Forecasting Growth and Exploring Trends in China's Pet Food Industry: A Multidimensional Analysis

Jia Luo *

School of Foreign Languages, Huazhong University of Science and Technology, Wuhan, China, 430074

* Corresponding Author Email: u202317016@hust.edu.cn

Abstract. In recent years, under the context of improvement together with aging population, Chinas pet food industry has made rapid development in the field of production and export, and faces the challenges brought by the economic policy changes in European and American countries. In order to study the sustainable development path of China's pet food industry, this paper analyzes the industrial development trend, market demand and the influence of international economic policy based on actual data and mathematical modeling methods. For different problems, we establish exponential smoothing, multivariate regression, ARIMA models and PEST analysis to explore market trends and drivers. It bridges research gaps by analyzing key factors and forecasting growth, offering actionable insights for strategic planning and sustainable industry development.

Keywords: Aging Societies, Prediction Model, Pet Industry.

1. Introduction

In the context of economic globalization and information technology, the pet industry, as one of the emerging industries, is gradually showing a strong momentum of development in the world. With the rapid development of economy and the steady increase of per capita income, people's lifestyle and consumption concept are undergoing profound changes [1]. This change is not only reflected in the pursuit of material life, but also reflected in the importance of spiritual life and emotional sustenance. Additionally, some pets like dogs can perform vital functions as guiding the vision-impaired in their daily life while comforting the overstressed employees [2-4]. Under such a social and cultural background, the pet industry has quickly won the favor of consumers with its unique emotional value and life companionship function.

The development of Chinas pet industry dates back to the early 1990s. In 1992, the establishment of the China Small Animal Protection Association marked the beginning of the Chinese pet industry on the right track. Then, in 1993, the international famous pet brands entered the Chinese market, laying a foundation for the internationalization and brand development of Chinas pet industry. The entry of these international brands has not only brought advanced pet products and service concepts, but also promoted the diversification and competitiveness of Chinas pet market. In recent years, with the rise of the "pet companionship" culture in China [5], implying inner link with China's severe aging population due to elderly loneliness, the market demand of the pet industry has shown an explosive growth [6]. Market segments such as pet food, pet supplies, pet medical care, pet grooming and pet training have all shown huge market potential and development space. Consumers care and investment in pets has expanded from basic feeding needs to various needs for pet health, education and entertainment. The diversification and personalization of this demand provide a broad space for the innovation and development of the pet industry.

However, in the face of increasingly fierce market competition and changing consumer demand, the development of Chinas pet industry is also facing many challenges. How to achieve sustainable development while maintaining market competitiveness; how to improve the quality of products and services while meeting consumer demand; and how to maintain local characteristics and cultural value in the process of international development are all problems for Chinese pet industry.

At present, most researchers predicting the future demand have utilized single Linear models or Likert scales. Few related works that involved these models for prediction are [7-10]. Generally, it is

reported in literature that ARIMA models are known to be robust as well as efficient while tackling financial time series forecasting [11-12], particularly when short-term prediction [13]. Other single statistical models seemingly not the best choice, especially linear regression due to unpredictable economic fluctuations [14]. These studies did not examine the difference in between pet food industry and others, which seemingly in the terms of independent variables, prediction accuracy. Moreover, Furthermore, the China's pet food market, which demonstrates great potential, is also seemingly ignorant. This paper intends to fill the void. In this research, the author will first review the development history of China's pet industry and analyze the changes of the number of pet cats as well as dogs from 2019 to 2023, thus identifying the key trends of the industry development. Meanwhile, the study will explore the internal and external factors affecting the development of the pet industry, such as economic growth, demographic alteration and the change of the consumption concept. By constructing a mathematical model, the research aims to predict the growth potential of China's pet industry in the next three years and provide a basis for strategic planning for industry participants. In the work, the article gives the corresponding analysis results by analyzing the data of the China's Pet Industry White Paper 2023-2024. In this research paper, the author investigates the U.S. pet industry by using economic, social, and technical (PEST) analysis.

