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Analyzing meat production dynamics and future prospects in Republic of North Macedonia

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Abstract: This study examines the current state and future perspectives of meat production in Republic of North Macedonia. The authors analyzed the volume of meat production (tons) by type (beef, pork, poultry, etc.), exploring production levels and market share for each type. Market capacity is assessed using time series data on domestic production and import volumes (disaggregated by meat type and total). Trends over time are investigated through chain and base index calculations. Finally, the triple exponential smoothing method implemented in Excel software is employed to forecast future meat production trends in North Macedonia.
Pork meat production increases in total meat production from around 35% in the period 2000–2010, up to the record levels of over 63% in 2020 and 2021. This suggests pork became the dominant meat in North Macedonia during this period. The share of beef meet production decreases from 23.6% in 2001, to 16.5%-18.5% in the last three years. Share of sheep meat production had an increase in the first decade of analyzed period reaching nearly 29.4% in 2011, but has decreased on around 13.5% -16.7% in the last decade. The share of poultry meat production in the analyzed period has decreased from 11.2% in 2004, up to 8.1% in 2022.
Additionally, the forecasts will offer valuable information for stakeholders regarding potential future directions and growth prospects within the industry.

Keywords*:* meat production; dynamic; quality; market capacity

INTRODUCTION

In the diet of a large part of the world's population, especially in developed countries, meat occupies a traditionally central position, in relation to other food products.

As the world population is close to 7 billion (FAO, 2009), food consumption has become a concern. The world's population is growing by more than 200.000 people a day and this has an impact on the increasing demands for food production. Economic development is normally accompanied by an increase in average household income and subsequent improvements in food supply.

Meat is one of the most important foods in the world and in some countries, it is considered an essential product with very high consumption rates. In fact, meat provides valuable amounts of protein, fatty acids, vitamins, minerals, and other bioactive compounds. In many countries, meat is only a supplement to an already balanced diet (Guerrero et al., 2013).

Today's modern consumer accepts meat and meat products differently than in the past. His choice is in accordance with the modern way of life, which is aimed at the economy and healthy life-healthy diet, (Matekalo - Sverak et al., 2007), (Dransfield et al., 2001, 2003; Ngapo & Dransfield, 2006).

In the Republic of North Macedonia, homework beef production satisfies only 20% of needs and has a continuous descending trend. In the observed period, production declined of 5.500 tons in 2014, to 4.000 in 2019. The need of 11.500 tons

of frozen and fresh beef meat everything satisfy from import in value from 36.5 million euros (in 2019), (National Strategy for Agriculture and Rural Development 2021-2027of Republic of North Macedonia).

However, the key product of sheep farming is lamb, which is exported to the traditional markets in the EU, mainly Greece, Croatia, and Italy (83% in 2019), and the rest to the markets of the former Yugoslavia. The share of exports to EU countries in the observed period decreases by 8% with a corresponding increase in other markets (Petrovski, I., 2017).

The pork production subsector is the only livestock subsector that fully meets the needs of the domestic market for fresh pork. In the period 2014-2020, the sub-sector showed a total increase in the number of raised heads by 13%, from 24 heads/year to 27 heads/year, and in meat production by 35%, from 9.886 tons in 2014 to 13.384 tons in 2019 (Report on registry bookkeeping, selection and monitoring of the situation in pig farming from 2010 to 2019, and SSO in Republic of North Macedonia).

In Republic of North Macedonia, according to the data of the (Food and Veterinary Agency, 2023), fifty (50) facilities for the processing of meat and meat products are registered. Twelve (12) of them are completely idle, thirty-eight (38) facilities are still operating and fifteen (15) are registered for the production of semi-durable and durable products with a capacity of 45.000 tons per year in one shift.

Such data speak of insufficiently used livestock and production potential, insufficient areas of agricultural land for own production of animal feed, which makes their production more expensive and less competitive, the low level of education of farmers, modern and innovative technology of cultivation, marketing, management and assortment of meat products, which is still standard, made according to usual technology.

The research aims to provide insights into the dynamics of the Macedonian meat production sector, including its current situation, market saturation levels and technological changes.

