

The Knitwear Capital Of India: An In-Depth Analysis Of Tirupur Textile Industry

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Abstract

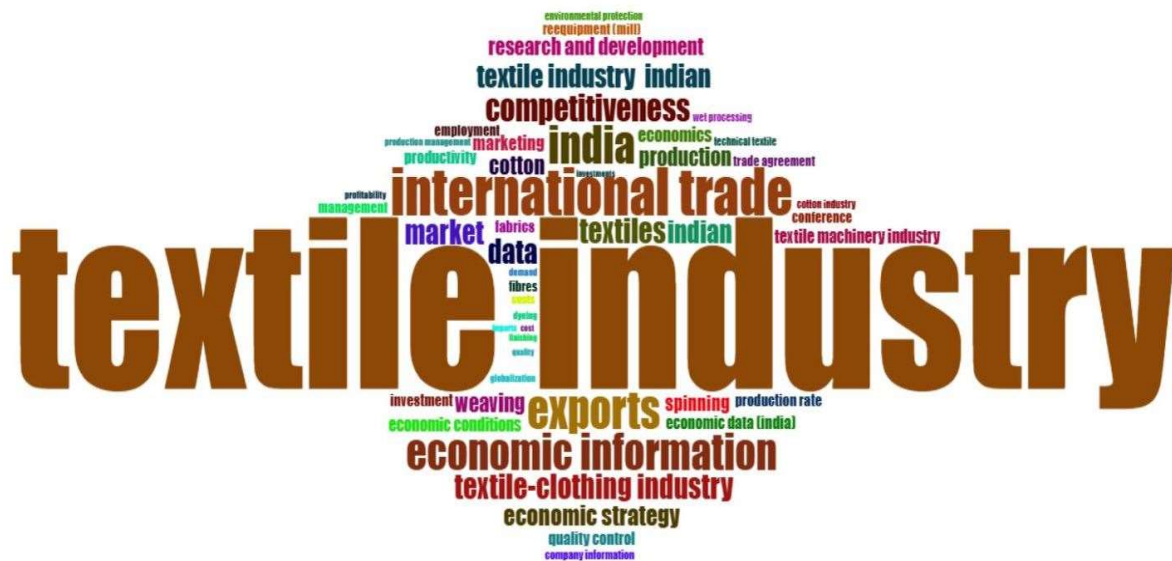
Tirupur, famously dubbed the "Knitwear Capital of India," is a vital hub in the nation's textile industry, accounting for nearly 90% of India's knitwear exports. This article delves into the evolution, economic significance, and contemporary challenges of Tirupur's textile sector. From its modest beginnings as a cluster of small-scale units in the early 20th century, Tirupur's industry has flourished, particularly from the 1980s onwards. Technological advancements, such as automation and the use of sustainable materials, have helped maintain Tirupur's competitive edge globally. The industry's resilience was showcased during the COVID-19 pandemic when many manufacturers swiftly pivoted to producing personal protective equipment (PPE). Socio-economic impacts are notable, with the industry providing vital employment opportunities, particularly for women, although the dependence on migrant labor highlights the need for improved job security and wages. Globalization has further shaped the industry's trajectory, with e-commerce expanding market reach and international standards becoming increasingly critical. This article concludes with policy recommendations aimed at promoting sustainable growth and enhancing Tirupur's position in the global textile market.

Keywords: Evolution of Textile industry; Textile exports; Textile market; Sustainability; Technology.

INTRODUCTION

The textile industry is a cornerstone of India's economy, with Tirupur emerging as a significant hub for textile production and export. Often referred to as the "Knitwear Capital of India", Tirupur accounts for a substantial share of India's textile exports, particularly in the knitwear segment. This city, located in the southern state of Tamil Nadu, has evolved from a small town into a major industrial centre over the past few decades. This review aims to provide an in-depth analysis of the textile industry in Tirupur, covering its history, economic impact, environmental challenges, and outlook. The Tirupur textile industry, known as the "Knitwear Capital of India", contributes nearly 90% of India's total knitwear exports, significantly impacting the local and national economy by providing direct employment (Rajesh & Velumani, 2013¹; Sridhar, 2015)². The industry's adoption of advanced technologies and continuous product innovation, including sustainable fabrics and digital printing, ensures high-quality standards and maintains its competitive edge in the global market (Narayanan & Soundararajan, 2016²; Ramesh & Parthasarathy, 2018³).