2. The basic fundamental of exponential model and ARIMA model

2.1. Exponential model

The exponential model is grounded in the principle that a variable changes at a rate proportional to its current value. This behavior can be expressed mathematically as:

$$y(t) = y_0 e^{kt} \tag{1}$$

Where $y(t)$ is the value at time t, y_0 is the initial value, k is the growth (or decay) rate, and e is the base of the natural logarithm. This model is particularly suited for systems exhibiting exponential growth or decay, such as population growth or radioactive decay. Adjusting the k parameter allows for fine-tuning of the model to match observed data trends. When extended to include a constant or additive noise, it provides flexibility for real-world applications.

2.2. ARIMA model

The ARIMA (Auto Regressive Integrated Moving Average) model is a powerful tool for modeling and forecasting time series data with complex patterns. It incorporates three key elements:

Autoregressive (AR):

$$y_0 = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \cdots + \phi_p y_{t-p} + \epsilon_t \tag{2}$$

where ϕ represents *AR* coefficients and ϵ_t is white noise.

Integration (I): differencing the data *d-time* to achieve stationary:

$$y_t' = y_t + y_{t-1} \tag{3}$$

for *d =1*.

Moving Average (MA):

$$y_t = \mu + \theta_1 \epsilon_{t-1} + \theta_2 \epsilon_{t-2} + \cdots + \theta_q \epsilon_{t-q} + \epsilon_t \tag{4}$$

where θ represents MA coefficients.

The general ARIMA model is denoted as $ARIMA(p, d, q)$, where p is the number of autoregressive terms, d is the differencing order, and q is the number of moving average terms. Combining these elements enables the ARIMA model to handle non-stationary data and uncover both trend and seasonal patterns effectively.

3. Experimental and results

3.1. The establishment of simulation model

The large data prediction model for the user's electricity consumption is implemented in the Clementine software. In order to construct and analyze the development trend and market demand of Chinese pet industry, the study makes the following assumptions in the model building process:

3.2. Model hypothesis

In order to construct and analyze the development trend and market demand of Chinese pet industry, the study makes the following assumptions in the model building process:

(1) Market stability hypothesis: It is assumed that Chinas pet market remains stable during the forecast period, and that no major market turbulence or policy changes will affect the development of the pet industry.

(2) Continuing hypothesis: assuming that consumer preference and consumption trend for pets will continue the current growth trend in the next three years without any sudden changes.

(3) Economic environment hypothesis: It is assumed that during the forecast period, the national economic environment remains stable, and the per capita income and consumption level will increase steadily, which will have a positive impact on the development of the pet industry.

(4) Policy continuity hypothesis: Assuming that relevant pet industry policies, such as pet medical treatment, insurance, registration management will maintain continuity and no major changes.

3.3. Data analysis

China’s pet food industry:

China’s Pet Industry White Paper 2023-2024 provides the number of pet cats and dogs from 2019 to 2023 (in 10,000). Analysis of the data of each we can reveal the dynamic trend of the number of cats and dogs, as shown in Figure.1.

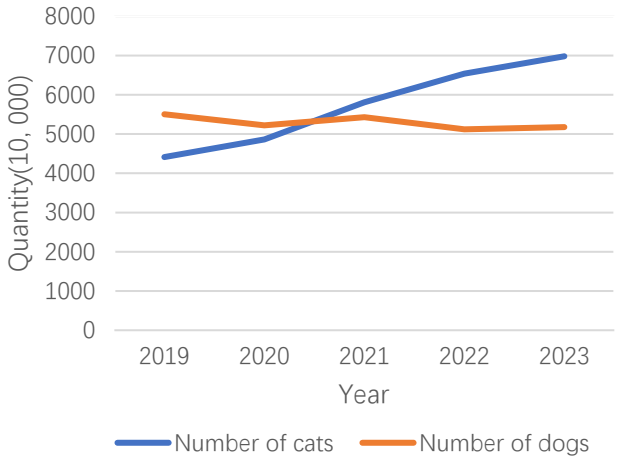

Figure.1. Trend of Pet Cat and Dog Population in China from 2019 to 2023

(1) Preliminary trend analysis of the data

The number of pet cats has shown significant growth in the past five years, growing from 44.12 million in 2019 to 69.8 million in 2023, with a growth rate of 58.2%. Then, the number of pet dogs fluctuated less, decreasing from 55.03 million in 2019 to 51.75 million in 2023, showing an overall downward trend.

