

LONG-TERM INSIGHTS INTO REGIONAL TRENDS AND FORECASTING IN GLOBAL SHEEP MEAT PRODUCTION

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ABSTRACT

This study analyses long-term trends in sheep meat production using data collected over a period of more than 50 years, which includes a wide variety of regions with different production systems and challenges. The production of meat is of significant importance to global food security and nutrition, providing sources of protein and essential nutrients. Using ARIMA modelling, the research evaluates historical patterns and forecasts future dynamics, providing valuable insights into the global sheep meat industry. Global sheep meat production trends were analyzed by examining major producer countries, including Algeria, Australia, China, New Zealand, and Türkiye, as well as the European Union, a significant collective producer, and overall global production, thereby highlighting regional differences in production trends and the crucial factors influencing each. The findings indicate that China is expected to maintain its growth trend, whereas production in the European Union may continue to decline in the short term without strategic interventions. ARIMA projections indicate that production in Algeria and Türkiye is likely to remain at a consistent growth trend, while Australia and New Zealand are expected to decline following marginal fluctuations. Although the European Union countries are still among the first 3 with the highest production capacity, it was found that the trend of decline in recent years is likely to persist. On a global scale, there is a projected annual increase in sheep meat production. By utilising these forecasts, the global sheep meat industry can more effectively manage the challenges and thereby ensure an ongoing role in the global food system. The present study underscores the vital necessity for long-term planning and international collaboration to ensure the sustainability and competitiveness of sheep meat production on a global scale.

Keywords: Livestock, Time series predictions, Sustainability, ARIMA modeling.

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INTRODUCTION

The increasing demand for food from a growing global population is putting pressure on the competitive production environment. In order to meet this growing demand, countries are moving towards a more efficient, demand-driven supply chain. It is expected that the value will continue to rise steadily until 2027, based on the forecasted increase in meat consumption (Soare *et al.*, 2023). Contemporary production is defined by a demand for greater product variety and selectivity from consumers who are becoming more selective in their purchasing decisions and consumption patterns.

Sheep meat is a widely globally consumed red meat due to its flavor and nutritional value, and globally recognised source of protein. As with all red meats, sheep meat provides a significant source of high-quality protein, which is an essential macronutrient along with carbohydrates, fats, vitamins, and minerals (Corazzin *et al.*, 2019; Ding *et al.*, 2024). These nutrients are vital for energy production, growth, tissue repair, and the

maintenance of physiological functions (Pethick *et al.*, 2021). Considering its nutritional importance, the selection of suitable sources of red meat is crucial for a healthy diet, and sheep meat offers a valuable option due to its favorable balance of nutritional and sensory properties, including rich flavor, tenderness, and juiciness. It is particularly recognized and consumed across the Middle East, Asia, the Mediterranean and Oceania (Ivanović *et al.*, 2016; Raeeszadeh *et al.*, 2022). In these regions, sheep farming plays an important role in supporting rural economies, ensuring food security and promoting sustainable agricultural practices. In the regions where agricultural land is not suitable for crop production, sheep can be effectively utilized to make use of these resources. Consequently, the production of sheep meat makes a significant contribution to the economic development of rural areas and is fully compatible with sustainable agricultural practices (Al-Barakeh *et al.*, 2024). In the global context, the leading producers of sheep meat are China, Australia, Türkiye, New Zealand, and Algeria. These countries play an important role in

international trade while meeting local consumption needs (FAO, 2024; TUIK, 2024).

Globally, 26% of total meat production is red meat, with sheep meat accounting for 11% of red meat. The leading countries in sheep meat production are China (26.1%), Australia (6.9%), Türkiye (4.8%), New Zealand (4.3%) and Algeria (3.4%) (Figure 1). In the European Union (EU) countries, sheep meat production accounts for 5.0% of total red meat production (FAO, 2024). While there has been a notable decline in sheep meat production in total EU countries in recent years, the increase in Turkey is particularly noteworthy. This increase is also observed in China, the major sheep meat producer, and therefore in global production.

The estimation of future sheep meat production is essential for the effective planning of agricultural activities, maintaining market stability and optimising supply chains (Benmehaia *et al.*, 2023; Dalgıç *et al.*, 2023). Accurate forecasts facilitate the ability of producers and policy makers to anticipate demand-supply dynamics, reduce costs and ensure the sustainability of resources (Dasyam *et al.*, 2015). Accurate forecasting of sheep meat production is essential for effective stock management. The volume of stock held is directly influenced by the demand forecast, and thus the use of an inaccurate demand forecast can result in significant costs and highlight inefficiencies in the process.

The ARIMA model has been widely used for forecasting agricultural products, including oil prices, cotton production, apricot production, honey production, beef production, and milk and dairy product quantities (Tularam, 2016; Çukur and Çukur, 2021; Uçar *et al.*, 2021; Uzundumlu *et al.*, 2021; Dalgıç *et al.*, 2023; Doğar *et al.*, 2024). Moreover, in studies comparing forecasting methods, the ARIMA method is among the methods recommended, particularly for ruminant animals (Ordu and Zengin, 2020).

This study aimed to considerably contribute to the current research literature by applying the Autoregressive Integrated Moving Average (ARIMA) model to forecast global sheep meat production in various regions. While ARIMA models have been widely used in agricultural forecasting, such as forecasting cow's milk and chicken meat production in various regions around the world, their relevance to global sheep meat production has been limited. In particular, there are significant gaps in comparing the countries and regions with the highest milk production with their global production. The capacity of the ARIMA model to capture temporal patterns and seasonality makes it a robust tool for forecasting in the agricultural sector. This study provides a comprehensive overview of sheep meat production in the major producer countries, particularly China, Australia, Türkiye, New Zealand, and Algeria, as well as European Union countries, over the past 50 years and projects potential changes in production in the next

decade thus filling a critical gap in the agricultural forecasting literature. Consequently, the study allows stakeholders valuable insights to make informed decisions by addressing potential challenges and opportunities in the livestock sector.

