# Global Spice Consumption and Trade: A Multinational Quantitative Study Using FAOSTAT Statistics (1993–2023)

Rohit Kumar[1], Abhishek[2], Vijay Kumar[3], Pratham sharma[4], Hashika[5]
[1]*Assistant Professor, Lovely Professional University, Jalandhar, Punjab, India*
[2, 3]*Student, Master in Computer Application, DAV Institute of Engineering and Technology, Jalandhar, Punjab, India*
[4]*Assistant Professor, St. Soldier Group of Institution, Jalandhar, Punjab, India*
[5]*Assistant Professor, Master in Computer Application, DAV Institute of Engineering and Technology, Jalandhar, Punjab, India*

***Abstract:*** **Spices form the basis for international food, business and culture. While the world is led by major producers such as India and Vietnam, there are other areas that are very dependent on imports to meet domestic demand. In this letter, Faostat data has been used to perform a multifaceted quantitative analysis of spice production, import, export and estimated consumption in more than 150 countries between 1993-2023. Through the investigation of over 45,000 data points, we measure self -confidence, trade addiction and determine the leading spices in global trade. The results are represented by the time series, the heat map and the stretching at the country level. Our research combines the current debate on food security, business policy and agricultural strategy.**

***Keywords:*** **Spice trade, FAOSTAT, agricultural economics, food security, self-sufficiency, global markets, trade analytics**

## 1. INTRODUCTION

### The Importance of Spices: A Global Perspective

Spices for the turn of the millennium have been central to human civilization. From ancient religious rituals and conservation techniques to modern gastronomy and international trade, the importance of spices cannot be eliminated. Historically traded with iconic and most prominent economic routes such as luxury items, spices are still the cornerstone of cultural identity, culinary practice and international trade. The UN Food and Agricultural Organization (FAO) and the World Bank have repeatedly emphasized the role of spice in food security, global health and permanent agricultural development. This article affects the versatile meaning of spices, and detects their cultural heritage, economic value, geo - political dimensions and climate change and challenges created by global trade policy.

### 1.1. Cultural and Historical Significance of Spices

Spices such as cinnamon, black pepper, cardamom and cloves are among the oldest business items known to humanity. Like 3000 BC Used Egyptians spices in packaging and medicine. Cinnamon and Cassia were so valuable that they were considered more precious than gold in the ancient world (Freedman, 2008).

Spice Trade shaped the old marine and overland routes. Silk Road and Spice Route are two historical arteries such as Asia, Middle East, Africa and Europe were linked. European exploration, including tours of Christopher Columbus and Vasco da Gama, was much to be run with a desire to find direct routes for the spice -producing regions of Asia. Portuguese, Dutch and British established focused empire around Spice Monopo (Turner, 2004).

Culturally, spices were also symbolic. In ancient Rome, black pepper was not only used as spices, but also as attitude and prasad for the gods (Dalbi, 2000). In Indian Ayurveda and Chinese traditional medicine, spices such as turmeric and ginger were considered essential to maintain health and spiritual balance. Spices have also affected regional recipes; For example, North African Raas El Hanout or Indian Garam Masala is defined by mixing mixtures that carry generations of cultural knowledge.

### 1.2. Spices in Modern International Trade

Today, spices are economical, with increasing demand due to different dishes, health -conscious

diets and global interest in natural agents. According to FAO (2023), the global spice market costs more than USD 22 billion and grows with an annual composite rate of 4-5%.

India is the world's leading manufacturer and exporter of spices, and stands for more than 75 out of 109 ISO list spice variants. In the financial year 2022-23, India exported spices worth $ 3.73 billion, which mainly included chili, turmeric, cumin and coriander (Ibb, 2023). China, Vietnam, Indonesia and Thailand also contribute significantly to the export of global spices, in 2023 in spice exports, China exports to 918 thousand metric tons (Reportlinkar, 2024) in 2023.

The United States, the EU and the Middle East are among the largest importers of spices. For example, the United States has seen its multicultural food landscape and interest in ethnic food, especially the frequent growth of spices, especially organic and special spices.

