al.* (2020) who have determined the best strategies for the development of organic farming based on comprehensive factors affecting organic farming, considering the interdependence among them under the uncertainty in the decision-makers' judgements with a focus on Iran, a country suffering from a decrease in organic farmland. There are three strategies discussed in the paper: (1) developing consumers' awareness programs; (2) creating a competitive market for organic products; (3) planning to teach the principles of organic farming. Liang and Lim (2020, pp. 394–415) suggest that stories are an important communication tool for buyers and sellers in Taiwan, and managers should use stories to deliver knowledge background about organic food. There are major differences between marketing strategies suitable for the offline organic product sales channel and the strategies effective for the online organic product sales channel. Lyu and Choi (2020) have determined that packaging design, nutritional information, food quality, delivery risk, freshness, and source risk are important factors in purchasing organic products online by Chinese consumers. Previous studies indicated that consumers buying organic food prefer promotional programmes involving price discounts irrespective of whether it is the offline or online purchase (Liang & Lim, 2020; Lyu & Choi, 2020).

Our suggestion is to develop a Green Public Procurement (GPP) policy in the EU to foster the growth of organic food market and to encourage farmers to convert to organic production (RQ2). Lindström *et al.* (2020) understand GPP as

> "a purchasing process where the public authority strives to procure goods, services and works with less environmental impact, based on life cycle costs, compared to the non-green alternative that would otherwise be procured."

Europe's public authorities are major consumers; they spend approximately 1.8 trillion euro annually, representing around 14% of the EU's GDP (EC, 2020e). By using their purchasing power to choose products with lower impacts on the environment, they can make an important contribution to sustainable consumption and production. For example, public authorities may purchase low-carbon means of transport for public transport, construct energy efficient buildings, purchase environmentally friendly food for school canteens, buy recyclable paper for state bodies, etc. The role of the public sector in the GPP area is twofold: on the one hand, it establishes the procurement policies and, on the other hand, it is a customer. Public institutions are considered one of the most influential groups and leaders in green management, and developing production and consumption of environmentally friendly products (Pacheco-Blanco & Bastante-Ceca, 2016, pp. 648–656). GPP is vital as it does not involve a single actor from the economy, but an entire supply chain. Moreover, it is relevant for both public and private entities (Chersan *et al.*, 2020, pp. 82–101). The benefits associated with the introduction and the diffusion of the GPP include environmental, social, health, economic and political benefits (Table 2).

The literature review highlighted the key barrier to GPP- higher upfront capital costs of greener products and services (Bouwer *et al.*, 2006, pp. 11–12; Butler & Keaveney, 2014, pp. 38–44; Chersan *et al.*, 2020, pp. 82–101). For example, Jörgensen (2012) estimated the price of an organic food basket, using Swedish public procurement data, to be on average 66% higher than the price of a conventional food basket (Lindström *et al.*, 2020, p. 106622). One way to overcome this barrier is to educate new and existing procurement officers, and numerous actors from the entire food supply chain (FSC), in the field of life cycle costing which they should then be encouraged to use at some level in their purchasing decisions. Other identified hindrances to GPP development are: the lack of availability of environmentally friendly products and services, the resistance to change of procurement procedures and the lack of methods to compare environmental credentials of greener goods and services (Butler & Keaveney, 2014, pp. 38–44).

Another idea is to support the use of blockchain technology in organic FSC to promote networking and increase the efficiency of the FSC (RQ2). The blockchain technology was invented by Satoshi Nakamoto in 2008 for use in the crypto currency bitcoin (Al-Sherbaz *et al.*, 2018; Baralla *et al.,* 2018, pp. 379–391). Blockchain is one of the Distributed Ledger Technologies (DLT), which can provide a cryptographically secure and immutable record of transactions and associated metadata (origin, contracts, process steps, environmental variations, microbial records, etc.) linked across the whole supply chains (Pearson *et al.,* 2019). The essence of the use of this technology in the FSC is to guarantee food quality and safety from a supply chain management perspective and to improve traceability performance by providing security and full transparency (Feng *et al.*, 2020). Several factors contribute to the need for transparency such as an increase in the global population, detection of foodborne illness outbreaks which undermines consumers' trust in food, efficient management of risks and recalls, and satisfying consumer demand (Astill *et al.*, 2019, pp. 240–247). Consumer trust is a key prerequisite for the development of a market for organic food products which are credence-based goods. Consumers' knowledge of irregularities found in organic food undermine their trust in the products, certification process, retailers and producers. Analysis of the RASFF (Rapid Alert System for Food and Feed) data on food safety (public data available through the RASFF Portal) has shown that: (1) there were 755 RASFF notifications for organic food products between May 1, 2004 and December 31, 2019; (2) the number of RASFF notifications related to organic food for one calendar year has increased over twelvefold from 10 in 2004 to 124 in 2018 (RASFF Portal, 2018). Even if we take into account the influence of purposive sampling on the dataset (Kowalska & Manning, 2021, pp. 906–919), the growing number of non-compliance incidents regarding organic food is a cause for concern. Mistrust in the control system and in the authenticity of food sold as organic has a significant negative impact on self-reported buying behavior (Nuttavuthisit & Thøgersen, 2017, pp. 323–337; Teng & Wang, 2015, pp. 1066–1081). Thus, we suggest to promote the use of new technologies in organic FSC, e.g. blockchain technology or the internet of things (IoT), to provide an information platform for all supply chain members based on openness, transparency, neutrality, reliability and security (RQ2).

