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Eggplant Production and Trade: Global Patterns and U.S. Market Trends and Forecasting

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ABSTRACT

Eggplant is a major vegetable crop in Asia and the Mediterranean and has experienced steady global expansion over the past decade. This study uses FAOSTAT and USDA data (2013-2023) to examine production dynamics, trade flows, and market trends in the U.S., and to forecast eggplant production through 2031. Global eggplant cultivation reached approximately 1.9 million hectares with 61 million tons of production in the year 2023, reflecting a 29% increase compared to 2013. China and India remained dominant producers, together accounting for more than 85% of global supply. Findings revealed that countries with limited domestic production capacity, including Iraq, the U.S., France, and Germany, were leading importers. In the U.S., production remained stable at an average of 98.7 thousand tons annually, with most of it concentrated in California, Georgia, New Jersey, and Florida. However, declining acreage and rising imports highlight increasing dependence on foreign supply, driven by labor constraints and competitive pressures from lower-cost producers. Trade analysis shows persistent deficits, with imports consistently exceeding exports despite modest growth in domestic production. Trend-based forecasting of U.S. eggplant production using linear, quadratic, and exponential models shows that the quadratic model provides the best fit, with the lowest Mean Absolute Deviation (1,273.70), Mean Squared Deviation (2,171,575.20), and Mean Absolute Percentage Error (1.29%). Based on this model, U.S. eggplant production is projected to decline by approximately 7.1% from 99,682.44 tons in 2025 to 92,625.52 tons by 2031. This study helps define the economic dimensions of eggplant cultivation and underscores the importance of labor-saving technologies, protected cultivation, and policy interventions to sustain production and enhance competitiveness in domestic and international markets

INTRODUCTION

Eggplant (Solanum melongena L.) is the third most important vegetable crop in Asia (Ghosh, 2022; Rakha *et al.*, 2021) and has significant value in global food markets. It is widely consumed across Asia and the Mediterranean region, where it supports agricultural revenue and local supply chains (Alam & Salimullah, 2021). The crop originated in the Indo-Chinese region and broader Asia, indicating a strong production foundation and genetic diversity in Asia (Sękara *et al.*, 2007; Kumar *et al.*, 2020). Globally, eggplant cultivation occupies around 1.9 million hectares, yielding nearly 61 million tons in 2023 (FAOSTAT, 2023). Although eggplant is a minor specialty crop in the U.S., it remains important in regional fresh markets and in meeting consumer demand. Recent census data shows that production is concentrated in a limited number of states, primarily California, Georgia, New Jersey, and Florida (USDA-NASS, 2023). Market performance depends on marketable production and cultivar selection, which directly influences net returns. Several specialty cultivars show better marketable yields and greater economic potential in the U.S. (Keinath, 2024). Additionally, variability among cultivars can lead to substantial yield differences, creating revenue instability and risk exposure for producers (Sideman *et al.*, 2024). Production outcomes are also influenced by post-harvest handling and quality management, as inadequate storage and handling systems significantly reduce product quality and marketable supply (Dhami *et al.*, 2023). Production might be affected by technology, quality management, and biological risks. Protected cultivation and improved management can increase yield and quality. However, they often require greater investment and operational expenses (Caruso *et al.*, 2017). Therefore, access to financial resources is critical, as it enables farmers to invest in productivity-enhancing inputs and technologies. Input decisions are influenced by pest and disease challenges, as fruit defects and damage reduce quality and price, thereby decreasing farm profitability (Kaniyassery *et al.*, 2022). Beyond agronomic considerations, pesticide use also introduces environmental, health, and socio-economic trade-offs that influence production decisions and long-term sustainability (Thapa *et al.*, 2024). Similarly, innovations such as improved cultivars and greenhouse fertigation techniques may enhance production and resource efficiency, both of which are essential for cost management and competitive advantage (Prodhan *et al.*, 2018; Islam *et al.*, 2023). Given the cost–return trade-offs

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and market pressures, production forecasting is essential for planning and policy, especially for determining future supply stability and market dependence (Li *et al.*, 2011).

Eggplant markets exhibit a widening gap between domestic production and consumer demand (USDA, 2023). In the U.S., domestic eggplant production has remained relatively stable, while rising consumption has increasingly been met through higher imports (USDA, 2023). This situation impacts the trade balance and reduces self-sufficiency. This also raises concerns about the supply chain's resilience for a labor-intensive specialty crop that competes with countries offering lower production costs (Simnitt & Martin, 2022). As a result, analyzing long-term production trends alongside trade dynamics is essential for understanding market dependence, guiding investment decisions, and formulating policies that improve domestic performance.