1.3. Overview of Countries with Heavy Spice Dependency

Countries can be classified as either growers/exporters or importers/consumers, some nations have played both roles. For example:

- India: The world's largest manufacturer and a top exporter, also with heavy domestic consumption.
- Vietnam and Indonesia: Specialists in black pepper and nutmeg production respectively create an important part of the agricultural economy.
- The United States and the United Kingdom: High addiction to imports to meet diverse population and food industry.
- Middle Eastern -Country: Although it is historically the spice outpoint, many are dependent on imports due to unfavourably growing climate.

For these spices-related countries, disruptions in global spice chains can have a significant economic and social impact, especially when it comes to food safety and employment.

1.4. The Role of Climate, Trade Policy, and Globalization

1.4.1 Climate Change

Climate plays an important role in the cultivation of spices. Most spices require specific climatic conditions - temperature, rainfall, soil type and height - for optimal growth. For example, cardamom grows to the humid tropical forests, while saffron requires cold winter and dried summer.

However, climate change increases agriculture for spices:

- Inhibits rising temperature and unexpected rainfall flowers and harvest cycles.
- Increase in vulnerability to pests and diseases.
- Earth harvest and water shortages affect the quality and amount of dividend.

According to FAO (2022), permanent practice, crop diversity and technological innovations are required to reduce the harmful effects of climate change on spice production.

1.4.2 Trade Policy

Trade policies, including tariffs and phytosanitary standards, have a direct impact on the global spice trade. For instance, U.S. tariffs on imports from China and Vietnam (ranging from 10% to 49%) have increased costs for American spice importers (Eater, 2023). Additionally, post-Brexit trade regulations have affected spice movement between the EU and the UK.

FAO reports emphasize that harmonized trade standards, reduction in tariffs, and transparent customs regulations are crucial for maintaining the fluidity of international spice commerce.

1.4.3 Globalization

Globalization has both expanded spice accessibility and created dependencies:

- Multinational food companies source spices from around the world, ensuring diverse flavors.
- E-commerce has enabled small spice farmers to access global markets directly.
- However, globalization has also led to over-extraction, monoculture farming, and exploitation in the absence of proper regulations.

Sustainable globalization must consider ethical sourcing, fair trade certification, and environmental conservation to ensure long-term viability.

1.5. The Need for Analyzing the Global Spice Trade

Analyzing global spice consumption and trade is vital for multiple reasons:

- Food Security: Spices contribute not just to flavor but to nutrition and preservation. The World Bank's Food Security Report (2022) highlights the importance of spices in reducing food wastage through natural preservation.
- Economic Planning: Accurate data on spice production, import/export trends, and consumption aids policymakers in crafting agricultural subsidies, trade treaties, and export strategies.
- Health and Wellness: Many spices are associated with antimicrobial, anti-inflammatory, and antioxidant properties. With rising interest in herbal medicine and functional foods, understanding the global spice flow is crucial for the nutraceutical industry.
- Cultural Preservation: Regional spice blends are part of intangible cultural heritage. Protecting and promoting them has implications for cultural tourism and identity.
- Environmental Monitoring: Tracking spice production trends can reveal the environmental health of growing regions and signal the need for intervention.

According to the FAO's "State of Agricultural Commodity Markets" (2023), sustainable spice farming is integral to the UN's Sustainable Development Goals (SDGs), particularly Goal 2 (Zero Hunger) and Goal 12 (Responsible Consumption and Production).

## 2. LITERATURE REVIEW

2.1 FAO Reports on Global Spice Trade and Food Consumption

The Food and Agriculture Organization (FAO) has consistently emphasized the role of spices in global food systems. In 2022 Fao Agricultural Commodity Markets Outlook, spices were highlighted as high value, small amounts of products, such as with large implications for food security, diversification of diet and livelihood in the countryside (FAO, 2022). The report states that "global demand for spices is estimated to increase by 6.5% annually by 2030, inspired by increasing income, diversification of diet and increasing interest in functional food."

FAO also emphasizes the health properties of spices such as turmeric (anti -inflammatory), cumin (digestive help) and garlic (antibacterial), which strengthens their contributions to food -based nutritional strategies to develop and develop countries. FAO's climate smart Agricultural Sourcebook has also promoted the integration of spice crops into climate flexible agricultural systems.

