Original Research Article
Dynamics of Global Honey Trade: A Longitudinal Analysis from 1961 to 2022

ABSTRACT

In this paper, we tried to analyze the global exchange of honey from the period of 1961 to 2022. The global honey trade acts as a fascinating arena for the study of socio-economic, environmental, and geopolitical dynamics. The journey of honey from production sites to consumer markets traverses a complex web of factors, including ecological systems, technological advancements, trade policies, and consumer preferences.

Our analysis shows increasing trends in honey trade across all the continents. Although the quantity and amount of trade across the continents varied significantly. The Spearman's rho test results show the varying strength of monotonic increasing trend across the regions. Instability across continents in terms of study variables was studied, along with a longitudinal analysis of the Trade Balance Index. Empirical evidence was analyzed to identify possible underlying factors responsible for the changing dynamics of the global honey trade. Through this research, we aim to elucidate the evolution, trends, and implications of honey trade dynamics for academia, industry, and policymakers.

Keywords: Honey, International Trade, Trend, Trade Balance, Instability

1. INTRODUCTION

Honey is highly valued as a traditional medicine[1] and has been a part of human civilization for a long time. It is a natural sweet substance produced by honeybees from the nectar of plants or from secretions of living parts of plants or excretions of plant-sucking insects on plants [2].

Allsop and Brand-Miller [3] showed the change in the production, consumption, and trade of honey throughout human history and across geographical entities. While it was used previously as a sweetener, a form of rent payment, and mead, but now the interest in honey has increased due to the presence of various compounds [4], responsible for its anti-microbial, antioxidant,and anti-inflammatoryproperties.

Global honey trade plays a significant role in the economic development of various communities. Through an examination of historical data spanning six decades, our research seeks to identify and analyze long-term trends and patterns in trade flows across major continents and regions. Through this paper, we aim to provide actionable insights and recommendations for academia, industry stakeholders, and policymakers engaged in the global honey trade.

2.MATERIALS AND METHODS

The data required to conduct the study was collected from the FAO STAT database. FAO collects trade-related data (import and export quantities, animal numbers, and dollar values for total and bilateral flows) from the United Nations Statistics Division (UNSD) and EUROSTAT database [5]. Several data points related to global trade were also collected from the "Trade Statistics for International Business Development (Trade Map)". In a harmonized product classification system, natural honey has a code of 04090000 as a part of the broader 04 category that includes dairy produce, eggs, natural honey, and

edible products of animal origin, not elsewhere specified. The data related to the types of honey traded is not available in the FAO STAT database.

The data was cleaned and arranged into regions (Asia, Europe, Africa, North America, South America, Oceania, and the Globe) for analysis. The Compounded annual growth rate of study variables (quantity of honey exported, quantity of imported honey, value of honey imported, value of honey exported, unit value of imported honey, and unit value of exported honey) was analyzed using the following formula:

$$CAGR = \left(\left(\frac{EV}{BV}\right)^{\frac{1}{n}} - 1\right) \times 100,$$

Here, *EV* stands for Ending Value, *BV* stands for Beginning Value, and *n* stands for the number of years considered for analysis.

Della Valle instability index [6] was used to measure the variability of honey export and import both in quantity and value, globally over the last 62 years. The instability index is derived from the coefficient of variation which is multiplied by the square root of the differences between the coefficient of determinations (R^2) and unity.

Della Valle Instability Index = CV x $(1 - R^2)^{0.5}$
Where, CV = Co-efficient of Variation and R^2 = Coefficient of determinations

The level of instability can be categorized into low instability (between 0-15), medium instability (between 15-30), and high instability (more than 30) [7].

To study the strength of the monotonic trend of study variables, Spearman's rho test was used. It is a test used to understand the strength of the relationship between two variables i.e. study variables (i.e. imported honey quantity) and study periods (1961-2022) in our case.

The assumptions for Spearman's Rho include:

1. Continuous or ordinal nature of variables
2. Monotonic relationship between two variables

The correlation coefficient is a value between -1 and +1, with classification as follows:

- 0.00 - ±0.19 "very weak"
- ±0.20 - ±0.39 "weak"
- ±0.40 - ±0.59 "moderate"
- ±0.60 - ±0.79 "strong"
- ±0.80 - ±1.00 "very strong".