(2) Analysis of the influencing factors

Analysis the influencing factors of the development of Chinas pet industry can provide reasonable basis for the prediction model. The main factors include:

Economic level: The level of urbanization and rising disposable income drives pet consumption.

Demographics: An aging population and the increase of people living alone have increased the demand for pets.

Cultural concepts: The popularity of pet companion culture has boosted the number of pets.

Policy support: The development of pet medical care, insurance, and registration management policies also affects the industry scale.

(3) Mathematical modeling process

Model objectives: build a forecasting model to predict the number of pet cats and dogs in the next three years (2024-2026), and then predict the development trend of the entire pet industry.

Data preprocessing: historical data on pet number were smoothed, and a suitable growth model was selected for fitting. First, calculating the change rate of the pet number: the number of cats and dogs with $N_{cat}(t)$ and $N_{dog}(t)$ represent year t respectively:

$$grow = \frac{N(t+1)-N(t)}{N(t)} * 100\% \tag{5}$$

After calculating the growth rate, it was found that the annual growth rate of the number of pet cats decreased year by year, while the number of pet dogs fluctuated.

Data standardization: to unify the growth trend and facilitate fitting, the data was standardized:

$$N_{norm}(t) = \frac{N(t)-min(N)}{max(N)-min(N)} \tag{6}$$

(4) Model selection

The exponential smoothing method is suitable for trending time series prediction with the following formula:

$$S_t = \alpha \cdot N_{\ t} + (1-\alpha) \cdot S_{t-1} \tag{7}$$

among: S_t is the smoothing value of time t; α is the smoothing coefficient ($0 < \alpha < 1$). The increasing trend of pet cats and dogs were fitted by parameter adjustment.

Multiple regression models were established with economic factors (such as residents' disposable income, per capita GDP), demographic factors (for example, proportion of population living alone, aging) and cultural factors (such as pet culture prevalence index) as independent variables:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \epsilon \tag{8}$$

among: Y is the number of pets;X_i is the influencing factor; $\beta_i$is the regression coefficient;
ϵ is the error term.

Since pet number is time series data, the ARIMA model is able to capture trends and seasonal changes in the data. The ARIMA model is defined as follows:

$$\phi(B)(1-B)dNt = \theta(B)\epsilon t \tag{9}$$

among:

$\phi(B)$ and $\theta(B)$ are autoregressive and moving average polynomials, respectively; and d is the difference order; ϵ t is the random perturbation term. The optimal parameters p, d, q were selected using the AIC criterion.

(5) Model implementation

Pet cat prediction: the increasing trend is obtained by fitting the historical data with the exponential smoothing method's predictor formula:

$$N_{cat}(t+1) = \alpha\ N_{cat}(t) + (1-\alpha) S\ cat(t) \tag{10}$$

Combined with the regression model, the influencing factors were used as independent variables to predict the growth rate in the next three years.

Pet dog prediction: the trend in the number of pet dogs was fitted by ARIMA model and calculated with historical data trends:

$$N_{dog}(t+1) = \phi_1 N_{dog}(t-1) + \phi_2 N_{dog}(t-2) + \epsilon\ t \tag{11}$$

Industry size forecast: total pet numbers can be estimated from the predicted number of pet cats and pet dogs:

$$N_{total}(t) = N_{cat}(t) + N_{dog}(t) \tag{12}$$

Combined with the average consumption level of the market, predict the market size of the whole pet industry.

International pet food industry:

Based on the data on the number of pet cats and dogs in the United States, France and Germany from 2019 to 2023, we will analyze the development of the global pet industry and build a mathematical model to predict the global demand for pet food over the next three years (2024-2026).