This research aims to analyze eggplant production trends, trade dynamics, and forecasting. The study examines patterns in global and U.S. eggplant production, identifies principal producing and importing countries, and measures U.S. self-sufficiency using standard trade measures. The research uses different trend-based forecasting models (linear, quadratic, and exponential) on U.S. eggplant production data and evaluates their effectiveness using accuracy measures. This technique provides data on the sustainability of domestic production, future forecasts, and implications for import dependence and market planning for the specialty crop sector in the U.S.

LITERATURE REVIEW

Nutritional and Health Benefits of Eggplants

Eggplants are low-calorie vegetables with significant phenolic contents, making them one of the healthiest food items (Caguiat & Hautea, 2014). Eggplants contain various vitamins, minerals, iron, calcium, antioxidants, and some phytochemicals having scavenging properties (Noda *et al.*, 2000; Whitaker & Stommel, 2003).

They are characterized by minimal fat content, and moderate levels of carbohydrate and protein. They also provide a relatively high amount of dietary fiber. In addition, they also provide essential minerals such as potassium and manganese, as well as small but significant amounts of antioxidant vitamins, including C, B complex, and K. Combined, these attributes contribute both nutritional value and health benefits within a balanced diet (Naeem & Ugur, 2019).

Factors affecting the trade of eggplants

Being eggplant is a highly perishable produce, management of post-harvest activities is crucial to ensure trader profitability. With an improved postharvest management, a trader selling one ton of eggplants can generate $207 in additional gross revenue per week (Rahman *et al.*, 2019). The insect-resistant varieties of brinjal generated through genetic engineering- Bt brinjal- producers' remarks were compared with those of non-Bt brinjal producers in Bangladesh in terms of marketing value generated. The findings indicate that Bt Brinjal generated 19.6% increase in yield and 21.7% higher revenue as compared to non-Bt varieties. Nonetheless, some consumers are willing to pay premium prices for Bt brinjal due to its reduced damage levels and improved marketability (Shelton *et al.*, 2020)

Similarly, fruit shapes, color, skin texture, and appearance affect the trade of eggplants. According to the USDA, there are 3 special grades and standards for egg plants - U.S. fancy, U.S. No.1, and U.S. No.2.

Table 1: Grades and standards of eggplants in the U.S.

Grade	Color	Shape	Firmness	Free From	Remarks
U.S. Fancy	Well colored	Well-shaped	Firm	Decay, worm holes, scars, freezing, disease, insects, or mechanical injury	Highest quality
U.S. No. 1	Fairly well colored	Fairly well shaped	Firm	Decay, worm holes, damage from scars, freezing, disease, insects, or mechanical injury	Good quality
U.S. No. 2	-	-	Firm	Decay, serious damage from freezing, disease, insects, or mechanical injury	Acceptable quality

Source: USDA AMS, (2025)

Factors that favor the high production of Eggplant

Favorable environmental conditions for optimal eggplant production include an annual temperature of 20-27 oC, annual rainfall of 1000-1500mm, an altitude of 0-1600 m above sea level, and soil pH of 5.5- 6.6, and high carbon content (Abrham and Shumbulo, 2024). Duri *et al.* (2025) found that with the combination of organic amendments and bio-stimulants, the production of eggplant has more potential to increase economic yield in comparison to mineral fertilizers because of improvement in fruit quality and high early production. The organic amendments used were compost and a solid digestate from livestock waste, while the sources of bio stimulants used were tropical plant fermentation and the fungal biocontrol agent, Trichoderma afroharzianum T-22. The application of vermicompost and biochar improves water use efficiency, growth and overall yield, especially during water deficit conditions (Ebrahimi *et al.*, 2021). Greenhouses, high tunnels, and shade nets help increase yield by protecting crops against environmental stress and extending the

the growing season compared to open-field production (Sideman *et al.*, 2024; Nguyen *et al.*, 2022).

The most important phase of eggplant production is the seedling stage, whose vigor and quality are basic criteria for successful fruit production (Caruso *et al.*, 2017) Eggplant production can be hindered due to biotic factors such as insects' and pests' infestation (Alam & Salimullah, 2021), with some major pests in solanaceous crops capable of causing severe yield losses and requiring integrated management strategies (Pandey *et al.*, 2023).. The eggplant fruit and shoot borer (EFSB), Leucinodes orbonalis, has been the most dangerous insect causing up to 90% yield loss (Haq & Rhizvi, 2023). Rajasekhar *et al.* (2024) found that Spinosad 45 C, an insecticide, was evaluated to be the most suitable pesticides for minimizing EFSB infestations by 8-9%, with a cost benefit ratio of 1:13.5. Similarly, pathogens such as Fusarium, Verticillium, Rhizoctonia, and Phytophthora cause wilting characterized by chlorosis of leaves, culminating in plant mortality (Pant *et al.*, 2024).

