

Barriers and Opportunities for Women Entrepreneurs in Climate-Smart Industries in India

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Abstract

Enhancing women entrepreneurship is being increasingly recognized as a powerful driver for India's economic growth (Ramya U et al, 2024). This study therefore examines the barriers and opportunities for women entrepreneurs in climate-smart industries in India- a sector that is crucial for sustainable development and economic growth. Although women's contributions to innovation and environmental sustainability are increasingly acknowledged, there are still barriers that prevent them from participating fully in these fields (Srinivasan A et al, 2012). The study identifies key barriers such as access to finance, lack of technical expertise, societal norms, and limited access to networks and mentorship. The prevailing gender prejudices in the entrepreneurial ecosystem exacerbate these barriers, making it more challenging for women to enter and succeed in climate-smart sectors (Arora M, 2024). The paper also highlights emerging opportunities for women entrepreneurs. Government initiatives, increased awareness about climate change, and the global shift towards sustainable practices are creating new avenues for women to engage in green businesses. The study suggests that targeted interventions through capacity building and skill development programs, better access to finance and networks along with effective mentorship, can significantly enhance the participation of women in climate-smart industries (Banu J, 2024).

Keywords: Women Entrepreneurs, Climate smart industries, Challenges, India

1. Introduction

India is one of the world's fastest-growing economies- as of 2024, India's GDP is estimated to be around \$3.7 trillion, making it the fifth-largest economy in the world (Mohapatra S, 2024). Thus, Indian economy today, stands at a pivotal juncture where industry and innovation play a crucial role in shaping its economic trajectory. For India industrial sector is a key growth driver in this dynamic environment, driving social and economic transformation in addition to economic expansion (Banu J, 2024). The booming sector of climate-smart enterprises and the increasing importance of women entrepreneurs are among the most promising aspects of this industrial transformation.

Globally growth of industries forms the backbone of modern economies, acting as catalysts for job creation, technological advancement, and infrastructure development. The industrial sector contributes significantly to the GDP and employment, providing the necessary momentum for economic expansion (George A. S, 2023). For the fiscal year 2024-25, the Indian economy is projected to grow at a rate of around 6.5 percent to 7 percent, according to various forecasts by the International Monetary Fund (IMF) and World Bank, major burden of which is being shouldered by rapid industrial growth especially under

the umbrella of “Make in India initiative”. Under the initiative a major thrust is being extended to enhance the competitiveness of Indian industries on a global scale, ensuring that they not only contribute to the national economy but also establish India as a manufacturing hub (Huang Y et al,2023).

Furthermore, in recent years, there has been a notable surge in women entrepreneurs across Indian industries. An inclusive economic environment is being created by the growing number women taking on leadership, innovation, and decision-making responsibilities in businesses. Initiation of programs such as the Stand-Up India Scheme and the Pradhan Mantri Mudra Yojana have been instrumental in providing a strong platform to young women entrepreneurs to not only advance in their career but also contribute to India’s growth trajectory. A number of factors, including shifting public perceptions, government assistance, and growing awareness of the potential of women-led enterprises, are contributing to this change (Balabantaray S. R, 2023).

Significant progress is being made by female entrepreneurs across a range of industries, including manufacturing, services, retail, and technology. Along with fostering innovation and raising standards of living in the neighbourhood, they are also producing jobs. There is an international imperative to address climate change and environmental sustainability, which is reflected in the increased focus on climate-smart industries. Climate-smart industries are emerging in India, a critical step toward striking a balance between ecological responsibility and economic development in a country where environmental issues and industrial progress are interwoven.

The integration of women entrepreneurs into climate-smart industries presents a unique opportunity for advancing both gender equality and environmental sustainability. Women, who have traditionally been underrepresented in industrial sectors, are increasingly participating in and leading initiatives that focus on green technologies and sustainable practices. This trend not only amplifies the impact of climate-smart industries but also ensures a more inclusive approach to tackling global challenges. Supporting women-led businesses in the climate-smart sector can drive significant progress in achieving sustainability goals while also promoting economic empowerment. Women entrepreneurs are often at the forefront of innovative solutions that address both environmental and social issues, making their contributions invaluable in the quest for a sustainable future.

