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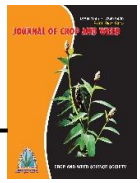

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Revealed comparative advantage analysis of trade of Indian silk and silk products

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ABSTRACT

The silk industry was spread over 60 countries in the world and it contributes to 0.2% of the global textile market. The competitiveness of the Indian silk industry during 2011 to 2021 was examined using the framework of Revealed Comparative Advantage (RCA). It was found that there was comparative advantage in the exports of silk yarn, silk waste and yarn spun from silk waste and fabrics woven with silk. India was not competitive in the exports of raw silk not thrown and silk as indicated by the negative values of Revealed Symmetric Comparative Advantage (RSCA). As the importing countries Gross Domestic Product (GDP) increases, the possibility of trade enhancement increases from India. Hence, to become globally competitive, India needs to focus on exports of silk products to the selective markets based on the comparative advantage. It will lead to revival of growth in silk exports.

Keywords: Advantage, Competitiveness, Exports, Silk

Competitiveness is the capability to tackle the competition while trading the products that meet the world demand, and along with safeguarding the profits (Turi *et al*., 2014). Competitiveness is a relative measure, as it may be within the domestic markets or between the international markets (Ariyawardana and Collins, 2013). The comparative advantage was defined based on the opportunity cost theory and hence, it is stated as the comparative cost (Haberler, 1936). The concept of Revealed Comparative Advantage (RCA) was introduced to measure comparative advantage depending on the performance of trade structure (Balassa,1965). It was concluded that the country's trade pattern imitates the input legacies changes and costs relativeness, which gives the advantage comparatively. The cereal producers were found to be competitive in both the global market and European Union. India has relative advantage in export of processed products (Andhale and Kannan, 2015). India was competitive in exports of cabbage, potato, tomato and onion, among which cabbage was the highest export competitive crop (Pal *et al*., 2015). India has comparative advantage in production and export of cotton during 1996 to 2011 (Sharma and Bugalya, 2014). Trade of wheat from India was advantageous compared to its competitors (Ranjini *et al.*, 2017). During 1988 to 2014, Malaysia documented high RCA indices for oilcake and other solid residues of oil from palm nuts or kernel; palm oil, refined, and its fractions and palm kernel or babassu oil, refined, and fractions thereof; as compared to other agricultural commodities (Liew *et al.*, 2021). Pakisthan had revealed comparative advantage in export of mangoes, citrus and dates during 2001-2018 (Ahmad *et al*., 2021). During 2007-2016, Morocco, Spain, pakisthan, Turkey and Peru had comparative advantage in the exports of Mandarin (Rehman *et al.*, 2019). India had competitive advantage in international trade of coconut, copra, and activated carbon (Narmadha and Karunakaran, 2022).

During 2021-22, 34,903 tonnes of silk was produced in India, standing second in position next to China. The sericulture industry in India is unique with its high employment scope and less investment. Sericulture was proven to provide the remunerative income to the farmers. The silk production was spread over 60 countries across the world, yet it contributes to less than 0.2% of the global textile market.

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Among the countries involved in production of silk, China contributes to 56.84% followed by India with 41.03% of the global silk production. The major silk consuming countries were USA, Italy, Japan, India, France, China, United Kingdom, etc. (Central Silk Board, 2023). Trade between the countries is determined by different factors which are both internal and external. In international trade, the impact on exports by these variables is widely examined by using the gravity model. Therefore, the competitiveness of the Indian silk industry was analysed with two objectives:

i) to assess the export competitiveness of the Indian silk and silk products (ii) to evaluate the different variables effect on silk products exports.

MATERIALS AND METHODS

The natural silk yarn, silk-fabrics, and made-ups silk carpet, readymade garments and silk waste were the silk products being exported from India. The products exported according to the Harmonized System Code (HS code 50) classification during 2011 to 2022 was estimated using the framework of RCA and Revealed Symmetric Comparative Advantage (RSCA) index. The exports quantity and value were collected and compiled from various secondary sources such as annual reports of the Central Silk Board, United Nations Comtrade database, publications of the Food and Agriculture Organization of the United Nations (FAOSTAT).