Conclusions

There are certain specific features of (organic) food economy, including agriculture, and among them dependence of agricultural production on natural conditions, relation with soil and spatial environmental conditions, changeability of harvest, seasonality of production, perishable nature and inhomogeneity of agricultural raw materials, that influence a farmer's market position. Fundamentally, agricultural activity is less agile than many other businesses of many other industries. Moreover, farming activities present a serious risk to the environment. On the other hand, agriculture and rural areas provide a whole range of public goods for the whole society (food safety, clean soils and waters, high quality of air, biological variety, landscape and culture of rural areas, innovations in agriculture), and generate positive external effects. Therefore, the state intervention in the food economy seems to be inevitable (Kowalska, 2019, pp. 28–35). On the basis of Council Regulation (EEC) No. 2078/92, an environmental management scheme was introduced to encourage farmers to serve society as a whole by introducing environmentally friendly practices, including organic farming. The support under CAP is continued. It is debatable whether direct organic subsidies in the EU are still effective. The existing support structures, including financial and institutional assistance, educational, information and media campaigns supported by governments, green marketing strategies etc., should be reviewed regularly and continuously improved. Future research may address the changes in organic food market conditions and farmers'/food business operators activities which have emerged in the aftermath of the COVID-19 crisis and the Russian invasion of Ukraine in 2022.

Warnings on climate change that are bombarding us daily resulted in the European Green Deal action plan being developed with a very ambitious goal to have 25% of agricultural land used for organic production in 2030.

We have tried to assess if this objective is attainable considering three different trend functions as three scenarios: pessimistic, realistic and optimistic. We have found out that even in the optimistic scenario the forecast is much lower than the 25% target (RQ1). Hower, the formulation of such an objective might be intended to mobilize the society for collective and individual actions to switch to organic production (at a regional and national level). We have proved that existing measures, including organic farming payments, are not sufficient to meet the goal of massive increase in the acreage under organic production. Therefore, it is necessary to develop new incentives e.g. Green Public Procurement, innovative and effective media campaigns and promotion strategies, building the dynamic network of actors of organic FSC with the use of blockchain technology (RQ2). Greening the consumption patterns of European public authorities would contribute significantly to meeting the EGD goals. Scientifically validated knowledge about organic food, farming and processing should be permanently disseminated among European consumers since it is not easy to find a clear, accurate and unbiased information on any food topic. Promoting the use of blockchain technology in food supply chains could over time add trust in organic food; and this is particularly important when credence-based food is involved. Recommending the use of blockchain-based approaches to climate neutralization is quite novel in the literature. Further work needs to be undertaken to gain insight into the structure of these measures in the EU MSs and to review other well-functioning measures in various regions of the world in order to use them as benchmark examples. The present study has certain limitations related to the time period in which it was conducted. The data used for diagnosing and forecasting the organic food market situation in the EU was for years 2000–2018 and this was the pre-pandemic period. The market uncertainty has been growing since 2018 and future studies should consider that. Further research could provide a proposal of enhancing measures which serve to increase organic food supply agility. Agility is crucial in managing deep market uncertainty or an unknown event such as COVID-19 pandemic or the armed conflict in Europe.

References

Aczel, A. D., & Sounderpandian, J. (2008). *Complete business statistics*. Boston: McGraw-Hill/Irwin.

Aghasafari, H., Karbasi, A., Mohammadi, H., & Calisti, R. (2020). Determination of the best strategies for development of organic farming: a SWOT – fuzzy analytic network process approach. *Journal of Cleaner Production, 277,* 124039. doi: 10.1016/j.jclepro.2020.124039.

Agri-food data portal: European Commission (2020). *CAP indicators. Organic production.* Retrieved from https://agridata.ec.europa.eu/extensions/DashboardIndicators/OrganicProduction.html?select=EU27_FLAG,1 (12.10.2020).

Ali, R., Ishaq, R., Bakhsh, K., & Yasin, M. A. (2022). Do agriculture technologies influence carbon emissions in Pakistan? Evidence based on ARDL technique. *Environmental Science and Pollution Research, 29*(28)*,* 43361–43370. doi: 10.1007/s11356-021-18264-x.