This study therefore examines the barriers and opportunities for women entrepreneurs in climate-smart industries in India- a sector that is crucial for sustainable development and economic growth. Although women's contributions to innovation and environmental sustainability are increasingly acknowledged, there are still barriers that prevent them from participating fully in these fields (Srinivasan A et al, 2012). The study identifies key barriers such as access to finance, lack of technical expertise, societal norms, and limited access to networks and mentorship. The prevailing gender prejudices in the entrepreneurial ecosystem exacerbate these barriers, making it more challenging for women to enter and succeed in climate-smart sectors (Arora M, 2024). The paper also highlights emerging opportunities for women entrepreneurs. Government initiatives, increased awareness about climate change, and the global shift towards sustainable practices are creating new avenues for women to engage in green businesses. The study suggests that targeted interventions through capacity building and skill development programs, better access to finance and networks along with effective mentorship, can significantly enhance the participation of women in climate-smart industries (Banu J, 2024).

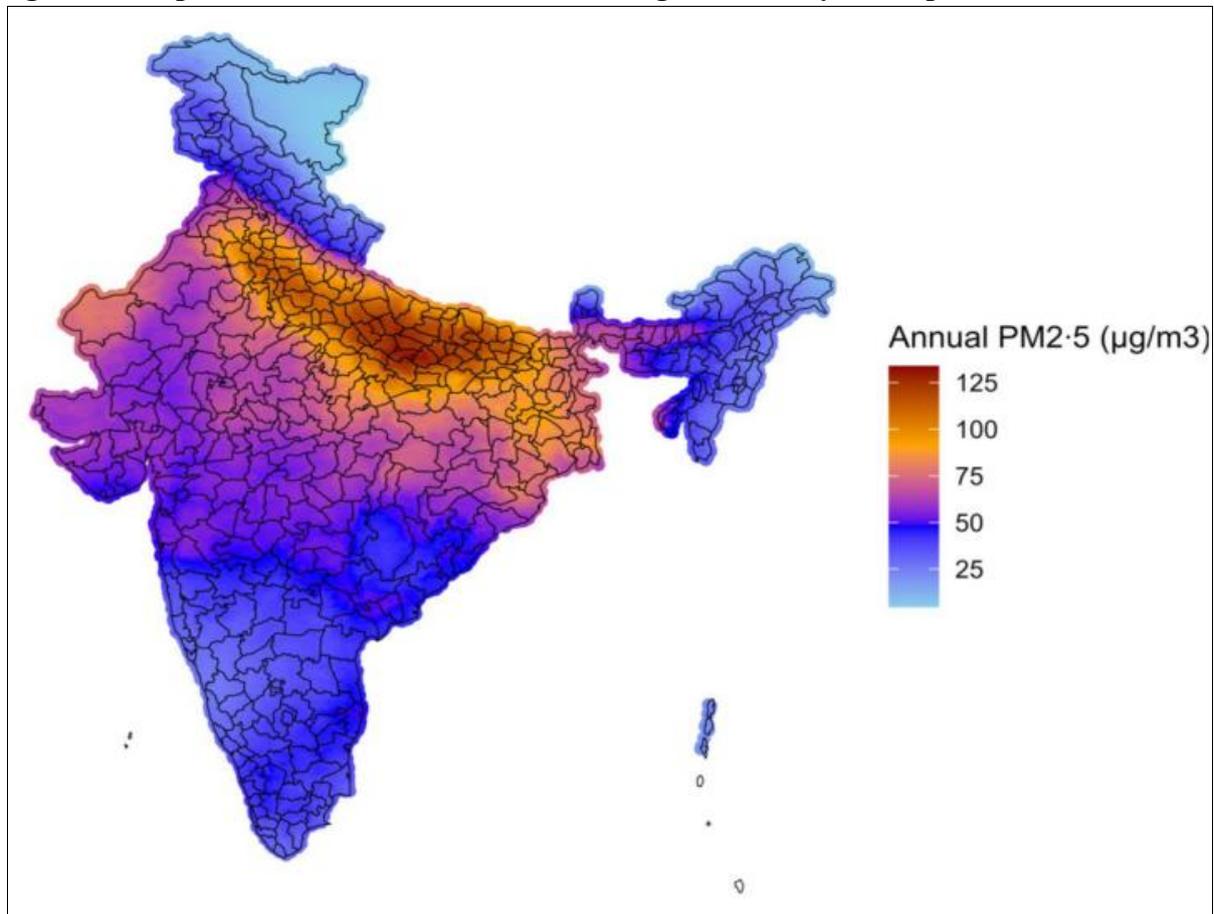
2. Overview of Climate smart industries in Indian economy