Relation of Consumer Preference with Production and Trade Potential of Eggplants

Seedless fruits are generally preferred by consumers, the presence of seeds in eggplants reduces their palatability and consumer acceptance (Alam & Salimullah, 2021). In addition, Seeds in eggplants can contribute towards browning of the flesh and cause bitterness (Du *et al.*, 2016). Eggplants also contain compounds like steroidal glycoalkaloids and saponins, which cause the bitter taste of the flesh (Toppino *et al.*, 2016), which reduces consumer preference for eggplants. Parthenocarpy is the method of making fruit seedless. It is introduced into eggplants through the application of plant growth promoters like auxin and genetically through manipulating the expression of SmARF8 (Du *et al.*, 2016), therefore enhancing consumer acceptability and increasing demand. Similarly, the widespread use of pesticides by exporting countries affects export opportunities and consumer preferences. Consumers prefer organic certified vegetables over inorganic produce; however, organic options are more expensive than inorganic ones (Dharmarathne *et al.*, 2025), which affects the trade.

Applications for Trend Models in Forecasting Agricultural Commodity Production

For time-series data, forecasting models such as the linear, the Quadratic, and the exponential growth model are commonly used (Habib *et al.*, 2013). A linear model estimates a constant change in a variable over time, which identifies whether production increases or decreases at a steady rate (Gujarati &and Porter, 2009). Quadratic trend model captures a non-linear trend when the patterns accelerate or decelerate (Montgomery *et al.*, 2015). Similarly, Exponential growth model determines the percentage-based growth, when the variables increase at a constant proportional rate.

To evaluate the accuracy measurement of these models, Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD), and Mean Squared Deviation (MSD) are used (Abbasi *et al.*, 2013).

The features of these evaluation metrics are:

i. Mean Absolute Percentage Error (MAPE): It measures the accuracy in percentage for the modeled time series values.

ii. Mean Absolute Deviation (MAD): It quantifies accuracy in the original units of the data sets, providing a clear interpretation of the magnitude of error.

iii. Mean Squared Deviation (MSD): MSD is computed using a consistent denominator across each model and is more responsive to extreme forecast errors.

Models that yield lower values of these measures are considered more reliable and better fitted for forecasting production and prices (Abbasi *et al.*, 2013; Abid *et al.*, 2018).

Table 2: Adoption of trend analysis and forecasting globally

Commodity	Region	References
Sorghum	Pakistan	*Habib et al., (2013)*
Maize	Pakistan	*Abid et al., (2014)*
Citrus	Pakistan	*Tahir, (2014)*
Wheat and Rice	Pakistan	*Abbasi et al., (2015)*
Potato	Pakistan	*Abid et al., (2018)*
Rice	India	*Singh and Singh, (2021)*
Plantation crop	Indonesia	*Nurfadila et al., (2022)*
Tomato	U.S.A.	*Sanwa et al., (2026)*

MATERIALS AND METHODS

Data Collection, Analysis, and Presentation

This research draws upon secondary time-series data on global and U.S. eggplant production for the period 2013–2023. The data were obtained from the Food and Agriculture Organization of the United Nations (FAOSTAT, 2025) and the United States Department of Agriculture (USDA). Global production statistics from FAOSTAT were employed to identify the five leading eggplant-producing countries between 2018 and 2023 and to examine long-term U.S. production trends. U.S. specific information on production and trade from USDA reports was analyzed to evaluate national production dynamics and trade performance, with particular emphasis on import and export flows.

Self-Sufficiency Ratio (SSR)

The self-sufficiency ratio (SSR) quantifies the proportion of national production relative to overall domestic consumption (FAO, 2001).

$$SSR = \frac{Production}{Production + Import - Export} * 100$$

Balance of Trade (BoT)

BoT = Exports– Imports

•If BoT < 0, the country has a trade deficit

•If BoT>0, the country has a trade surplus (Nuraini, 2019).

All data were organized and processed using Microsoft Excel, and were visualized using bar graphs and line charts.

Selection of Forecasting Models and Model Evaluation Metrics for U.S. Eggplant Production

For the forecasting, three different models were employed: Linear trend model, Quadratic trend model, and exponential growth model to determine the best fitted model in terms of production in the U.S. (Singh and Singh, 2021; Abid et al., 2018; Hossain. 2021).