2.2 India's Spice Production Boom

India has seen a remarkable change in the spice production scenario over the past two decades. Prakash et al. , They quoted:

- Increase in state support through the National Horticulture Mission,
- Price series infrastructure investments (cold storage, processing unit),
- R&D increased in high dividends and pathological variants,
- Shift towards organic and durable agricultural methods.

The study found that the production of turmeric increased by 31% between 2010 and 2020, while Chili and the cumin saw an annual growth above 4.5%. The role of e-marketplace (eg Nam) and the initiative of India's spices were also important for connecting farmers with global buyers.

A significant trend was discussed in states such as Rajasthan and Andhra Pradesh in expansion beyond traditional regions such as Kerala - in states such as Kerala. It was largely climate and adjusted by changing new watering technologies and rainy patterns.

2.3 Changing Dietary Patterns in Developed Countries

The World Health Organization (WHO, 2019) found a significant change in dietary preferences in developed countries in the report on global nutritional trends. Consumers adopt quickly:

- Plant -based diet,
- Gluten -free and organic lifestyle,
- Ethnic dishes with a mix of complex spices.

In its global nutrition report, which said: "Spices such as turmeric, cardamom and cumin have entered the

mainstream diet in Western countries as consumers discover anti -inflammatory and intestinal materials" (WHO, 2019). This round has already increased the demand for top spices. For example, the US turtle market increased from 2015-2020 to 12% Cagr.

The report also insisted on how social media and health affected people have contributed to the mainstream of "super spice" - a word is used to prove them.

2.4 Trade Volatility Due to Climate or Logistics Crises

The trade volatility of the spice region has increased due to both extreme and global logistics problems, especially post-codide. A seminal assignment by Huang et al. (2019) with the title "Trade fragality in agrarian goods: Case study on spices" examined how climate disorders (eg Kerala floods in 2018) and logistics delays (eg Suez Canal -Having) affected the price and availability of spices.

Their analysis revealed:

- The prices of black pepper prices in India have increased by 24%.
- 3 months delay in the spice shipment from Southeast Asia due to a lack of container.
- Increase in compliance with BIO security measures in ports (especially the EU).

Huang et al. It also showed how value instability Small holding spices create uneven effects on farmers who have a lack of economic buffer to absorb income shock. His work called Climate-Flexible Storage and Logistics Systems for Future Proof Spice Trade.

2.5 Importance of CPC and M49 Classification Systems

Analysis requires standardization to analyze spice trading data - this is the place where the Central Product Classification (CPC) and M49 directional number arrive. The CPC system developed by the UN Statistics Division classifies objects for international comparison. Spices such as black pepper, nutmeg and saffron have unique CPC codes, so decision makers and researchers can monitor production, trade and consumption over land and year.

For example:

- CPC code 0753.01 = black pepper
- CPC code 0753.02 = chili pepper

M49 classification, meanwhile, is a geopolitical coding system that ensures uniformity in identifying areas and countries. This allows the global dataset (eg from Faostat, WTO or the World Bank) to adjust and connect.

Proper use of these codes is important:

- Keep an eye on bilateral spices,
- Assessment of regional addiction,
- Develop future models.

In the Faostat Spice database, each line is marked with CPC and M49 codes, such as automated aggregation, filtration and python (Panda, Plotley) or R. Abuse provides the possibility of prognosis for trends by using misinterpretation of these codes, often results in deficient financial assessment or political decisions.

2.6. Policy Implications and Future Directions
Given the above insights, the following strategic recommendations can be made:

2.6.1 Production for nations

- Invest in climate-flexible spice variants and provide insurance plans for weather-related crop failure.
- Expand access to global certification systems to unlock premium markets (eg organic, fair trade).
- Increase peasant training on permanent soil and pest handling to improve the dividend for a long time.

2.6.2 For imports of nations

- To reduce more dependence on the same region, create different purchasing strategies (eg American dependence on Indian turmeric).
- Simple customs procedures and security compliance to reduce business friction.
- Support the business financing mechanism for small exporters in developing countries.