Industries that integrate environmental considerations into their operations with the goal of promoting sus-

tainable practices, lowering carbon footprints, and conserving resources are known as climate-smart industries (Quaranta D, 2024). This covers developments in sustainable agriculture, green manufacturing, waste management, and renewable energy. With initiatives like the National Action Plan on Climate Change and other state-level programs centered on renewable energy and environmental protection, India is trying hard to achieve great strides in this area.

The employment of renewable energy sources is one of the main factors propelling the expansion of the climate-smart business in India. With lofty goals established for boosting the number of renewables in the energy mix, solar and wind power are growing quickly. With investments from the public and commercial sectors, the development of green technology and infrastructure is also accelerating. These initiatives are promoting innovation and opening up new commercial prospects in addition to lessening the environmental effects of industrial activity (Guo B et al 2024).

Figure 1: Map of annual PM2.5 values indicating the severity of air pollution across India



Source: George, P. E., Thakkar, N., Yasobant, S., Saxena, D., & Shah, J., 2024.

The above figure showcases the severity of air pollution that Indian subcontinent is troubled with. According to NASA Socioeconomic Data and Applications Centre (SEDAC) and the World Health Organization, the global annual PM2.5 data on air quality guideline recommends that annual PM2.5 emissions should be $< 5 \text{ mg/m}^3$ and for India this level is recommend to be $< 40 \text{ mg/m}^3$. The above figure clearly indicates that major parts of Indian subcontinent are emitting way more than the prescribed limits-rapid industrial growth in India, being one of the major contributing factors.

Among the main producers of emissions in India are the manufacturing, cement, steel, and power generat-

ion (particularly from coal-fired power plants) industries. Another major source of emissions in India is the transportation industry (Garg A et al, 2017). The number of cars, lorries, buses, and two-wheelers on the road has increased, particularly in urban areas, raising serious concerns about emissions from these types of vehicles. Furthermore, building activities have increased as a result of rapid urbanization, which raises the emissions of dust and other particulates adding to the growing pollution concerns in the region. Thus, a balanced strategy that supports both environmental sustainability and economic development is needed to address these emission concerns and move towards attainment of SDGs. Climate-smart industries, therefore, frequently offer a win-win situation by providing both environmental and economic advantages. Businesses can save operating costs by implementing energy-efficient technologies, and they can expand their market reach and improve their brand's reputation by adopting sustainable practices. Thus, the nexus of business, innovation, and environmental sustainability offers a wealth of opportunities for development and cooperation, especially among developing countries like India.

3. Women entrepreneurs as engine of growth in Indian economy

The future growth landscape of India is being profoundly shaped by the growing involvement of Indian women entrepreneurs (Baral R et al, 2023). As more women pursue entrepreneurial endeavours, they foster inclusion, innovation, and social transformation in addition to economic growth. The economic engine of India is increasingly dependent on women entrepreneurs. A Bain & Company analysis (2020) suggests that improving women's involvement in the workforce and promoting gender equality could boost India's GDP by \$700 billion by 2025.

Economists strongly believe that India's future growth will be significantly influenced by the growing number of Indian women entrepreneurs, who will be a driving force behind social advancement, gender equality, and economic success (ibid). In addition to revolutionizing India's economy, female entrepreneurs are laying the groundwork for a more just and sustainable future by encouraging innovation, generating jobs, and encouraging inclusive growth. Women are becoming vital actors in India's quest to become a global economic powerhouse, and as more of them enter and succeed in entrepreneurship, their influence on the country's growth trajectory is bound to increase.