FIGURE NO.1



However, the environmental impact of textile processing, particularly water pollution from dyeing and bleaching processes, has raised significant concerns (Sankar, 2014). In response, many units have implemented Zero Liquid Discharge (ZLD) systems to reduce their environmental footprint (Muthuraj, 2017). Despite issues such as low wages and poor working conditions (Kumar, 2015), efforts by NGOs and government policies aim to improve labor conditions, focusing on fair wages and better working environments (Patel & Sharma, 2019). The industry's resilience and adaptability are evident from its quick pivot to manufacturing PPE during the COVID-19 pandemic (Chandrasekaran, 2021). Overall, while the Tirupur textile industry remains a significant economic driver with a strong global presence, ongoing efforts in sustainability and labor improvements are crucial for its sustained success.

REVIEW OF LITERATURE

HISTORICAL DEVELOPMENT

The growth of Tirupur's textile industry can be traced back to the early 20th century. According to Ramachandran (2003), the industry initially comprised small-scale units, which expanded significantly during the 1980s and 1990s due to favourable economic policies and entrepreneurial initiatives. The introduction of modern machinery and technology has been pivotal in transforming the sector into a large-scale, organized industry (Ramesh, 2010). The town's strategic location, with access to ports like Cochin and Chennai, further facilitated export activities, contributing to its growth as a major textile hub.

ECONOMIC IMPACT

Tirupur's textile industry is a major economic driver for the region. (Shanmugam and Rajendran, 2012) highlight that the industry provides employment to over 600,000 people and contributes significantly to India's textile exports. The city's knitwear products are in high demand globally, with key markets including the United States, Europe, and the Middle East. The industry's growth has also spurred the development of ancillary sectors such as dyeing, printing, and logistics (Sridharan, 2015). According to the (Tirupur Exporters' Association, 2020) the city's annual export revenue has surpassed \$3 billion, underscoring its economic significance.

ENVIRONMENTAL CONCERNS

One of the major challenges facing Tirupur's textile industry is environmental sustainability. According to a study by (Kumar and Jayakumar ,2014) the sector is notorious for its high-water consumption and pollution levels, particularly due to the dyeing and bleaching processes. The contamination of local water bodies has led to severe ecological and health issues, prompting the need for stringent environmental regulations and the adoption of eco-friendly practices (Ravi, 2016). The Supreme Court of India, recognizing the severity of the pollution, ordered the closure of several dyeing units in 2011, mandating the implementation of Zero Liquid Discharge (ZLD) systems to mitigate environmental damage.

GOVERNMENT POLICIES AND INITIATIVES

The Indian government, along with state authorities, has implemented various policies to support the growth of the textile industry in Tirupur. The establishment of industrial clusters and the introduction of schemes like the Technology Upgradation Fund Scheme (TUFS) have been instrumental in enhancing the industry's competitiveness (Singh, 2018). Moreover, initiatives aimed at promoting sustainable practices are critical for addressing environmental challenges (Vijayakumar, 2020). The Integrated Processing Development Scheme (IPDS), for instance, focuses on improving infrastructure for textile processing units, with an emphasis on water and waste management.

TECHNOLOGICAL ADVANCEMENTS

Technological advancements have played a significant role in the growth of Tirupur's textile industry. According to (Joseph and Balasubramanian,2013) the adoption of advanced machinery, automation, and digital technologies has improved productivity and product quality. The development of smart textiles and the use of sustainable materials are emerging trends that offer new opportunities for the industry (Lakshmi, 2021). The incorporation of Industry 4.0 technologies, including IoT and AI, is revolutionizing production processes, enabling real-time monitoring and enhancing supply chain efficiencies.

SOCIO-ECONOMIC IMPACTS

The textile industry in Tirupur has had profound socio-economic impacts on the region. (Mani and Selvan, 2017) discuss how the industry's growth has improved living standards and created job opportunities, particularly for women. However, the industry also faces challenges related to labor rights and working conditions, which require attention to ensure inclusive and sustainable development (Nair, 2019). The sector's reliance on migrant labor has highlighted issues of job security and fair wages, necessitating policy interventions to protect workers' rights and well-being.

MARKETING AND GLOBAL TRADE DYNAMICS

The globalization of trade has significantly influenced the marketing strategies and operational dynamics of Tirupur's textile industry. According to (Jain and Khanna, 2019) the advent of e-commerce platforms has opened new avenues for market expansion, allowing local manufacturers to reach international consumers directly. Additionally, compliance with global standards such as Fair Trade and organic certifications has become crucial for accessing premium markets. The competitive pricing, coupled with adherence to international quality standards, has enabled Tirupur to maintain its edge in the global textile arena.

