

## COMPARATIVE FORECAST OF ORGANIC EGG PRODUCTION IN ROMANIA AND THE EUROPEAN UNION: INSIGHTS FOR 2014–2030

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### Abstract

*The study analyses and forecasts organic egg production in Romania and the European Union (EU) from 2014 to 2030, emphasizing significant variations in scale, growth patterns, and market maturity. Data from EUROSTAT (2014–2022) were analyzed utilizing Excel forecasting tools, employing performance metrics including SMAPE, MASE, and RMSE to evaluate model accuracy. In this regard, the EU exhibited consistent growth, with egg production increasing to 4.7 billion by 2022 and anticipated to reach 7.25 billion by 2030. In contrast, Romania's production, although smaller in scale, experienced significant growth of over 250% during the same period and is projected to reach 85 million eggs by 2030. The findings highlight Romania's developing role in the organic sector, the variability of trends, and the potential for targeted interventions to improve its market position.*

**Key words:** organic egg production, European Union, Romania, agricultural forecasting, sustainable farming

### INTRODUCTION

Organic agriculture is gaining popularity worldwide, reflecting a growing consumer demand for sustainable and ecologically friendly farming practices. This trend is being driven by increased health awareness, environmental concerns, and a desire for high-quality food products. Organic farming emphasises the use of natural processes and materials while avoiding synthetic fertilisers and pesticides, which promotes biodiversity and soil health [2, 15, 23, 25, 26]. The organic industry has grown significantly, with organic egg production emerging as a critical component of this movement, providing not only a premium product but also aligning with consumer ideals such as animal welfare and

environmental sustainability. Organic egg production stands out in the world of organic farming. It is distinguished by greater animal welfare regulations, such as outdoor access and organic diet, which improves the nutritional value of the eggs. Research shows that organic eggs have lower saturated fat levels than conventional eggs [15, 18]. This part of organic farming not only serves to health-conscious consumers [29], but it also contributes significantly to the general sustainability of agricultural operations by encouraging the use of more humane and environmentally sound farming methods [20]. The European Union (EU) has played an important role in boosting organic production by establishing a strong regulatory framework and providing subsidies [30]. The EU's

Common Agricultural Policy (CAP) offers financial assistance to farmers who switch to organic practices, encouraging sustainable agriculture [1]. Furthermore, strict restrictions ensure that organic products fulfil high standards, thereby preserving customer trust and market integrity [1, 10].

The EU's commitment to organic farming is evident in its ambitious aims for growing organic land area and production, which aim to improve food security and environmental sustainability across member states [10]. Romania stands out in the European Union's organic agriculture environment. With its rich agricultural history and diversified ecosystems, Romania has the potential to become a major participant in the organic market. Despite its historical dependence on conventional farming methods, the country has shown a growing interest in organic practices, particularly in egg production [1, 11, 24, 31]. The shift to organic farming in Romania is aided by both EU subsidies and rising domestic demand for organic products, allowing the country to capitalise on its agricultural legacy while adopting modern sustainable practices [10].

This contrast of history and innovation makes Romania an appealing subject for studying the growth of organic egg production in the larger context of the EU's organic market from 2014 to 2030.

This paper aims to analyse and forecast organic egg production trends in Romania and the European Union from 2014 to 2030. By comparing historical data and projected growth patterns, the study seeks to identify key factors influencing production dynamics, identify disparities and opportunities between Romania and the larger EU market, and provide insights to inform policy-making, sustainable development, and market strategies in the organic egg sector.

## MATERIALS AND METHODS

The data for this study was obtained from EUROSTAT and comprised the annual production of organic eggs for both Romania and the European Union from 2014 to 2022. The analysis was carried out using Microsoft

Excel, with the built-in forecasting features used to predict production trends from 2022 to 2030.

The forecasting feature was implemented with a 95% confidence interval to determine upper and lower bounds. Missing data points were interpolated, and duplicate entries were aggregated using the average function.

Key performance indicators and metrics, such as Alpha, Beta, Gamma, Mean Absolute Scaled Error (MASE), Symmetric Mean Absolute Percentage Error (SMAPE), Mean Absolute Error (MAE), and Root Mean Squared Error (RMSE), were calculated to ensure the accuracy and reliability of the forecasts. The forecasting model's accuracy and performance were comprehensively assessed using these metrics.

## RESULTS AND DISCUSSIONS

The statistical metrics used to evaluate the forecasting model for organic egg production in the European Union provide insights into the model's accuracy and assumptions. The Alpha value of 0.90 indicates that the model heavily relies on recent data, applying significant smoothing to prioritize recent trends in the production of organic eggs. Both Beta and Gamma values are 0.00, suggesting that the model assumes no adjustments for trend or seasonality. This implies that the forecast is linear and does not account for potential seasonal variations or evolving trends over time.

