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Study on Growth and Instability of Gum Arabic Export and Import in India

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ABSTRACT

Background: Gum arabic is a vital biopolymer with diverse industrial applications. India presents a paradoxical case: it is a huge net importer, heavily reliant on a few African countries, while simultaneously having a highly volatile export sector. This study analyzes the growth and instability of India's gum arabic trade for uniform strategies to reduce import dependency and harness domestic potential.

Methods: The study analyzed India's gum arabic trade data from 1996-97 to 2024-25, sourced from the Directorate General of Commercial Intelligence and Statistics (DGCI and S). The analysis employed the Compound Annual Growth Rate (CAGR) to measure growth trends and the Cuddy della Valle Index to quantify export and import instabilities in volume and values.

Result: The results reveal a stark contrast. Imports grew steadily (CAGR of 6.45% in volume, 12.83% in value), leading to a soaring import bill. Conversely, exports were highly volatile, with periods of explosive growth (*e.g.*, 113.53% CAGR) followed by sharp decline, It reflected an alarmingly high instability indices (108.46 for export quantity). A promising recent shift towards value-added exports was observed. The findings highlight a critical strategic vulnerability due to import concentration and export instability.

Key words: Export, Growth, Gum arabic, Import, Instability.

INTRODUCTION

Gum arabic (GA), a natural exudate primarily derived from the *Acacia senegal* tree. It is one of the world's oldest and most vital commercial biopolymers, with a documented history of use spanning over five millennia. GA is a key ingredient in the food, pharmaceutical, cosmetic, printing and adhesive industries due to its excellent emulsifying, stabilizing and binding properties (Whistler and BeMiller, 1993). Historically significant-from its use as a pigment binder in ancient Egyptian paints to the embalming of mummies-GA remains critically relevant in modern global markets.

The production of GA is predominantly concentrated in the sub-Saharan African belt, with Sudan being the world's leading producer, renowned for the highest quality output (Balla, 2006; Prasad *et al*., 2022). The commodity plays a multifaceted role in these producing nations: GA is a crucial source of foreign exchange earnings, supports sustainable agro-forestry practices, aids in combating desertification and provides vital socio-economic benefits to rural communities of the producing countries (Karamalla *et al*., 1998; Mukhtar, 2001). The global market for GA has expanded significantly, with average annual exports of crude and semi-processed gum surging from approximately 35,000 tons in 1992-94 to 102,000 tons in 2014-16, valued at an average of $337 million per year during the latter period (Jales, 2018).

In stark contrast to producing nations, India is a net importer of GA, relying heavily on shipments from Sudan and Nigeria to meet robust domestic demand. This import dependency has grown precipitously; from 3,855 tons in 1992, to 47,559 tons in 2016 (Jales, 2018). This growing import bill highlights a significant national vulnerability and a missed economic opportunity. Paradoxically, India possesses substantial potential for domestic GA production. The arid and semi-arid regions consists of 40% of India's geographical area-highly suitable for cultivating *Acacia senegal* (Tewari *et al*., 2017). Notably, vast tracts of untapped *Acacia senegal* trees already exist in regions like arid Western Rajasthan, indicating immense potential for production enhancement through improved tapping methods and resource mobilization.

Promoting *Acacia senegal* cultivation aligns with both environmental and economical Sustainable Development Goals (SDGs). The tree is ideal for bio-fencing, protecting agricultural fields from animal intrusion with its characteristic thorns. When integrated into agro-forestry systems-either as sole plantations (potential yield: ~100 kg/ha/year) or as boundary plantings (~20 kg/ha/year)-it offers farmers an additional income stream while contributing to carbon sequestration and preventing land degradation (Prasad, 2024).

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In the light of economical and environmental potential in India, the development of a domestic GA sector remains underexplored. There is a pressing need to understand the dynamics of India's trade in this commodity to formulate strategies that reduce import dependence and harness domestic capabilities. Among the natural resins and gums, studies on growth and instability of lac production and export have been carried out (Jaiswal *et al*., 2022; Kumar *et al*., 2022; Pal, 2010). The study of instability in production and productivity of Horticultural crops and other crops have been also carried out (Bhuyan and Kokoky, 2023). However, the literature surveyed reveals that such study on GA is lacking. This paper seeks to address this gap by conducting a comprehensive analysis of the growth and instability in India's GA export and import. The study aims to identify key challenges within the GA trade and propose a sustainable way forward. The ultimate objective is to inform strategies that enhance domestic GA production, balancing economic interests with environmental conservation and socio-economic well-being.