Revealed Comparative Advantage (RCA)

The Revealed Comparative Advantage index measures the comparative advantage in exports of a country. It reveals trade advantage and disadvantage of the countries in trade. The RCA index is used in international economics for calculating the relative advantage or disadvantage of a certain country in a certain class of goods or services (Granabetter, 2016). It is calculated as per the formula presented in equation 1.

$$RCA_{jk} = \frac{\frac{X_{jk}}{X_j}}{\frac{X_{kw}}{X_w}} = \frac{S_{it}}{S_{wt}} \text{.....(1)}$$

Where,

X_{jk}= India's (j) export of silk product k

X_j= India's (j) total silk and silk products export

X_{kw}= Exports of silk product k in world

X_w= Total silk and silk products exports w to world

RCA value lies between 0 and ∞. A country is said to have a comparative advantage if the value exceeds 1 and vice-versa.

Revealed Symmetric Comparative Advantage (RSCA)

The RCA index is asymmetric, as it ranges from zero to infinity (Chaitra and Sonnad, 2024). It is a major limitation of RCA. In order to reduce the skewness problem, the RSCA index is employed (Dalum *et al.*, 1998). It can be calculated by the following formula:

$$RSCA = \frac{(RCA-1)}{(RCA+1)} \text{.....(2)}$$

The RSCA value lies between -1 and +1. The positive value of index confirms the advantage while the negative value reflects the disadvantage comparatively.

Bilateral Revealed Comparative Advantage Index (BRCAI)

The Bilateral RCA analyses selected comparator country exports with another country. It shows for which product, a country has revealed comparative advantage, relative to another country. It compares the global trade of country *i* to country *j* (Jones and Bethmann, 2023). The Bilateral RCA is calculated using formula:

$$\text{Bilateral Revealed Comparative Advantage } {}^{k}_{ijw} = \frac{\frac{x^k_{iw}}{X_{iw}}}{\frac{x^k_{jw}}{X_{jw}}} \text{..(3)}$$

Where,

X^k_{iw}= India's (i) export of silk product (k) to world (w)

X_{iw}= India's (i) total silk and silk products export to world (w)

X^k_{jw}= Comparative country's (j) export of silk product (k) to world (w)

X_{jw}= Comparative country's (j) total silk and silk products export to world (w)

Bilateral RCA has the same formula as for the RCA, but where trade with the world is compared country j's trade with the world. Like the RCA, the BRCA1 can also be computed in a normalised form.

Factors influencing the India's exports of silk and silk products

i. The international trade gravity model

To assess various factors influencing the exports of various silk products from India, the gravity model was employed. This model is widely used to validate theoretical hypotheses besides explain bilateral trade. In international economics, it is one of the utmost effective empirical models (Anderson, 1979). The gravity model in its standard form states that the trade is influenced negatively through the distance between the two countries and positively by the country's Gross Domestic Product (GDP).

This model was improved with more variables to assess the relevance in elucidation of the trade between different countries (Zarzoso *et al.*, 2003). The model in its linear form is presented as below:

$$\ln X_{ij} = \alpha + \beta \ln Y_i + \gamma \ln Y_j - \delta \ln D_{ij} \text{ ..... (iv)}$$

Where,

Y_i and Y_j denote national incomes of the trading countries and

D_{ij} are the distance between the two countries.

Though this model provides relatively good results, there are some other factors influencing the trade. Hence, to capture the contiguity effects, historical and cultural similarities, trade preference agreements and regional integration, other trade policies and so on, the dummy variables were employed.

To analyse the silk and silk products exports of India, the following gravity model was employed:

$$\ln X_{ijt} = \alpha + \beta_1 \ln Y_{jit} + \beta_2 \ln Y_{jipct} + \beta_3 \ln D_{ij} + \beta_4 \ln ER_{jt} + \beta_5 \ln TO_{ij} + \mu \quad \ldots\ldots\ldots (v)$$

Where,

i denote the exporter (India),

j gives the trading partners (importers)

t provides the period considered.

Other than the dummy variables, the variables are provided in the form of natural logarithm.

Total trade (export and import) of j^{th} importing country is divided with GDP of that country to estimate trade openness.

The table 1 provides the variables description along with their signs expected.