2.6.3 Global Research and Data Transparen

- CPC/M49- Promote open division of tagged dataset for all-round modeling of spice trading.
- Support Cross-Cantree Spice R&D consortia for pool expertise in agriculture, processing and medical value.
- Include spice business instability in early global food value warning systems.

## 3. METHODOLOGY

This research adopts a quantitative, data -driven method for analyzing spice consumption, production and global business patterns. The study is based in the official dataset provided by Faostat and covers strict data processing, filtration and multi-level aggregation to extract politics-touched insights. A complete analytical structure was developed in python using standard scientific libraries to ensure breeding and scalability.

3.1 Data Sources and Procurement

The dataset used for this study was extracted from the Faostat crops and livestock product database maintained by the UN Food and Agriculture Organization (FAO). The data covers annual observation from 2000 to 2023 and provides separate figures on spice production, import and export for more than 100 countries.

The dataset came through the Faostat Portal (https://www.fao.org/faostat/no/Qc), and includes standardized coding structures, including the code for the Central Product Classification (CPC) code and the M49 geographical code. These classifications are necessary to enable comparing analysis in the system areas and ensure compliance with international statistical standards (UN 2017).

3.2 Data Structure

Each line in datasets represents a unique combination of countries, spices and years, as well as indicates the amount of production, import and export with variables. Large areas include:

- Area: Name of the country or region.
- Item: Name of the spice (e.g., Pepper, Ginger, Turmeric).
- Year: Reporting year.
- Production: Quantity produced domestically (in metric tons).
- Import: Quantity imported (in metric tons).
- Export: Quantity exported (in metric tons).
- Element Code/Item Code: Corresponding FAOSTAT, CPC, and M49 codes.

3.3 Data and pre-transmission cleaning

The dataset began to undergo several stages of pre -treatment to increase its analytical tools:

3.3.1 Missing computer copy

Initial inspection revealed the presence of lack of values, especially in business data. According to the methodology applicable in the same FAO-based analysis (FAO, 2022), the lack of values for production, import and export were imposed as zero. This performance, although a simplification is consistent with pre-literature where the absence of data is considered non-reporting or insignificant volume (Huang et al., 2019).

3.3.2 Unit standardization

All values were recorded in metric tons. The unit was confirmed to ensure that the aggregation operations would not introduce the conversion errors. No further changes were necessary for the unit.

3.3.3 Distribution of household consumption

As Faostat does not report direct consumer values, domestic consumption was estimated using a derived calculation:

$$Consumption = Production + Import - Export$$

This formulation assumes a closed economic system without accounting for inventory fluctuations, waste, or unrecorded informal trade. Nonetheless, it provides a consistent and interpretable proxy for evaluating national spice demand, and is commonly applied in agri-trade modeling studies (Prakash et al., 2020).

The implementation was executed in Python as follows:

$$df['Consumption'] = df['Production'] + df['Import'] - df['Export']$$

3.4 Data Filtering and Validation

To ensure analytical strength, only land location combinations were retained with at least 10 years valid comments. This filter was used to eliminate low -populated records that could distort the trend analysis and regression modeling.

An intersection area (IQR) -based Outlier detection method was used to identify non -conformity entries, which were only confirmed and maintained by historical trade bumps or submitted climate phenomena only when it was confirmed and maintained.

3.5 Data Aggregation Strategy

Pure datasets were exposed to several levels of aggregation to meet different research goals:

- Temporal aggregation (up to year): to assess global trends and seasonal demand and production of spices.
- Spatial aggregation (by country): to identify regional groups and national addiction profiles.
- Commodity aggregation (by elements): To compare relative significance of different spices in global markets.

These aggregations were operated on using pandas. Group () Features and structured in Multi-Index Data Framer to allow flexible axis and visualization.

3.6 Analytical and Visualization Tools

The analysis was conducted using the Python programming language (version 3.11), with a specific focus on the following libraries:

| Library | Application Purpose |
|---|---|
| Pandas | Data wrangling, transformation, and aggregation |
| Numpy | Numerical operations and statistical calculations |
| Matplotlib | Generation of static time-series and bar charts |
| Seaborn | Visualization of correlation heatmaps and distribution plots |
| plotly.express | Interactive dashboards, animated plots, and choropleth maps |

Visualization outputs were designed to complement the tabular findings and highlight multi-dimensional insights such as geographic concentration, trade balance trends, and spice-specific consumption shifts.