Preliminary trend analysis

By visualizing the attached data as follows (shown in Figure.2.):

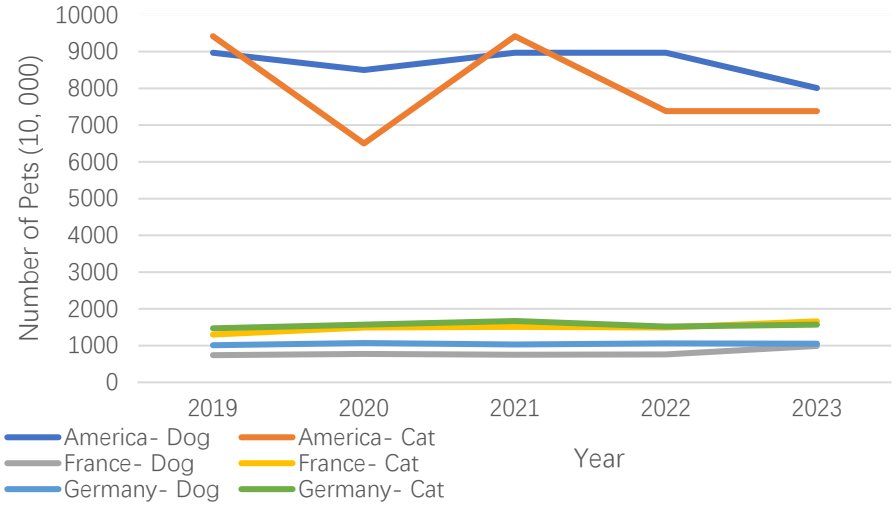

Figure.2. Global Pet Population Trends (2019-2023)

The United States

The number of pet cats remained stable after decreasing in 2020 (73.8 million). The number of pet dogs fluctuated less, reaching 80.1 million in 2023, slightly down from 89.7 million in 2019.

France

The number of pet cats has been steadily increasing, from 13 million in 2019 to 16.6 million in 2023, with a high average annual growth rate. The number of pet dogs fluctuated slightly.

Germany

The number of pet cats changed less, reaching 15.7 million in 2023 while the number of pet dogs remained stable.

(2) Mathematical modeling process

Model objectives: forecasting global demand for pet food for the next three years (2024-2026).

Data preprocessing: first, calculate the annual growth rate Order $N_{cat,i(t)}$and $N_{dog,i(t)}$indicate the number of pet cats and dogs in year *t*, respectively:

$$grow = \frac{N(t+1)-N(t)}{N(t)} * 100\% \tag{13}$$

Per capita pet food consumption:

The average annual food consumption per pet in each country is assumed to be as follows:

American pet cat: 120 kg / year, pet dog: 250 kg / year;

French pet cat: 100 kg / year, pet dog: 220 kg / year;

German pet cat: 110 kg / year, pet dog: 230 kg / year.

Calculate national pet food demand in 2023:

$$D_i\ (t) = \sum_{type} N_{type,i(t)} * C_{type,i} \tag{14}$$

Among them, $C_{type,i}$ indicate the annual consumption of pet food in the country.

(3) Model selection

The number of pets shows a certain trend with time, which is suitable for exponential smoothing modeling:

$$S_t = \alpha \cdot N_{\ t} + (1-\alpha) \cdot S_{t-1} \tag{15}$$

Pet food demand D (t) can be regarded as a linear function of the number of pets:

$$D(t) = a * N_{cat}(t) + b * N_{dog}(t) + c \tag{16}$$

Future demands were calculated by fitting the historical data to parameters a, b, c and combined with the predicted value of pet number.

(4) Model implementation and formula deduction

The prediction formula of pet number

The number of pets is predicted by the exponential smoothing method, and the number formula for 2024 is:

$$N(t+1) = \alpha N(t) + (1-\alpha)S(t) \tag{17}$$

Pet food demand forecast formula

Total demand for pet food is:

$$D(t) = \sum_{i=1}^{k}(N_{cat,i}(t) * C_{cat,i} + N_{dog,i}(t) * C_{dog,i}\ ) \tag{18}$$

where, k is the total number of countries.