Table 1: Variables employed in the gravity model and their description

Code assigned	Variable details	Unit of the variable	Expected sign
$\ln X_{ijt}$	X is the export, *i* refers to the silk products to the j^{th} country at time t	Million USD	
$\ln Y_{jit}$	j^{th} country GDP at time t	Million USD	+
$\ln Y_{int}$	i^{th} country (India) GDP at time t	Million USD	+
$\ln D_{ij}$	i^{th} country (India) and j^{th} importing country's aerial distance with reverence to their capital	Kilometer	-
$\ln T_{ojt}$	T_{ojt} indicates the trade openness	Million USD	+
β_i	Coefficients of the explanatory variables	-	-
μ_i	Error-term	-	-

The framework of gravity model and procedure of estimation

Fundamentally, the gravity model of international trade is a technique involving panel data. In present scenario, it is extensively employed in analyzing the socio-economic aspects, performance of trade and others. Hence, the gravity model of international trade was assessed by employing balanced panel data of 7 major countries involved in trade of the silk products. The panel data were analyzed as discussed below.

i. Pooled Ordinary Least Square

The pooled OLS results were obtained by regressing the panel data by pooling all the observations (both cross-sectional and time series). It was assumed that for all the countries, there is constant and same regression coefficient. By pooling the observations, there might the correlation between the error term and regressors by violating the Classical Linear Regression Model (CLRM) assumption resulting in a biased and inconsistent estimation (Gujarati, 2012). Even, the unobserved, time invariant variables and regressor might also correlate leading to autocorrelation. If the individual effects are correlated (α_i) with regressor (X_i), FEM was employed, otherwise the REM was used.

ii. Fixed Effects Model

The fixed effect replicates that the intercept may differ across countries and time invariant (Gujarati, 2012). The intercept variation for different countries might be owed to the geography, socio-economic conditions *etc*. It was assumed that there is correlation between regressor (X_i) and individual specific effects (α_i) (Hatab *et al*., 2010).

iii. Random Effect Model

This is also termed as Error Component Model (ECM) and was analyzed using the Generalized Least Squares (GLS). Under the REM, the individual unit intercept is random and from its mean value it is deviated (Gujarati, 2012). It was assumed that the regressor (X_i) and specific effects of individual (α_i) are not correlated. If they are found to be correlated, then REM result will be inconsistent. The error term considers the individual specific effects (α_i). The error component comprises of two terms such as the individual specific error or cross-section and idiosyncratic term indicating the combined time series and cross-section error.

Hausman's Specification test was employed to select FEM or REM under null hypothesis stating that the REM was suitable and it is rejected (*i.e.* p-value is less than 0.05) otherwise FEM is appropriate. To select the model among the REM and pooled OLS, Breusch-Pagan Lagrange Multiplier test (LM test) was employed assuming null hypothesis that pooled OLS is preferred over the REM.

RESULTS AND DISCUSSION

Exports and imports of silk products

In the world, India stands third in position to export the textiles and apparel. The textile industry plays a vital role in bolstering the economy of the nation. In the fiscal year 2021-22, the textile and apparel sector accounted for 10.5% of India's overall merchandise share. India's contribution to global trade in textiles and apparel stands at 4.6%.

The export dynamics of Indian silk and silk products were investigated with the quantity and earnings of exports during 2011-12 to 2021-22. The status of exports and imports of the silk products are presented in Table 2. In the fiscal year 2021-22, the export value of silk products from India amounted to USD 95,000, representing 0.02% of the nation's total export earnings. During 2011-12 to 2021-22, the proportion of silk imports to total imports has decreased from 0.067% to 0.037%. The quantity of imports of raw silk in the last decade reduced substantially from 4959 tonnes during 2011-12 to 1978 tonnes during 2021-22. The production of import substitute bivoltine silk was increased to satisfy the increasing domestic demand in the country.

Table 2: India's exports and imports of silk and silk products during 2011-12 to 2021-22

Year	Total national exports (USD 000)	National silk exports (USD 000)	Share of the silk exports to total national exports (%)	Total national imports (USD 000)	National silk imports (USD 000)	Share of the silk imports to total national imports (%)	Import of the raw silk (t)
2011-12	289565	164	0.056	488976	326	0.067	4959
2012-13	336611	164	0.049	466046	236	0.051	3260
2013-14	317545	141	0.044	459369	219	0.048	3489
2014-15	263889	111	0.042	390799	201	0.051	3529
2015-16	260964	91	0.035	356686	209	0.059	3795
2016-17	295862	77	0.026	443853	251	0.056	3712
2017-18	323998	83	0.026	509273	209	0.041	2785
2018-19	323251	84	0.026	478884	211	0.044	3315
2019-20	275489	82	0.030	367980	111	0.030	1804
2020-21	394814	117	0.030	570402	136	0.024	1978
2021-22	452684	95	0.021	732566	274	0.037	1377