MATERIALS AND METHODS

Data: The study utilised data on global sheep meat production from 1970 to 2022, focusing on major producer countries such as China, Australia, Türkiye, New Zealand, and Algeria, as well as European Union countries. The data were sourced from the Food and Agriculture Organization (FAO, 2024) and the Turkish Statistical Institute (TUIK, 2024), national statistical agency. The Autoregressive Integrated Moving Average (ARIMA) model, a robust statistical method for analysing time series data, was used to forecast sheep meat production volumes from 2022 to 2030.

ARIMA analysis: The Box-Jenkins methodology (Box and Jenkins, 1976) consists of the following key steps;

Model Identification: The stationarity of the time series is tested using unit root tests. If the series is found to be non-stationary, differencing is applied (denoted as "d" in ARIMA (p, d, q)). The values of p (autoregressive term) and q (moving average term) are determined based on the autocorrelation function (ACF) and partial autocorrelation function (PACF) plots (Hyndman and Athanasopoulos, 2018).

Parameter Estimation: Once the model order is determined, the parameters are estimated using maximum likelihood estimation (MLE) (Shoko and Belete, 2017).

Diagnostic Checking: The residuals of the model are analyzed to confirm white noise properties, ensuring an adequate model fit (Mishra *et al.*, 2021).

To ensure the validity of the ARIMA model, stationarity tests were conducted using the Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests;

Phillips-Perron (PP) Test: This test accounts for autocorrelation and heteroscedasticity in the residuals, improving the robustness of stationarity checks (Awal and Siddique, 2011).

Augmented Dickey-Fuller (ADF) Test: The ADF test extends the standard Dickey-Fuller test by including lagged differences to address autocorrelation issues (Dasyam *et al.*, 2015).

Both tests were conducted under three conditions: (1) with a constant, (2) with a constant and trend, and (3) without a constant and trend. The results indicated that the original series was non-stationary, but after first differencing, all series became stationary, validating the appropriateness of the ARIMA model for forecasting

purposes (Uçar *et al.*, 2021; Dalgıç *et al.*, 2023). These values are determined using autocorrelation functions (ACF) and partial autocorrelation functions (PACF), Phillips Peron (PP), and augmented Dickey Fuller (ADF) test (Awal and Siddique, 2011). ACF and PACF shapes are used as tools to determine the stationarity of variables and the lag length of the ARIMA model when predicting ARIMA models. The ADF test is applied to non-stationarity during stationarity testing. Studies utilizing the ARIMA model commonly apply ADF and PP unit root tests in a similar manner to achieve stationarity in the series (Uçar *et al.*, 2021; Dalgıç *et al.*, 2023). PACF or partial correlogram is used to determine the appropriate number of lags for the autoregressive (AR) model. The number of non-zero relationships in PACF determines where AR lags should be included. The ACF correlogram is used to determine the number of lags for the moving average (MA) model, where again, non-zero relationships indicate where lags should be included.

Mathematical Representation of the ARIMA Model:

The ARIMA model consists of three main components: Autoregression (AR), Integration (I), and Moving Average (MA), which are mathematically represented as follows:

$$Y_t = c + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \dots + \phi_p Y_{t-p} + \varepsilon_t$$

Here, Y_t is the value of the time series at time t , c is a constant, $\phi_1, \phi_2, \dots, \phi_p$ are autoregressive parameters, and ε_t is the white noise error term.

Integrated (I) Component: The integrated component involves differencing the time series to achieve stationarity. The order of differencing is denoted by d , and the integrated component is represented by:

$$Y_{t'} = Y_t - Y_{t-1}$$

The MA model function is: The MA component involves modeling the relationship between the current value of the time series and past forecast errors. The MA (q) component is represented by:

$$Y_t = \mu + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \dots + \theta_p \varepsilon_{t-p} + \varepsilon_t$$

Here, μ is the mean of the time series, $\theta_1, \theta_2, \dots, \theta_p$ are MA parameters, and ε_t is the current error term.

Generally, the ARIMA model is as follows: $\Delta d Z_t = c + (\theta_1 \Delta d Z_{t-1} + \dots + \theta_p \Delta d Z_{t-p}) - (\theta_1 \varepsilon_{t-1} + \dots + \theta_p \varepsilon_{t-p}) + \varepsilon_t$

Here, Δ denotes the difference as shown below: Z_{t-1}, Z_{t-p} are the values of the past series with delays of 1, p, respectively.

$$\Delta Z_t = Z_t - Z_{t-1}$$

$$\Delta^2 Z_{t-1} = \Delta Z_t - \Delta Z_{t-1}$$

RESULTS

The data presented in Table 1 were analyzed using Phillips–Perron (PP) and ADF unit root tests to ensure stationarity. These tests were applied with three

variations: constant, constant and trend, and without trend, examining both the level and first difference of the series to identify their stationarity properties.

The results from both tests indicated that the series become stationary when their first differences are taken. Based on this finding, it was determined that further analysis would be conducted on the first-differenced series. This outcome confirms that the optimal level of stationarity for the analysis is achieved at the first difference of the series.

The details of the regression models selected for modelling the economies of the countries included in the study are given in Table 2. The AR, MA, and differencing (d) parameters of the ARIMA models were identified for each country. The significance of these parameters was assessed by analyzing the p-values associated with the ACF and PACF coefficients.