The forecasting models under evaluation are as follows:

1. Linear Trend Model: Y = b0 + b1t …….…............(i)
2. Quadratic Trend Model: Y= b0+ b1 t + b2 t2 .... (ii)
3. Exponential Growth Model: Y=b0 ebt ………....(iii)

where,

Y = Production of eggplants in the US at time t (2013-2023)

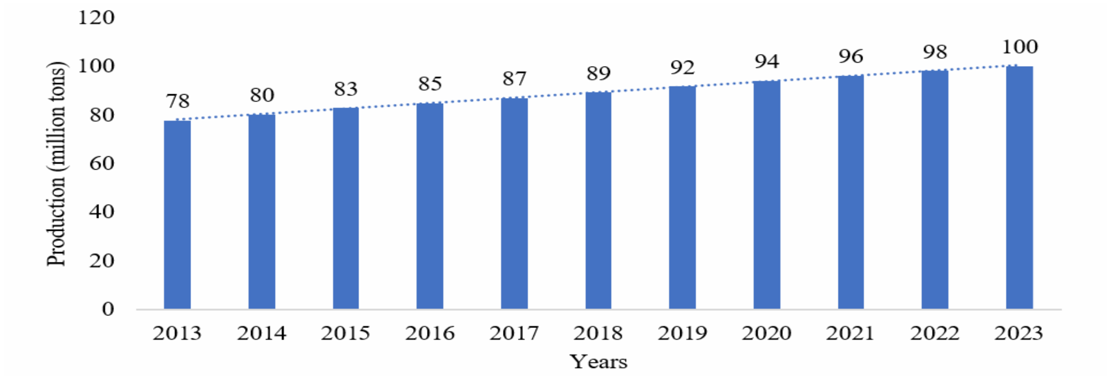

Figure 1: Global production of eggplants (2013-2023)

t = time trend value, which reflects the increase or decrease of value over time parameters

b0 and b1 = coefficients of the model

To determine the reliability of the forecasting model, Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD), and Mean Squared Deviation (MSD) were evaluated, and the value with the minimum error was chosen as the best model to run the forecasting (Abbasi et al., 2015; Abid et al., 2018; Habib et al., 2013).

RESULTS AND DISCUSSIONS

Global eggplant production trend

Production of eggplants rose from approximately 78 million tons in 2013 to 100 million tons in 2023, a 28.2% increase over the period of 10 years (Figure 1). Furthermore, the data were found to be consistently increasing each year, averaging 2.2 million tons per year, while the average production over 2013-2023 was 89.3 million tons. This upward trend is due to the increasing consumer demand, improvement in genetic resources, improved water and soil management, adoption of greenhouse technologies, and the expansion of eggplant plantations to several regions in Asia, Africa, and Europe (Gramazio et al., 2023; Rasouli et al., 2023; Sanyang et al., 2025). However, the growth rate declined gradually from 3.75% in 2015 to 2.04% in 2023, indicating a stabilized market over time.

Country-wise contribution to global eggplant production

The graph indicates that China is the leading eggplant-producing country, followed by India, Egypt, Turkey,

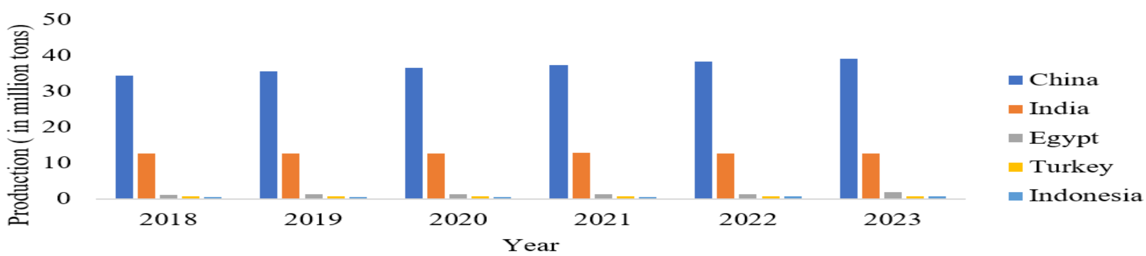

Figure 2: Eggplant production by country (2018-2023)

and Indonesia (Figure 2). In 2023, China accounted for approximately 65.65% of global eggplant production, clearly demonstrating its dominance in the sector. This is largely attributed to extensive cultivation areas, technological advancements, and effective soil fertility management, all of which have substantially enhanced eggplant productivity in the country (Zhang et al., 2022; Wang et al., 2024; Ghani et al., 2023).