Source: United Nations Comtrade database

A brief glance of the RCA and RSCA estimates would throw light on the details of export competitiveness of silk of India. The RCA value of higher than one designates that there is competitiveness of the country and a lower value indicates the relatively disadvantageous position. The results of the silk products exported from India during 2011 to 2022 are provided in Table 3. The RCAs of silk trade in India revealed that RCA patterns vary across different silk products exported, although the inter-product factor intensified. A positive RCA value indicates that the country specializes in and has a comparative advantage in exporting silk products, whereas a negative value suggests otherwise. The positive values of RCA inferred that among the silk products, silk yarn along with yarn spun from silk waste, silk waste and woven fabrics were found to have the comparative advantage during 2011 to 2022. But, the lower value of RCA for silk waste indicates the relatively disadvantageous position. The RCA index of silk waste increased from 9.72 during 2011 to 13.53 during 2022. RCA index of woven fabrics was found to be decreasing over the period of time and it was 2.50 in the year 2022. For silk yarn and yarn spun from silk waste, RCA values showed increasing trend during 2014 to 2022. RCA index of cocoons has decreased from 0.18 during 2011-12 to 0.01 during 2022-23 as the quantity of cocoons exported was very meagre of the total exports of silk products.

Table 3: Year-wise Revealed Comparative Advantage of silk and silk products during 2011-12 to 2021-22

Year	Cocoons (5001)	Raw silk not thrown (5002)	Silk waste (5003)	Silk yarn (5004)	Yarn spun from silk waste (5005)	Silk yarn and yarn spun from silk waste (5006)	Woven fabrics (5007)	Overall silk products
2011	0.18	0.09	9.72	0.41	1.17	3.31	6.27	0.22
2012	0.32	0.09	11.47	0.27	0.58	1.55	4.39	0.30
2013	0.25	0.09	12.77	0.10	1.12	1.52	3.85	0.34
2014	0.26	0.04	10.96	0.24	0.99	4.13	3.75	0.34
2015	7.21	0.04	11.93	0.17	0.73	6.75	3.84	0.35
2016	0.75	0.01	13.40	0.09	0.55	4.38	3.41	0.39
2017	0.12	0.02	10.59	0.06	0.67	6.36	3.06	0.46
2018	0.03	0.03	11.47	0.09	1.22	5.99	2.85	0.44
2019	0.05	0.02	9.68	0.05	1.00	4.68	3.25	0.41
2020	0.11	0.05	12.78	0.10	1.96	6.39	5.54	0.24
2021	5.84	0.35	14.02	0.54	1.35	6.00	5.23	0.23
2022	0.01	0.13	13.53	0.26	0.63	5.72	2.50	0.44
Avg	0.21	0.08	11.86	0.20	1.00	4.73	4.00	0.35

The RSCA estimates of India's silk and silk products exports are presented in Table 4. It was found that India was not competitive in exports of silk yarn, raw silk not thrown, silk during the study period as the values of RSCA were negative. India was found to be competitive in the exports of silk waste, woven fabrics and "silk yarn and yarn spun from silk waste". On an average, the RSCA of yarn spun from silk waste was zero; hence, it could be competitive by focusing on the level of production and cost involved. Over the years, its comparative advantage and competitiveness seems to be worsening. The trade policies of a country, including government interventions, import restrictions, subsidies, and tariffs, both domestically and internationally, can significantly impact trade. A disadvantageous situation may imply that the trade policies are not conducive to the export of the commodity.