3.4. Results analysis and business implications

China's pet food industry:

(1) Analysis of the prediction results of pet numbers in the next three years

According to the prediction results of the exponential smoothing model and the ARIMA model, the number of pet cats and pet dogs in China in the next three years (2024-2026) shows the following changing trends (shown in Figure.3. and Table.1.):

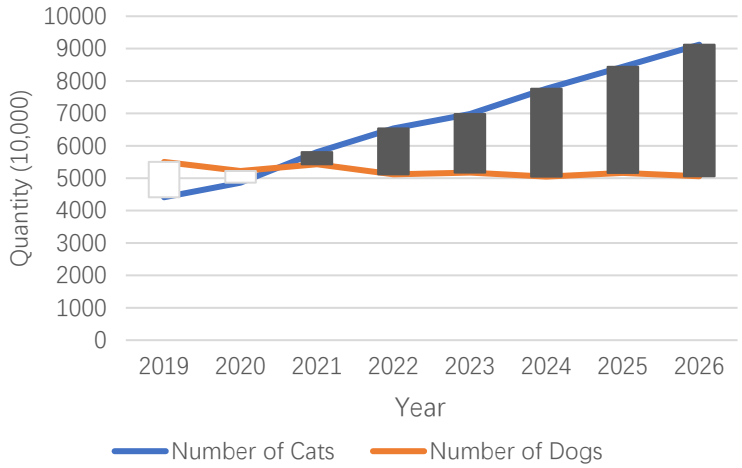

Figure.3. Forecast of Pet Cat and Dog Numbers in China from 2019 to 2026

Table.1. 2024-2026 Number of Pet Cats and Dogs in China (in 10,000s)

Particular Year	Number of Pet Cats (1000)	Number of et dogs (1000)
2024	7,760.81	5,048.70
2025	8,441.52	5,163.32
2026	9,122.24	5,059.30

The number of pet cats is expected to be 77,6081 million in 2024,84,415,200 in 2025 and 91,222,400 in 2026.The number of pet cats has maintained rapid growth, with annual growth rates expected to remain between 7% and 9%. This is consistent with the growth trend of the pet cat market in recent years, reflecting the increasing preference of residents for pet cats.

The number of pet dogs is expected to be 50.487 million in 2024,51,633,200 in 2025 and 50.59300 in 2026.The number of pet dogs is expected to remain stable, showing a slight fluctuation trend, with a limited growth range. The reasons may be related to the management restrictions related to dog ownership, the changes in residents living habits, and the relative saturation of the pet dog market.

(2) Forecast analysis of market size of pet industry in the next three years

Based on the predicted number of pets and the assumed annual per capita consumption level (3,000 yuan for pet cats and 2,500 yuan for pet dogs), the market size of Chinas pet industry in the next three years is expected to be as follows (shown in Figure.4.):

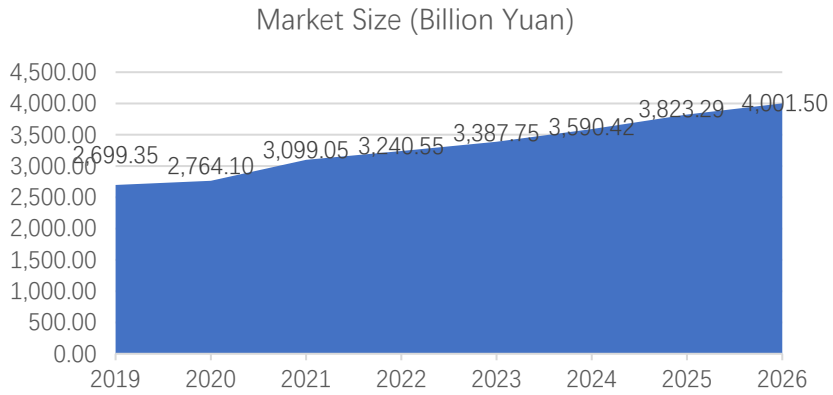

Figure.4. Forecast of China Pet Industry Market from 2019 to 2026

Growth of the market size. The market size is expected to be 359.042 billion yuan in 2024,382.329 billion yuan in 2025, and 400.15 billion yuan in 2026.The market size of the pet industry is increasing year by year, and it is expected to exceed 400 billion yuan by 2026, an increase of about 18% compared with 2023.