Statistically significant coefficients were selected, and models (1,1,1) for Algeria, Türkiye and the EU countries, (2,1,1) for Australia, (1,1,2) for China, (2,1,2) for New Zealand and the World, and (1,1,1) for other regions were preferred. The AR and MA coefficients of the selected models for all countries were found to be statistically significant ($p < 0.05$ and $p < 0.01$). This high level of significance supports the reliability of the models and validates the chosen modeling approach.

Table 3 presents the forecasted values of sheep meat production in the countries between 2023 and 2030. The data indicates that the global production of sheep meat is expected to increase by 7.7% from 2023 to 2030. This suggests the existence of a general growth trend. At the country level, production in countries such as Algeria and China are expected to demonstrate a consistent upward trajectory, reaching 388,693.7 tons and 3,158,595 tons, respectively, by 2030. A comparable upward trajectory is discernible in Türkiye, where production is anticipated to attain 524,330.5 tons by 2030, representing an increase from 499,242.5 tons in 2023.

Although the data reveals fluctuating trends, the forecasting model indicated a decline in sheep meat production of 5.3% in Australia and 4.6% in New Zealand from 2023 to 2030. On the other hand, sheep meat production in the EU countries is forecast to experience a decline of 20.3 per cent from 2023 to 2030. These forecast findings highlight regional variations in sheep meat production, underscoring the significance of future market opportunities and the necessity for enhanced productivity. Countries experiencing growth offer avenues for the providing of global demand, while countries undergoing declines may require a reassessment of their production processes. The declines in sheep meat production in important exporting countries Australia and New Zealand is thought to be due to economic reasons and natural disasters, particularly the drought. Nevertheless, the expansion in global sheep meat production forecasts a sustainable upward trend.

Table 1. Unit root tests (ADF-PP).

UNIT ROOT TEST TABLE (PP)								
At Level		Algeria	Australia	China	EU	New Zealand	Türkiye	World
With Constant	t-Statistic	0.7556	-2.783	1.4255	-0.4033	-1.984	-0.5218	1.5975
	Prob.	0.9923	0.0677	0.9989	0.9007	0.2928	0.8782	0.9994
With Constant and Trend	t-Statistic	-1.7396	-3.4571	-2.4175	-1.5637	-2.7665	-0.0679	-2.4132
	Prob.	0.7192	0.0549	0.3666	0.7937	0.2159	0.9942	0.3687
Without Constant and Trend	t-Statistic	3.4467	-0.4157	4.2569	-0.5062	-0.6377	0.5985	4.6686
	Prob.	0.9998	0.5287	1	0.4924	0.4363	0.8425	1
At First Difference		D	D	D	d (EU)	d (New Zealand)	d (Türkiye)	d (World)
		(Algeria)	(Australia)	(China)				
With Constant	t-Statistic	-6.4915	-6.4494	-3.9188	-5.5614	-8.7665	-6.1345	-5.4201
	Prob.	0	0	0.0037	0	0	0	0
With Constant and Trend	t-Statistic	-6.6256	-9.6538	-4.3211	-6.3485	-8.7212	-6.4722	-5.8306
	Prob.	0	0	0.0062	0	0	0	0.0001
Without Constant and Trend	t-Statistic	-5.0953	-6.5963	-1.9058	-5.5808	-8.8059	-6.1307	-4.1475
	Prob.	0	0	0.0547	0	0	0	0.0001
UNIT ROOT TEST TABLE (ADF)								
At Level		Algeria	Australia	China	EU	New Zealand	Türkiye	World
With Constant	t-Statistic	1.1682	-4.3675	0.9944	0.0106	-2.0102	-0.3836	1.7663
	Prob.	0.9976	0.001	0.996	0.9551	0.2817	0.9041	0.9996
With Constant and Trend	t-Statistic	-2.2874	-4.9727	-2.6022	-1.5637	-2.7229	-0.0393	-2.3374
	Prob.	0.4327	0.0009	0.2812	0.7937	0.2321	0.9947	0.407
Without Constant and Trend	t-Statistic	4.5232	-0.5011	1.5151	-0.5749	-0.6377	0.6387	5.2122
	Prob.	1	0.4944	0.9664	0.4635	0.4363	0.8511	1
At First Difference		d	d	d	d (EU)	d (New Zealand)	d (Türkiye)	d (World)
		(Algeria)	(Australia)	(China)				
With Constant	t-Statistic	-3.0301	-5.5401	-3.9461	-5.5013	-8.7426	-6.1446	-5.4159
	Prob.	0.0389	0	0.0035	0	0	0	0
With Constant and Trend	t-Statistic	-3.0951	-5.5633	-4.2838	-6.3485	-8.6943	-6.4722	-5.862
	Prob.	0.1187	0.0002	0.0069	0	0	0	0.0001
Without Constant and Trend	t-Statistic	-2.1882	-5.6343	-1.188	-5.5173	-8.7883	-6.1397	-4.1056
	Prob.	0.0289	0	0.2117	0	0	0	0.0001

*: p<0.05; **: p<0.01; ***: p<0.001; ns: Not Significant

Table 2. ARIMA model results for countries

Country	Model		Coefficients	Std. error	t-value	P-value
Algeriawa	ARIMA (1,1,1)	C	6354.684	2309.586	2.751	0.008
		AR (1)	0.769	0.252	3.048	0.003
		MA (1)	-0.605	0.318	-1.900	0.006
Australia	ARIMA (2,1,1)	C	-4313.749	7880.334	-0.547	0.586
		AR (2)	-0.371	0.128	-2.897	0.005
		MA (1)	0.338	0.141	2.385	0.021
China	ARIMA (1,1,2)	C	51202.69	11382.59	4.498	0.000
		AR (1)	0.352	0.135	2.602	0.012
		MA (2)	0.570	0.121	4.709	0.000
New Zealand	ARIMA (2,1,2)	C	-2905.405	5565.174	-0.522	0.604