MATERIALS AND METHODS

The data on GA trade in India from 1996-97 to 2024-25were collected from the Directorate General of Commercial Intelligence and Statistics (DGCI and S), Kolkata website (https://dgciskol.gov.in). The minimum, maximum, mean values and the volatility of GA export and import and their compound annual growth rate (CAGR) has been computed using the standard methodology. The Annual Compound Growth Rate (ACGR) was worked out by fitting the exponential function given below:

$$Y = a*b^t$$

Where,
Y= The dependent variable (Export or import).
a= Constant term.
b= Regression coefficient.
t= Time variable in years.

The equation is rewritten in the logarithmic form as follows:

$$\text{Log } Yt = \log a + t \log b$$

Where,
Yt= Production or export or import of commodity in the t year.

$$\text{ACGR in \% (r)} = (\text{Antilog of log b-1}) \times 100$$

Where,
r= Compound growth rate per annum (%).

There are various techniques that are used to estimate the instability of export and import, such as coefficient of variation (CV), dispersion, Cuddy della Valle Index (CDVI), Coppock Instability Index, *etc*. But in this study, the Cuddy della Valle Index was used to estimate the instability index of gum arabic export and import in India. A low value of this index indicates low instability in gum arabic export and import and vice versa. CDVI was originally developed by Cuddy and Valle, 1978 for measuring the instability in time series data that is characterized by its trend. It is expressed as follows:

$$IX = CV * (1-r^2)^{1/2}$$

Where,
IX= Instability index.
CV= Coefficient of variance.
r^2= Coefficient of determination from a time-trend regression.

RESULTS AND DISCUSSION

The analysis of India's GA trade from 1996-97 to 2024-25 reveals a complex and dynamic narrative (Fig 1 and 2). It paints a picture of a nation that is a significant and growing net importer of raw gum arabic, reliant on the African "gum belt," while simultaneously developing a volatile but increasingly valuable export sector for processed or re-exported products. This section delves into the trends, growth patterns, inherent instabilities and trading partnerships that define this unique agricultural commodity market.

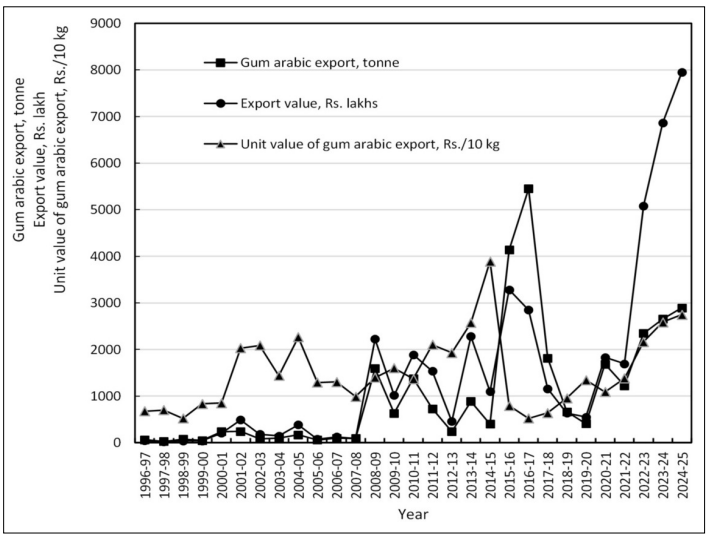


Fig 1: Gum arabic export, total value of export and unit value of export during 1996-97 to 2023-24.

Trend in gum arabic export

The trajectory of India's GA exports is best described as episodic and highly volatile, characterized by dramatic boom-and-bust cycles rather than a steady progression. This volatility is evident in both the quantity exported and the value derived from it (Fig 1).

The initial decade of the data (1996-97 to 2005-06) was a period of low-volume instability. Exports fluctuated wildly, from a mere 26.72 tons in 1997-98 to a peak of 240.52 tons in 2001-02. This phase suggests an immature export market, potentially responsive to isolated international orders rather than sustained demand. The unit value during this time also varied significantly, ranging from Rs. 520.53 to Rs. 2,265.76 per 10 kg, indicating a lack of price standardization and possibly the export of different grades.

A shift occurred from 2008-09 onwards, marking a phase of volume surge to 1,592.04 tons in 2008-09. It reached a peak of 5,450.32 tons in 2016-17. However, this surge presents a paradox. The total export value did not increase proportionally with the volume. For instance, in the peak volume year of 2016-17, the unit value plummeted to Rs. 522.62 per 10 kg, one of the lowest in the entire dataset. This inverse relationship suggests that this boom may have been driven by the export of lower-grade GA or that Indian exporters were leveraging competitive pricing to capture market share, sacrificing unit value for volume.