Allen, P. G. (1994). Economic forecasting in agriculture. *International Journal of Forecasting, 10*(1), 81–135. doi: 10.1016/0169-2070(94)90052-3.

Astill, J., Dara, R. D., Campbell, M., Farber, J. M., Fraser, E. D. G., Sharif, S., & Yada, R. Y. (2019). Transparency in food supply chains: a review of enabling technology solutions. *Trends in Food Science & Technology, 91,* 240–247. doi: 10.1016/j.tifs.2019.07.024.

Baralla, G., Ibba, S., Marchesi, M., Tonelli, R., & Missineo, S. (2018). A blockchain based system to ensure transparency and reliability in food supply chain. In *Euro-Par 2018: parallel processing workshops. Euro-Par 2018. Lecture notes in computer science* (pp. 379–391). Springer. doi: 10.1007/978-3-030-10549-5_30.

Barr, S. (2007). Factors influencing environmental attitudes and behaviours; a UK case study of household waste management. *Environment and Behaviour, 39*(4), 435–473. doi: 10.1177/0013916505283421.

Becchetti, L., Piscitelli, P., Distante, A., Miani, A., & Uricchio, A. F. (2021). European Green Deal as social vaccine to overcome COVID-19 health & economic crisis. *Lancet Regional Health – Europe, 2,* 100032. doi: 10.1016/j.lanepe.2021.100032.

Bouwer, M., Jonk, M., Berman, T., Bersani, R., Lusser, H., & Nappa, V. (2006). Green Public Procurement in Europe 2006: conclusions and recommendations. Retrieved from https://ec.europa.eu/environment/gpp/pdf/take_5.pdf (19.10.2020).

Bryła, P. (2016). Organic food consumption in Poland: motives and barriers. *Appetite, 105,* 737–746. doi: 10.1016/j.appet.2016.07.012.

Butler, P., & Keaveney, M. (2014). An analysis of the barriers to and drivers of Green Public Procurement in achieving a more sustainable construction industry. International Virtual Conference, University of Zilina, Slovakia. doi: 10.21427/kdwh-na85.

Chersan, I. C., Dumitru, V. F., Gorgan, C., & Gorgan, V. (2020). Green Public Procurement in the academic literature. *Amfiteatru Economic, 22*(53), 82–101. doi: 10.24818/EA/2019/53/82.

Council Regulation (EEC) No 2078/92 of 30 June 1992 on agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside (OJ L 215/85, 30.7.1992).

EC (2020a). *A European Green Deal. Striving to be the first climate-neutral continent.* Retrieved from https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en#policy-areas (8.10.2020).

EC (2020b). *Benefits of GPP.* Retrieved from https://ec.europa.eu/environment/gpp/benefits_en.htm (19.10.2020).

EC (2020c). European Green Deal: Commission prepares new initiatives to boost the organic farming sector. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1548 (19.10.2020).

EC (2020d). How the future CAP will contribute to the EU Green Deal. https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/sustainability_and_natural_resources/documents/factsheet-how-cap-contributes-to-green-deal_en.pdf

EC (2020e). *What is GPP.* Retrieved from https://ec.europa.eu/environment/gpp/what_en.htm (19.10.2020).

EIT Food (2021). COVID-19 impact on consumer food behaviours in Europe Retrieved from https://www.eitfood.eu/media/news-pdf/COVID-19_Study_-_European_Food_Behaviours_-_Report.pdf. (30.07.2021).

Eurostat (2020). *Organic farming statistics.* Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php/Organic_farming_statistics#Total_organic_area (27.10.2020).

FAO (2022). Organic agriculture FAQ. Retrieved from https://www.fao.org/organicag/oa-faq/oa-faq1/en/ (22.02.2022).

Feng, H., Wang, X., Duan, Y., Zhang, J., & Zhang, X. (2020). Applying blockchain technology to improve agri-food traceability: a review of development methods, benefits and challenges. *Journal of Cleaner Production, 260,* 121031. doi: 10.1016/j.jclepro.2020.121031

FiBL Statistics (2020a). *Organic area.* Retrieved from https://statistics.fibl.org/europe/area-europe.html?tx_statisticdata_pi1%5Bcontroller%5D=Element2Item&cHash=72cfbc753cb538a4b246661c521cf598 (12.10.2020).

FiBL Statistics (2020b). *Organic retail sales.* Retrieved from https://statistics.fibl.org/world/retail-sales-world.html (19.10.2020).

Fromartz, S. (2007). *Organic Inc: natural foods and how they grew*. Houghton Mifflin Harcourt, Orlando, Florida.