Table 4 : Year-wise silk and silk products Revealed Symmetric Comparative Advantage during 2011-12 to 2021-22

Year	Cocoons (5001)	Raw silk not thrown (5002)	Silk waste (5003)	Silk yarn (5004)	Yarn spun from silk waste (5005)	Silk yarn and yarn spun from silk waste (5006)	Woven fabrics (5007)	Overall silk products
2011	-0.70	-0.83	0.81	-0.42	0.08	0.54	0.72	-0.65
2012	-0.52	-0.84	0.84	-0.57	-0.26	0.22	0.63	-0.54
2013	-0.60	-0.84	0.85	-0.81	0.06	0.21	0.59	-0.49
2014	-0.59	-0.92	0.83	-0.61	-0.01	0.61	0.58	-0.49
2015	0.76	-0.92	0.85	-0.71	-0.15	0.74	0.59	-0.49
2016	-0.14	-0.98	0.86	-0.83	-0.29	0.63	0.55	-0.44
2017	-0.78	-0.97	0.83	-0.89	-0.20	0.73	0.51	-0.37
2018	-0.95	-0.95	0.84	-0.83	0.10	0.71	0.48	-0.39
2019	-0.91	-0.97	0.81	-0.91	0.00	0.65	0.53	-0.42
2020	-0.81	-0.91	0.85	-0.81	0.33	0.73	0.69	-0.62
2021	0.71	-0.48	0.87	-0.30	0.15	0.71	0.68	-0.62
2022	-0.97	-0.78	0.86	-0.58	-0.23	0.70	0.43	-0.39
Avg	-0.66	-0.85	0.84	-0.67	0.00	0.65	0.60	-0.49

Among the silk products exported, which were found to be competitive based on the RCA values such as the woven fabrics, "the silk yarn and yarn spun from silk waste" put up for retail sale; silkworm gut and silk yarn (excluding that spun from silk waste and that put up for retail sale), bilateral RCA with the competing country in global exports are presented in Table 5. For exports of woven fabrics, high competitiveness was found with France (2.20) and China (1.12). Exports of silkworm gut (5006), silk yarn and yarn spun from silk waste, put up for retail sale; were competitive with all the competing countries like China (12.37), Japan (4.07), Germany (3.21) and Italy (1.26). Silk yarn was not competitive in the global trade as revealed from the positive and lower RCSA values.

Table 5: The Bilateral RCAI of major silk products during 2011-12 to 2021-22

Year	Woven fabrics of silk or of silk waste (5007)			Silk yarn and yarn spun from silk waste, put up for retail sale; silkworm gut (5006)				Silk yarn [excluding that spun from silk waste and that put up for retail sale] (5004)			
	China	Italy	France	Germany	China	Japan	Italy	China	Romania	Italy	Brazil
2011	1.45	1.20	4.68	1.58	2.55	1.29	0.81	0.09	0.01	0.16	0.07
2012	1.00	0.78	3.05	1.06	2.85	0.92	0.38	0.08	0.00	0.09	0.04
2013	0.95	0.64	1.97	2.82	11.47	5.95	1.14	0.03	0.00	0.04	0.01
2014	0.97	0.64	1.72	4.17	15.01	6.04	1.17	0.09	0.00	0.08	0.03
2015	1.10	0.63	1.96	6.60	32.75	11.33	1.17	0.07	0.00	0.06	0.02
2016	0.95	0.56	1.75	2.50	9.64	4.26	0.64	0.03	0.00	0.03	0.01
2017	0.81	0.48	1.84	3.64	10.20	6.07	1.04	0.02	0.00	0.02	0.01
2018	0.72	0.45	1.58	3.16	8.09	3.86	1.60	0.04	0.00	0.03	0.01
2019	0.87	0.50	1.65	3.20	7.98	2.28	2.59	0.02	0.00	0.01	0.00
2020	2.10	0.76	2.34	3.76	14.69	2.54	1.30	0.05	0.00	0.03	0.01
2021	1.75	0.76	2.64	3.12	16.58	2.82	1.35	0.30	0.01	0.15	0.05
2022	0.78	0.35	1.27	2.96	16.65	1.52	2.00	0.12	0.00	0.06	0.03
Avg	**1.12**	**0.65**	**2.20**	**3.21**	**12.37**	**4.07**	**1.26**	**0.08**	**0.00**	**0.06**	**0.02**

The export price elasticity of Indian silk and silk products

The coefficients and their robust standard errors estimated using gravity model are presented in Table 6. The Breusch-Pagan LM test was conducted to assess the suitability of pooled OLS and FEM. At a significance level of 1%, the null hypothesis was rejected, suggesting that an individual specific effect model was superior to

the pooled model. The Hausman specification test was performed with the null hypothesis favoring the Fixed Effects Model (FEM). The rejection of the null hypothesis indicated that individual or country-specific effects and regressors were correlated. With a p-value less than 0.01, the null hypothesis was rejected, indicating that the Hausman test favored the Fixed Effects over the Random Effects model.