The recent period, (2021-22 to 2024-25), indicates a potential strategic pivot towards value-driven exports. While volumes have increased remarkably from 1,225.28 to 2,891.78 tons, the most impressive growth is in value. The total export value has more than quadrupled from Rs. 1,694.26 lakhs to Rs. 7,948 lakhs and the unit value increased to Rs. 2,748.48 per 10 kg. This suggests a possible move towards exporting higher-value, processed, or specialized grades of GA that command premium prices on the global market. This trend, if sustained, could significantly enhance the profitability and stability of India's GA export industry.

Trend in import of gum arabic

In stark contrast to the erratic export pattern, India's import trend for GA tells a story of consistent, massive and growing dependency on foreign sources to meet its domestic industrial demand (Fig 2). The scale of imports dwarfs exports, typically by an order of magnitude.

The data reveals a steady upward trajectory in import volume. Starting from 12,921.43 tons in 1996-97, imports have generally climbed, with periods of accelerated growth, particularly between 2005-06 and 2016-17, where volumes exceeded 30,000 and even 46,000 tons. The projected figure for 2024-25 is 44,128.64 tons. This consistent growth is a direct indicator of the expanding industrial base within India-in sectors like food and beverages, pharmaceuticals, printing and cosmetics-that relies on gum arabic as a critical emulsifier, stabilizer and binder.

The most alarming trend within the import data is the exponential rise in cost. The unit value of imports (Rs. per tons) increased from Rs. 16,907.88 in 1996-97 to Rs. 1,10,052.57 in 2024-25. This represents an increase of over 650% in nearly three decades. Consequently, India's import bill has ballooned, reaching a projected Rs. 48,564 lakhs in 2024-25. This soaring cost imposes significant financial pressure on downstream industries within India and negatively impacts the national trade balance for this commodity. Factors behind this rise likely include global inflation, increased international demand, supply chain disruptions and possibly a shift towards importing higher-grade varieties.

Growth in export and import

Analyzing the compound annual growth rates (CAGR) across different periods provides a nuanced understanding of the momentum behind these trade flows, revealing the underlying volatility of exports and the robust, costly growth of imports.

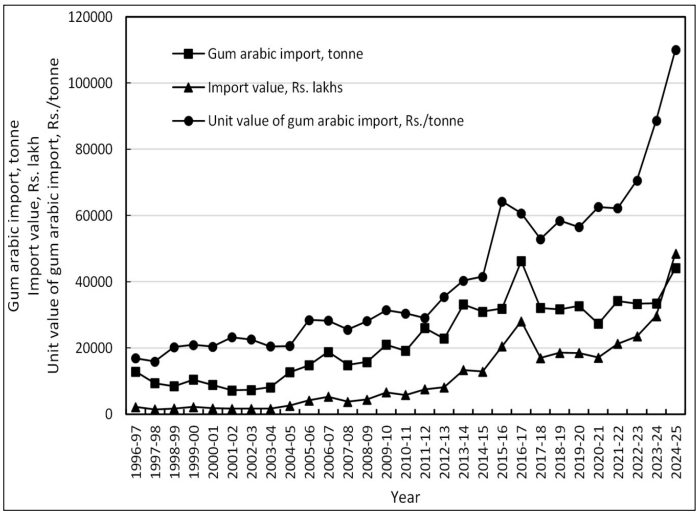


Fig 2: Gum arabic import, total value of export and unit value of export during 1996-97 to 2023-24.

The export growth narrative is one of extreme highs and lows (Table 1). The overall CAGR from 1997-2024 is positive and strong for quantity (16.15% per annum) and value (18.14% per annum). However, this overall figure masks severe period-wise volatility. For example, the period 2006-2010 saw an explosive growth of 113.53% per annum in quantity, followed by a devastating contraction of -48.99% per annum in 2016-2020. This erratic pattern underscores the high-risk environment for exporters, who are likely highly susceptible to global price fluctuations, competition and shifting international demand. The recent period (2021-2024) shows a healthy and more sustainable growth of 22.27% for quantity and a spectacular 65.83% for value, reinforcing the observed shift towards value-added exports.

Conversely, import growth has been remarkably stable and positive (Table 2). The overall CAGRs of 6.45% per annum for quantity and 12.83% per annum for value confirm the steady, inelastic demand from domestic industry. The fact that the value growth is double the quantity growth is directly attributable to the rising unit cost discussed earlier. Periods of negative growth, such as -3.23% for quantity in 2016-2020, are minor deviations in an otherwise consistent upward trend, potentially caused by temporary economic slowdowns or inventory adjustments.