Pet cats contribute more. As the growth rate of the number of pet cats is significantly higher than that of pet dogs, and the average annual consumption level of pet cats is higher, it contributes more to the growth of the market size. As the number of pet cats continues to increase, its market share is expected to further increase, promoting the rapid development of the pet industry.

Stable pet dog market. Although the number of pet dogs grew relatively slowly, its market share is still important, especially in first-tier cities and suburban areas where there is high demand for dogs.

International pet food industry:

(1) Change trend of total global pet food demand (shown in Figure.5.)

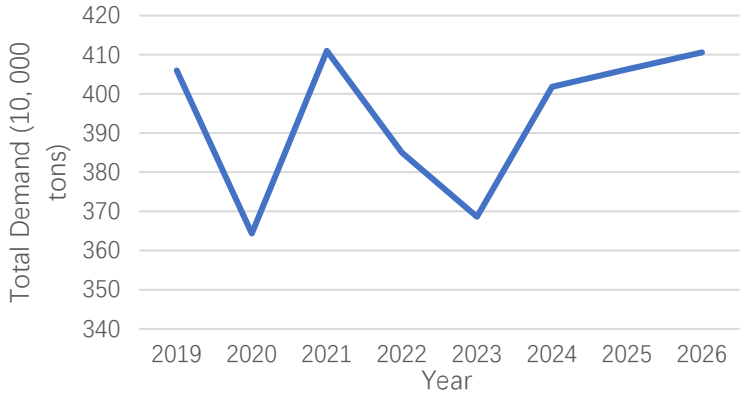

Figure.5. Global Total Pet Food Demand (2019-2026)

According to the model forecast and data analysis, the total global pet food demand (in 10,000 tons) showed a steady growth trend between 2019 and 2026. The specific manifestations are:

Historical demand: global demand for pet food in 2019 was 40,597,000 tons, then dropped to 3.6433 million tons in 2020, but then recovered from year to year to 3.6861 million tons in 2023.

Future demand forecast: demand will increase to 4,018,800 tons in 2024, 4,0624 million tons in 2025 and 4.106 million tons in 2026. It can be seen that the growth in the next three years is mainly due to the economic development and the steady increase in the number of pets.

(2) Analysis of international pet food demand requirements (shown in Figure.6.)

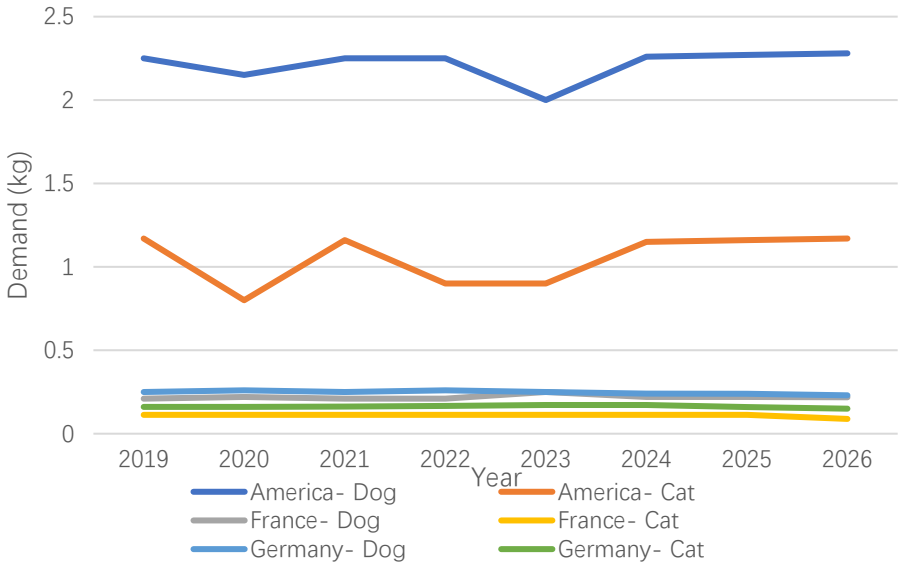

Figure.6. Pet Food Demand by Country and Type (2019-2026)