MATERIAL AND METHOD

Data from the State Statistics Office of the Republic of North Macedonia for the period from 2012 to 2022, were taken as the material for the examination in order to analyze the volume of meat production, by exploring production levels and the market share for each type.

Trends over time are investigated through chain and base index calculations. Finally, the triple exponential smoothing method implemented in Excel software is employed to forecast future meat production trends in Macedonia.

The Excel software generates the results using the following formula, (Berenson, M.L &Levine, D.M., 1996):

$$F = Lt + h * bt + St \quad (1)$$

Where:

• F - Forecast

• Lt: Level at time t (forecasted level for the next year)

• h: Number of future periods (years).

• bt: Trend at time t

• St: Seasonal index for period s within the cycle (In annual data, s = 1, as seasonality repeats annually)

Level (Lt):

$$Lt = \alpha * Yt + (1 - \alpha) * (Lt\text{-}1 + bt\text{-}1) \quad (2)$$

• α: Level smoothing parameter (between 0 and 1)

• Yt: Actual meet production value for year t

• Lt-1: Smoothed level for the previous year (t-1)

• bt-1: Trend component for the previous year (t-1)

Trend (bt):

$$bt = \beta * (Lt - Lt\text{-}1) + (1 - \beta) * bt\text{-}1 \quad (3)$$

• β: Trend smoothing parameter (between 0 and 1)

• Lt: Smoothed level for current year (t) calculated with formula (2)

• Lt-1: Smoothed level for the previous year (t-1)

• bt-1: Trend component for the previous year (t-1)

Seasonal Index (St):

When using annual data seasonality repeats annually:

$$St = \gamma * (Yt / Lt) + (1 - \gamma) * St\text{-}1 \quad (4)$$

(where St-1 = St, as seasonality repeats annually)

• γ: Seasonal smoothing parameter (between 0 and 1)

• Yt: Actual meat production value for year t

• Lt: Smoothed level for current year (t) calculated with formula (2)

• St-1: Seasonal index for the previous year (t-1) (When using annual data, St-1 becomes the seasonal effect for the current year St due to s = 1)

Alpha (Level Smoothing)

A value of 0.25 for pork and poultry production suggests moderate smoothing. The model incorporates 25% of the current year's data (Yt) and weights the remaining 75% on the smoothed level (Lt-1) and trend (bt-1) from the previous year.

A value of 0.90 for sheep and beef production indicates a much stronger emphasis on historical data. The model relies heavily on the smoothed level (Lt-1) from the previous year, potentially due to slower changes in these types of production.

Total Meat Production (α = 0.00): A zero value for alpha relies solely on historical information.

Beta (Trend Smoothing)

A value of 0.00 for all meat types except pork (β = 0.25) suggests that the model doesn't consider short-term trends in poultry, sheep, and beef production. This is reasonable when production levels are relatively figure year-to-year.

For pork (β = 0.25), the model incorporates some information about recent trends, potentially due to faster fluctuations in pork production compared to the other categories.

Gamma (Seasonal Smoothing)

A value of 0.00 for all meat types indicates that seasonality is not considered in the model for any of the production categories. This suggests the model assumes no recurring seasonal patterns in the data.

So, the model prioritizes historical data (Lt-1) for sheep and beef production (α = 0.90, β = 0.00), potentially due to their slower changes. The model considers some recent trends in pork production (β = 0.25). Seasonality is not considered for any meat type (γ = 0.00).

RESULTS AND DISCUSSION

Based on the processed statistical data, the following results were obtained.

According to the results from Figures 1 and 2, the share of Pork meat production increases in total meat production from around 35% in the period 2000 – 2010, up to the record levels of over 63% in 2020 and 2021. This suggests pork became the dominant meat in North Macedonia during this period. Share of beef meet production decreases from 23.6% in 2001, to 16.5%-18.5% in last three years. Share of sheep meat production had an increase in the first decade of analyzed period reaching nearly 29.4% in 2011, but has decreased on around 13.5% -16.7% in the last decade. Share of poultry meat production in the analyzed period has decreased from 11.2% in 2004, up to 8.1% in 2022. However, the decrease is not as drastic as that observed in beef and sheep production.