According to the National Sample Survey Office's (NSSO) Sixth Economic Census, in India, there are about 8.05 million female entrepreneurs i.e. around 13.76% of the country's total of 58.5 million entrepreneurs as shown in Figure 2. This data clearly shows a significant under representation of women in 'entrepreneurship': which is globally being recognised as the key driver for rapid economic spurt. As a result, this gap presents a vast opportunity for growth, particularly through engaging more women especially in green entrepreneurial enterprises.

Table 1: State wise distribution of women entrepreneurship in India by type of establishment.

State/UT	Number of Establishments by type			Percentage share of establishments
	Without Hired Workers	With at least One Hired Worker	All	
01 - Jammu & Kashmir	23012	8280	31292	0.39
02 - Himachal Pradesh	45229	3944	49173	0.61
03 - Punjab	83916	27005	110921	1.38
04 - Chandigarh	4921	862	5783	0.07
05 - Uttarakhand	26828	4591	31419	0.39
06 - Haryana	113224	11300	124524	1.55
07 - Delhi	50403	20031	70434	0.87

08 - Rajasthan	193234	54758	247992	3.08
09 - Uttar Pradesh	371730	110649	482379	5.99
10 - Bihar	90115	63495	153610	1.91
11 - Sikkim	4383	921	5304	0.07
12 - Arunachal Pradesh	4438	1975	6413	0.08
13 - Nagaland	11840	1817	13657	0.17
14 - Manipur	84550	3736	88286	1.1
15 - Mizoram	12808	3020	15828	0.2
16 - Tripura	13168	1338	14506	0.18
17 - Meghalaya	21540	7990	29530	0.37
18 - Assam	130338	23820	154158	1.91
19 - West Bengal	762247	69090	831337	10.33
20 - Jharkhand	19827	34905	54732	0.68
21 - Odisha	223875	25725	249600	3.1
22 - Chhattisgarh	62328	15648	77976	0.97
23 - Madhya Pradesh	155898	67507	223405	2.77
24 - Gujarat	403569	125054	528623	6.57
25 - Daman & Diu	566	239	805	0.01
26 - D & N Haveli	352	952	1304	0.02
27 - Maharashtra	580337	83963	664300	8.25
28 - Karnataka	492506	53300	545806	6.78
29 - Goa	13539	3117	16656	0.21
30 - Lakshadweep	329	131	460	0.01
31 - Kerala	863797	50120	913917	11.35
32 - Tamil Nadu	793646	293963	1087609	13.51
33 - Puducherry	8192	1977	10169	0.13
34 - A & N islands	2011	502	2513	0.03
35 - Telangana	292512	63974	356486	4.43
36 - Andhra Pradesh	736146	113766	849912	10.56
All India	6697354	1353465	8050819	100.00
	83.19%	16.81%	100.00%	

Source: All India report of sixth economic census. Ministry of Micro, Small and Medium Enterprises, Government of India 2016

In India, increasing the number of women involved in green entrepreneurial ventures can have a substantial positive impact on economic growth, environmental issues, and gender equality (Mondal S, 2023). The benefits of female-led green enterprises have already been observed in some of Indian states across sectors like waste management, eco-friendly products, renewable energy, and sustainable agriculture.

In cities like Pune and Mumbai, waste management and recycling companies are increasingly being run by women entrepreneurs. "Stree Mukti Sanghatana" is one such organization that is led by women with the objective of composting, recycling, and trash segregation. According to Joshi A. N. (2017), these programs assist in lowering greenhouse gas emissions, decreasing landfill waste, and providing jobs for women from underserved communities. Similar to this, women are heavily involved in the renewable energy business in Kerala, especially with solar electricity. Self-help groups (SHGs) and female entrepreneurs have played a significant role in encouraging the use of solar energy in rural regions and in the installation and maintenance of solar panels. In addition to being a sustainable energy source, this also gives women more social and economic influence (Bedi H. P, 2022).