The performance metrics further confirm the reliability of the forecast. The Mean Absolute Scaled Error (MASE) is 0.59, indicating that the model performs significantly better than a naive forecast. Similarly, the Symmetric Mean Absolute Percentage Error (SMAPE) is 0.06, reflecting an impressive accuracy rate with minimal deviation—only 6%—from actual values.

In terms of absolute errors, the Mean Absolute Error (MAE) of approximately 229,701 (in thousands of eggs) represents the average forecast error, while the Root Mean Squared Error (RMSE) of 309,467 (in thousands of eggs) highlights that the forecast errors are

relatively consistent, with no significant outliers affecting the projections.

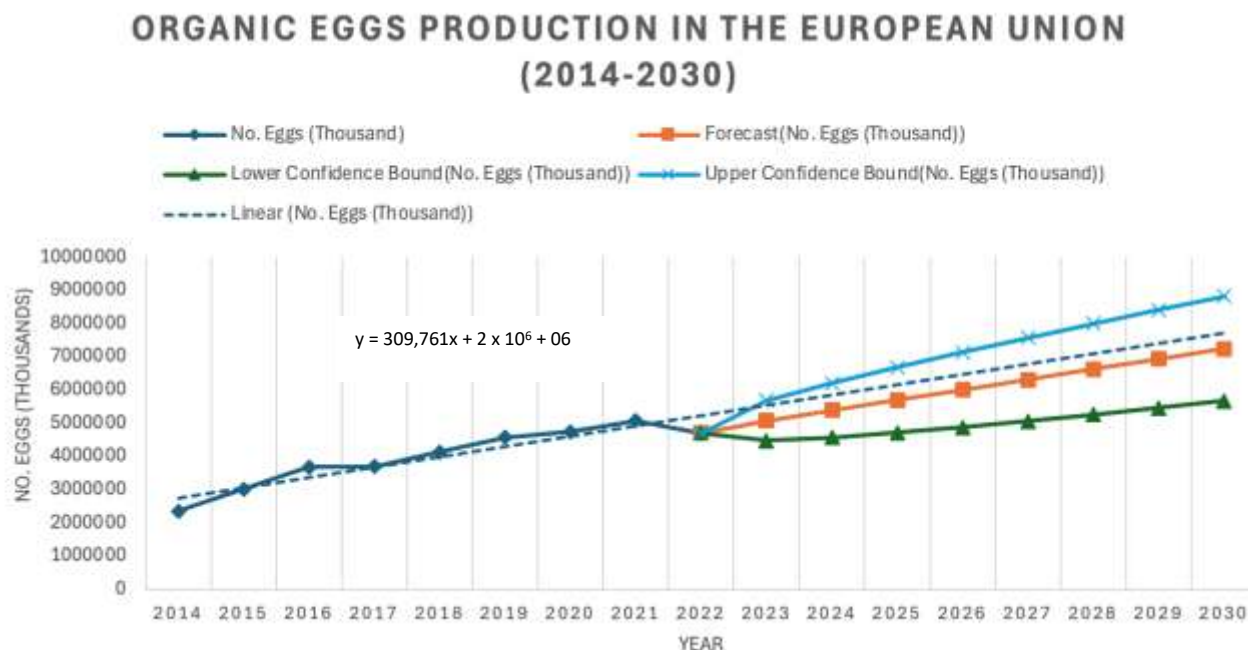


Fig. 1. European Union organic egg production (2014-2030)  
 Source: Eurostat [8].

Figure 1 indicates that from 2014 to 2022, organic egg production in the European Union demonstrated a consistent increase. In 2014, egg production was approximately 2.3 million thousand eggs, which nearly doubled by 2022, reaching around 4.7 million thousand eggs. This growth indicates a rise in consumer demand for organic products, promoted by supportive EU policies and subsidies designed to enhance organic farming. The annual increase highlights the growing popularity of organic farming practices among member states, influenced by environmental factors and market incentives.

The forecast for 2023 to 2030 indicates a sustained upward trajectory. By 2030, organic egg production in the European Union is projected to reach approximately 7.25 million thousand eggs. This indicates an increase exceeding 54% relative to the levels of 2022. The forecast suggests a steady growth rate, characterised by the absence of significant fluctuations or disruptions throughout the forecast period.

The confidence intervals offer insights into the range of possible outcomes. The lower bound estimates production will reach a minimum of 5.68 million thousand eggs by

2030, whereas the upper bound projections may surpass 8.82 million thousand eggs. This range indicates the strength of the forecast model and the possible impact of external factors, including policy changes, economic conditions, or alterations in consumer behaviour.