INNOVATION IN TEXTILE DESIGN

Innovation in textile design is another critical aspect contributing to the industry's success. A study by (Mehta and Sharma, 2020) highlights the role of research and development in creating innovative fabric blends and finishes that cater to the evolving preferences of global consumers. The integration of fashion trends with functional attributes, such as moisture-wicking and anti-microbial properties, has positioned Tirupur as a leader in the

production of high-performance textiles. Collaborative efforts between designers and manufacturers have resulted in a diverse range of products that appeal to both fashion and functionality-conscious markets.

OBJECTIVE OF THE STUDY

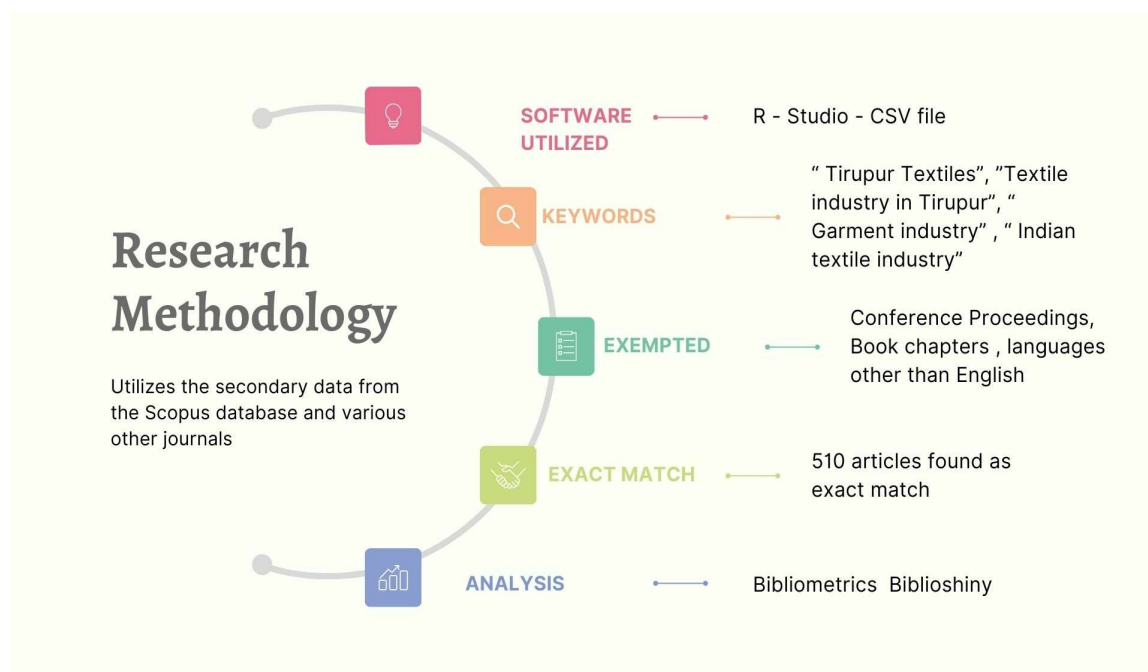
The objective of this article is to provide a comprehensive review of the textile industry in Tirupur, India, tracing its historical development, assessing its economic contributions and environmental challenges, examining the impact of government policies and technological advancements, analyzing socio-economic impacts and global trade dynamics, and identifying future opportunities and challenges to offer policy recommendations for sustainable growth and development.

RESEARCH QUESTION

RQ. 1: What major themes and research patterns have emerged during the past 50 years in the study of the textile industry in Tirupur?