The data reveals significant changes in the types of meat produced in North Macedonia over the analyzed period (2000-2022). We can observe a shift in preferences and production levels towards pork and away from beef, sheep, and poultry.

The results that indicate an increased production of pork in the examined period are due to the quality Macedonian pig farms that apply modern technological solutions and breeding methods, to reach the highest standards of production efficiency per head and quality of pigs in terms of production characteristics, which is close to the level of developed countries (National Strategy for Agriculture and Rural Development 2021-2027).

Initial Increase (2000-2004): Total meat production experienced a rise in the first five years,

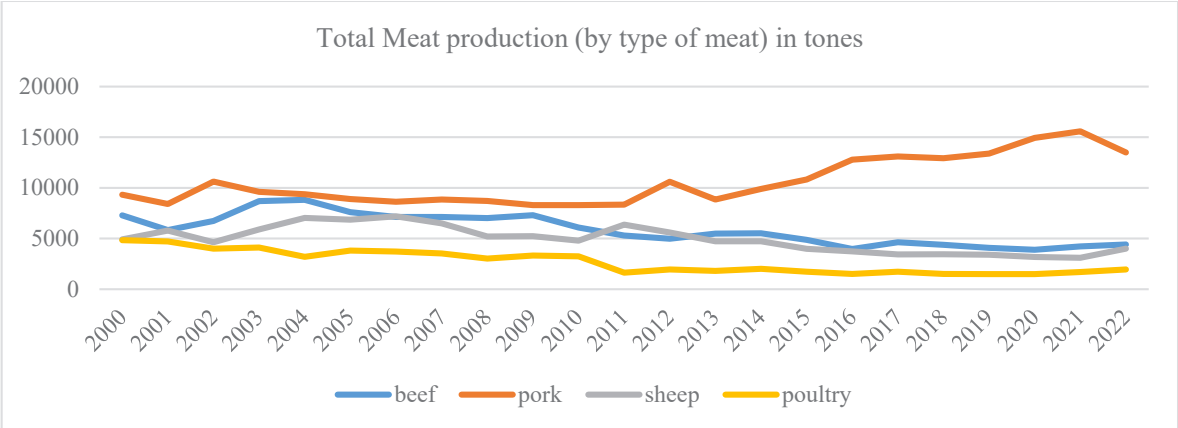

Figure 1. Total Meat production in North Macedonia

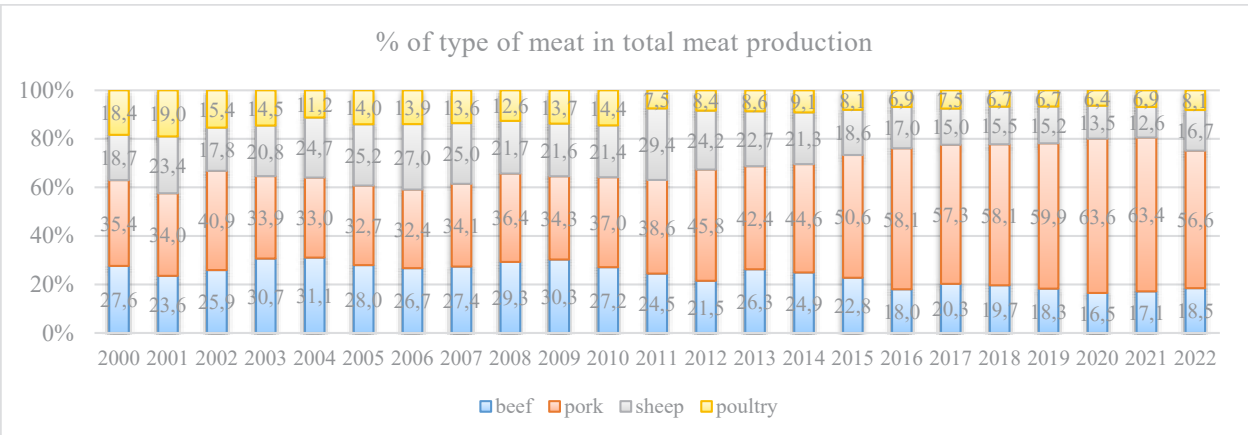

Figure 2. (%) of Meat type in total meat production in North Macedonia

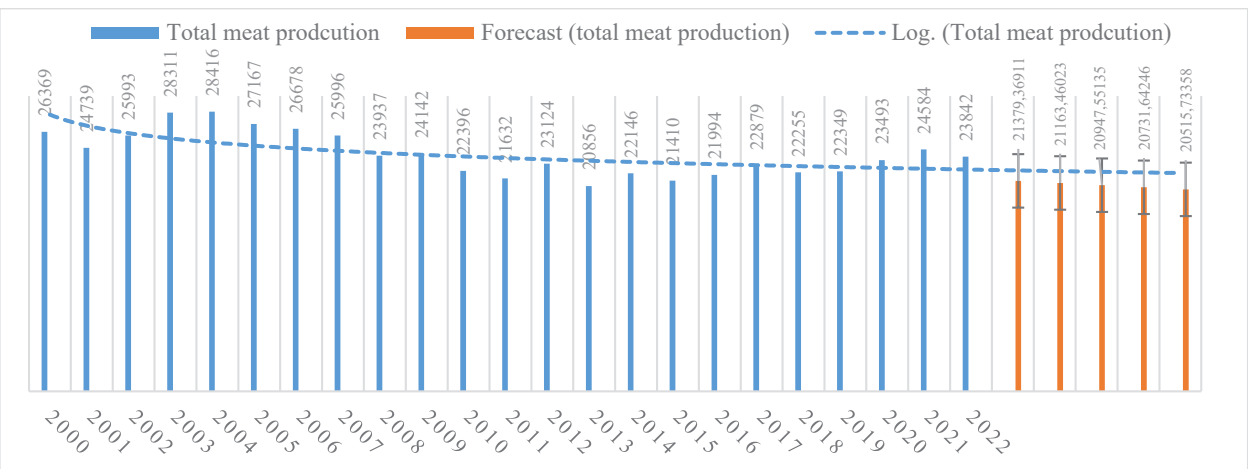

Figure 3. Total Meat Production (tones), (Fluctuating Trend with Expected Decline)

**Log (trendline in the examined period)*

reaching a peak of 28.416 tons in 2004. Following Decline (2005-2013): The next decade witnessed a downward trend, with production reaching a low of 20.856 tons in 2013. Recent Increase (2014-2022): There has been a recovery in recent years, with production climbing back up to 24.000 tons. Forecast: The forecast predicts a decline in total meat production in the coming years, with an expected average of around 21.000 tons. However, there's a confidence interval of 2.700 tons, indicating a range of possible production levels between 18.300 and 23.700 tons with 95% confidence.