This dichotomy in growth patterns solidifies India's role: it is a stable and growing sink for global gum arabic production, while its export capability, though promising, remains a high-risk, opportunistic venture.

Table 1: Growth in export of gum arabic from India (per cent/annum).

Period	Export quantity	Total export value	Unit value of export
1997-2000	3.19	6.78	3.47
2001-2005	-14.48	0.53	17.56
2006-2010	113.53	124.50	5.13
2011-2015	-20.44	-6.63	17.34
2016-2020	-48.99	-39.78	18.04
2021-2024	22.27	65.83	35.62
Over all 1997-2024	16.15	18.14	1.71

Source: Author's calculation.

Table 2: Growth in import of gum arabic in India (per cent/annum).

Period	Import quantity	Total import value	Unit value of import
1997-2000	-7.03	1.54	9.25
2001-2005	8.86	7.72	-1.04
2006-2010	5.34	7.41	1.96
2011-2015	12.78	23.99	9.93
2016-2020	-3.23	-6.01	-2.87
2021-2024	5.98	19.16	-12.42
Over all 1997-2024	6.45	12.83	5.99

Source: Author's calculation.

Instability in gum arabic export and import

The instability indices quantify the risk and uncertainty embedded in India's gum arabic trade, confirming that exports are a far riskier enterprise than imports.

Export instability is exceptionally high (Table 3). The overall instability indices for export quantity (108.46) and value (91.07) are alarming. The period 2006-2010 was particularly turbulent, with an index of 102.91 for quantity, coinciding with the volume surge. This high level of instability poses a major challenge for policymakers and exporters alike, making it difficult to forecast earnings, invest in capacity and formulate long-term strategies. It suggests vulnerability to external shocks beyond India's control.

Import instability, while significant, is considerably lower than for exports (Table 4). The overall instability index for import quantity is 22.67, indicating a relatively stable and predictable demand stream. However, the instability for import value is higher (37.33), driven almost entirely by volatility in global prices rather than quantity. For Indian industries, this means that while the physical supply of raw material is relatively assured, its cost is a major variable that can impact profitability. The lower instability in quantity reflects the essential nature of gum arabic as an industrial input.

Table 3: Instability in the export of gum arabic from India.

Period	Export quantity		Total export value		Unit value of export	
	CV (%)	Instability index	CV (%)	Instability index	CV (%)	Instability index
1997-2000	40.05	39.99	31.6	30.99	18.86	17.99
2001-2005	43.79	34.81	52.75	52.75	33.67	26.76
2006-2010	133.27	102.91	132.77	98.42	16.77	14.40
2011-2015	61.50	47.35	48.66	47.80	25.57	9.14
2016-2020	88.72	43.03	75.62	24.29	37.65	24.57
2021-2024	32.55	19.23	65.57	22.33	38.28	6.39
Over all 1997-2024	134.25	108.46	126.11	91.07	46.88	45.02

Source: Author's calculation.

Table 4: Instability in the import of gum arabic in India.

Period	Import quantity		Total import value		Unit value of import	
	CV (%)	Instability index	CV (%)	Instability index	CV (%)	Instability index
1997-2000	18.53	15.39	18.20	18.12	13.34	6.78
2001-2005	25.45	20.17	21.92	17.15	6.24	6.00
2006-2010	16.05	13.53	22.83	19.04	7.36	6.61
2011-2015	21.65	11.42	35.26	12.75	15.89	5.46
2016-2020	18.13	17.15	21.46	18.75	7.27	5.51
2021-2024	9.98	7.07	22.88	4.10	17.44	7.50
Over all 1997-2024	50.69	22.67	88.22	37.33	51.38	19.30

Source: Author's calculation.

Table 5: Ten major export destination of gum arabic from India during 2024-25.

Country	Export quantity, kg	Value of export, Rs. in lakhs
Russia	1181208	3237
Indonesia	314600	1010
France	193028	597
UAE	168135	325
Nepal	133678	200
Australia	99654	286
Turkey	95034	252
U s a	83803	254
Germany	63484	153
Spain	60301	186
Others (75)	498862	1448
Total	2891787	7948

Table 6: Ten major countries from where India imported gum arabic during 2024-25.