RESEARCH METHODOLOGY

FIGURE NO: 2



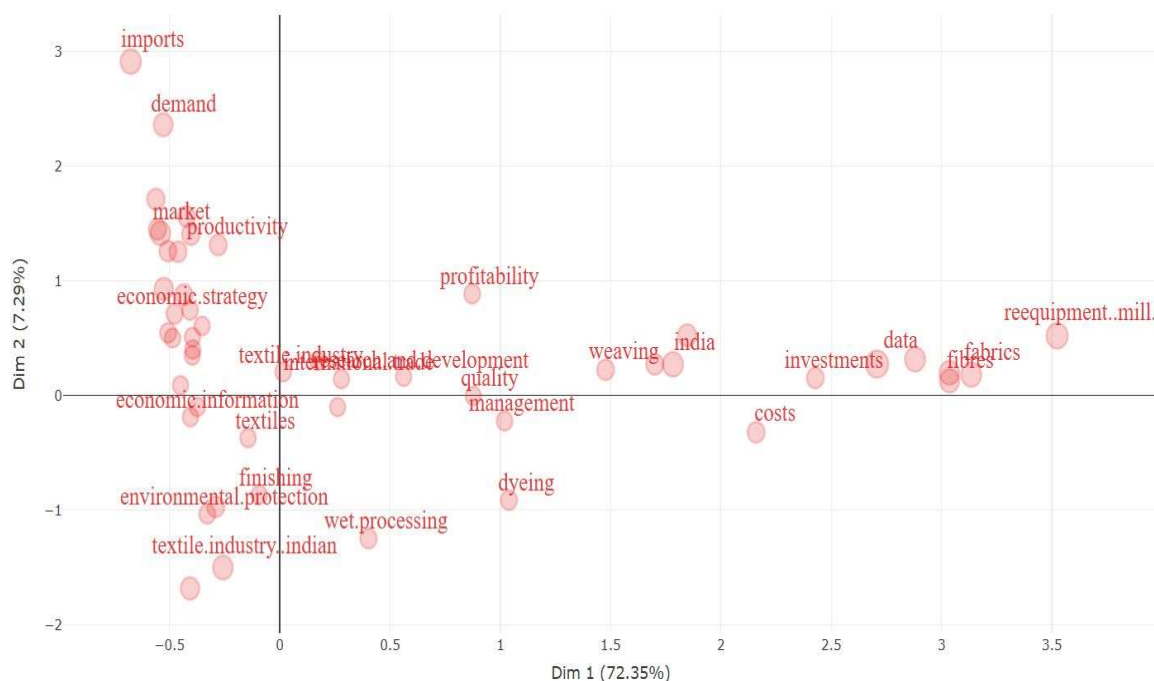
ANALYSIS & DISCUSSION

FIGURE NO.: 3



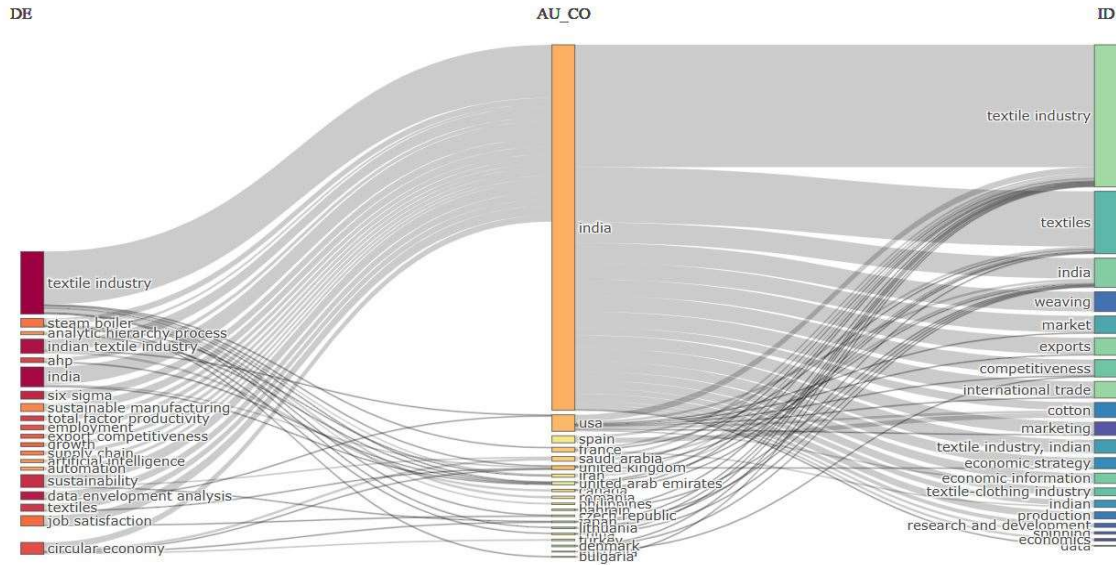
This bibliometric investigation covers a significant 50-year period, from 1974 to 2024. Over this time, 161 different sources including journals and conferences have published 510 documents in total which exactly matches to describe the objective and research question. With an annual growth rate of 2.81%, publications show a consistent upward trend in research production throughout time. 571 authors' contributions are highlighted in the analysis. Out of these, 198 have written single-authored documents which demonstrates the noteworthy individual contributions to this area. The presence of co-authors from various nations is evident in 3.922% of the texts, indicating a moderate but significant degree of international research collaboration. Each document has an average of 1.39 co-authors, indicating a collaborative approach to research albeit one with tiny teams. The 437 distinct keywords that the writers have included in their articles can be used to detect trends and focus areas in the field of study. Together, the citations in the documents cite 5,175 sources, indicating the breadth of the material surveyed and a deep web of intellectual relationships. With an average age of 20.3 years, the documents in this analysis show that both historical and more contemporary studies are considered, offering a thorough understanding of the field's evolution over time. An average of 2.588 citations are given to each document, indicating the influence and respect that the published work has throughout the academic world. This comprehensive bibliometric analysis provides a thorough summary of the trends in publications, patterns of collaboration, and the overall influence of research in the subject throughout the previous fifty years.

