

MILK PRODUCTION FORECAST ANALYSIS IN ROMANIA - A PROBLEM TO POSSIBLE SOLUTIONS APPROACH

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Abstract

Romania is a country located in southeastern Europe, known for its rich history, culture, and agriculture. One of the most important agricultural sectors in this country is milk production. In recent years, the milk production industry has faced numerous challenges. In this direction, the aim of our paper was to use the exponential smoothing method of forecasting in order to analyse the milk production future trends, based on empirical data provided by FAOSTAT, and to provide some insights regarding possible solutions. According to our observations, in the following period (2023-2033) the milk production tends to slowly decline, situation that impose some measures. In conclusion, regarding the forecasted situation, Romania can avoid the milk production decline and improve the current situation by adopting and implementing some preventive measures.

Keywords: milk production, trend, forecast analysis

1. INTRODUCTION

One of the most important agricultural sectors in Romania is milk production [1].

Historically, milk production in Romania has been an important part of the country's economy and culture. The first records of milk production in Romania date back to the Roman Empire, when the province of Dacia (which covered parts of modern-day Romania) was known for its high-quality cheese and dairy products. During the Middle Ages, monasteries and religious communities played a major role in developing and promoting milk production in Romania [2].

Today, milk production in Romania is still an important sector of the country's economy. Romania has a large number of small and medium-sized dairy farms, which account for the majority of milk production in the country. The main breeds of cows used for dairy production in Romania are Holstein, Romanian Brown and Romanian Spotted [3,4].

In recent years, the milk production industry in Romania has faced a number of challenges. One major issue is the lack of investment in the sector. Many of the country's dairy farms are outdated and in need of modernization, but farmers often lack the financial resources to make the necessary improvements. Another issue is the lack of access to markets. Many Romanian dairy farmers struggle to find buyers for their milk, which leads to low prices and reduced profits [1].

Despite these challenges, the milk production industry in Romania has a growing potential. The country has a favourable climate and good soil conditions for dairy farming, which makes it well-suited for milk production. Additionally, the European Union's Common Agricultural Policy (CAP) provides support for the sector, which can help farmers to modernize their operations and improve the quality of their products [5].

In general, there are several factors that can influence the milk production at the national level, such as:

1. *Climate*: The climate of a country plays a major role in determining the type of grass and feed that is available for cows, which in turn affects their milk production. Countries with a favourable climate for grazing cows, such as mild winters and cool summers, tend to have higher milk production [6].
2. *Government policies*: Government policies can play a major role in determining the level of investment and support for the dairy industry. Policies that support the development of the industry, such as subsidies for farmers and research and development, can lead to increased milk production [7].
3. *Market conditions*: The global market conditions can also have a significant impact on a country's milk production. Countries that have access to large export markets tend to have higher milk production, as they can sell their milk at a higher price [7].
4. *Technological advancements*: Advances in technology, such as genetic improvement of cattle and the use of precision farming, can also lead to increased milk production [7, 8].
5. *Animal health*: A country's animal health situation is also an important factor that can influence milk production. The animals' good health ensures that they will produce more milk, and also reduces the costs of veterinary care [5].
6. *Labour and infrastructure*: The availability of skilled labour and the infrastructure to support the dairy industry, such as feed storage, milking parlours, and transportation, also play a role in milk production.
7. *Socio-economic conditions*: The socio-economic conditions of a country, such as poverty and lack of education, can also affect milk production. In countries where resources are scarce, it may be difficult for farmers to invest in the necessary infrastructure and technology to increase milk production.

8. *Breeds and genetics*: The genetic makeup of the animals also play a role in milk production.

In this regard, there are several ways in which the milk production in a country can be improved, including livestock genetic improvement, additional measures in health and nutrition, use of precision farming techniques, government policies and investments, market development, improving the management of cow's health and reproduction and improving the infrastructure and technology. Cow farms need to ensure optimal environmental conditions with constant parameters, for performance and competition, in obtaining milk and meat production from a quantitative and qualitative point of view, as well as animal health. Animal health is the element that must concern us permanently. Only a healthy animal will perform in production and benefit the farm. [14].

2. MATERIALS AND METHODS

The forecast analysis was based on Romania's milk production data collected between 2010 and 2021 (the data was not updated for 2022-2023) and presented on FAOSTAT Data Base [9].