While both Romania and the EU show a strong reliance on recent trends (Alpha = 0.90) and do not account for trend or seasonality (Beta and Gamma = 0.00), the forecasts for Romania are less accurate than those for the EU. The higher MASE (0.72) and SMAPE (0.22) values for Romania suggest that its organic egg production is more variable and potentially influenced by external or structural factors not reflected in the linear model. This variability could stem from Romania's smaller and less developed organic farming sector, which is still in a growth phase compared to the more established markets in the EU.

In contrast, the EU's larger scale of production and more mature organic farming systems result in higher absolute errors (for Romania – MAE = 5,130.38 and RMSE = 6,639.32) but relatively better proportional accuracy (lower SMAPE and MASE). This reflects a more

predictable and consistent growth trend across the EU as a whole.

According to Figure 2, between 2014 and 2022, Romania's organic egg production experienced significant growth, reflecting the rapid development of its organic farming sector. Production increased from approximately 14,473 thousand eggs in 2014 to 50,628 thousand eggs in 2022, marking a growth of over 250% in just eight years. This expansion highlights Romania's increasing alignment with EU organic farming standards and growing consumer demand for organic products. Notably, the sharp rise between 2020 and 2021 (+44.5%) indicates the sector's recovery from the COVID-19 pandemic and a heightened interest in sustainable food sources.

The forecast for 2023–2030 projects continued growth, with production expected to reach approximately 85,000 thousand eggs by 2030, an increase of 68% compared to 2022 levels. The lower confidence bound predicts a production of at least 51,266 thousand eggs, while the upper bound suggests it could reach as high as 118,734

thousand eggs, reflecting the sector's potential and its sensitivity to external factors such as policy changes, market dynamics, and investments in infrastructure.

The historical data and forecasted trends reveal a developing but still small organic egg market in Romania compared to the broader EU. While the consistent upward trajectory underscores the sector's promise, the variability in annual growth rates and wide confidence intervals highlight its vulnerability to external shocks. These challenges, alongside the relatively modest production scale, suggest a need for targeted interventions to stabilize growth and enhance Romania's role in the EU organic market.

While the EU's organic egg production represents a mature and well-established industry, Romania's sector is in a developmental phase, characterized by rapid growth but greater variability. Romania's relatively small-scale highlights opportunities for further expansion, but achieving sustained growth will require strategic investments, policy support, and market development.