		AR (2)	-0.853	0.056	-15.229	0.000
		MA (2)	0.970	0.028	33.935	0.000
		C	4113.801	5785.563	0.711	0.480
Türkiye	ARIMA (1,1,1)	AR (1)	-0.870	0.075	-11.534	0.000
		MA (1)	0.948	0.024	39.366	0.000
		C	114678.3	1186.261	0.132	0.895
World	ARIMA (2,1,2)	AR (2)	0.698	0.128	5.433	0.000
		MA (2)	-0.928	0.089	-10.399	0.000
		C	-17338.00	8459.231	-2.049	0.045
EU	ARIMA (1,1,1)	AR (1)	0.947	0.029	31.727	0.000
		MA (1)	-0.977	0.022	-43.999	0.000

Table 3. Forecasted value of sheep meat production amount (tons) of countries between 2023-2030

Year	Algeria	Australia	China	New Zealand	Türkiye	World	EU
2023	350,759.2±19,462.0	674,682.1	2,779,925	437,408.1	499,242.5	10,256,700	494,156.0
2024	353,818.2±29,117.9	663,981.6	2,844,246	432,832.9	498,327.9	10,388,441	480,306.5
2025	359,399.7±37,493.0	658,502.9	2,900,075	430,511.8	506,820.6	10,478,798	466,272.4
2026	365,236.2±45,368.4	656,560.8	2,952,909	429,031.6	507,121.1	10,605,387	452,063.7
2027	371,098.5±53,046.4	652,679.6	3,004,687	425,627.5	514,555.7	10,703,087	437,689.5
2028	376,963.4±60,680.7	674,485.2	3,056,092	421,505.6	515,777.6	10,826,080	423,158.5
2029	382,828.5±68,359.8	643,010.8	3,107,367	419,025.9	522,409.8	10,928,905	408,479.1
2030	388,693.7±76,139.7	639,024.1	3,158,595	417,158.8	524,330.5	11,049,389	393,659.2

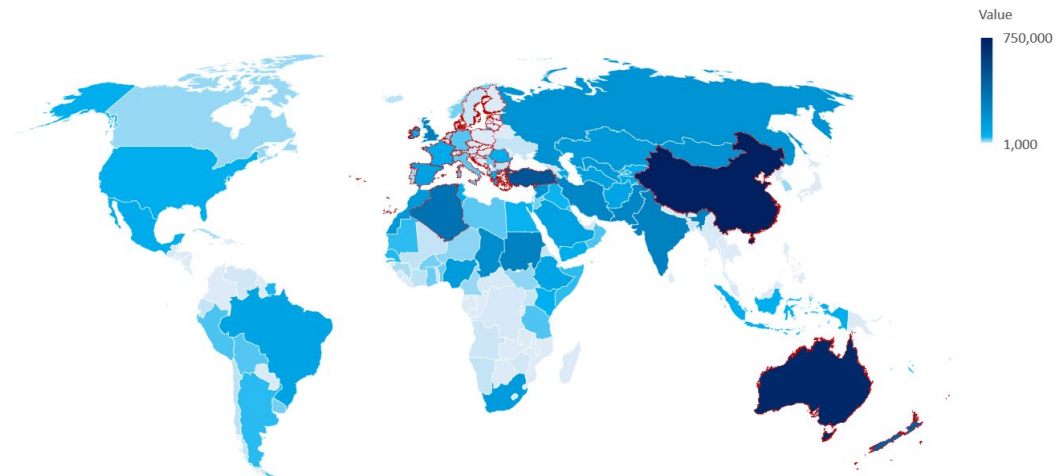


Figure 1. Global sheep meat production (tons) map

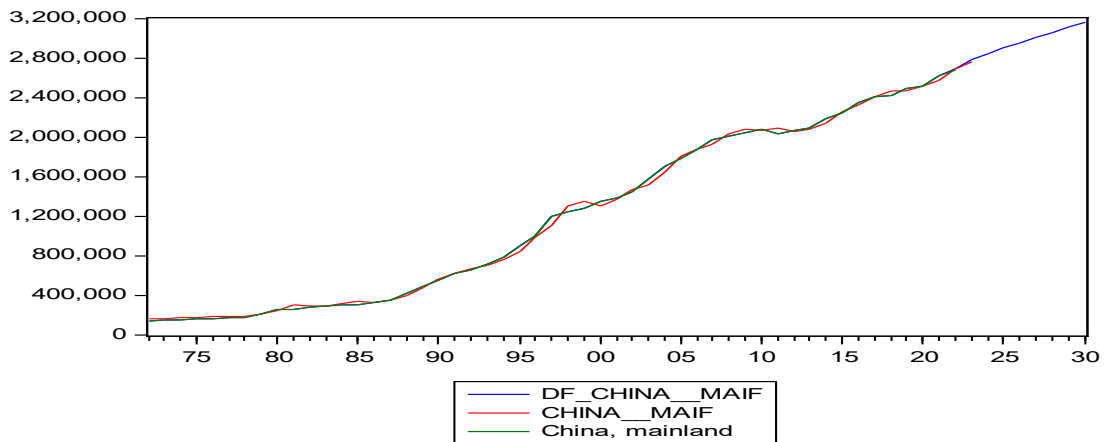


Figure 2. Sheep meat production amount projection (tonnes) graph for countries in China between 1970 and 2030 (China, mainland: Action data; China_MAIF: Static forecast; DF_China_MAIF: Dynamic forecast).