The United States:

Historical trends: the United States has the highest share of pet food demand. Food demand for pet cats fluctuated from 1,130,400 tons in 2019 to 885,600 tons in 2023, while food demand for pet dogs gradually decreased from 2,242,500 tons in 2019 to 2,0025 million tons in 2023.

Future forecast: the forecast shows that in 2026, the food demand for pet cats in the United States will increase to 1,156,500 tons, and the food demand for pet dogs will increase to 2,324,900 tons, indicating that the demand for pet food in the US market will gradually recover.

France:

Historical trends: French pet food demand shows small fluctuations. Demand for pet cat food increased from 13.00 10,000 tons in 2019 to 166,000 tons in 2023, while demand for pet dog food reached 217,800 tons in 2023, the peak in the past five years.

Future forecast: demand for pet cat food in France will fall to 110,200 tons in 2026, and demand for pet dog food will fall to 124,400 tons. Suggesting that the French market may be saturated.

Germany:

Historical trend: German demand for pet food is relatively stable, with pet cat food demand gradually increasing from 161,700 tons in 2019 to 172,700 tons in 2023; and pet dog food demand increasing steadily from 232,300 tons in 2019 to 241,500 tons in 2023.

Future forecast: by 2026, pet cat food demand in Germany will fall to 159,800 tons, while pet dog food demand will drop slightly to 230, 200 tons.

(3) Analysis and business implications

Overall trends of the global pet food market:

The global pet food market will continue to grow over the next three years, with the recovery growth in the U. S. market as the main driver.

Demand for pet food in France and Germany could be saturated or declining, indicating a gradual stabilization in Europe.

Regional differences and market potential:

American market: due to the high consumption of pet dogs, the American market is still the largest consumer market for pet food in the world. It is recommended that enterprises focus on the research and development of high-end pet food products.

European market: demand for pet food in the French and German markets tends to decline, and companies are recommended to explore new consumption growth points in the European market, such as functional food for pet health.

Drivers of future growth:

Pet number growth: while pet number growth is slowing in some countries, the overall global pet number growth trend will continue to support the expansion of the pet food market.

Economic level: the increase in per capita income will further drive the demand for high-end pet food.

Market penetration rate: in some countries and regions, the proportion of homemade pet food is relatively high, and the increase of market penetration rate will provide growth space for industrial pet food products.

4. Conclusions

Under the influence of an aging population, China's pet industry is undergoing substantial growth, driven by increasing demand for companionship and evolving consumer preferences. By 2026, the industry is projected to surpass 400 billion yuan, marking an 18% growth from 2023. The accelerated rise in pet cat ownership, coupled with higher annual expenditures, serves as a primary growth driver, while pet dogs maintain significant market share, particularly in urban and suburban areas. Simultaneously, the global pet food market is projected to reach 4.106 million tons, with the U.S. and Europe leading demand for premium products. To harness these trends, enterprises should pursue diversified market strategies, including expansion into Southeast Asia and the Middle East, supported by government initiatives to reduce trade barriers and enhance export capabilities. Additionally, optimizing product structures, improving brand value, and investing in innovation will be critical for sustaining growth and increasing international competitiveness. Proactive policies promoting domestic consumption, such as subsidies and educational campaigns on pet care, can further bolster market expansion. Government support for quality standardization, certification, and training programs in animal nutrition and veterinary sciences will address industry talent gaps while fostering innovation and competitiveness among SMEs. By integrating these strategies within a robust policy framework, China’s pet industry is poised to meet both domestic and international demands, significantly contributing to societal well-being and economic growth.

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