In Rajasthan, environmentally conscious handicrafts are made by female business owners using sustainable materials like bamboo, jute, and recycled textiles (Dutta M, 2023). By giving these women access to markets and training, organizations like the Self-Employed Women's Association (SEWA) assist in the preservation of traditional crafts while advancing sustainability. Women entrepreneurs in Uttar Pradesh are also actively engaged in the clean energy industry; in particular, they are pushing for the

adoption of clean cooking solutions and biogas in rural regions. These women are contributing to a decrease in reliance on conventional biomass fuels, which enhances health outcomes and lessens deforestation, by offering accessible and sustainable energy options (Shailaja R, 2000)

Furthermore, in West Bengal, women play a significant role in the handloom and textile industries, emphasizing on use of environment friendly production techniques (Chaudhuri S, 2023). These women-led businesses contribute not only to the preservation of cultural legacy but also towards preservation of environment by employing natural colours and traditional weaving techniques. These illustrations from across different Indian states clearly showcase the growing importance of women entrepreneurs engaged in 'green entrepreneurial practices. India can promote sustainable development, empower women, and build more resilient and inclusive communities by assisting female entrepreneurs in the green sector. Even though women in India have a great deal of potential to run green businesses, a number of obstacles still stand in the way of their success which are discussed in subsequent section.

4. Challenges faced by women entrepreneurs in adapting green technology

In 2019, the Federation of Indian Chambers of Commerce and Industry (FICCI) conducted a poll which found that a mere 10% of small and medium-sized enterprises (SMEs), which are predominantly female-owned, have implemented green technologies. Adopting green technology presents a number of hurdles for Indian women businesses as shown in Figure 2. These difficulties include gaps in technical understanding, societal standards, and financial limitations (Pathak D. K et al, 2024).

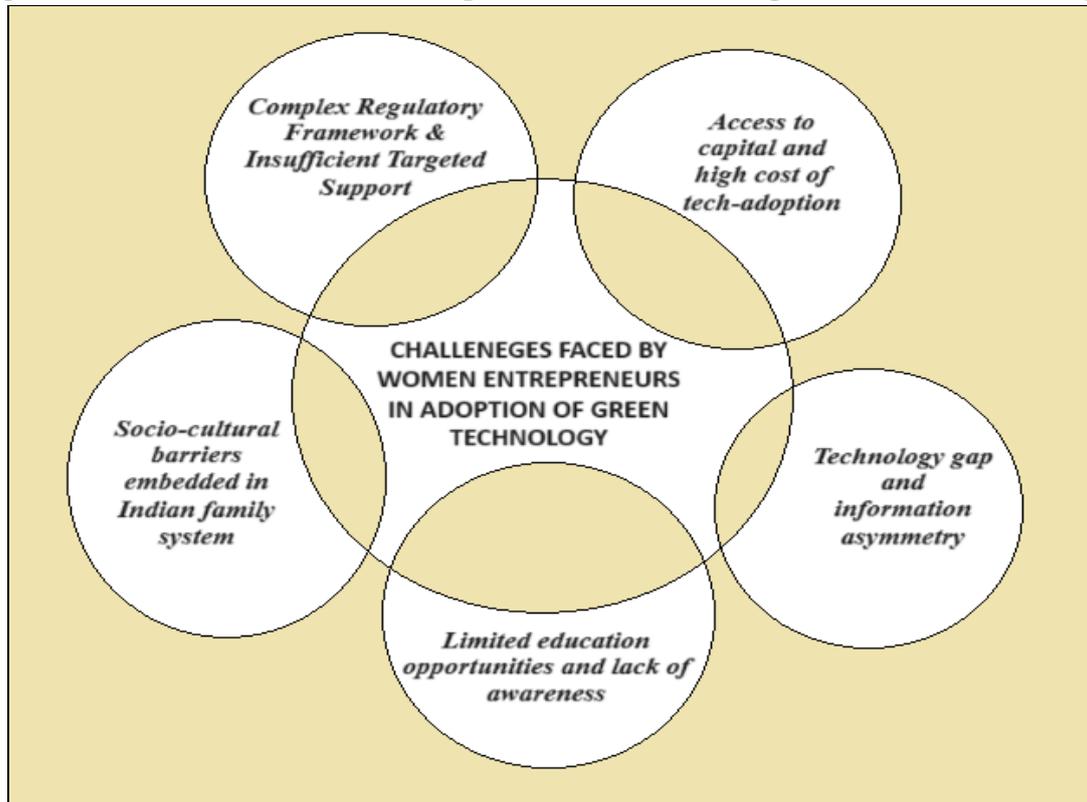
4.1 Access to capital and high cost of tech-adoption