FIGURE NO.:4



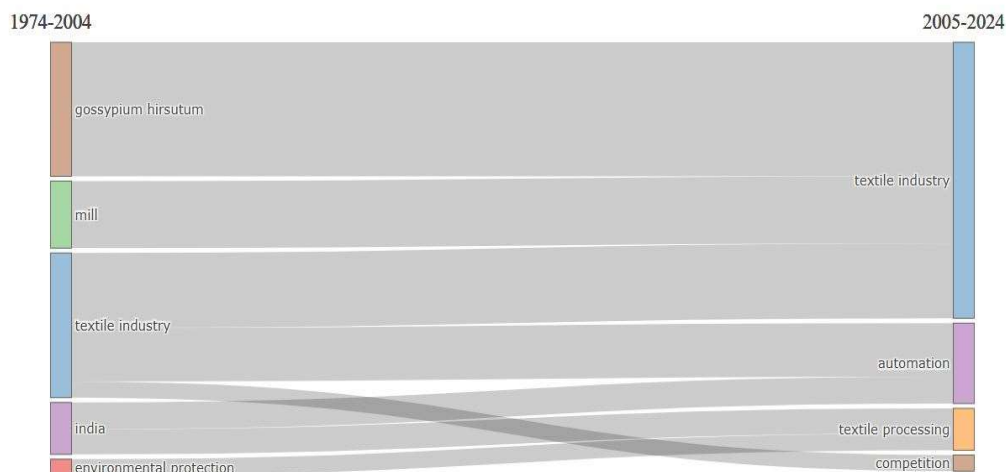
This bibliometric analysis shows the correlations and distribution of different keywords related to the textile sector through a factorial analysis chart. It indicates that traditional, environmental, and process-oriented subjects are on the left, and modern, economic, and infrastructure-focused issues are on the right, along the x-axis (Dim 1), which accounts for 72.35% of the variance. With Dim 2 making up 7.29% of the variance, the y-axis appears to be able to discriminate between specific operational factors at the bottom and more general market dynamics at the top. The phrases "imports," "demand," and "market" are clustered together in the top left quadrant, suggesting that the focus is on market dynamics and external variables that impact the textile business. Among the terms in the bottom left quadrant are "textile industry," "Indian," "environmental protection," and "wet processing," which emphasize the importance of environmental and process-related factors, especially in the context of India. The top right quadrant, which includes the terms "profitability," "weaving," and "India," indicates studies that focus on the financial results and particular textile processes in India. With terms like "reequipment," "mill," "fabrics," and "investments," the bottom right quadrant, at last, indicates a focus on infrastructure investment, material specifications, and economic considerations. The present study unveils discrete subsets of research subjects, so exhibiting the wide range of concentrations and heterogeneity in the literature related to the textile sector.