Goodland, R. (1995). The concept of environmental sustainability. *Annual Review of Ecology and Systematics, 26,* 1–24. doi: 10.1146/annurev.es.26.110195.000245.

Granger, C. W. J., & Jeon, Y. (2007). Long-term forecasting and evaluation. *International Journal of Forecasting, 23*(4), 539–551. doi: 10.1016/j.ijforecast.2007.07.002.

Hansmann, R., Baur, I. P., & Binder, C. R. (2020). Increasing organic food consumption: an integrating model of drivers and barriers. *Journal of Cleaner Production, 275,* 123058. doi: 10.1016/j.jclepro.2020.123058.

Hickel, J., & Kallis, G. (2020). Is green growth possible? *New Political Economy, 25*(4), 469–486. doi: 10.1080/13563467.2019.1598964.

IFOAM (2020). *How organic agriculture helps achieve sustainable development Goals.* Retrieved from https://www.ifoam.bio/sites/default/files/2020-05/oasdgs_web.pdf (11.10.2020).

Janssen, M., Chang, B. P. I., Hristov, H., Pravst, I., Profeta, A., & Millard, J. (2021). Changes in food consumption during the COVID-19 pandemic: analysis of consumer survey data from the first lockdown period in Denmark, Germany, and Slovenia. *Frontiers in Nutrition, 60*. doi: 10.3389/fnut.2021.635859.

Jörgensen, C. (2012). *Mål som styrmedel: målet för den offentliga konsumtionen av ekologiska livsmedel*. Lund: AgriFood Economics Centre.

Jungbluth, N., Tietje, O., & Scholz, R. W. (2000). Food purchases: impacts from the consumers' point of view investigated with a modular LCA. *International Journal of Life Cycle Assessment, 5*, 134–142. doi: 10.1007/BF02978609.

Kahn, H., & Wiener, A.J. (1967). *The year 2020 - A framework for speculation on the next thirty-three years.* New York: MacMillan Company.

Kowalska, A. (2010). *Quality and competitiveness issues in organic agriculture.* Warsaw: Difin SA.

Kowalska, A. (2013). Trends in the organic market worldwide. *Annals of the Polish Association of Agricultural and Agribusiness Economists, 15*(4), 218–223.

Kowalska, A. (2019). *Economic problems of food adulteration. Prevention measures.* Lublin: Wydawnictwo UMCS.

Kowalska, A., & Manning, L. (2020). Using the rapid alert system for food and feed: potential benefits and problems on data interpretation. *Critical Reviews in Food Science and Nutrition, 61*(6), 906–919. doi: 10.1080/10408398.2020.1747978.

Kowalska, A., Ratajczyk, M., Manning, L., Bieniek, M., & Mącik, R. (2021). "Young and green" a study of consumers' perceptions and reported purchasing behaviour towards organic food in Poland and the United Kingdom. *Sustainability, 13*(23), 13022. doi: 10.3390/su132313022.

Kriščiukaitienė, I., Šarūnas Eirošius, Š., & Virginia Namiotko, V. (2013). The evaluation of the determinants of adopting organic farming practices. *Ekonomika ir vadyba: aktualijos ir perspektyvos, 2*(30), 37–43.

Laborde, D., Martin, W., Swinnen, J., & Vos, R. (2020). COVID-19 risks to global food security. *Science, 369*(6503), 500–502. doi: 10.1126/science.abc4765.

Lernoud, J., & Willer, H. (Eds.). (2016). *The world of organic agriculture. Statistics and emerging trends 2016.* Bonn: Research Institute of Organic Agriculture (FiBL), Frick, and IFOAM – Organics International.

Liang, A. R.-D., & Lim, W.-M. (2020). Why do consumers buy organic food? Results from an S–O–R model. *Asia Pacific Journal of Marketing and Logistics*, *33*(2), 394–415. doi: 10.1108/APJML-03-2019-0171.

Lindström, H., Lundberg, S., & Marklund, P-O. (2020). How Green Public Procurement can drive conversion of farmland: an empirical analysis of an organic food policy. *Ecological Economics, 172,* 106622. doi: 10.1016/j.ecolecon.2020.106622.

Lorenz, K., & Lal, R. (2016). Environmental impact of organic agriculture. *Advances in Agronomy, 139,* 99–152. doi: 10.1016/bs.agron.2016.05.003.

Łuczka, W., & Kalinowski, S. (2020). Barriers to the development of organic farming: a Polish case study. *Agriculture, 10*(11), 536. doi: 10.3390/agriculture10110536.

Lyu, F., & Choi, J. (2020). The forecasting sales volume and satisfaction of organic products through text mining on web customer reviews. *Sustainability, 12*(11), 4383. doi: 10.3390/su12114383.