The inability of female business owners to obtain capital limits their ability to make investments in environmentally friendly technology. The International Finance Corporation (IFC) estimates that there is a \$158 billion funding gap in India that affects women-owned enterprises (Swais A, 2024). Green technologies, like solar panels or energy-efficient machines, can need a large initial investment. Without outside assistance, many female entrepreneurs, particularly those in small and medium-sized businesses (SMEs), find it difficult to afford this technology.

4.2 Technology gap and information asymmetry

In India, a large number of female business owners lack the technical expertise required to successfully integrate green technologies. The under representation of women in STEM professions is partially to blame for this. In India, women only account for 14% of the workforce in STEM (science, technology, engineering, and mathematics) professions, according to a 2018 World Economic Forum report. As a result, it becomes challenging for female entrepreneurs to make educated judgments as they have restricted access to information on green technologies. This problem is particularly noticeable in rural places where there are less educational resources and people are less aware of green technologies. This includes a lack of knowledge about the advantages, expenses, and methods of implementation of these technologies.

Figure 2: Hurdles for Women Entrepreneurs in Embracing Sustainable Technologies



Source: Compiled by Author

4.3 Limited education opportunities and lack of awareness

Rural women in India have less access to higher education, especially in the fields of science and technology, which are essential for comprehending and applying green technologies. Rural Indian women are less likely than urban women to have completed more than basic school, according to the National Sample Survey Office (NSSO), which may hinder their comprehension of technical information regarding green technologies. Particularly in rural areas, there is a dearth of focused awareness campaigns and workshops on green technologies for female entrepreneurs (Correa V. S, 2024).

4.4 Socio-cultural barriers embedded in Indian family system

Traditional gender norms and societal expectations restricts women from pursuing entrepreneurship, especially in fields like manufacturing and technology that are primarily dominated by males. Cultural norms have a major impact on the lower rates of entrepreneurship among women in India, according to a 2020 report by the Global Entrepreneurship Monitor (GEM). Women are typically expected to prioritize family and household chores before commercial activity (Banu J et al, 2023). Their time and energy to learn about and adopt new technologies may be restricted by this dual load. Traditional gender norms therefore, prevents women from being exposed to new ideas and technologies.

4.5 Complex Regulatory Framework & Insufficient Targeted Support

In India it can be difficult for women to navigate the complicated regulatory landscape for green technology, especially if they have never dealt with bureaucratic procedures before. India is ranked 63rd out of 190 nations in the World Bank's 2020 "Ease of Doing Business" report, suggesting that regulatory barriers are still rather high. Moreover, although certain government initiatives exist to assist female entrepreneurs, they frequently lack focused initiatives meant to promote the uptake of environmentally friendly technologies. Furthermore, a lot of female business owners are either ignorant of these programs

or find the application procedures difficult.

5. Conclusion

Empowering women entrepreneurs to lead and participate in climate-smart businesses is an essential tactic for sustainable development. As established in above sections, women can spur innovation, create jobs, and strengthen the greener, more resilient economy as long as they have access to the resources, tools, and support they require. India can lead the way towards a future that is more sustainable and inclusive by tackling the obstacles and seizing the chances.