Country	Import quantity, kg	Value of import, Rs. in lakhs
Mali	14848193	14946
Sudan	11495596	12997
Senegal	9784196	9616
Chad	5543475	5759
Cameroon	1045350	959
Nigeria	434550	348
France	378539	2423
Kenya	198000	239
Ireland	90000	499
Benin	80497	053
Others (23)	230244	725
Total	44128640	48564

Exporting and importing countries during 2024-25

The direction of trade in 2024-25 offers a clear snapshot of India's strategic position in the global gum arabic network.

India's export destinations are diverse, spanning Europe, Asia and the Middle East (Table 5). The top ten countries account for the majority of the Rs. 6500 lakhs export value. Russia stands as the largest market (1,181,208 kg, Rs. 3237 lakhs), followed by Indonesia and European nations like France and Germany. This geographical spread indicates that Indian exports meet quality standards required by sophisticated markets and are used in a variety of applications, from food in Europe to industrial uses in Russia and Southeast Asia.

The picture for import sources is one of extreme concentration and strategic vulnerability. India's supply is overwhelmingly dominated by the African "gum belt" nations. Mali (14,848 tons), Sudan (11,496 tons) and Senegal (9,784 tons) together supply over 80% of India's import volume (Table 6). This heavy reliance on a geographically concentrated region, often prone to political instability, climate change impacts and economic volatility, presents a major strategic supply chain risk. Any disruption in these countries could severely impact Indian industries dependent on GA, leading to shortages and price spikes.

In conclusion, India's GA trade is defined by a critical dependency on raw material imports from a volatile region, leading to an increasing import bill, juxtaposed with a promising but high-risk export sector that is showing signs of moving up the value chain. The key challenges lie in mitigating the supply chain risks associated with imports and stabilizing the export sector to harness its full potential for generating foreign exchange. Strategic initiatives could include exploring sustainable domestic cultivation, diversifying import sources and adding value to exports through processing and quality certification to reduce volatility and enhance earnings.

Way forward

The data in Fig 2 and Table 2, indicates that there is a huge demand for GA in India, which is not met by its own production. The wide gap in the demand-supply is overcome by a large scale import of of GA. Approximately 40% of its geographical area in India consists of arid and semi-arid regions, which are highly suitable for cultivating *Acacia senegal* (Tewari *et al*., 2017). Notably, vast tracts of untapped trees already exist in regions like arid Western Rajasthan, indicating immense potential for

production enhancement through improved tapping methods and resource mobilization. Beyond economic benefits, promoting *Acacia senegal* cultivation aligns with environmental goals. The tree is ideal for bio-fencing, protecting agricultural fields from animal intrusion with its characteristic thorns. When integrated into agro-forestry systems-either as solid plantations (potential yield: ~100 kg/ha/year) or as boundary plantings (~20 kg/ha/year)-it offers farmers an additional income stream while contributing to carbon sequestration and preventing land degradation (Prasad, 2024). Despite this clear potential, the development of a domestic gum arabic sector in India remains underexplored. There is a pressing need to understand the dynamics of India's trade in this commodity to formulate strategies that reduce import dependence and harness domestic capabilities.

CONCLUSION

The study concludes that India's GA trade is defined by a critical and costly import dependency juxtaposed with a high-risk, opportunistic export sector. The relentless growth in import volume and value underscores strong domestic industrial demand but also exposes the economy to global price shocks and supply chain vulnerabilities, given the extreme concentration of sources in geopolitically volatile regions. Meanwhile, the export market, though showing a promising recent shift towards higher-value products, is characterized by severe instability, making it an unreliable source of foreign exchange.

A strategic shift is necessary to address the challenges in GA. First, India must aggressively pursue domestic production by leveraging its extensive arid and semi-arid lands suitable for *Acacia senegal* cultivation, both through new plantations and improved tapping of existing trees. This would provide import substitution, enhance rural livelihoods and offer environmental benefits. Second, policy efforts must focus on stabilizing the export sector by encouraging processing, quality grading and certification to move up the value chain, thereby reducing volatility and increasing earnings. Diversifying import sources and building strategic reserves could further mitigate supply risks. A concerted effort towards domestic production and a value-driven export strategy is essential for achieving a sustainable and secure gum arabic trade balance.

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Disclaimers

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Author contributions

Niranjan Prasad: Writing -original draft, review, editing, supervision of study and funding acquisition; S.C. Sharma: Data collection, writing -original draft; and M.S. Udaykumar: Data analysis.

Data availability

Information will be provided upon request.

Declaration of generative al and AI-assisted technologies in the writing process

No generative AI or AI-assisted technologies were used during the preparation of this work.

Declaration

I declare that the manuscript has not been published in any journal/book or proceedings or in any other publication, or offered for publication elsewhere in substantially the same or abbreviated form, either in print or electronically.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

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