The Trade Balance Index [8] of honey for study regions was calculated using the following formula.

$TBI = \frac{X_j^i - M_j^i}{X_j^i + M_j^i}$, where X_j^i stands for export of commodity i (honey) from region j (study region), and M_j^i stands for import of commodity i from j region.

If the Trade Balance Index for a particular region and particular commodity is positive, then the region will be a net exporter of that commodity and if the TBI is negative, the region is a net importer of that commodity.

A country's share in the world trade of honey was determined by the following formula:

$$Country's\ share = \frac{Total\ honey\ trade\ by\ country\ between\ 1961\ to\ 2022}{Global\ honey\ trade\ between\ 1961\ to\ 2022}$$

This country's share formula is used to analyze the top twenty countries, i.e. top ten importers, and top ten exporters of honey. These countries were further analyzed for their year-on-year growth using the following formula.

$$Percent\ growth\ as\ compared\ to\ previous\ year = \left(\frac{X_2 - X_1}{X_1}\right) * 100$$

Where X_2 is the absolute value of trade in the current year and X_1 is the absolute value of trade in the previous year.

3. RESULTS

Globally, all the study variables increased between 1961 and 2022 (Table 1). The quantity of honey exported in 2022 was almost ten times the quantity of honey exported in 1961 with a compounded annual growth of 3.84 percent. Similarly, the total value of exports exhibited an annual growth of 8.29 percent to reach from 19 million USD in 1961 to 2.66 billion USD in 2022. The unit value of exports also grew at 4.28% annually between 1961 and 2022. This growth is not symmetric across various regions (refer to Figure 1).

Table 1 Overall Change in the World Trade of Honey (Source: Authors Calculation)

World Export of Honey				
Variables	1961	2022	Increase (%)	CAGR (%)
Exported Quantity (Tonnes)	74462	770562	934.84	3.84
Exported Value (USD thousand)	19085	2660577	13840.67	8.29
Unit value of Export (USD thousand/ Tonne)	0.26	3.45	1247.13	4.28