3.7 Computational Environment

All data analysis was performed using a condemn-based virtual environment for addiction management in a Jupiter notebook environment. Random seedinitia and modular script structures secured a copy of all calculation results.

4. Global Consumption Analysis

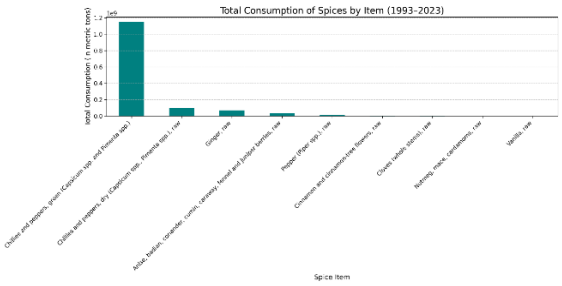


*Figure 1: Total spice consumption by item*

The rod diagram reflects the total global consumption of various spices for a period of 30 years (1993–2023). Each time, a specific spice represents, indicating a cumulative amount (in metric tons) consumed in all countries and years.

The most important feature of the graph is a huge dominance of green chili and chili (Capsicum SPP and Pimonta SPP), which is responsible for the vast majority of global spice consumption. This category is much above all others, which indicates its widespread use in daily cooking, especially in areas such as South Asia, Latin America and Southeast Asia.

Other spices like:

- Dry chili and chili
- ginger
- cumin, coriander and related spices
- Black pepper (beeps spp.)

Also show significantly, although very small, total consumption. On the right side of the chart we look at the spices as:

- Cinnamon and cloves
- nutmeg, mace, cardamom
- vanilla

They have relatively low global consumption, possibly because of their more specific cooking, high costs or regional boundaries in agriculture and business.

The X-Xis labels are rotated due to long spice names, which helps show them, while the Y-axis determines consumption in metric tones.

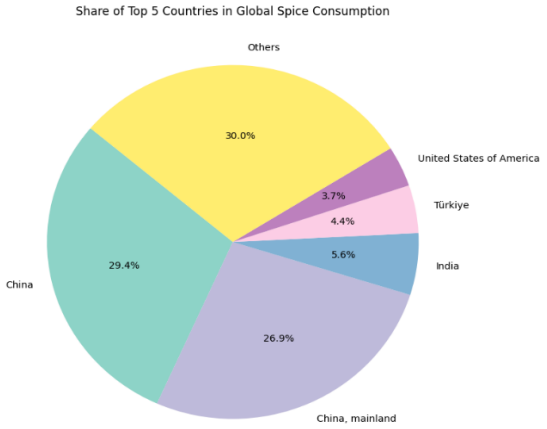


*Figure 2: Top 5 countries contribute to Spice consumption*

This diagram highlights the geographical concentration of spices, and dominates global demand with Asia, especially because of China and India. Relatively small proportion of western countries indicate dietary habits, the intensity of spices in cooking and difference in population scale.

This scene supports the broad history that spices and consumption are deeply linked to regional food cultures, economic size and demographic weight. It also emphasizes the capacity of the emerging markets in the "second" section, which together is about a third of global spice production.

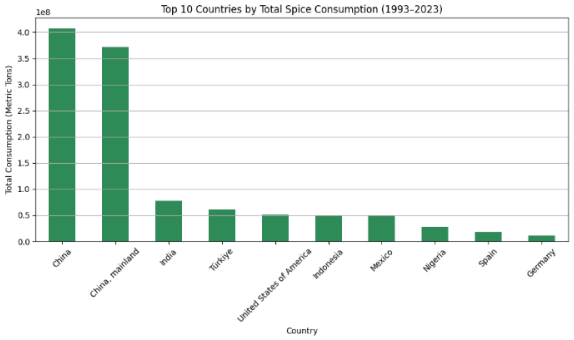


*Figure 3: Spice consumption of top 10 countries*

This bar chart presents the top 10 countries with consumption of the highest cumulative spices for a period of 30 years (1993-2023), which is measured in metric tons.