Total meat production in North Macedonia has exhibited fluctuations over the past two decades, with an initial increase, a period of decline, and a recent recovery. The forecast anticipates a slight decline in the coming years, with some uncertainty around the specific production levels.

The results for fluctuations and expected trends for beef production in tones are given in figure 4.

Overall Decline: There has been a general downward trend in beef production over the last two decades. Beef production in 2022 (4.415 tons) is nearly 40% lower, compared to 2000 (7.287 tons). Breakdown of the Trend: Initial Increase (2000-2004): Beef production showed a slight increase in the first few years, reaching a peak of 8.824 tons in 2004. Steady Decline (2004-2010): Following the peak in 2004, there was a steady decline in beef production for the next six years. Fluctuations (2010-2022): Since 2010, beef production hasn't shown a clear direction. There have been minor fluctuations, but overall, production remains below 2000 levels.

The data shows a clear downward trend in beef production in North Macedonia over the past two decades. While the reasons are not entirely clear from the figure itself, a shift in consumer preferences, production costs, and government regulations could be some contributing factors.

Overall, pork meat production in North Macedonia has shown a significant increase over the past two decades, with a recent decline in 2022 (Figure 5).

In the first decade (2000-2010): Pork meat production exhibited a steady pattern with minimal fluctuations during this period. In the second decade (2011-2020), the production witnessed a significant increase over most of this decade, with an overall growth exceeding 85% compared to the first decade. However, there was a decline in production in 2022. The forecast predicts relatively production in the coming years, hovering around 15.000 tons annually.