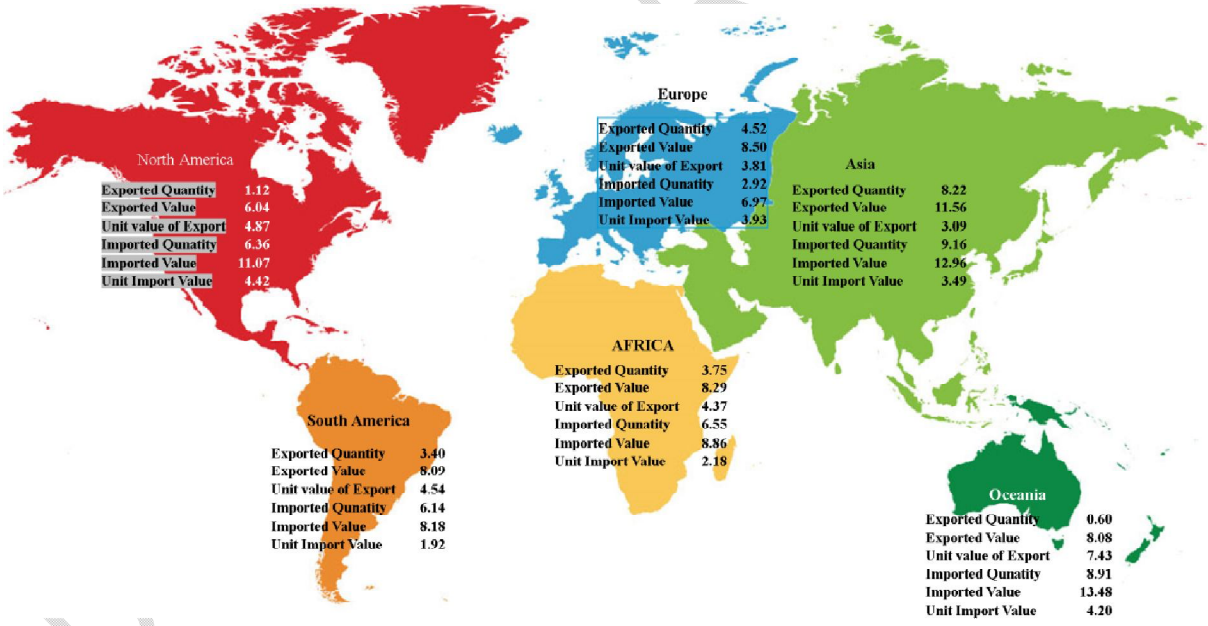

Figure 1 Compounded Annual Growth Rate of study variables across different continents (Source: Author's construction)

In the case of Africa, the quantity exported grew from 577 tonnes in 1961 to 5652 tonnes in 2022, with a CAGR of 3.5 percent., while the quantity imported grew at 6.55 percent. Similarly, the value of exports grew from 144 thousand US dollars to 31 million US dollars, indicating a compound annual growth of 8.29 percent. At the same time, honey imports also saw a significant rise. Interestingly, the unit value of exports witnessed a substantial rise of 4.37 percent, indicating improvement in the quality or value-added nature of Africa's exports over the years. However, Africa's share in world trade is low as compared to other continents (refer to Figure 2). In terms of exports, Africa's significant share is further coupled by high

export instability both in terms of quantity exported and value exported (refer to Table 2). However, the instability seemed to be streamlined when analyzed for the second half of the study period i.e. from 1992 to 2022. A similar type of improvement is seen in the case of honey imports to Africa as well. However, Africa shows a mix of correlation strengths across different trade variables. Exported quantity shows a moderate positive correlation (0.549) with a significant monotonic trend (refer to table no 3), indicating a discernible but not an over-strong relationship with time. However, other metrics such as Exported Value, Unit Export Value, Import Quantity, Imported Value, and Unit import value, display a strong positive correlation, ranging from 0.781 to 0.905, suggesting a strong monotonic trend. The analysis demonstrates a mixed pattern of Africa's trade balance index (refer to Figure No. 3). Initially, starting with negative values, indicating trade deficits, it improved trade balances over the years, with noticeable fluctuations. This journey from trade deficits to occasional surpluses reflects the shift in production, consumption, and trade policies within African countries. Africa's improving trade balance, together with growth in exports and gradually stabilizing instability suggest potential opportunities for growth and development in the continent's honey sector.

Table 2 Instability of trade indicators of various continents during the analysis period (source: Author's construction)

		Africa	North America	Asia	Europe	Oceania	South America
Export Quantity	1961-2022	81.71	23.97	28.72	38.28	23.84	21.85
	1961-1991	56.59	16.53	31.51	15.27	29.06	21.54
	1992-2022	28.35	15.68	16.78	16.81	16.89	15.44
Export Value	1961-2022	96.11	34.81	59.16	61.61	101.31	46.35
	1961-1991	87.54	23.28	37.66	19.76	24.31	26.44
	1992-2022	35.47	26.22	25.39	18.33	41.31	20.42
Import Quantity	1961-2022	76.08	30.58	13.03	13.60	103.88	107.32
	1961-1991	94.24	42.25	22.22	10.25	44.28	82.88
	1992-2022	26.67	12.12	7.89	7.73	55.56	72.87
Import Value	1961-2022	87.83	71.40	62.49	43.08	110.01	90.77
	1961-1991	110.51	42.94	20.91	19.86	48.90	99.00
	1992-2022	29.72	28.28	23.23	15.00	45.72	62.33