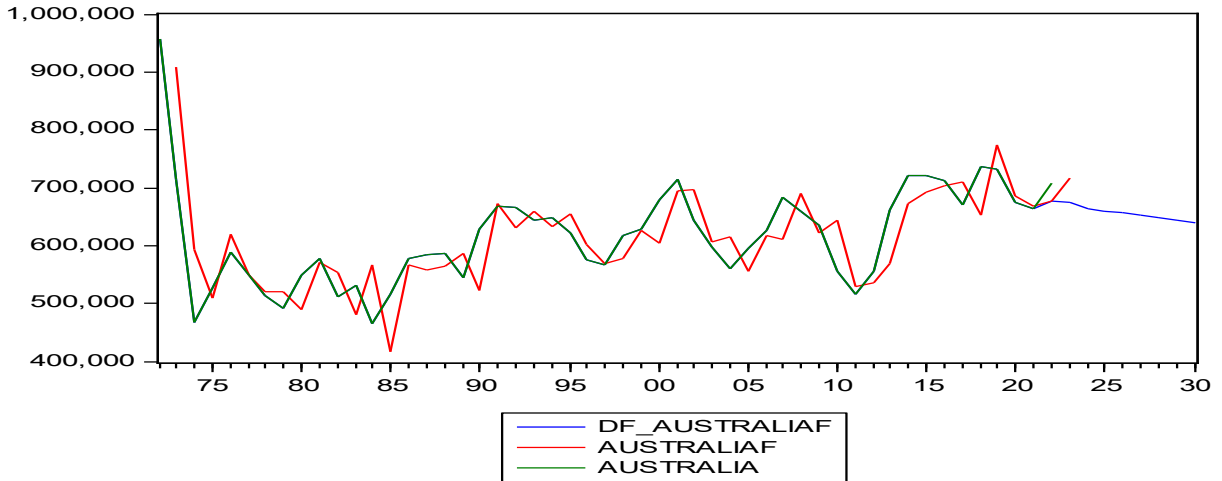


Figure 3. Sheep Meat production amount projection (tonnes) graph for countries in Australia between 1970 and 2030 (Australia: Action data; AustraliaF: Static forecast; DF_AustraliaF: Dynamic forecast).

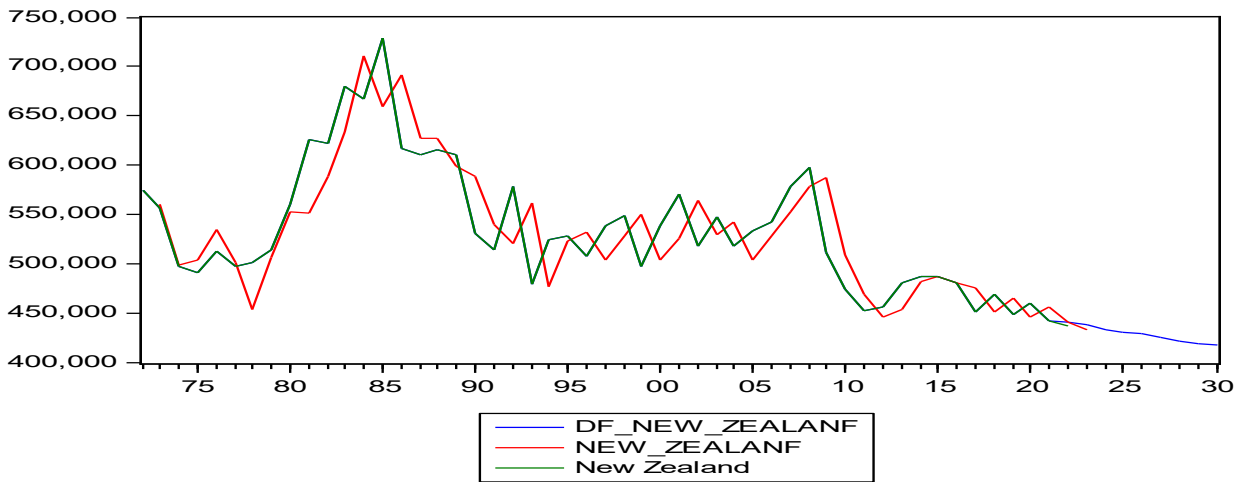


Figure 4. Sheep Meat production amount projection (tonnes) graph for countries in New Zealand between 1970 and 2030 (New Zealand: Action data; New ZealanF: Static forecast; DF_New ZealanF: Dynamic forecast).