FIGURE NO.:5



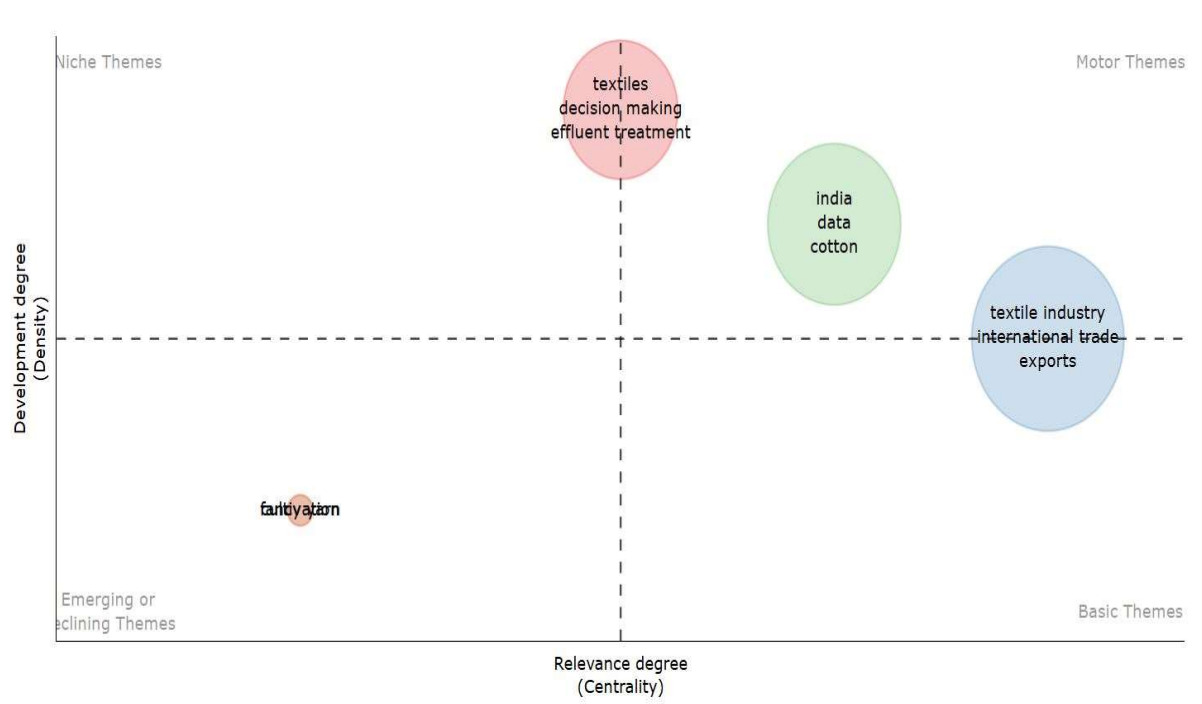
Within the textile industry study topic, this bibliometric analysis shows the relationships between author countries (AU_CO), document IDs (ID), and keywords (DE). Important subjects including "textile industry," "steam boiler," "analytic hierarchy process," and "sustainable manufacturing" are listed in the left column (DE), demonstrating a wide range of research interests. The countries where the study originates are highlighted in the middle column (AU_CO), with India being the most notable, followed by the USA, Spain, France, and a few other nations. This shows that Indian researchers have made a substantial contribution to the textile industry. Document IDs associated with research fields, such as "textile industry," "textiles," "India," "weaving," "market," "exports," and "competitiveness," are shown in the right column (ID), which highlights the main areas of interest for these studies. The links and relationships between keywords, nations, and particular research topics are depicted by the lines that flow between these columns. For example, the close relationship between India and the terms "textile industry" and "India" suggests that Indian researchers have given the home textile sector a lot of attention. Furthermore, links to subjects like "sustainable manufacturing," "total factor productivity," and "artificial intelligence" point to an industry that is becoming more and more interested in efficiency and innovation. In summary, the present analysis sheds light on the principal themes, geographic distribution, and particular research interests within the textile sector.

FIGURE NO.:6



The thematic evolution of study topics in the textile industry from 1974 to 2024 is illustrated by this bibliometric analysis. Topics that were popular from 1974 to 2004 are represented on the left, and topics from 2005 to 2024 are represented on the right. There has been a perceptible change in the focus of research over time. At first, discussions centered on *Gossypium hirsutum*, a type of cotton, mills, and the textile industry. The textile industry continued to play a major role, and these themes remained prevalent throughout the latter century. But in recent times, new issues have surfaced or become more prominent, like automation, textile processing, and competitiveness, which reflect global market dynamics and technical breakthroughs. Furthermore, issues such as environmental protection and India have decreased, which could suggest changes in the industry's research goals or geographic priority areas. This shift emphasizes how the industry is changing and how important it is to use contemporary technologies and competitive tactics to stay ahead of the competition.