North America has also witnessed a remarkable growth in exports but slightly lower than that of Africa with 1.12 percent in quantity exported and 6.04 percent growth in the value of honey exported. However, in terms of absolute value, North America has always been a bigger player than Africa both in terms of exports and imports (refer to Figure 2). The imports into North America saw a substantial increase, with an annual increase of 6.36 percent in quantity and 11.07 percent in value terms. This growth is primarily driven by growth in imports of honey from the USA and Canada. The honey trade in North America is found to be highly stable for all the study variables except the value of imports (refer to Table 2). This variable was found to be stabilized for the second half of the analysis period. The analysis of the strength of monotonic trends shows results almost similar in Africa. The Exported quantity demonstrates a weak monotonic trend, indicating a less pronounced association with time compared to other continents. However, the remaining trade variables exhibit very strong positive correlations ranging from 0.937 to

0.976, indicating highly synchronized trade patterns and significant roles in the global honey trade. The analysis of the Trade balance index shows North America's movement from a net exporter of honey to a net importer of honey (refer to Figure No. 3). North America started to have a negative Trade Balance Index in 1993, and the negative trend continued since then, making it a significant importer in the global honey market.

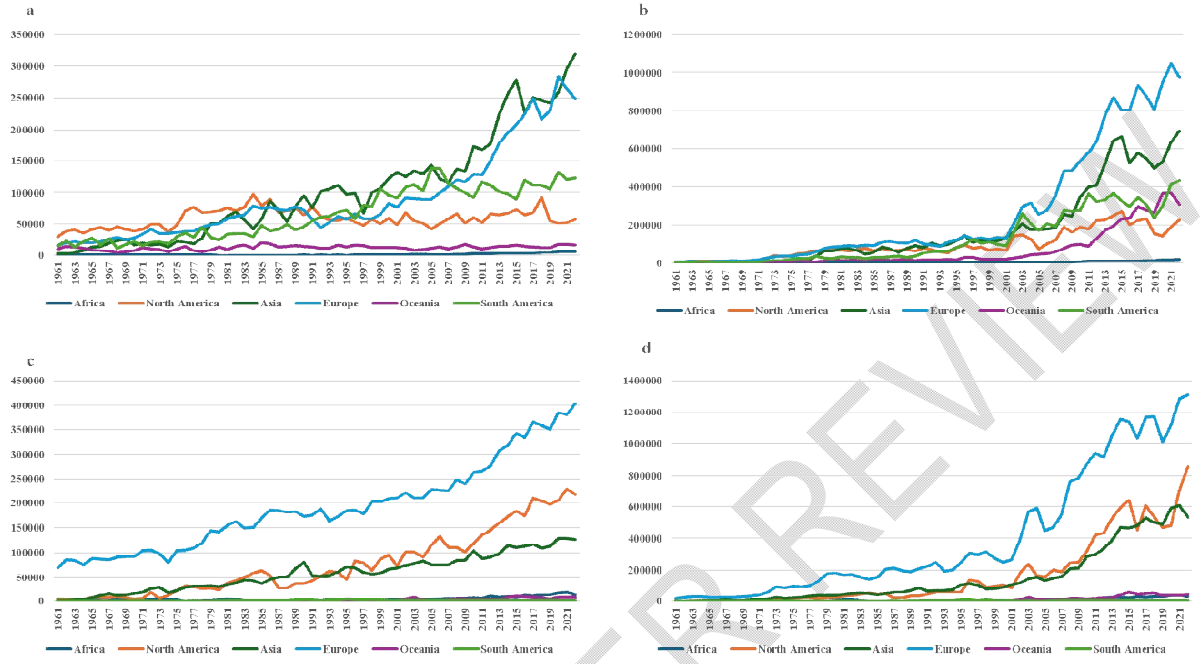

Figure 2 Changes in the study variables a) Export Quantity, b) Export Value, c) Import Quantity, d) Import Value (source: author's construction)

During the period of analysis, Asia emerged as a powerhouse in the global honey trade, witnessing exponential growth in both exports and imports over the decades. Exported quantities and values skyrocketed with an annual growth rate of 8.22 and 11.56 percent, respectively primarily driven by increasing economic integration with the global markets. Imports into Asia also rose significantly, showcasing demand for foreign-origin honey. As of now, Asia holds, first place in the quantity of honey exported and second place just after Europe in terms of the value of honey exported. It shows that honey exported by Asia receives lower prices in the international market as compared to exports by Europe. In the case of Asia, all the trade variables display a strong positive correlation, ranging from 0.892 to 0.994, indicating a synchronized and robust trade pattern. Even in the case of Trade Balances, Asia maintains an overall positive trade balance. This shows the continent's overall strength in honey exports, driven by the high production capacities of countries including China and India. However, countries like Japan and China are also regarded as significant importers of honey globally. In the case of Asia, instability in all four study variables seemed to be very less as compared to other countries except for imported value variables, which seemed to stabilize during the second period of analysis, showcasing Asia's dominance as a key driver of the global honey market.