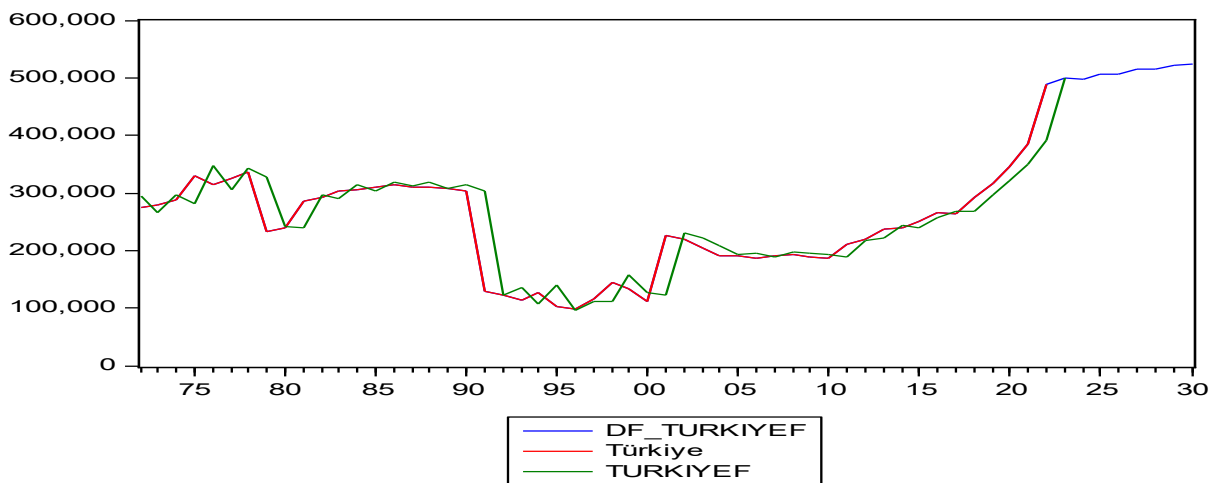


Figure 5. Sheep Meat production amount projection (tonnes) graph for countries in Türkiye between 1970 and 2030 (Türkiye: Action data; TürkiyeF: Static forecast; DF_TürkiyeF: Dynamic forecast).

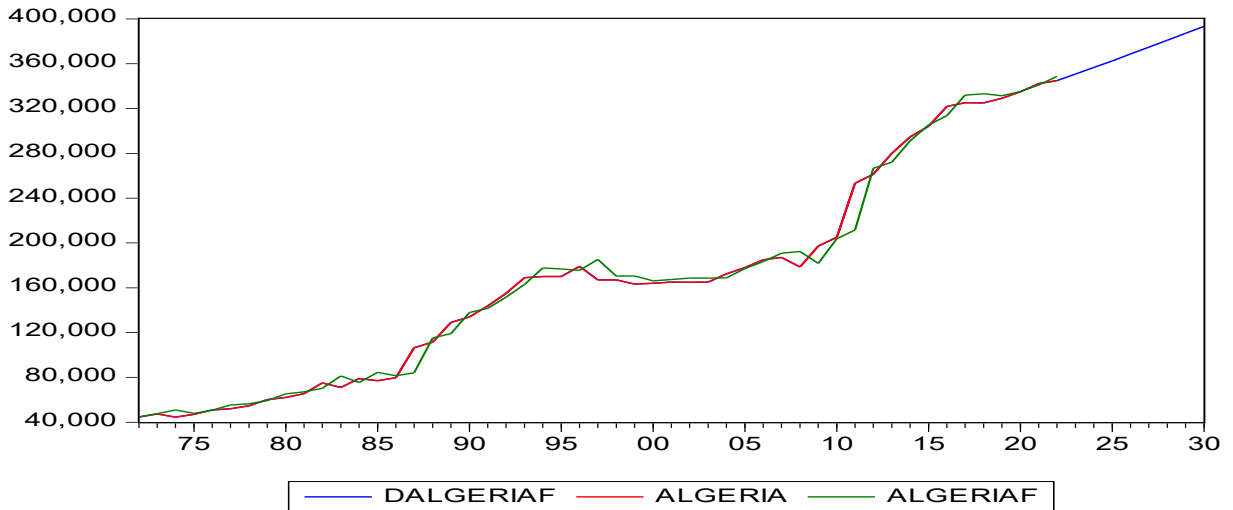


Figure 6. Sheep Meat production amount projection (tonnes) graph for countries in Algeria between 1970 and 2030 (Algeria: Action data; AlgeriaF: Static forecast; DALgeriaF: Dynamic forecast).

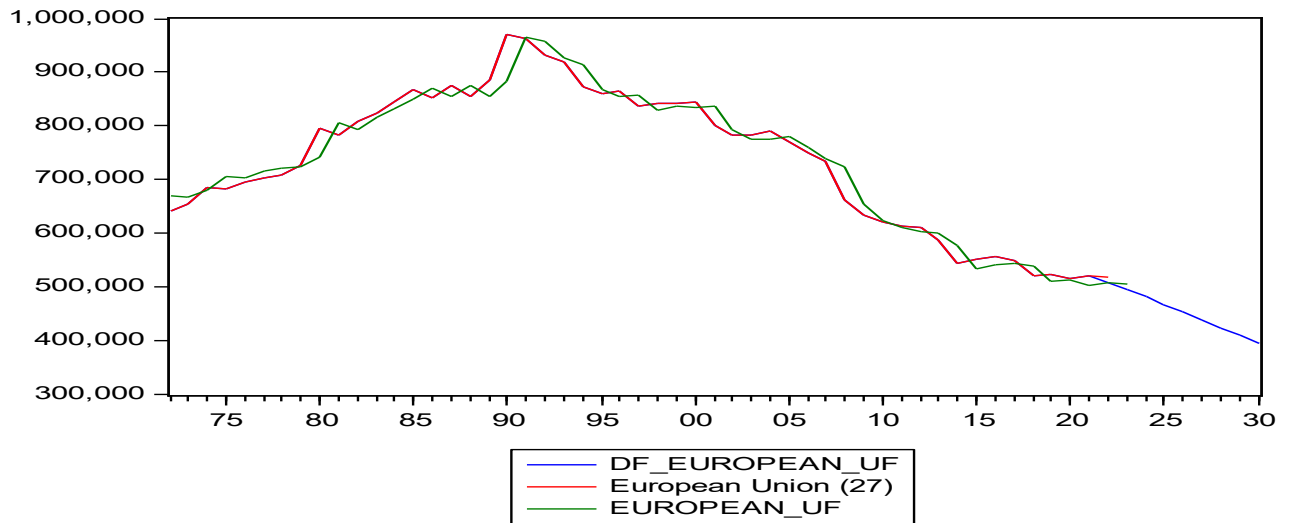


Figure 7. Sheep Meat production amount projection (tonnes) graph for countries in EU between 1970 and 2030 (European Union: Action data; European_UF: Static forecast; DF_European_UF: Dynamic forecast).