In Asia, eggplant production is significantly higher due to the combination of favorable climatic conditions, cultural and dietary importance, and rich genetic resources. Eggplants thrive better in warm climates, which are common in Asia, making the region more favorable for large-scale production (Agustin and Tabaquero, 2024). Furthermore, eggplant is an economically important part of the diet in Asian regions such as China and India (Meyer et al., 2012). Additionally, South Asia and East Asia are the primary domestication centers of eggplant, which has made the region rich in genetic diversity and supported productivity and adaptation (Barchi et al., 2022).

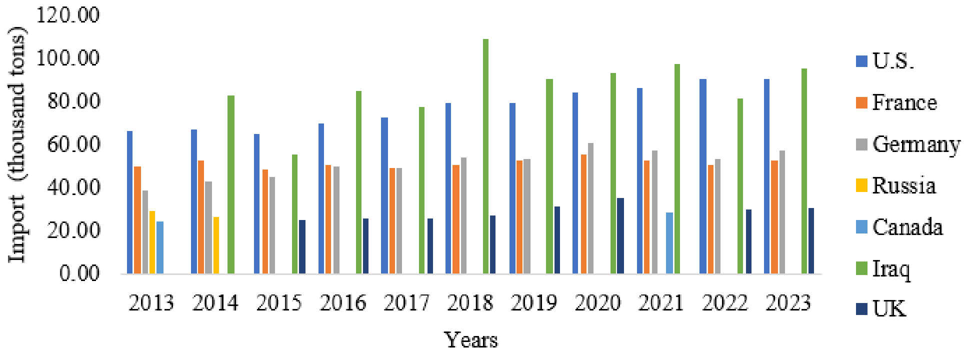

Figure 3: Top eggplant-importing countries in the world (2013-2023)

Top-importing countries in the world

The chart reveals that Iraq was the largest importer of eggplant in most years between 2013 and 2023, while U.S. imports were consistently high but lower than Iraq's, ranging between 70,000 and 90,000 tons (Figure 3). In European countries such as France and Germany, import levels were moderate but stable, contributing 40,000-60,000 tons. Iraq's strong reliance on imports is largely attributable to limited domestic vegetable production infrastructure, agro-ecological conditions, and post-conflict food security strategies.

In the U.S., agricultural imports grew significantly at a compound annual growth rate of 3.8% between 2007–09 and 2019–21, and 40% of the fresh vegetables consumed are imported (Khanal et al., 2024). This has contributed to a steady increase in eggplant import values in the U.S. Additionally, eggplants are a part of Mediterranean cuisine, and have significant antioxidant and nutritional properties. These factors have increased consumer demand and thus the imports of eggplants in European countries such as Germany and France (Caruso et al., 2017; Sharma and Kaushik, 2021)

Eggplant production trend in the U.S.

Figure 4 represents annual eggplant production in the U.S. from 2013 to 2023. Peak production, approximately

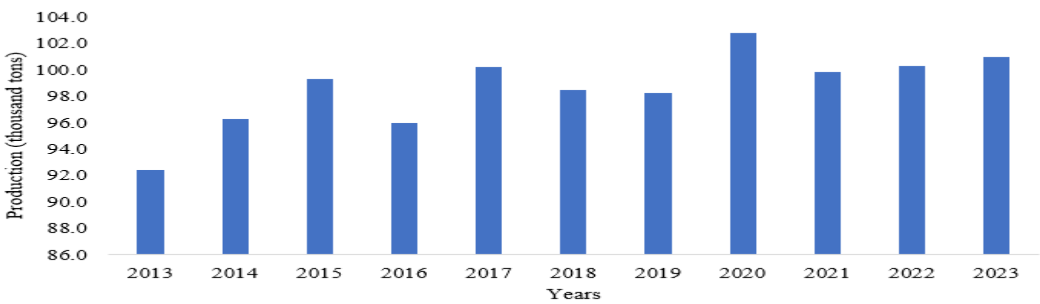

Figure 4: Production trend of eggplants in the U.S. (2013-2023)

102 thousand tons, was observed in 2020, which then declined to 99.8 thousand tons in 2018. Production increased slightly during the period between 2021 and 2023, reaching 101 thousand tons in 2023. Maximum yield and fruit set of eggplants can be obtained at 25-30 oC. Since eggplant yield is highly sensitive to heat stress, especially during flowering and fruit set, seasons with relatively moderate temperatures and fewer prolonged hot spells can support higher production than seasons dominated by extreme or sustained heat (Hannachi et al., 2022; Lin et al., 2022).

Trade relationship of eggplants in the U.S.