Europe's trade dynamics showed steady growth in exports but at a slower pace compared to Asia. The exported quantities and values rose 4.52 and 8.5 percent per annum respectively. However, the imports into Europe rose modestly, with a 2.92 and 6.97 percent annual rise in terms of quantity and value. Figure no 2 shows Europe's leadership position in all study variables. It is the number one exporter in terms of value, and number one importer both in terms of quantity and value. This shows Europe's position as a potential re-exporter of honey. However, this dominant position of Europe has a problem of high export instability both in terms of quantity and value, but both imported value and imported quantity seemed to be highly stable. Europe's significant strength as an importer of honey is further supported by its negative trade balance index**,** showcasing a demand for domestic consumption. Europe has very strong positive correlations ranging from 0.952 to 0.990, showcasing Europe's position as a leading player in the global honey market.

Table 3 Strength of monotonic trend of trade indicators of continents during the analysis period

Spearman's Rho test							
	Africa	N America	Asia	Europe	Oceania	S America	World
Exported Quantity	.549**	.332**	.979**	.952**	.449**	.940**	.988**
	0.000	0.008	0.000	0.000	0.000	0.000	0.000
Exported Value	.905**	.937**	.989**	.990**	.981**	.977**	.992**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Unit Export Value	.781**	.968**	.892**	.958**	.970**	.942**	.962**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Import Quantity	.672**	.976**	.984**	.985**	.844**	.510**	.996**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Imported Value	.854**	.985**	.994**	.987**	.952**	.766**	.993**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Import unit value	.837**	.959**	.957**	.952**	.935**	.905**	.964**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000

South America showed a moderate growth in exports and imports over the decades (refer to Figure 1). South America's share in the world honey import is quite low; but in terms of exports, it can outpace all other players. South America has constantly managed a positive trade balance index, supported by a low level of instability as compared to its import values. South America shows weaker correlations in Import quantity, showcasing a potential variability. However, the remaining trade variables exhibit a very strong correlation ranging from 0.766 to 0.977, suggesting South America's position as a leading exporter of honey in the world trade, driven by the high production volumes of Argentina and Brazil.

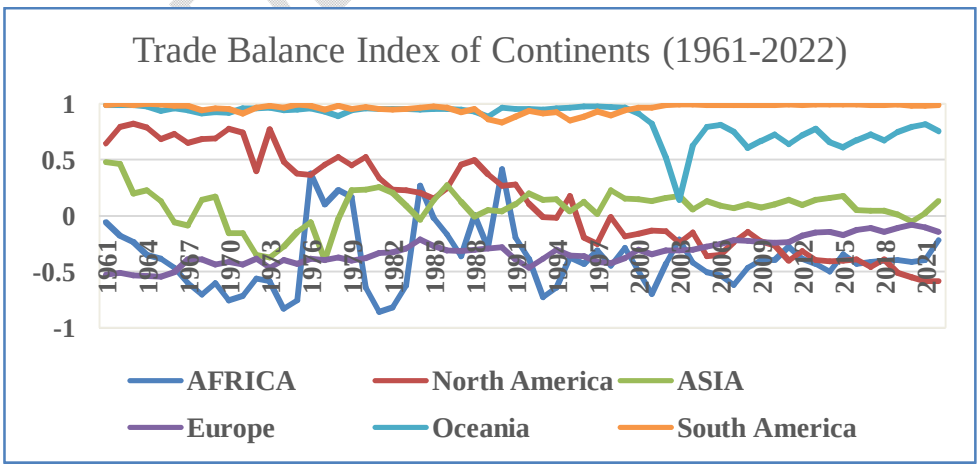

Figure 3 Trade balance index of continents, in terms of honey trade.