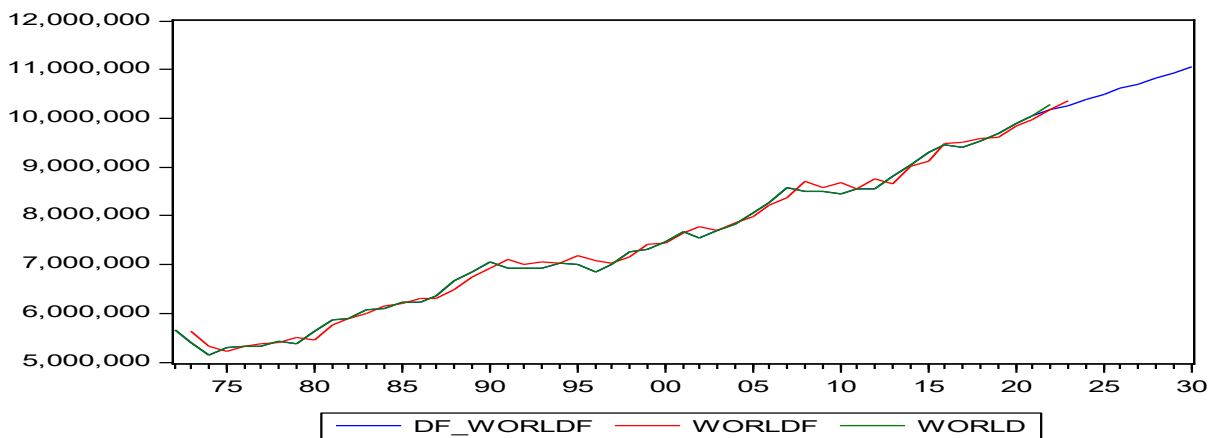


Figure 8. Sheep Meat production amount projection (tonnes) graph for countries in World between 1970 and 2030 (World: Action data; WorldF: Static forecast; DF_WorldF: Dynamic forecast).

DISCUSSION

The progress made by various countries according to a number of criteria that span the period from 1970 to 2030 is illustrated using the graphs in Figure 2-8. These comparisons highlight the disparate growth trajectories of countries, shaped by their specific economic, demographic and sectoral characteristics. While Türkiye and Algeria follow steady and sustainable growth paths, China demonstrates dramatic expansions driven by factors such as industrialisation and urbanisation. These developments reveal broader global trends and the persistence of development inequalities.

Figure 2 shows that China is forecasted a significant growth trend in sheep meat production. This trend is indicative of China's increasing role as a major market, influenced by a rising population, evolving dietary preferences, and economic development. The relatively modest increase from 1970 onwards accelerated significantly in the post-1990 period, with a marked substantial acceleration. This considerable growth had been attributed to the reform and opening-up movements, which have collectively served to enhance China's global economic power (Wang *et al.*, 2024). Recent studies have emphasised the significance of adopting sustainable practices, including the integration of drought-resistant forage crops such as sorghum and millet, which have the potential to reduce feed costs and minimise environmental impacts (Iqbal *et al.* 2015; Chetroui *et al.* 2024). It is therefore vital that strategies are adopted that will ensure the continued availability of forage, as climate change is a significant threat to this resource, and will therefore affect both the productivity and profitability of sheep farming operations. Furthermore, the optimisation of livestock nutrition and management practices is regarded as a crucial strategy for ensuring the resilience and sustainability of sheep meat production (Mazinani and Rude, 2020; Wang *et al.*, 2024).

The current status and future forecast graphs for Australia and New Zealand are given in Figures 3 and 4. In the graph of Australia, a regular and steady upward trend has been observed since 1975, potentially representing the country's sustainable economic or population growth. A similar stable growth trend is observed for New Zealand, albeit on a smaller scale. New Zealand's growth is slower and starts from a lower baseline compared to Australia. The balance of demand from China, a major importer for both Australia and New Zealand, plays a critical role in sheep meat production, depending on export trends. Studies on sheep population trends in these countries highlight their leadership in sheep meat production but also estimate challenges due to declining sheep numbers. Sheep meat exports have increased by 143% since 1990 as the Australian sheep industry has shifted from a primary focus on wool

production to a much more sheep meat export focus. However, the long-term sustainability of this shift remains uncertain due to the potential impact of climate variability, changes in land use, and evolving market conditions. Industry reports emphasize the capacity of Australia to sustain exports through genetic improvements, higher carcass weights and access to high quality markets. The forecasts support the view that targeted policy actions, sustainable pasture management and climate-adaptive livestock practices will be essential to address future production limits. For New Zealand, both ARIMA model and sector assessments indicate a persistent decline in sheep meat production. The primary factors contributing to this trend include competition from dairy farming, expansion of forestry, and sustainability policies such as emissions pricing. A parallel trend in Australia is seen with a significant decline in the national sheep population since the 1980s. Forecasts suggest that despite stable export volumes in recent years, long-term production may continue to decline as land use changes and environmental policies continue to limit flock expansion. (Ferguson *et al.*, 2014; USDA, 2023; Storer *et al.*, 2025).