Figure 5 illustrates trends in eggplant production, import,

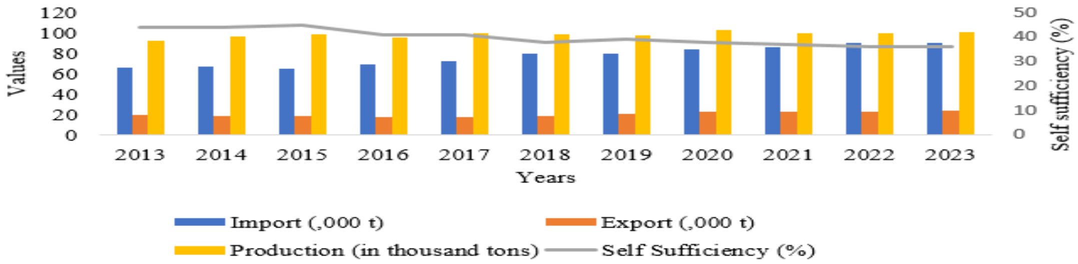

Figure 5: Production, Import, Export, and Self-sufficiency in the U.S. (2013-2023)

export, and self-sufficiency in the U.S. from 2013 to 2023. Domestic production continued to fluctuate throughout the decade, with an average of 98.6 thousand tons. However, production consistently exceeded imports. Compared with production and imports, exports remain low, but have increased steadily since 2016, reaching 24.09 thousand tons in 2023. Meanwhile, the self-sufficiency ratio shows a steady decline over the period, indicating that the U.S. is increasingly reliant on imported eggplants in order to meet the domestic demand.

U.S. eggplant production is highly labor-intensive and is burdened by comparatively higher wage rates than those in other producing countries, which reduce production and increase imports of specialty crops such as eggplants (Win et al., 2025). According to Wu et al (2018), Central Mexico's strawberry labor costs were around 120% less than Florida's in 2014/2015. Furthermore, countries such as the Netherlands, Spain, and Mexico dominate vegetable exports due to lower production costs and established global supply chains (Gibba, 2017).

Figure 6 shows U.S. eggplant import, export, and trade deficit trends from 2013 to 2023. The imports are increasing steadily, and exports and the trade deficit persisted throughout the period. Eggplant production is labor-intensive and requires large manpower for harvesting, sorting, and grading purposes. The US has higher labor costs than Mexico and other exporting countries, so it imports a large proportion of eggplants (Calvin, 2022). Furthermore, eggplant production is seasonal and more concentrated in Florida, California, and Georgia, however consumer demand is year-round and therefore must be met through imports. Additionally, due to the close proximity of exporting countries like Mexico and favorable climatic conditions for eggplant production, marketing costs are lower, which helps keep prices low (Huang, 2004).

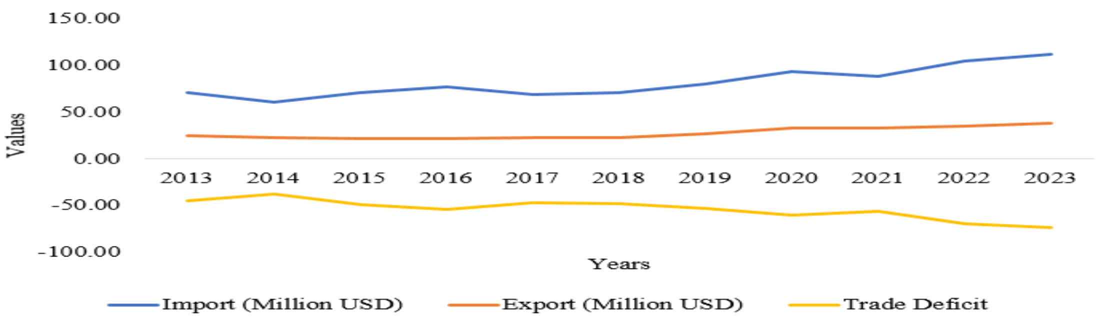

Figure 6: Import value, export value, and trade deficit of eggplants in the U.S.

State-wise acreage in the U.S.