Oceania's trade dynamics showed modest growth in exports but significant growth in imports over the decades (refer to Figure 1). Interestingly, Oceania's unit export value skyrocketed 7.43 percent outpacing the numbers of all other continents. It shows rising prices of Oceanian honey primarily driven by the Manuka honey of New Zealand. Oceania consistently maintains positive trade balances as a significant net exporter of honey, particularly with countries like Australia and New Zealand contributing to its trade surplus. However, Oceania's imports seemed to be more stable as compared to its exports. Oceania has a moderate correlation with time in both exported and imported quantities, indicating somewhat less synchronized trade patterns compared to other continents. However other variables displayed a strong positive correlation suggesting a robust monotonic trend.

As is it not possible to study each country engaged in the world trade, identification of the countries with a major share in the world trade of honey is necessary. By summing up the exports and imports of each nation and then dividing it by the total world trade of honey, we can discern the proportional contributions of individual countries to the global honey market over this period. The graphical representation of each country's share is presented in Figure4.

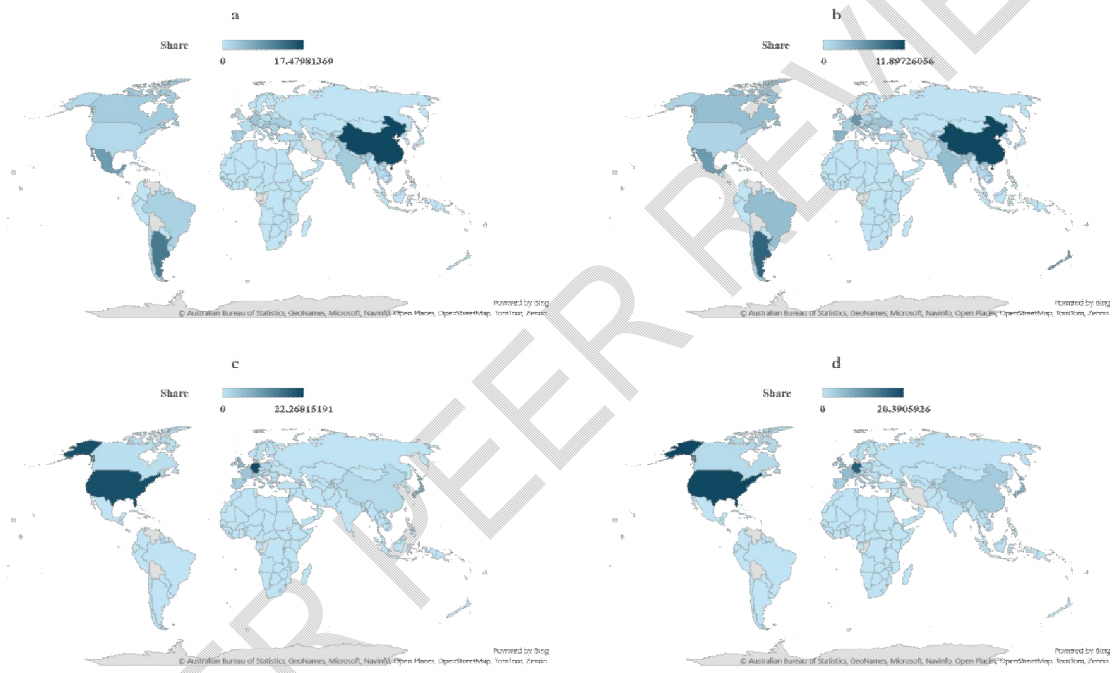

Figure 4 Individual country's share in the world trade of honey a) share in terms of quantity of honey exported, b) share in terms of the value of honey exported, c) share in terms of quantity of honey imported, and d) share in terms of the value of honey imported (source: author's construction).