The forecast analysis based on the exponential smoothing method was performed using Microsoft Excel tools, for a 10 years period. This method uses the weighted average of past data to make predictions about future values. The weight given to each past data point decreases exponentially as the data point gets older. This means that more recent data points are given more weight in the calculation, while older data points are given less weight. In this direction, the following smoothing parameters were calculated:

1. *Alpha*: also known as the smoothing factor controls the weight given to the most recent data point. A higher alpha value will give more weight to the most recent data point and less weight to older data points, while a lower alpha value gives less weight to the most recent data point and more weight to older data points.

2. *Beta*: which was used to control the weight given to the trend component of the data. A higher beta value gives more weight to the trend component and less weight to the other components, while a lower beta value gives less weight to the trend component and more weight to the other components.

3. *Gamma*: used to control the weight given to the seasonal component of the data. A higher gamma value gives more weight to the seasonal component and less weight to the other components, while a lower gamma value will give less weight to the seasonal component and more weight to the other components.

Additionally, the following performance metrics were calculated, in order to evaluate the accuracy of our model prediction:

1. *Mean Absolute Scaled Error (MASE)*: this metric is used to compare the forecast error of a model to the mean forecast error of a naive forecast. It is a scale-independent measure of forecast accuracy and is particularly useful

when comparing forecasts of time series with different scales.

2. *Symmetric Mean Absolute Percentage Error (SMAPE)*: as the average of the absolute percentage errors. It is symmetric, meaning that overprediction and underprediction are treated the same and it is commonly used to evaluate the accuracy of forecasts.

3. *Mean Absolute Error (MAE)*: calculated as the average of the absolute errors. It is a measure of the average magnitude of the errors in a set of forecasts, without considering their direction.

4. *Root Mean Squared Error (RMSE)*: This metric is calculated as the square root of the average of the squared errors. It is a measure of the average magnitude of the errors in a set of forecasts, but gives more weight to large errors.

3. RESULTS AND DISCUSSIONS

Historically, during the communist era, Romania underwent significant industrialization and collectivization, including in the agricultural sector. The government implemented policies aimed at increasing milk production and modernizing the dairy industry [10]. This led to the construction of large, state-run dairy farms and the forced collectivization of small, family-run farms. During this time, milk production grew as a result of government policies, but the quality of the milk was frequently inferior due to inadequate nutrition and care for the animals (Figure 1). In addition, the lack of support for farmers and the absence of competition contributed to a deficit in innovation and business productivity [10].

After 1989, the country underwent a process of political and economic transition, which included the privatization of state-run farms and the decentralization of the dairy industry [10].

Currently, the dairy industry in Romania is made up of a combination of small, family-run farms and larger commercial farms. The country has been able to increase its milk production and improve the quality of the milk produced [5].

Between 2010 and 2020, Romania has been able to slightly increase its milk production, with a raise in the number of cows and the amount of milk produced. The government has also been supporting the development of the industry through policies and investments. Romania has been able to increase its exports of dairy products, which has been a positive trend for the industry. However, there has also been a decline in the number of small farms that in turn has led to a concentration of dairy production in large farms [11].

At the national level were also actions taken in order to improve the genetic potential of its cows and to implement new technologies to increase milk production efficiency. It is worth mentioning that the dairy industry in Romania, like in many other countries, has been affected by the Covid-19 pandemic and the decrease in consumption of milk products (Figure 1) [12].

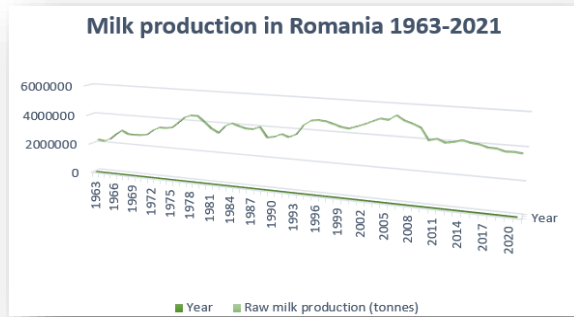


Figure 1. Milk production in Romania in the period 1963-2020

Regarding the statistical analysis associated with the milk production forecasted for 2021-2023, we have obtained a MASE value of 0.43. This value indicates that the forecast errors are on average 43% of the variability of the data, the forecast being relatively accurate compared to a higher value.

SMAPE had a value of 0.02, which means that the forecast errors are on average 2% of the average of the actual and forecasted values. This indicates that the forecast is very accurate.