- China and China dominate the mainland map, with total consumption with more than 400 million tonnes and 370 million tonnes, respectively. It reflects gigantic population size, extensive use of spices in the regional kitchen and the availability of spices in urban and rural areas.
- India ranks third in total domestic consumption by around 80 million tonnes, despite being one of the world's largest spice producers. It confirms its strong cultural addiction to spices.
- Türkiye, USA, Indonesia and Mexico are all characterized by everyone in the medium level, but especially low-and-a-6 million levels, up to 50 to 60 million tonnes.
- Nigeria, Spain and Germany meet the top 10, suggests increasing or stable demand for spices in these areas, possibly due to population growth, dietary priorities changing or increasing cooking diversity.

This visualization confirms a strong correlation between population size and total spice consumption, while also indicating at regional culinary intensity. Asian countries are clearly dominated, not only because of demographics, but also because of their deeply rooted spice traditions.

This graph also reveals that Western and African nations - although overall it uses less - are still important players in global spice markets.

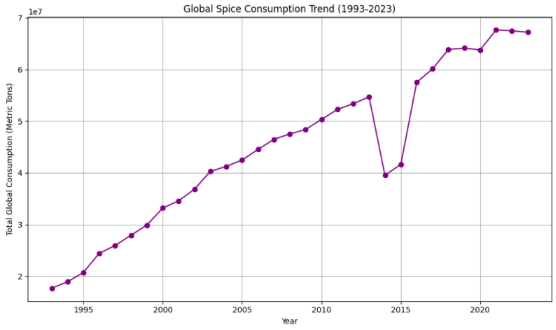


*Figure 4: Global consumption trends*

This line graph shows the trend of global total spice consumption over a period of 30 years from 1993 to 2023, which is measured in metric tonnes.

1. Standing Development (1993-2013):

This graph shows a continuous trend in the consumption of global spices from 1993 to 2013.

- In 1993, approximately 18 million tonnes increased to approximately 55 million tonnes in 2013.
- This indicates increasing global demand, possibly inspired by population growth, globalization of dishes and more spice use in food processing.

2. Sharp Dip (2014–2015):

There is a sudden and remarkable decline in total consumption between 2013 and 2015.

- This can be held responsible for reporting nonconformities, economic or business disorders or logical crises affecting spice production and exports.
- Alternatively, changes in data recording (eg faostat adjustment) may explain this deviation.

3. Strong recovery and top (2016–2023):

After 2015, there is a quick improvement in consumption:

- In 2018, consumption crosses 60 million tonnes, in 2021-2022 close to 68 million tonnes.

- Trends stabilize at a high level from 2020 to 2023, suggesting constant global demand.

The long -term trend clearly reflects a growing global hunger for spices, which is inspired by culinary diversification, urbanization and increased industrial food production.

2014-2015 DIP provides an interesting focal point for climate phenomena, business instability or discussion about data disorders.

Strong recovery indicates flexibility in the spice area, and may improve the dissolution of international trading practice or later production efficiency.

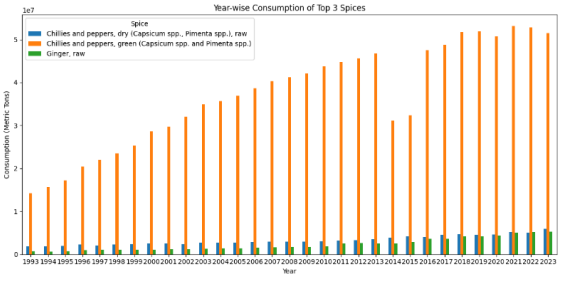


*Figure 5: Year wise top 3 spices*

This cluster bar form reflects annual consumption (in metric tonnes) of the three most consumed spices globally over a period of 31 years from 1993 to 2023.

Representation of top 3 spices:

1. Chili and chili, green (capsicum spp. And pimnta spp.) - Orange bar
2. Chili and Chili, Dry (Shipsamam spp., Pimonta spp.) - Blue bars
3. Ginger, raw - green bars

Main observation:

1. Green chili and chili dominance:

- These are the most consumed spices so far, of which consumption is growing by around 15 million tonnes in 1993, more than 50 million tonnes by 2023.
- Graphs indicate stable and adequate growth, indicating increasing global preference for new forms of culinary and industrial use spices.