An analysis of the figure number 4 indicates that the major honey exporting countries along with their share in terms of value of honey exported to the world are China(11.90%), Argentina(9.72%), Germany(6.05%), New Zealand(5.90%), Mexico(5.64%), Hungary(3.83%), Spain(3.82%), Brazil(2.97%), India(2.94%), Canada(2.85%), and major importing countries are USA(20.39%), Germany(17.51%), Japan(7.18%), United Kingdom(6.16%), France(5.28%), Italy(3.64%), China(3.23%), Saudi Arabia(2.89%), Spain(2.89%), and the Netherlands(2.54%). Germany shows its presence in both importer and exporter country lists, indicating the presence of Germany as a major re-exporter of honey. In terms of exported quantity, New Zealand has a very small share (less than 1 percent) in world trade but a significant share in terms of exported value, indicating a high export value of New Zealand-originated honey.China secures its position both as an importer and exporter of honey, while Chinese honey is exported to the globe, honey imports into China are majorly dominated by New Zealand-originated honey. In terms of the quantity of honey imported, Germany has more share as compared to the USA, but in terms of value, the numbers are reversed. During the 1970s, the major honey exports to the world were dominated by Argentina, Mexico, and Hungary (refer to Figure 5 (a)). During this period, the USA and USSR also hold a significant share in global honey exports. With USSR's disintegration and fall of honey

production in the USA, led to the rise of newer players in the world market. Exports by Hungary rose moderately. However, very soon an export trend started from Asia with the rise of China as a major producer and exporter of honey in the first half of the 1980s (refer to Figure 5 (a)). A similar kind of trend was observed in the case of Germany too. During this same period, exports from Spain and New Zealand also saw a rise. In the years, 1971, 1976, and 1979, exports by New Zealand rose more than 150 percent. as compared to their preceding years. In the case of India, honey exports saw a major rise, after the L-P-G reforms of 1991. Before 1991, Indian export numbers were highly fluctuating with frequent years of zero exports. But, in 1993, India's exports rose by almost 7650 percent and the growth trajectory continued since then, with minor fluctuations in following years.

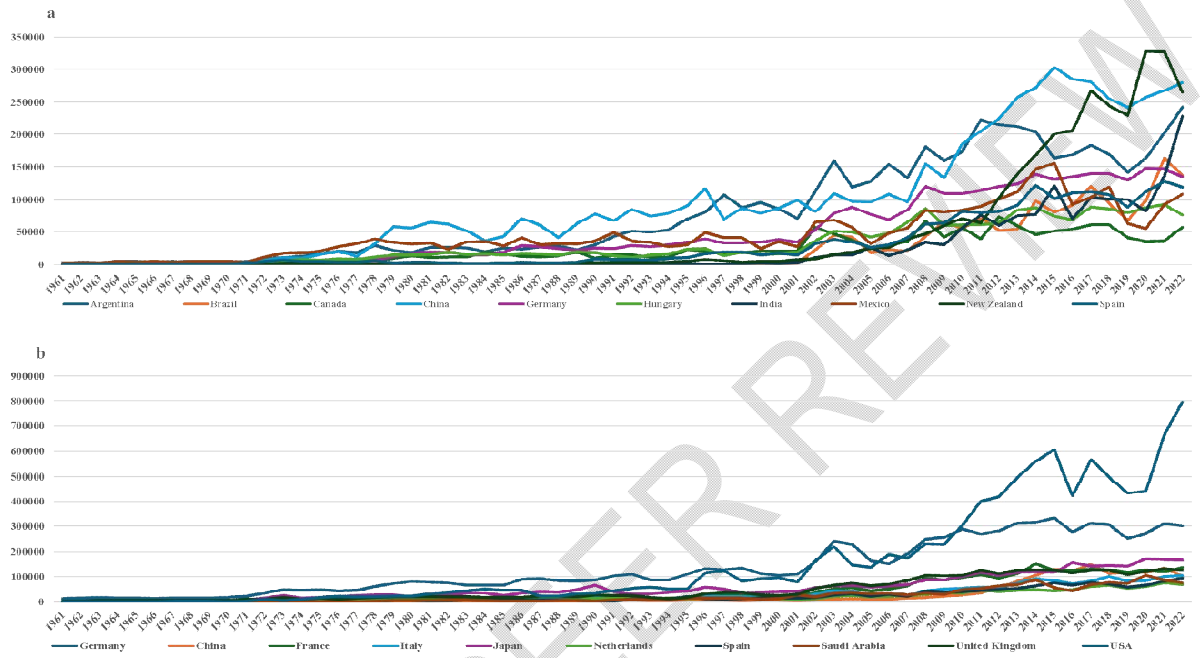

Figure 5 Rise in Trade numbers of major players in the global honey market, a) Major Exporters, b) Major Importers