Manning, L., & Kowalska, A. (2021). Considering fraud vulnerability associated with credence-based products such as organic food. *Foods, 10*(8), 1879. doi: 10.3390/foods10081879.

McCarthy, B., & Liu, H-B. (2017). 'Waste not, want not' exploring green consumers' attitudes towards wasting edible food and actions to tackle food waste. *British Food Journal, 119*(12), 2519–2531. doi: 10.1108/BFJ-03-2017-0163.

Meier, M. S., Stoessel, F., Jungbluth, N., Juraske, R., Schader, Ch., & Stolze, M. (2015). Environmental impacts of organic and conventional agricultural products – are the differences captured by life cycle assessment? *Journal of Environmental Management, 149,* 193–208. doi: 10.1016/j.jenvman.2014.10.006.

Melbye, E. L., Onozaka, Y., & Hansen, H. (2016). Throwing it all away: exploring affluent consumers' attitudes toward wasting edible food. *Journal of Food Products Marketing, 23*(4), 416–429. doi: 10.1080/10454446.2015.1048017.

Morseletto, P. (2020). Targets for a circular economy. *Resources, Conservation and Recycling, 153,* 104553. doi: 10.1016/j.resconrec.2019.104553.

Mowlds, S. (2020). The EU's farm to fork strategy: missing links to transformation. *Acta Innovations, 36,* 17–30. doi: 10.32933/ActaInnovations.36.2.

Moore, A. D., & McCabe, G. P. (2006). *Introduction to the practice of statistics.* New York: W. H. Freeman and Company.

Muller, D. S., Schader, C., El-Hage Scialabba, N., Brüggemann, J., Isensee, A., Erb, K-H., Smith, P., Klocke, P., Leiber, F., Stolze, M., & Niggli, U. (2017). Strategies for feeding the world more sustainably with organic agriculture. *Nature Communications, 8*(1), 1–13. doi: 10.1038/s41467-017-01410-w.

Nuttavuthisit, K., & Thøgersen, J. (2017). The importance of consumer trust for the emergence of a market for green products: the case of organic food. *Journal of Business Ethics, 140*(2), 323–337. doi: 10.1007/s10551-015-2690-5.

Ozturk, A., Cavusgil, S. T., & Ozturk, O. C. (2021). Consumption convergence across countries: measurement, antecedents, and consequences. *Journal of International Business Studies, 52*(1), 105–120. doi: 10.1057/s41267-020-0033 4-w.

Pacheco-Blanco, B., & Bastante-Ceca, M. J. (2016). Green public procurement as an initiative for sustainable consumption. An exploratory study of Spanish public universities. *Journal of Cleaner Production, 133,* 648–656. doi: 10.1016/j.j clepro.2016.05.056.

Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B, 365*(1554), 3065–3081. doi: 10.1098/rstb .2010.0126.

Pearson, S., May, D., Leontidis, G., Swainson, M., Brewer, S., Bidaut, L., Frey, J.G., Parr, G., Maull, R., & Zisman, A. (2019). Are Distributed Ledger Technologies the panacea for food traceability? *Global Food Security*, *20*, 145–149. doi: 10.1016/j.gfs.2019.02.002.

Pe'er, G., Bonn, A., Bruelheide, H., Dieker, P., Eisenhauer, N., Feindt, P., Hagedorn,G., Hansjürgens, B., Herzon, I., Lomba, Â., Marquard, E., Moreira, F., Nitsch, H., Oppermann, R., Perino, A., Röder, N., Schleyer, C., Schindler, S., Wolf, C., Zinngrebe, Y., & Lakner, S. (2020). Action needed for the EU Common Agricultural Policy to address sustainability challenges. *People and Nature, 2,* 305–316. doi: 10.1002/pan3.10080.

Pe'er, G., Zinngrebe, Y., Moreira, F., Sirami, C., Schindler, S., Müller, R., Bontzorlos, V., Clough, D., Bezák, P., Bonn, A., Hansjürgens, B., Lomba, A., Möckel, S., Passoni, G., Schleyer, C., Schmidt, J., & Lakner, S. (2019). A greener path for the EU Common Agricultural Policy. *Science, 365*(6452), 449–451. doi: 10.1126/science.

Potting, J., Hekkert, M., Worrell, E., & Hanemaaijer, A. (2017). *Circular economy: measuring innovation in the product chain.* PBL–Netherlands Environmental Assessment Agency.

Prosser, L., Lane, E. T., & Jones, R. (2022). Collaboration for innovative routes to market: COVID-19 and the food system. *Agricultural Systems, 188,* 103038. doi: 10.1016/j.agsy.2020.103038.

RASFF (Rapid Alert System for Food and Feed) (2018). *RASFF portal.* Retrieved from https://webgate.ec.europa.eu/rasff-window/portal/?event=SearchForm&c leanSearch=1 (28.10.2020).

Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007 (OJ L 150, 14.6.2018, p. 1–9).

Ritchie, H., & Roser, M. (2021). Environmental impacts of food production. Retrieved from https://ourworldindata.org/environmental-impacts-of-food (22.02.2022).

Sandberg, M., Klockars, K., & Wilén, K. (2019). Green growth or degrowth? Assessing the normative justifications for environmental sustainability and economic growth through critical social theory. *Journal of Cleaner Production, 206,* 133–141. doi: 10.1016/j.jclepro.2018.09.175.

Seufert, V., Ramankutty, N., & Foley, J. A. (2012). Comparing the yields of organic and conventional agriculture. *Nature, 485*(7397), 229–232. doi: 10.1038/nature11069.

Seufert, V., Ramankutt, N., & Mayerhofer, T. (2017). What is this thing called organic? – How organic farming is codified in regulations. *Food Policy, 68,* 10–20. doi: 10.1016/j.foodpol.2016.12.009.

Al-Sherbaz, A., Turner, S. J., Dohan, M., & Clarke, E. (2018). Blockchain: no thunder no wonder. Paper presented at British Computing Society (BCS) Northampton Talk. doi: 10.6084/m9.figshare.5979625.v2

Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S. R., De Vries, W., De Wit, C. A., Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B., & Sorlin, S. (2015). Planetary boundaries: guiding human development on a changing planet. *Science, 347*(6223), 1259855. doi: 10.1126/science.1259855.

Teng, Ch-Ch., & Wang, Y-M. (2015). Decisional factors driving organic food consumption: generation of consumer purchase intentions. *British Food Journal, 117*(3), 1066–1081. doi: 10.1108/BFJ-12-2013-0361.

Treu, H., Nordborg, M., Cederberg, Ch., Heuer, T., Claupein, E., Hoffmann, H., & Berndes, G. (2017). Carbon footprints and land use of conventional and organic diets in Germany. *Journal of Cleaner Production, 161,* 127–142. doi: 10.1016/j.jclepro.2017.05.041.

Tuomisto, H., Hodge, I., Riordan, P., & Macdonald, D. (2012). Does organic farming reduce environmental impacts? - A meta-analysis of European research. *Journal of Environmental Management, 112,* 309–320. doi: 10.1016/j.jenvman.2012.08.018.

UNEP (2011). *Decoupling natural resource use and environmental impacts from economic growth.* United Nations.

Willer, H., Schlatter, B., Trávníček, J., Kemper, L., & Lernoud, J. (Eds.) (2020). *The world of organic agriculture. Statistics and emerging trends 2020.* Bonn: Research Institute of Organic Agriculture (FiBL), Frick, and IFOAM – Organics International.

Willer, H., Trávníček, J., Meier, C., & Schlatter, B. (Eds.). (2021). *The world of organic agriculture. Statistics and emerging trends 2021.* Bonn: Research Institute of Organic Agriculture (FiBL), Frick, and IFOAM – Organics International.

Wojciechowska-Solis, J., Kowalska, A., Bieniek, M., Ratajczyk, M., & Manning L. (2022). Comparison of the purchasing behavior of Polish and United Kingdom consumers in the organic food market during the COVID-19 Pandemic. *International Journal of Environmental Research and Public Health, 19*(3), 1137. doi: 10.3390/ijerph19031137.

Zuba-Ciszewska, M., Kowalska, A., Manning, L., & Brodziak, A. (2019). Organic milk supply in Poland: market and policy developments. *British Food Journal*, *121*(12), 3396–3412. doi: 10.1108/BFJ-11-2018-0750.

Acknowledgments

This work was supported by the grant funded by the National Science Centre, Poland no 2019/35/D/HS4/00801.

Annex

Table 1. The accuracy of the trend functions in the pessimistic, realistic and optimistic scenario

Statistical measure	Pessimistic trend	Realistic trend	Optimistic trend
MAPE	3.21%	1.98%	2.85%
Adjusted R^2	0.9855	0.992	0.987
2030 forecast [%]	10.6	12.6	16.5
Ex-ante error of the 2030 forecast	2.44%	1.51%	0.32%