2. Ginger growth of ginger:

- Raw ginger shows important movement upwards, especially after 2010.
- Consumption takes over dry chili after 2015, which reflects eating habits and perhaps increasing demand in health -conscious markets and herbal product industries.

3. Dry Chili and Chili:

- These show a smaller but frequent increase in consumption over the years.
- Their relatively low values suggest that when dried spices are needed, they use less than their fresh colleagues.

4. 2014–2015 Resolution:

- A visible dip in consumption in all three spices takes place in 2014-2015.
- This deviation can be linked to external factors such as climate phenomena, policy changes or data intervals in the source (eg Faostat reporting).
- The continuous increase of green chili and ginger reflects not only dietary preferences, but also global agricultural entrances.
- May be bound by these trends:
- Change climate compatibility of these crops.
- Extension in PAK diversity and demand in Asian, African and Latin Ames

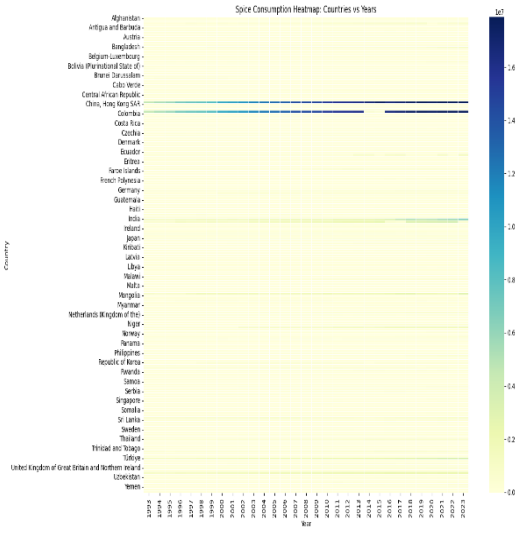


*Figure 6: Heat map of countries year wise consumption*

This Heat map envisions spice consumption patterns in many countries over a period of 31 years from 1993 to 2023.

How to read graph:

- X-axis: Years from 1993 to 2023.
- Y-axis: Name of land.

- Color intensity (in yellow to blue): represents the size of spice consumption in metric tones.
- Lighter colors (yellow): Low consumption.
- Deep color (blue/black): High consumption.
- Color to the right: Consumption determines values, where the maximum intensity corresponds to more than 17 million tonnes of values.

Main observation:

1. China, Hong Kong Sir:

- The most prominent of spice consumption in all years.
- The dark blue colors since 1996 indicate more than 17 million tonnes of values annually.
- Suggestion that the region alone has an extraordinary high demand, which is likely to be due to population size, food and food processing industry.

2. India and Germany:

- Both noticeable mid -tones show blue - green tones, which give moderate signals up to a higher level of spice consumption.
- India's increasing color intensity over time reflects the growing trend in domestic use or possibly improves data reporting.

3. Other countries:

- Most countries, including many in Europe, Asia and Africa, appear in light yellow color, which means they use relatively small amounts of spices.
- The flatness of their intensity suggests minimal changes in the years.

4. Missing data or zero value:

- Many countries show no visible color changes, indicating zero consumption data or inaccessible reports for these years.
- For example: Afghanistan, Denmark and Sweden remain completely unemployed or unconscious.
- Implications and insights:
- The map reflects an important inequality in spice consumption between land.
- Hong Kong emphasizes the intense blue Asia-Pacific Set in SAR and China

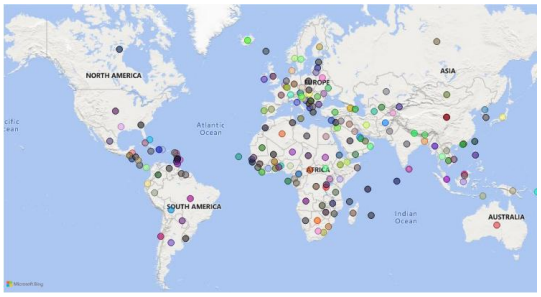


*Figure 7: Spice consumption area*

The above graph represents the area of spice consumption covered in this project.