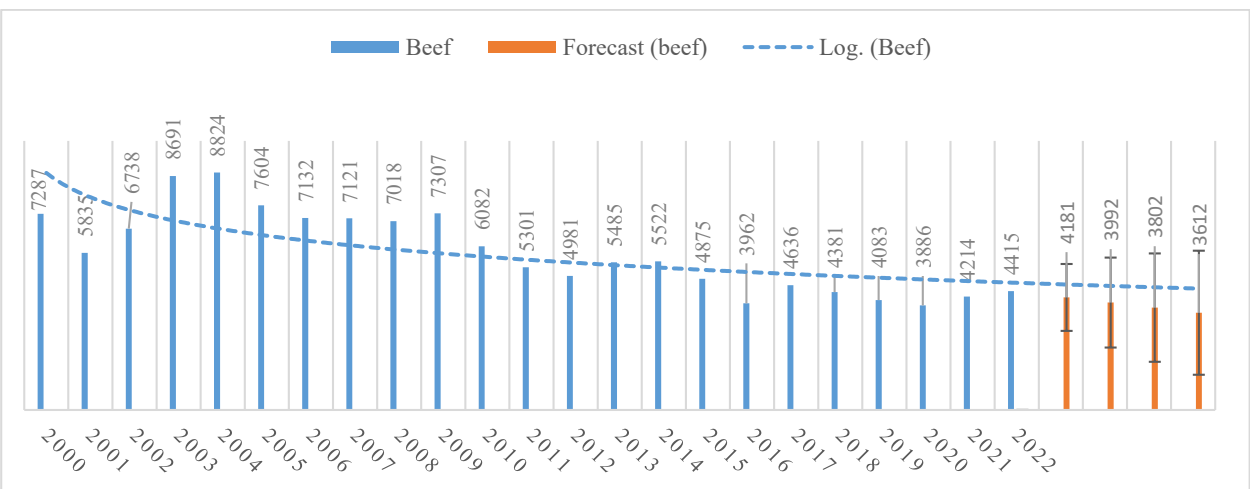

Figure 4. Beef Meat Production (tones), (Fluctuating Trend with Expected Decline)

**Log (trendline in the examined period)*

In the last years, modern technical technological solutions have caused the increase of the average gain per animal and also contributed to the increase of work productivity and economic efficiency in animal rearing (Jovanović et. al, 2009).

In order to achieve this goal, the genetic potential should be promoted and expanded, which will be realized according to the activities provided by the provisions of the Law on Animal Husbandry (National Strategy for Agriculture and Rural Development, 2021-2027).

The results for fluctuations and expected trends for sheep production in tones are given in figure 6. In the first decade (2000-2011), sheep meat production exhibited significant fluctuations throughout this period. It reached a high of 7.198 tones in 2006 but also dipped to 4.919 tones in 2000, and ended at 6.370 tons in 2011. Second