The forecasted 5% decline in sheep meat production in Australia over the next decade could be affected by a number of external factors, including climate change in the form of ongoing droughts and fluctuations in global demand. Despite its significant role as an exporter, the industry has been affected by competition from emerging producers and climate-related challenges, which have impacted production levels. In order to ensure the long-term viability of the industry, future strategies should focus on enhancing climate resilience, reducing reliance on a narrow range of export markets, and investing in sustainable practices. This will help to mitigate the challenges currently facing the industry and maintain Australia's position as a leading exporter of sheep meat.

The production of sheep meat in New Zealand has experienced a gradual decline as a consequence of changes in land use priorities, including the conversion of pastures to forestry and other agricultural uses. Furthermore, the reliance on exports to major markets, such as China, makes the industry susceptible to market fluctuations. The strengthening of bilateral trade agreements, the widening of export destinations and the encouragement of sustainable farming practices can assist New Zealand in achieving greater stability in its production levels and in maintaining its competitive position in the global market.

Türkiye's current production and future forecast graph is given in Figure 5. In the case of Türkiye, a steady upward trend is observed. However, its growth rate is more modest compared to China. Studies on livestock populations in Türkiye predict a continued upward trend in sheep numbers. Time-series analyses on

red meat consumption also indicate that per capita consumption is expected to rise, reflecting the sustainability of this growth (Özen *et al.*, 2019; Soare *et al.*, 2023).

It is essential to acknowledge the encouraging advancements in sheep meat production in Turkey in recent years, to sustain this growth and focus on economic and production-enhancing policies. It is crucial to enhance animal husbandry, particularly in terms of productivity and quality, and to maintain supportive policies in this regard. The analysis indicates a favorable growth trajectory for Turkey, suggesting potential avenues for producers to extend their market reach and offer sheep meat at more competitive prices. However, this growth could also result in an oversupply in the market, which may lead to a reduction in prices and a subsequent decline in producers' incomes. While Türkiye is a leading producer of sheep meat, its export performance is constrained by high domestic consumption and local market prices that exceed international levels. This encourages producers to prioritize the domestic market.

The current situation and future forecast graph of Algeria is given in Figure 6. The graph for Algeria shows a more limited upward trend, probably reflecting the constraints of its oil and natural resources dependent economy. Benmehaia *et al.* (2023) analyzed the dynamics of red meat demand in Italy, Morocco, Tunisia, Spain, France and Algeria, and according to the obtained data, the red meat demand growth is expected to occur in Algeria. The modest growth in sheep meat production in Algeria is indicative of the country's continued reliance on traditional practices and resource limitations. As demand for red meat increases, there is a clear necessity for investment in modern production techniques and infrastructure. In order to increase production while simultaneously overcoming environmental and economic limitations, it is essential to develop strategies that enhance feed efficiency, improve genetic resources, and facilitate the adoption of sustainable farming systems.

The EU countries current situation and future forecasts are given in Figure 7. The graph shows a decline in the sheep meat production since the 1990s. This trend aligns with the EU's sustainable growth policies, over-saturated economy and demographic structure comprising an aging population. In this regard, the EU has become a net importer of sheep meat, importing considerable quantities. The competitive pricing and supply of imported products exert downward pressure on sheep meat production. Despite the difficulties, the EU countries' policies concerning sustainability and animal welfare offer prospects for reforming the sector towards a higher level of production value. Providing greater support for rural economies and promoting the sale of locally produced lamb could help

maintain production levels while responding to changing consumer preferences.

Finally, the current production of the world and the future forecast graph are given in Figure 8. The world graph shows a global upward trend, potentially representing continuous growth in population, economic production, or energy consumption. Countries with rapid growth, such as China, contribute significantly to this trend, while regions such as the EU countries and New Zealand make more balanced contributions. In general, countries' growth dynamics are shaped by their internal characteristics and their positions in the global context. China's sharp growth and the balanced growth of Türkiye and Algeria show the impact of various economic and political approaches on growth. Countries such as Türkiye and Australia position themselves between these two extremes, following their own paths of sustainable development.

Conclusion: This study presents a comprehensive methodology for the construction of an ARIMA model for the estimation of sheep meat production. The findings of the experimental study conducted with the most effective ARIMA model demonstrated the capability of ARIMA models to provide reliable estimate forecasts of sheep meat production in the forthcoming years. This situation provides an incentive for producers to increase production of animal products.

The development of sheep and goat breeding practices for the Chinese meat industry offers valuable insight for the advancement of the livestock economy in developing countries. In China, the rapid process of urbanisation and the growing demand for animal products have driven significant advancements in breeding practices and production efficiency. Nevertheless, the continued focus on environmental sustainability and resource management is of critical importance for the maintenance of growth. The usage of the ARIMA model, in conjunction with a comprehensive dataset extending over a period of more than five decades, provides a robust framework for the forecasting of trends in sheep meat production. This methodological approach serves to enhance the reliability of the projections and offers valuable insights for researchers.

It is forecast that global sheep meat production will increase, driven by countries such as China and Turkey. This growth highlights the necessity of achieving a balance between increased production and environmental sustainability. Policies that focus on technological advancement, efficient resource utilisation and market diversification will be vital in supporting sustainable growth while reducing regional disparities in production dynamics.

The results also demonstrate the substantial impact of global crises, such as pandemics, on the agricultural sector. Proactive policies for agriculture and

livestock are vital to mitigate production, consumption and trade risks during such events. These policies will play a pivotal role in ensuring the stability and resilience of the sector.

Conflicts of Interest. The authors declare no conflicts of interest.

Author contribution. FNO: Conceptualization, Formal analysis, Investigation, Methodology, Software, Visualization, Writing – original draft. UD: Conceptualization, Investigation, Validation, Visualization, Writing – original draft, and editing. DT: Conceptualization, Data curation, Investigation, Validation, Writing – original draft, and editing.

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