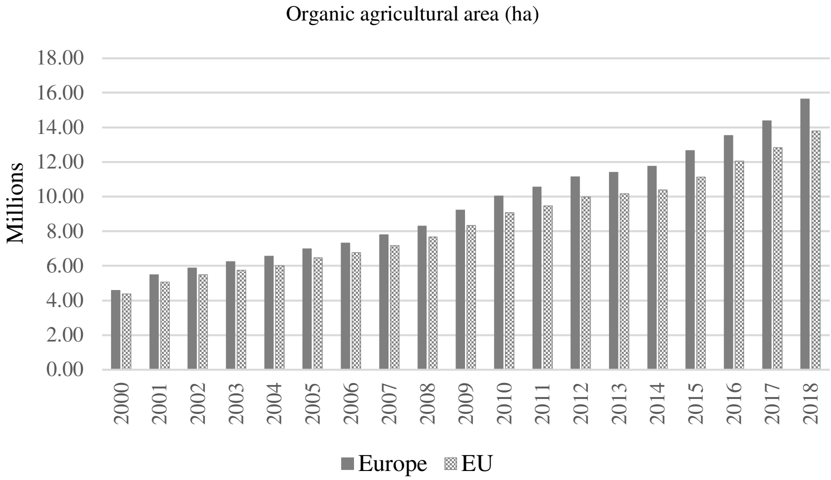
Source: own calculations based on FiBL Statistics (2020a).

Table 2. Benefits of Green Public Procurement

	GPP gains
Environmental benefits	– GPP allows public authorities to achieve environmental targets (to reduce greenhouse gas emissions, to promote sustainable agriculture, to prevent deforestation, etc.); – GPP sets an example to private consumers; – GPP raises awareness of environmental issues;
Social and health benefits	– GPP improves quality of life; – GPP helps establish high environmental performance standards for goods and services;
Economic benefits	– GPP saves money and resources when life-cycle costs are considered; – GPP provides incentives to industry to innovate; – GPP can reduce prices for environmental technologies;
Political benefits	– GPP is an effective way to demonstrate the public sector's commitment to environmental protection and to sustainable consumption and production

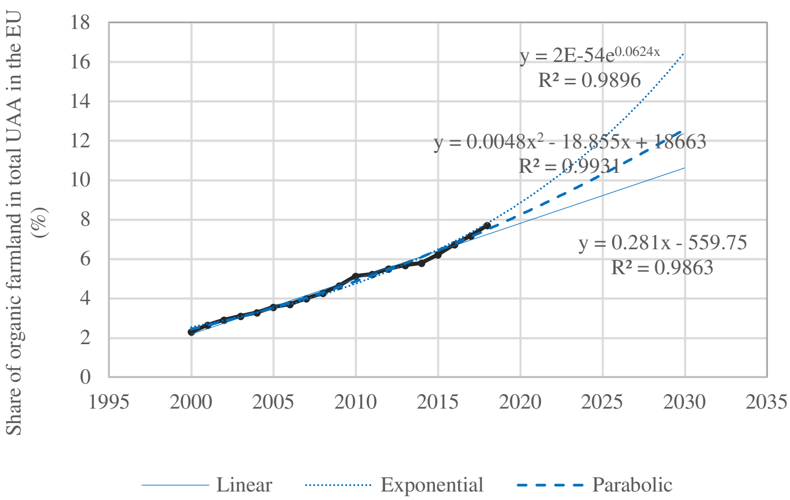
Source: The study based on EC (2020b).

Figure 1. The growth of organic farmland in Europe and the EU within the period 2000–2018



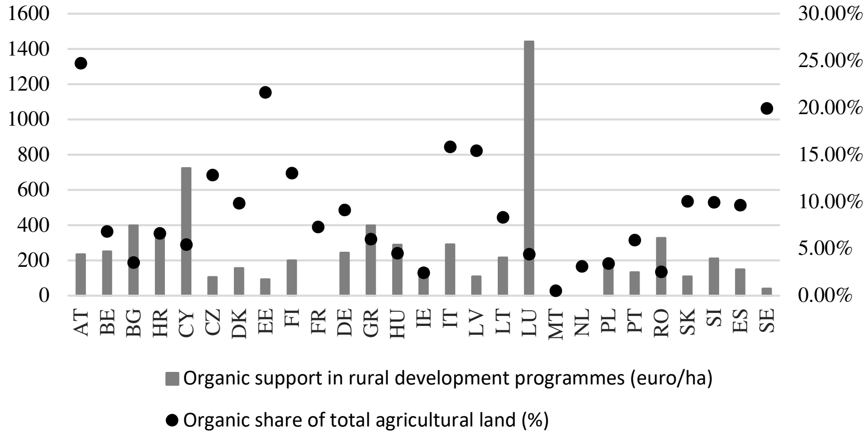
Source: own calculations based on FiBL Statistics (2020a).

Figure 2. Forecasting of the share of organic farmland in the EU



Source: own calculations based on FiBL Statistics (2020a).