FIGURE NO.:7



This thematic map, which is divided into four quadrants according to their centrality (degree of significance) and density (degree of development), shows the evolution and applicability of numerous study issues in the textile industry.

Motor Themes (High Centrality, High Density): Central topics that are well-developed are represented by the upper right quadrant. The placement of the terms "textile industry," "international trade," and "exports" here suggests that these topics are not only very pertinent, but also well-established and have been well studied in the subject. These topics set the research agenda and are essential to the growth of the sector.

Basic Themes (High Centrality, Low Density): Themes that are significant but underdeveloped are displayed in the lower right quadrant. The terms "India," "data," and "cotton" fit into this group, indicating that although these topics are pertinent to the business, further study and development is necessary for them to realize their full potential.

Niche Themes (Low Centrality, High Density): Specialized themes with strong development but lesser overall importance to the larger study area is found in the top left quadrant. The inclusion of "textiles," "decision making," and "effluent treatment" here suggests that these are well-researched subjects with potential specialized interest or limited industry applicability.

Emerging or Declining Themes (Low Centrality, Low Density): Themes that are either new or becoming less relevant are shown in the bottom left quadrant. "Fantiyation" and "cotton" are displayed here, indicating that the scientific community is either not giving these issues much attention yet or is beginning to lose interest in them.

All in all, the map demonstrates the dynamic character of research in the textile sector by highlighting issues that may need more attention or are fading in relevance, as well as areas of strength and future expansion.

FIGURE NO.:8



Based on bibliometric data, this treemap illustrates the frequency and distribution of study themes in the textile industry. The size of each block denotes the number of papers linked to a specific theme, demonstrating the theme's predominance within the research corpus. With 18% of the study documents devoted to it, the "textile industry" theme is the most prevalent and emphasizes the sector's crucial position in the field. After that, "international trade" makes up 5%, indicating a strong interest in the issues of textile exchange on a worldwide scale. The terms "India" and "Exports" account for 4% of the texts, suggesting a regional concentrate on India and an emphasis on the global market. Subjects including "market," "competitiveness," "textiles," "economic information," "textile-clothing industry," and "data" each account for 3% of the documents, demonstrating their significant presence in the study. Other themes with lower but noteworthy proportions (2%), such as "cotton," "production," "weaving," "research and development," and "spinning," are indicative of their specialized as well as plays a significant role in textile research. The treemap also exhibits additional specialized topics, such as "economics," "productivity," "management," "investment," "marketing," and "production rate," each of which contributes 1% to the research landscape. These topics demonstrate a wide range of interests and specialized areas

within the textile industry, from technical aspects to economic strategies and market dynamics. All things considered, the treemap highlights the complexity of the textile industry by presenting a wide range of research topics that address different facets of production, market dynamics, economic data, and regional studies. This highlights the wide range of research devoted to comprehending and developing the field.

In order to mould these research gaps, the practices that are proceeding in the Indian textile industry need to concentrate on the factors such as the strategic ways which strengthen the textile exports of India to face cut – throat competition with the global market are as follows.

Enhancing Sustainability and Ethical Practices

Tirupur's textile industry is at a pivotal juncture where embracing sustainability and ethical practices is not just a necessity but a strategic advantage. The increasing global emphasis on environmental conservation and ethical production practices has created a market demand for textiles that are not only high in quality but also produced sustainably. This section will delve deeper into the initiatives and practices that can support the existing objective of sustainable growth and development in Tirupur's textile industry.

i) Adoption of Green Technologies

The adoption of green technologies is paramount in addressing the environmental challenges faced by Tirupur's textile industry. Innovative technologies such as waterless dyeing, which uses supercritical CO₂ instead of water, can significantly reduce water consumption and pollution. Moreover, the implementation of advanced effluent treatment plants (ETPs) and Zero Liquid Discharge (ZLD) systems ensures that wastewater is treated and recycled, minimizing environmental impact. The use of renewable energy sources, such as solar and wind power, can further reduce the industry's carbon footprint.

ii) Eco-Friendly Materials and Processes

The shift towards eco-friendly materials and processes is essential for sustainable textile production. Organic cotton, recycled polyester, and other sustainable fibres are increasingly being used to meet the demand for environmentally friendly textiles. The industry is also exploring biodegradable and compostable materials, which can significantly reduce waste. Implementing eco-friendly processes, such as digital printing, which uses less water and chemicals compared to traditional methods, can further enhance sustainability.