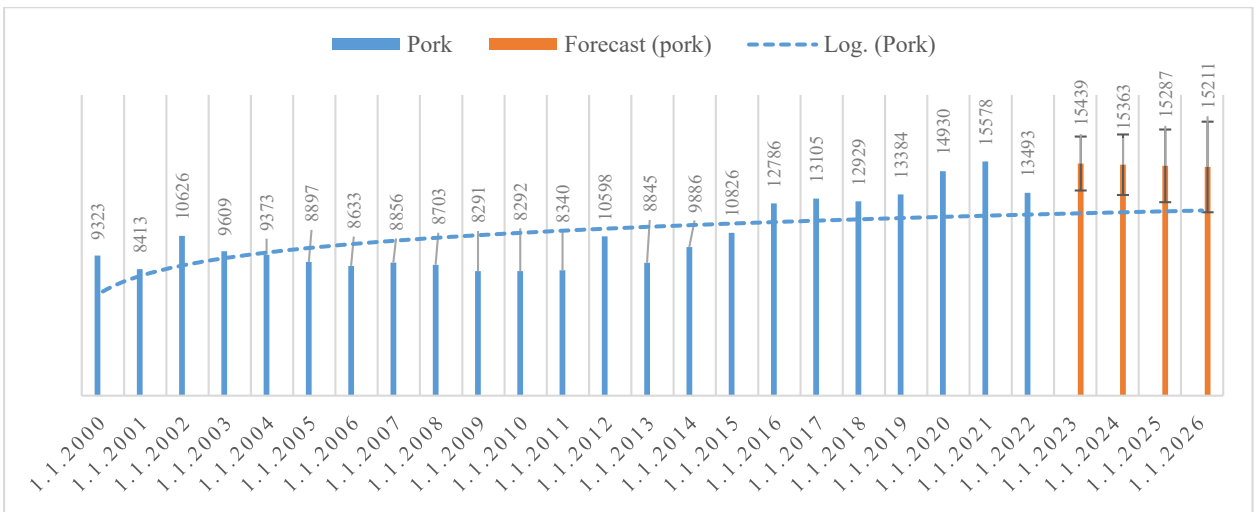

Figure 5. Pork Meat Production (tons), (Fluctuating Trend with Expected Decline)

**Log (trendline in the examined period)*

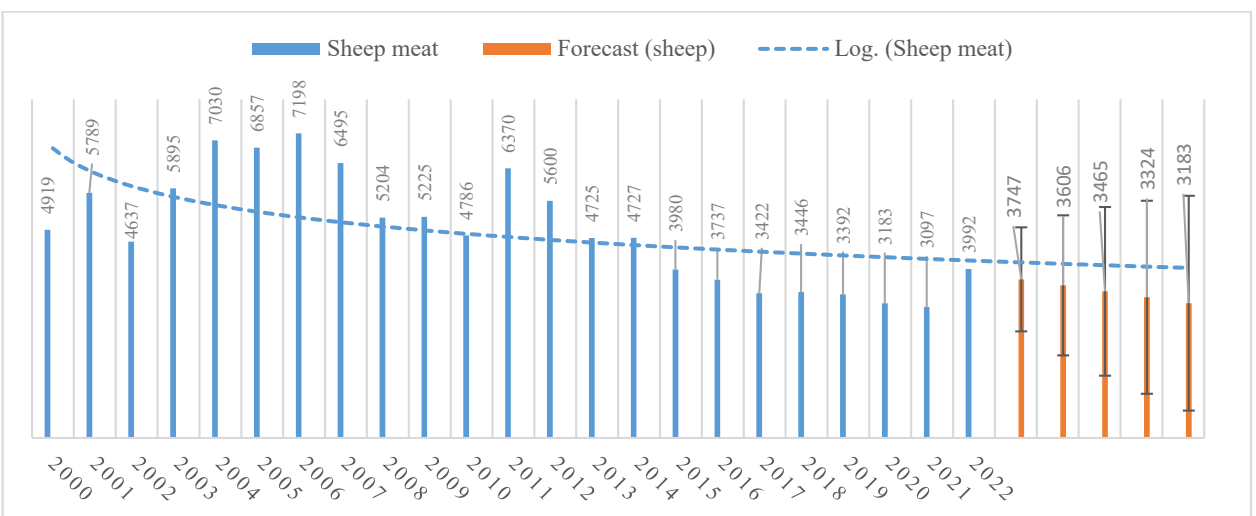

Figure 6. Sheep Meat Production (tons), (Fluctuating Trend with Expected Decline)

**Log (trendline in the examined period)*

Decade (2012-2022), production generally declined over this decade, reaching a low of 3.097 tons in 2021. However, there was a slight increase to 3.992 tons in 2022.

The forecast predicts a continuing decline in sheep meat production in the coming years, with an expected average of around 3.500 tons annually. There's a confidence interval of 1.200 tons, indicating a range of possible production levels between 2.300 and 4.700 tons with 95% confidence. It's important to note that the confidence interval widens in each following year, indicating increasing uncertainty in the forecast. If we want to increase the production of meat, it is necessary to take numerous measures in society. First of all, measures which will motivate the producers for this type of production (Ažderski & Pejkovski, 1997).