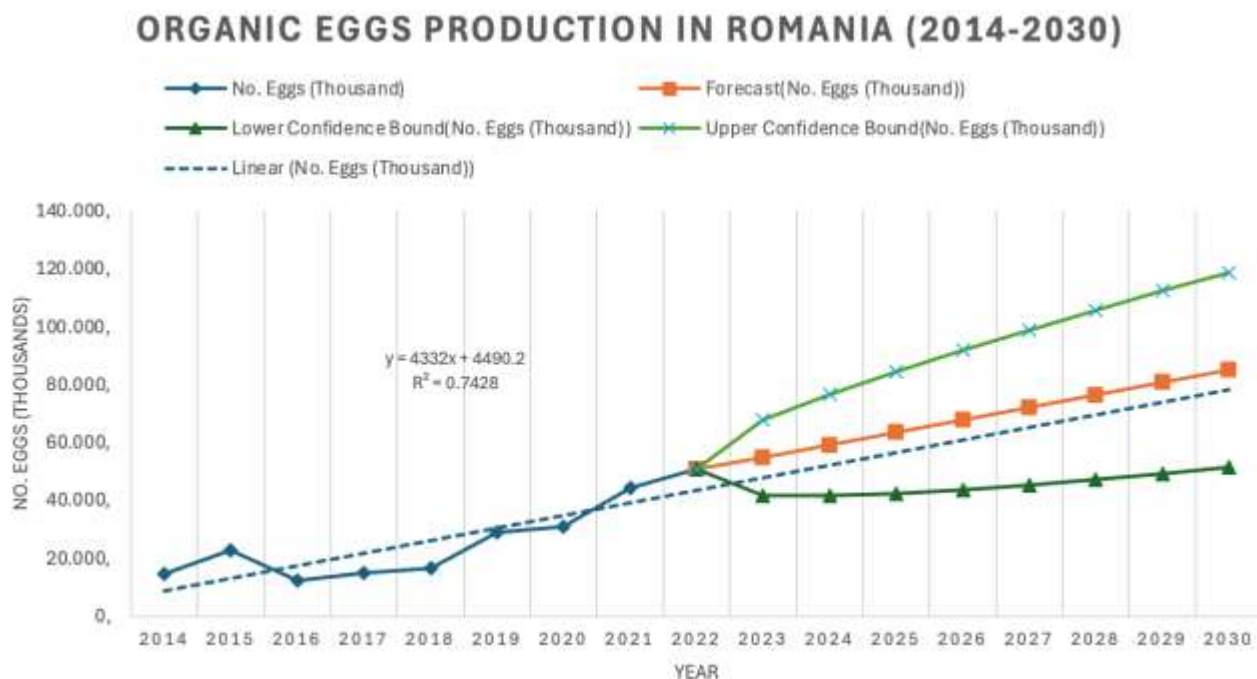


Fig. 2. Organic egg production in Romania (2014-2030)  
 Source: Eurostat [8].

A variety of variables drives the growth of organic egg production in Romania and the

European Union (EU), including consumer preferences, agricultural methods, regulatory

frameworks, and market dynamics. Understanding these characteristics is critical for stakeholders looking to improve the organic egg industry, especially in a country where conventional farming methods coexist with increasing organic markets. One of the most important elements driving organic egg production is customer demand for high-quality, ethically produced food. According to research, consumers are increasingly prepared to pay a higher price for organic eggs due to concerns about health, animal welfare, and environmental sustainability [6, 10, 13]. Consumers in Romania and across the EU are becoming more aware of the benefits of organic products, which have resulted in a preference for organic eggs over conventional options [4, 19]. This shift in consumer behaviour is reinforced by research that suggest customers are motivated by the perceived quality and safety of organic eggs, which are frequently associated with higher nutritional profiles and lower levels of pollutants. Another important consideration is the influence of agricultural methods and production systems on egg quality and yield. The choice of housing systems for laying hens, such as free-range or organic systems, has been demonstrated to influence not only the animals' welfare but also the quality of the eggs produced [7, 27]. For example, organic production systems often give hens more opportunity to exhibit natural behaviours, which can contribute to superior egg quality features, such as higher Haugh units, which indicate fresher eggs [21]. Furthermore, the nutritional content of the hens' diets is important in determining egg quality, with research indicating that adding organic minerals and specialised dietary supplements might improve production performance [22,9, 3]. Regulatory structures and financial support from the EU are also important in encouraging organic egg production. The EU's Common Agricultural Policy (CAP) offers subsidies and incentives to farmers shifting to organic approaches, which can help reduce some of the financial challenges associated with organic farming [16]. Furthermore, strict regulations governing organic certification ensure that producers

meet high standards, increasing customer trust in organic products [12]. In Romania, aligning national policy with EU standards has supported the growth of the organic industry, allowing local producers to access larger markets and benefit from rising consumer demand [5, 14]. Finally, market variables, such as price changes and competition in the egg market, have a substantial impact on organic eggs production. As the demand for organic eggs grows, producers must balance competitive cost with quality [28]. Consumers' willingness to pay higher prices for organic eggs can encourage producers to invest in improved production practices and technologies, resulting in higher output [17]. However, market saturation and the availability of cheaper conventional eggs might provide hurdles for organic producers, needing effective marketing methods to differentiate their products [6, 19].

## CONCLUSIONS

The analysis of organic egg production in the European Union and Romania reveals significant differences in scale, growth trajectories, and market maturity. While the EU represents a global leader in organic farming with a well-established and stable market, Romania's organic egg sector is characterized by rapid growth and untapped potential. From 2014 to 2022, the EU's production more than doubled, reaching 4.7 billion eggs, whereas Romania's output increased over 250% to 50.6 million eggs, underscoring its emerging role in the organic market.

The forecast for 2023–2030 indicates continued growth for both the EU and Romania, with production expected to reach 7.25 billion eggs and 85 million eggs, respectively, by 2030. However, Romania's smaller scale, higher variability, and less predictable trends reflect the challenges of a developing sector. Factors such as limited infrastructure, reliance on external policies, and market volatility contribute to these differences.

Despite these challenges, Romania's rapid growth presents significant opportunities for

expansion and development. Targeted interventions, including investments in infrastructure, training, and alignment with EU agricultural policies, could help Romania stabilize its production and strengthen its role in the European organic egg market. Meanwhile, the EU's stable growth reflects its leadership in organic farming, driven by strong consumer demand and well-implemented sustainability policies.

In conclusion, while the EU's organic egg market exemplifies maturity and consistency, Romania's sector is poised for transformation. With the right strategies and support, Romania has the potential to significantly enhance its contribution to the European organic egg market, fostering sustainable agriculture and meeting the growing demand for organic products.

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