iii) Circular Economy Models

Adopting circular economy models can revolutionize the textile industry in Tirupur. This approach emphasizes the reuse, recycling, and regeneration of materials, creating a closed-loop system that minimizes waste in the textile industry. Initiatives such as textile recycling programs, where old garments are collected, processed, and reused to create new products, that can reduce the need for virgin materials and decrease environmental impact. Additionally, designing for durability and recyclability ensures that products have a longer life cycle and which can be easily repurposed or recycled.

iv) Ethical Labor Practices

Ensuring ethical labor practices is crucial for the sustainable development of Tirupur's textile industry. The industry must prioritize fair wages, safe working conditions, and job security for its workers. Implementing social compliance standards and certifications, such as SA 8000 and Fair Trade, can help improve labor conditions and ensure that workers' rights are protected. Providing training and development opportunities for workers can also enhance their skills and improve productivity, contributing to the overall growth of the industry.

Strengthening Global Trade Dynamics

i) Market Diversification

To sustain and expand its global market presence, Tirupur's textile industry must focus on market diversification. While traditional markets like the United States and Europe remain crucial, exploring emerging markets in Asia, Africa, and Latin America can provide new growth opportunities. Diversifying the market base reduces dependency on a few regions and mitigates the risks associated with market fluctuations and trade policies.

ii) Compliance with Global Standards

Compliance with global standards is essential for maintaining a competitive edge in the international market. Adhering to standards such as the Global Organic Textile Standard (GOTS) and OEKO-TEX certification ensures that products meet stringent environmental and social criteria, enhancing their appeal to environmentally conscious consumers. Moreover, complying with international trade regulations and quality standards builds trust and credibility with global buyers, fostering long-term business relationships.

iii) Leveraging E-Commerce

The rise of e-commerce platforms presents a significant opportunity for Tirupur's textile industry to reach a global audience. Leveraging online marketplaces and direct-to-consumer (DTC) channels allows manufacturers to bypass traditional intermediaries and engage directly with customers. This approach not only expands market reach but also provides valuable insights into consumer preferences and trends, enabling manufacturers to tailor their products accordingly.

CONCLUSION

In conclusion, the textile industry in Tirupur has made significant strides in establishing itself as a global leader. By addressing the challenges of sustainability and ethical practices and leveraging opportunities in global trade dynamics, the industry can continue to thrive and contribute to India's economic growth. The bibliometric analysis of relevant literature indicates that focused research and policy interventions can significantly contribute to the sustainable development of Tirupur's textile industry, ensuring its continued prominence in the global market. Tirupur's textile industry stands as a testament to the transformative power of entrepreneurship and innovation. While the industry has achieved remarkable success, it must navigate the challenges of sustainability, ethical practices, and evolving global trade dynamics to maintain its competitive edge. By embracing green technologies, adopting circular economy models, ensuring ethical labor practices, and leveraging e-commerce, Tirupur can continue to thrive as a global leader in the textile industry. The future success of Tirupur's textile industry hinges on its ability to balance economic growth with environmental stewardship and social responsibility, creating a sustainable and inclusive path forward.

FUTURE RESEARCH DIRECTIONS

Future research should focus on the long-term impacts of sustainability initiatives, the role of digital transformation in the textile industry, and the socio-economic effects of evolving trade dynamics on local communities. Additionally, exploring innovative business models and technologies that can further enhance sustainability and competitiveness will provide valuable insights for industry stakeholders and policymakers.

POLICY RECOMMENDATIONS

1. **Incentivize Sustainable Practices:** Governments should provide financial incentives, such as tax breaks and subsidies, to encourage the adoption of green technologies and sustainable practices in the textile industry.
2. **Strengthen Regulations:** Implementing and enforcing stringent environmental and labor regulations can ensure compliance with sustainability and ethical standards, protecting the environment and workers' rights.
3. **Promote Research and Development:** Investing in research and development can drive innovation in sustainable materials, processes, and technologies, enhancing the industry's competitiveness.
4. **Enhance Training and Education:** Providing training and educational programs for workers can improve their skills and knowledge, contributing to productivity and job satisfaction.
5. **Foster International Collaboration:** Collaborating with international organizations and industry associations can facilitate the exchange of best practices, technologies, and market insights, fostering sustainable growth and development.

CONFLICTS OF INTEREST

The authors of the article entitled “The Knitwear Capital of India: An In-Depth Analysis of Tirupur's Textile Industry” has no conflicts of interests.

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