Figure 7 shows the highest eggplant-cultivating states in

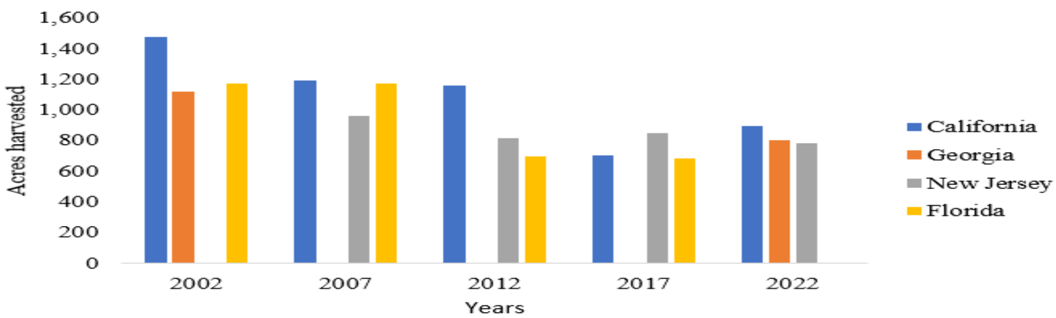

Figure 7: State-wise eggplant production acreage

the U.S. in the last two decades, between 2002 and 2022. California was found to be the leading state, followed by Georgia and Florida in terms of eggplant production in 2002. Though Georgia was the second largest eggplant producing state in 2002, the total harvested area declined over the following two decades before returning to second place in 2022. In contrast, Florida did not maintain its position as the third leading state in the same year. Eggplant is a warm season crop that requires a hot, dry summer with temperatures between 65°F and 85°F, therefore the production is highest in states California, Georgia, and Florida, where the climatic conditions are optimal (Li et al., 2021; Gazula, 2025; Davis, 2026).

On the other hand, the overall production has been decreasing in the U.S. This decline in acreage across key states is due to labor constraints and import pressure mainly faced by Florida, Georgia, and California, due to the cheap labor market and an efficient marketing system in Mexico (Win et al., 2025; Huang et al., 2022).

Model selection for eggplant production using forecast evaluation metrics

Table 3: Comparison of trend models for forecast accuracy measures

Model trend	MAD	MSD	MAPE (%)	R^2	Adjusted R^2
Linear	1,349.53	3,113,942.59	1.37	0.56	0.51
Quadratic	1,273.70	2,171,575.20	1.29	0.69	0.62
Exponential	1,363.71	3,150,006.74	1.38	0.56	0.51

Note: MAD = Mean Absolute Deviation; MSD = Mean Squared Deviation; MAPE = Mean Absolute Percentage Error. Lower values indicate superior forecast performance.

U.S. eggplant production from 2013 to 2024 was analyzed using three trend models: linear, quadratic, and exponential (Table 3). The accuracy of the forecasts was evaluated using commonly employed metrics: MAD (Mean Absolute Deviation), MSD (Mean Squared Deviation), and MAPE (Mean Absolute Percentage Error). This approach was used to identify the model that best captures historical production patterns and provides the most reliable basis for forecasting future production.

The linear trend model shows relatively higher error metrics (MAD = 1,359.53; MSD=3,113,942.59, MAPE = 1.37%) and R^2 = 0.56, indicating that it explains 56% of the variation in the data. Similarly, the exponential model showed slightly higher forecast errors (MAD = 1,363.71; MSD = 3,150,006.74; MAPE = 1.38%) and R^2 = 0.56, indicating that the model explains 56% of the variation in the data. The results show that the linear and exponential models did not adequately capture the actual pattern, and the data likely follow a more complex, nonlinear trend. Among the trend models studied, the quadratic trend had the lowest MAD, MSD, and MAPE values. The MAD was 1,273.70, compared with 1,349.53 for the linear model and 1,363.71 for the exponential model. Similarly, the quadratic model had the lowest MSD = 2,171,575.20 and MAPE = 1.29%. Likewise, the quadratic model had higher explanatory power with an R^2 value of 0.69, indicating that it explains about 69% of the variation in the data. The adjusted R^2 remains relatively high at 0.62, indicating that improved fit reflects a meaningful nonlinear pattern rather than model overfitting. The better performance of the quadratic model suggests that eggplant production shows a nonlinear trend over time. Growth initially increased but subsequently declined in subsequent years. This pattern cannot be sufficiently represented by a constant linear trend or by exponential expansion. Thus, based on the forecasting error metrics and model fit values, the quadratic trend model was chosen as the best fit model for producing final forecasts.

Table 4: Forecasted Eggplant production (2025-2031) using the quadratic trend model

Year	Forecast	Lower CI	Upper CI
2025	99,682.44	95,704.07	103,660.80
2026	98,966.52	93,592.22	104,340.80
2027	98,066.51	91,057.03	105,076.00
2028	96,982.40	88,110.66	105,854.20
2029	95,714.20	84,759.46	106,669.00
2030	94,261.91	81,006.98	107,516.80
2031	92,625.52	76,855.35	108,395.70

Note-CI: Confidence Interval

Quadratic Forecasting Model

The estimated equation for eggplant production is

Yt = 92,236.66 + 1,769.38t – 92.05t2

The linear time coefficient is positive, showing an initial rise in eggplant production, while the negative squared time indicates a gradual decrease in production over time.