During the 1960s, the global import of honey was primarily dominated by European countries with Germany, France, and the United Kingdom taking the top spot. In 1979, the import numbers of Spain rose, significantly, and the trend continued since then. Although Germany had the top spot as an importer of honey in 1961, its numbers were overthrown by the USA's import numbers. While Germany's import values grew at an annual rate of 5.46 percent, USA's number grew by 11.27 percent. A similar kind of growth was seen in the case of Asian countries like China and Japan during the latter half of the 1980s. Saudi Arabia's import numbers witnessed a significant rise in 1991 and 2001, and the growth trajectory has continued since then.

4. DISCUSSION AND CONCLUSION

The dynamics of the global honey trade have undergone significant transformations over the period from 1961 to 2022, as evidenced by our longitudinal analysis. This comprehensive study has shed light on various aspects of honey trade, including quantities exported and imported, the value of exports and imports, unit export value, unit import value, trade balance, and the role of different continents and major countries in shaping the global honey market. We found out the degree of instability across trade indicators was more in the first half of the analysis i.e. from period 1961 to 1991, which became stable during the second half of the analysis period, i.e. from 1992 to 2022. It is mainly due to increasing integration of global trade, and certain policy reforms. We found out that the export dynamics of honey are shifting from developed countries to developing countries, with India, China, and Brazil. However, New Zealand is a major exception with its high-value exports, mainly due to high-quality offerings capable enough of fetching higher prices in the international market.

For these developing countries, honey exports can play a significant role in fuelling their economic growth, but inherent problems of the global honey trade need to be identified and carefully solved. First, the production-related issues of the honey trade need to be addressed. Several factors including habitat loss [9], pesticide usage, pest infestation, disease occurrence, and climate change [10] are changing to bee production scenario globally. However, Phiri *et al.* [11] observed a global uptrend in the production of honey and the number of managed bee colonies between 1961 and 2017. This growth is highly prominent in the case of Asia, Africa, South America, and Oceania. This can explain the trade growth also, as observed in our studies.

Phiri *et al.* [11] showed that in the case of North America, the number of bee colonies declined in 2017 as compared to 1961. At the same time, the demand for honey in the US market has surged to its all-time high [12], converting it into the largest importer of honey in the world. The gradual negative trend of the Trade Balance Index, in the case of North America, as observed in our study can be explained by this fact. The honey industry is globally driven by its perceived health benefits, and the market is expected to transform, in the covid pandemic period as well.

Honey is the third most adulterated food in the world [13]. At the same time, the complexity of the honey trade and over-filtration practices is making the detection of origin more difficult. Even the import norms differ from country to country and the lack of global quality norms or grading systems is a major hindrance. While developed countries like New Zealand have successfully created proper certification systems, for their honey, it is very difficult for developing countries to repeat the same due to a lack of competent certifying authorities. Due to a lack of competent authorities capable of distinguishing between superior and lower quality products, firms capable of producing higher quality products are in a disadvantageous position when bargaining for price [14]. Moreover, the cost of measuring honey quality parameters is also a major cause of concern in the case of developing countries.

The study of continents and important countries revealed the emerging trend of honey exports, while all the continents had their important roles to play. The trend analysis of various countries shows the importance of economic integration and policy reforms in improving the trend of honey. From the analysis, it can be safe to say that, from the dominance of European countries in the 1970s to the rise of Asian exporters in the 1980s and beyond, the global honey trade has witnessed dynamic changes driven by various economic, political, and environmental factors.

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