MAE indicated that the forecast errors are on average 93.948,62. This shows that the forecast is relatively accurate compared to a higher value.

RMSE had a value of 113.239,66. This indicates that the forecast is relatively accurate compared to a higher value. Additionally, Alpha was equal with 1, Beta and Gamma being 0. Meaning that the forecast is based solely on the most recent data point.

Overall, the combination of these values and parameters indicate that the forecast model is relatively accurate, with low forecast errors.

The data obtained for the milk production between 2021 and 2023 is presented in Figure 2.

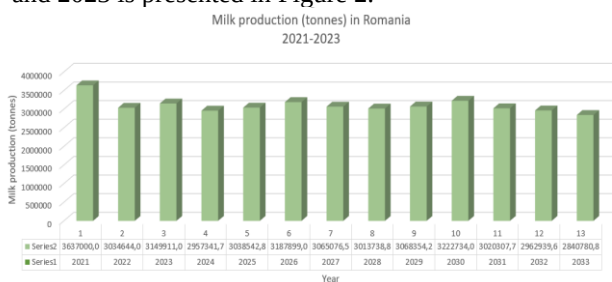


Figure 2. Milk production forecasted for 2021-2023, using the exponential smoothing method

Regarding the results, as it is shown in Figure 3, the milk production in the following 10 years is expected to decrease. Some of the main reasons can include the low milk prices offered to farmers. This can additionally lead to a decrease in the number of dairy farms along with the milk production [1].

Another possible reason could be the lack of investment needed by many farmers to modernize their farms and improve milk production.

With increased investments in the sector, many of the country's dairy farms could become more modern and efficient. This could lead to increased milk yields, improved milk quality, and reduced costs, which would make the industry more competitive on the global market. Additionally, the lack of knowledge and technology may be a problem.

It is important to mention that the use of precision farming techniques such as controlled feeding, automated milking and data collection can increase milk production by allowing farmers to optimize the conditions for their animals, resulting in more milk per cow.

The lack of EU subsidies in the past may also influence the current production.

The competition from other EU countries that produce more milk at lower costs represents another associated reason.

In this direction, developing new domestic and foreign markets for milk and dairy products can be a possible solution. Romania has a large number of small and medium-sized dairy farms, which means that the industry is well suited for producing high quality, niche dairy products.

This could potentially lead to increased exports to other countries, particularly in the European Union, as well as to countries outside of Europe.

Additionally, there is a growing demand for organic milk products worldwide, and Romania can become a major player in this market. The country's small and medium-sized dairy farms are well suited for organic milk production, and the industry could benefit from increased investment in this area.

On the other hand, Romania's rich history and culture provide a unique opportunity for the country to develop new and unique dairy products. This could include a focus on traditional cheeses and other products, which would appeal to both domestic and international consumers [13]. Along with the aforementioned reasons, there may be even natural causes for the possible decrease.

Romania has seen a series of drought in the past years, which affected the pasture and the vegetation, leading to a decline in the milk production.

Moreover, the EU has been tightening the regulations on animal welfare, which can raise the costs of production for dairy farmers and reduce the milk production.

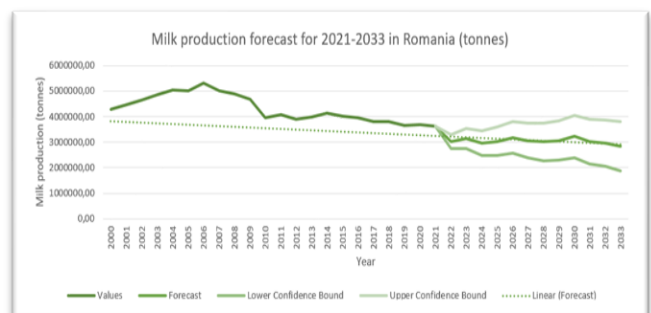


Figure 3. Milk production forecasted for 2021-2023 trend

4. CONCLUSIONS

The dairy industry is a significant contributor to a country's economy, and a decrease in milk production can lead to job losses and economic downturns in rural areas where the industry is concentrated. On the other hand, milk and dairy products are an important source of nutrition for many people, particularly for children and the elderly. A decrease in milk production can lead to a shortage of these products, which can affect the population's health and food security. This can also impact a country's trade, as it may decrease the exports of dairy products and increase the imports.

It's important to note that the consequences of a possible decrease in Romania's milk production can be mitigated by government policies and investments, as well as by the efforts of the industry to increase efficiency and productivity.

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