Forecasted Eggplant Production Using the Quadratic Model

The quadratic trend model was used to forecast future eggplant production. This model was chosen because it had the lowest forecast error of MAD, MSD, and MAPE. Based on this model, point forecasts and 95 percent prediction intervals have been calculated for the period of 2024–2031 (Table 4).

The forecasts predict a gradual decrease in eggplant production after 2025. This pattern agrees with the negative squared time coefficient derived from the quadratic model. Therefore, production growth appears to decline over time.

Although point projections continuously decline, the prediction intervals widen in subsequent years. This indicates increasing uncertainty in long-term forecasts. Thus, the findings indicate that eggplant production is expected to stay at lower levels rather than continue to grow.

Figure 8 presents the observed eggplant production in the U.S. and forecasted production through 2031. The black line represents actual production, which fluctuated moderately but stayed within the range of 92,000 and 101,000 tons. Production peaked around 2020 and remained relatively stable, with only small year-to-year fluctuations, until 2024. The blue line shows the forecasted values from 2025 to 2031. It indicates a clear downward trend after 2024. This pattern supports the quadratic model and the validity of a nonlinear production trend over time.

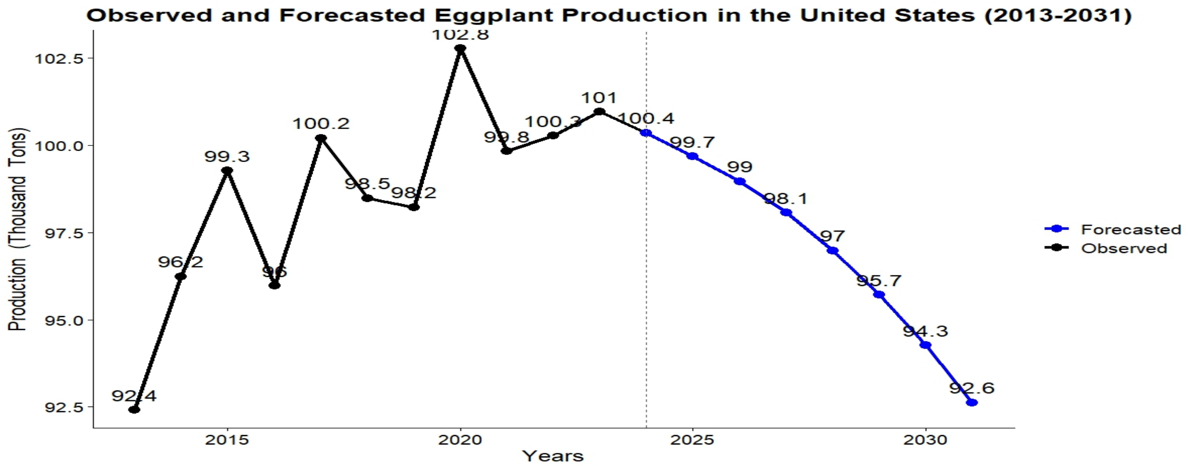

Figure 8: Observed and Forecasted Eggplant Production in the U.S. (2013-2031)

CONCLUSIONS

Global eggplant production increased between 2013 and 2023, with growth mainly concentrated in Asia, Africa, and Europe. This growth was driven by rising consumer demand, improved cultivars, and the wider adoption of protected and advanced production systems. China and India continue to dominate global production, with China alone supplying nearly two-thirds of total output. Favorable climatic conditions, strong cultural preferences, and rich genetic diversity help sustain Asia's leading role in eggplant cultivation. In contrast, countries that cannot meet domestic demand rely heavily on imports. Iraq remains the largest importer, while the U.S. consistently imports large quantities each year, reflecting structural constraints such as high labor costs that limit the competitiveness of domestic production.

Based on the evaluation metrics, the quadratic model was the best fit, indicating that production does not follow a simple linear or exponential pattern. According to this model, production is expected to continue to decline, from 99,682.44 tons in 2025 to 92,625.52 tons by 2031. These findings highlight ongoing challenges for domestic growers and suggest that improving self-sufficiency will require strategic efforts, including labor-saving technologies, protected cultivation systems, and competitive pricing structures. We used only ten years of production data and relied on a quadratic trend model; therefore, the forecasts should be viewed as an initial indication of future patterns, rather than exact predictions of production in future years. Using a longer time series of production data or more flexible forecasting methods could provide a clearer and more realistic view of future production. Models such as ARIMA, exponential smoothing, or advanced machine-learning methods achieve higher accuracy by detecting complex and nonlinear patterns in agricultural data.

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