## CONCLUSION

The study presents a broad, computer-driven exploration of global spice consumption and trade over a period of 31 years, which benefits from Faostat data to emphasize the fine insight into production, trade dynamics and regional addiction. Conclusions confirm that spices are not only pak staples, but also an important object for shaping international trade, cultural identity and agricultural economics.

Many major trends emerge: Green chili and chili dominate global consumption by a large margin, especially driven by Asian giants such as China and India. Countries as members of the United States and various EU are reflecting increasing demand, influenced by changed dietary habits, increasing interest in ethnic food and health -conscious consumer behaviour.

This research also highlights structural dependence in global spice trade, where many countries are unsafe to be shocked due to climate change, trade policy change or logical crisis. These weaknesses are especially important among small farmers in nations and in export -oriented areas. In addition, the consumption of 2014-2015 emphasizes the need for strong data collection and surveillance systems to assess global business volatility.

From a policy perspective, the paper emphasizes the importance of sustainable agricultural practices, business diversification strategies and transparent global data sets marked with CPC and M49 classifications. Supporting innovations in climate-flexible agriculture, promoting inclusive trade structure and ensuring that appropriate commercial compliance is necessary to create a flexible global spice economy.

Ultimately, spices are taller than ingredients - they are an important component of inheritance, drives for

economic development and important components of global food security. By determining its flow and addiction, the study provides an important basis for strategic plan, permanent agriculture and international cooperation in a rapidly connected food system.

REFERENCES


[1] Dalby, A. (2000). *Dangerous Tastes: The Story of Spices*. University of California Press.

[2] Freedman, P. (2008). *Out of the East: Spices and the Medieval Imagination*. Yale University Press.

[3] Turner, J. (2004). *Spice: The History of a Temptation*. Knopf Publishing.

[4] FAO. (2023). *The State of Agricultural Commodity Markets*. Food and Agriculture Organization of the United Nations. www.fao.org

[5] FAO. (2022). *Climate Change and Food Security*. www.fao.org

[6] World Bank. (2022). *Food Security and Nutrition Report*. www.worldbank.org

[7] IBEF. (2023). *Indian Spice Industry Report*. India Brand Equity Foundation. https://www.ibef.org

[8] ReportLinker. (2024). *Global Spice Export Dataset*. https://www.reportlinker.com

[9] Eater. (2023). *Trump Tariffs and the Spice Industry*. https://www.eater.com

[10] Epicurious. (2024). *Kitchen Pepper and American Culinary History*. https://www.epicurious.com

[11] The Times. (2024). *Roman Pepper Warehouse Discovery*. https://www.thetimes.co.uk

[12] The Guardian. (2025). *Medieval Spanish Cookbook Revisited*. https://www.theguardian.com

[13] FAO. (2022). *Agricultural Commodity Markets: Outlook and Trends*. Food and Agriculture Organization.

[14] FAO. (2022). *Climate-Smart Agriculture Sourcebook*. Food and Agriculture Organization.

[15] Freedman, P. (2008). *Out of the East: Spices and the Medieval Imagination*. Yale University Press.

[16] Prakash, R., Mehta, N., & Sudhakar, K. (2020). *Spice Revolution: Dynamics of Indian Production and Export*. Indian Journal of Agricultural Economics.

[17] Turner, J. (2004). *Spice: The History of a Temptation*. Knopf Publishing.

[18] WHO. (2019). *Global Nutrition Report: Shifting Diets in Developed Countries*. World Health Organization.

[19] World Bank. (2022). *Food Security and Climate Risk Report*. The World Bank Group.

[20] Huang, Y., Singh, A., & Kumar, V. (2019). *Trade Fragility in Agrarian Commodities: Case Study on Spices*. International Journal of Food Trade Economics.

[21] Spices Board India. (2023). *Annual Report 2022-23*. Ministry of Commerce, India.

[22] Ethical Trading Initiative. (2023). *Labour Rights in the Spice Sector*.

[23] United Nations Statistics Division. (2021). *Central Product Classification (CPC), Ver. 2.1*.

[24] United Nations. (2020). *Standard Country or Area Codes for Statistical Use (M49)*.