Table 6: Estimates of the gravity model for exports of silk and silk products from India

Variable	Pooled OLS		Fixed Effect Model		Random Effect Model	
	Coefficient	P value	Coefficient	P value	Coefficient	P value
Constant	10.76*** (1.89)	0.000	6.24*** (1.72)	0.000	3.08** (1.55)	0.04
lnY_{jit}	0.40*** (0.10)	0.000	1.85 *** (0.14)	0.000	1.59*** (0.14)	0.000
lnY_{int}	-1.11 *** (0.13)	0.000	-1.69*** (0.10)	0.000	-1.59*** (0.10)	0.000
lnD_{ij}	0.00*** (0.00)	0.000	-0.01*** (0.00)	0.000 (0.02)	-0.0003*** (0.04)	0.000
lnT_{ojt}	1.50 *** (0.30)	0.000	0.32** (0.28)	0.03	0.60* (0.34)	0.07
F test	24.84***	0.000	107.57***	0.000	246.15***	0.000
No. of observation	140		140		140	
Adjusted R^2	0.40		0.71		0.69	
Breusch and Pagan LM test	-		62.53***	0.000	-	
Hausman test	-		1169***	0.000	-	

*Note: Significance levels are denoted as ***, **, and *, representing significance at the 1%, 5%, and 10% levels, respectively and the robust standard errors were denoted within parentheses.*

According to the Fixed Effects (FE) model, the GDP of the importing country exhibited a positive and significant relationship, with a coefficient of 1.85. This suggests that a 1% increase in the GDP of the importing country is associated with a 1.85% increase in the export of silk and silk products from India. Consequently, with the rise in the GDP of importing countries, there is a greater potential to enhance trade from India. 'Increased GDP of importers implies more demand for goods to fulfil the excess demand, thereby enhanced the trade from India (Ebaidalla and Awad, 2015). The coefficients for India's GDP in the export of silk and silk products were negative (-1.69) and statistically significant at the 1% level of probability. With increase in 1% of GDP, the exports decreased by 1.69%, which indicates that the growth in GDP of India had resulted decrease in total trade value of silk and silk products. As, there is high domestic demand of silk, the increase in affordability of silk products could enhance the domestic consumption, thereby decrease in international trade.

The coefficient of trade openness for the importing country, which was statistically significant and positive at 0.32%, aligns with theoretical expectations. The higher trade ratio suggests that the country's economy is more integrated into the world market. By removing trade restrictions and adopting liberal policies, the economy becomes more open to external markets, leading to an expansion of economic activities and an increase in foreign investment.

Based on the Breusch-Pagan LM test, for time-invariant variables the Fixed Effects (FE) model was preferred. As expected, the coefficient of the distance variable was found to be negative (-0.01) and statistically significant. The distance variable between the two countries serves as an alternative measure for transportation costs, impacting the trade of the exporting country negatively. A negative distance coefficient implies that as the distance between the exporting and importing countries increases, it reduces the quantity to be exported. Therefore, the country may increase its exports with adjacent countries by reducing transportation costs. Hence, the hypothesis suggesting an inverse relationship between the GDP of the importing country and the demand for Indian silk and silk products was accepted.

The study has determined the existence of comparative advantage of exporting silk and silk products. Mangoes, citrus and dates are found to have revealed comparative advantage during entire study period with highest values of these indices. Onions and potatoes also showed comparative advantage but with lower values and also showed revealed comparative disadvantage in some years. Increased openness of the economy to external markets through the removal of trade restrictions and adoption of liberal policies leads to expanded economic activities and stimulates foreign investment. To become globally

competitive, India would need to focus on consolidating domestic industry for scale efficiency, and addressing target exports of silk goods to selective markets based on comparative advantage which leads to revival of growth in silk exports. The domestic demand and supply assessment is also required to tap the existing potential for India to become a global leader by increasing the silk production. Export promotion of Indian silk/silk products is to be done through market research and selection, brand strategy, pricing and trading terms, sales and distribution.

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