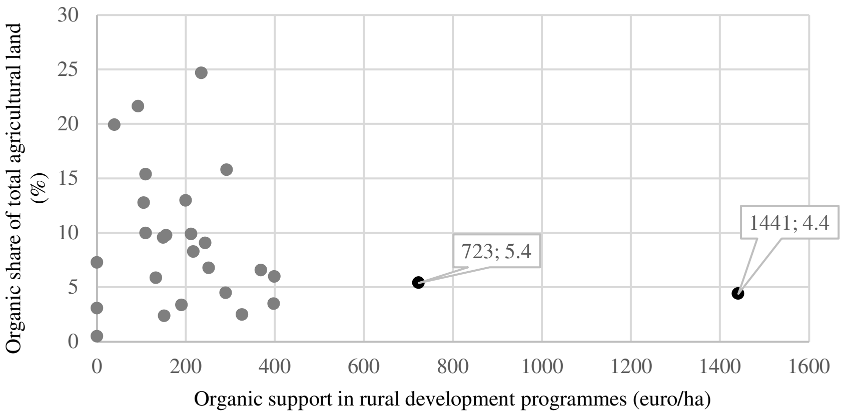
Figure 3. Organic area payments and organic share of total agricultural land in the EU MSs in 2018



Note: AT – Austria, BE – Belgium, BG – Bulgaria, HR – Croatia, CY – Cyprus, CZ – Czechia, DK – Denmark, EE – Estonia, FI – Finland, FR – France, DE – Germany, GR – Greece, HU – Hungary, IE – Ireland, IT – Italy, LV – Latvia, LT – Lithuania, LU – Luxemburg, MT – Malta, NL – Netherlands, PL – Poland, PT – Portugal, RO – Romania, SK – Slovakia, SI – Slovenia, ES – Spain, SE – Sweden.

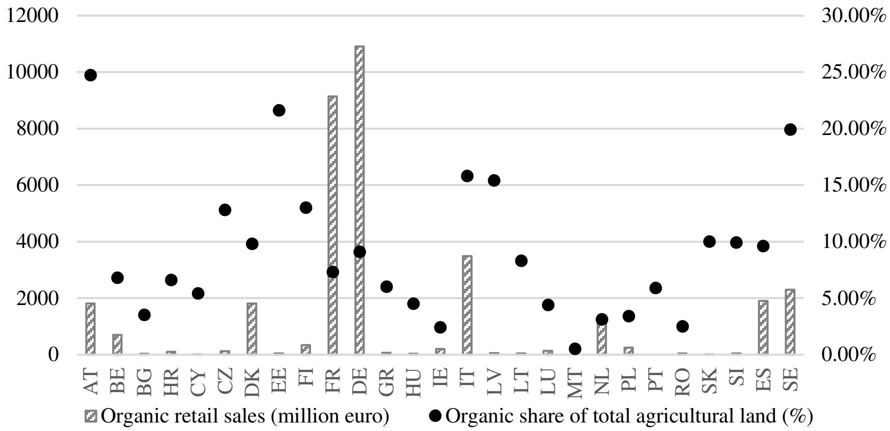
Source: own calculations based on Agri-food data portal: European Commission (2020), FiBL Statistics (2020a).

Figure 4. The scatter plot of organic area payments and organic share of total farmland in 2018 for each EU country



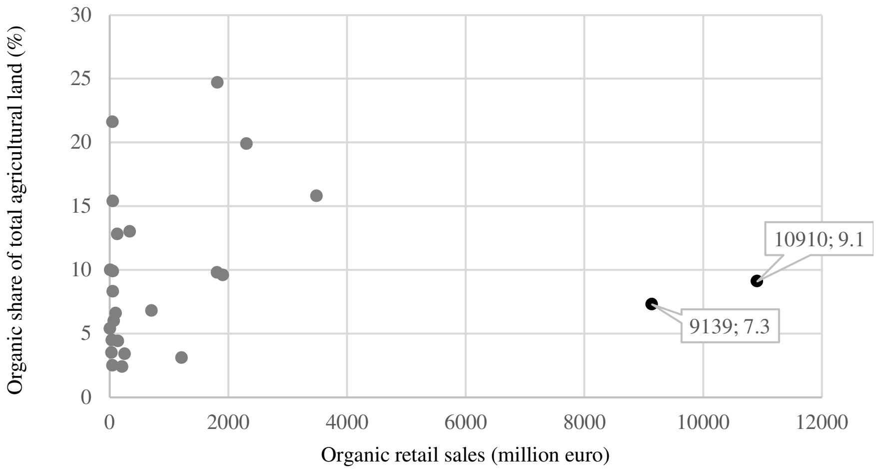
Source: own calculations based on Agri-food data portal: European Commission (2020), FiBL Statistics (2020a).

Figure 5. Organic retail sales and organic share of total agricultural land in the EU MSs in 2018



Source: own calculations based on FiBL Statistics (2020a, 2020b).

Figure 6. The scatter plot of organic retail sales and organic share of total farmland in 2018 for each EU country



Source: own calculations based on FiBL Statistics (2020a, 2020b).