With the aim of sustainable production and in the direction of increasing market share, support will be provided to producers and exporters of lamb meat to find and access new non-traditional markets, such as the markets of the Near and Far East by concluding free trade agreements and providing contacts with importers there.

The main goal of the poultry subsector remains satisfying the domestic market with eggs and gradually improving the percentage of coverage of domestic poultry meat needs with own production.

The results of Fluctuating Production with Expected Decline are given in Figure 7.

Poultry meat production experienced a steady and significant decline, dropping from 4.840 tons in 2000 to 3.236 tons in 2010. Production nearly halved in 2011, compared to the previous year, reaching a low of 1.600 tons. Since 2011, poultry meat production has exhibited low fluctuations around 1.500 tons per year, with a slight increase to 1.900 tons in 2022. The forecast predicts a continuation of this stagnant trend, with an expected average production of around 1.600 tons annually. There's a confidence interval of 300-350 tons, indicating a possible range of 1.250 to 1.950 tons with 95% confidence.

Due to downward trends and market imbalances, entities involved in the sector need further income support and investment support to achieve the required animal welfare standards and modernization (Nikolova & Kocevski, 2017).

CONCLUSION

On the basis of the obtained results and the expected situation of meat production in our country, the following conclusions can be drawn:

Domestic beef production meets only 20% of its needs and has a continuous downward trend. Imports meet the needs for frozen and fresh beef.

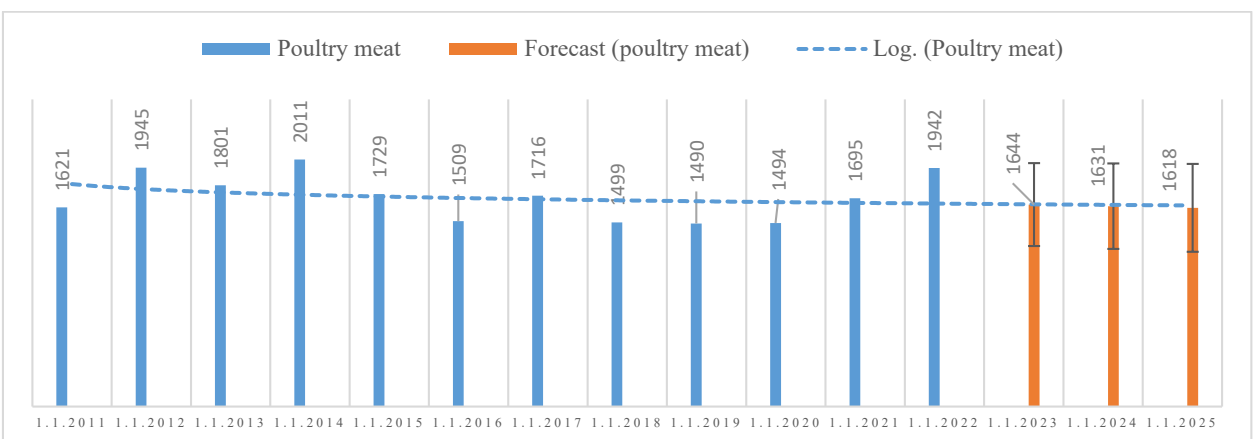

Figure 7. Poultry Meat Production (tons), (Fluctuating Trend with Expected Decline)

**Log (trendline in the examined period)*

The main quoted drawback is that cattle breeders have insufficient agricultural land for their own feed production, which makes their production more expensive and less competitive.

The pork production subsector is the only livestock subsector that fully meets the needs of the domestic market for fresh pork. Unlike the fresh pork market, which is satisfied by the production of domestic farms, the processing industry is completely oriented to the procurement of raw materials through the import of chilled and frozen pork. Pig farming in our country requires further maintenance and improvement of genetic potential, meeting high environmental standards, and reducing the impact of climate change.

Lamb meat exported to traditional markets in the EU, mainly Greece, Croatia, and Italy, has seen a decline and consequently a decrease in the total production of sheep meat.

Poultry meat is mostly imported; therefore, it is necessary to take measures to encourage the initiation of small self-sustaining businesses for the production of poultry meat.

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