There are particular challenges that Indian women entrepreneurs must overcome in order to engage in climate-smart sectors. Their capacity to prosper in this industry is severely hampered by issues including restricted access to cash, inadequate technical knowledge, socio-cultural limitations, and a lack of focused support and market access. These obstacles are particularly noticeable in rural areas, where there are less educational resources and people are less aware of green technologies. This further reduces the prospects available to female entrepreneurs.

Despite these challenges climate smart industries or entrepreneurial ventures hold significant prospects for women to be empowered. India can help women entrepreneurs overcome these obstacles by expanding access to financing, offering focused training and capacity-building programs, promoting inclusive policies, and utilizing community networks. Furthermore, encouraging digital inclusiveness and raising public knowledge of the financial and ecological advantages of green technologies can help women-owned enterprises find new markets.

Closing the knowledge gap can be facilitated by creating training courses and programs on green technologies that are tailored to the local language. These initiatives must be created with rural women's literacy levels and cultural backgrounds in mind. Using community networks to your advantage, such women's clubs and self-help groups (SHGs), can assist spread knowledge about green technologies. These groups can act as forums for the exchange of best practices and peer learning. Increasing the availability of digital infrastructure in rural regions and offering digital literacy training to women can improve their access to online materials about environmentally friendly technologies.

Reference

1. Arora, M., & Singh, S. (2024). Women's Empowerment Through Entrepreneurship in Emerging Economies: Analyzing the Dimensions and Policy Implications. In *Drivers of SME Growth and Sustainability in Emerging Markets* (pp. 205-223). IGI Global.
2. Banu, J., Baral, R., & Vijayalakshmi, V. (2024). The enablers and stumbling blocks in sustaining growth of women-owned micro-enterprises in India—a qualitative inquiry. *Journal of Enterprising Communities: People and Places in the Global Economy*.
3. Baral, R., Dey, C., Manavazhagan, S., & Kamalini, S. (2023). Women entrepreneurs in India: a systematic literature review. *International Journal of Gender and Entrepreneurship*, 15(1), 94-121.
4. Balabantaray, S. R. (2023). Women's Leadership and Sustainable Environmental Initiatives: A macroscopic investigation from Ecofeminism framework. *International Journal of Multidisciplinary Research and Growth Evaluation*, 4(4), 1039-1046.
5. Bedi, H. P. (2022). Solar power for some? Energy transition injustices in Kerala, India. *Environment and Planning E: Nature and Space*, 5(3), 1146-1163.
6. Chaudhuri, S., & Bhattacharyya, S. (2023). Sustainability of Weavers Communities of West Bengal:

- Investigating the Role of Public Policy Interventions. In *Public Policies and Sustainable Development in Post-Reform India: Regional Responses and the Way Forward* (pp. 165-178). Singapore: Springer Nature Singapore.
7. Correa, V. S., Lima, R. M. D., Brito, F. R. D. S., Machado, M. C., & Nassif, V. M. J. (2024). Female entrepreneurship in emerging and developing countries: A systematic review of practical and policy implications and suggestions for new studies. *Journal of Entrepreneurship in Emerging Economies*, 16(2), 366-395.
 8. Dutta, M. (2023). *Creative Economy and Sustainable Development: The Context of Indian Handicrafts*. Taylor & Francis.
 9. Garg, A., Shukla, P. R., Kankal, B., & Mahapatra, D. (2017). CO2 emission in India: trends and management at sectoral, sub-regional and plant levels. *Carbon Management*, 8(2), 111-123.
 10. George, A. S. (2023). Evaluating India's economic growth: challenges and opportunities on the path to 5 trillion dollars. *Partners Universal International Innovation Journal*, 1(6), 85-109.
 11. George, P. E., Thakkar, N., Yasobant, S., Saxena, D., & Shah, J. (2024). Impact of ambient air pollution and socio-environmental factors on the health of children younger than 5 years in India: a population-based analysis. *The Lancet Regional Health-Southeast Asia*, 20.
 12. Guo, B., Hu, P., & Lin, J. (2024). The effect of digital infrastructure development on enterprise green transformation. *International Review of Financial Analysis*, 92, 103085.
 13. Huang, Y., Haseeb, M., Khan, J., & Hossain, M. E. (2023). Structural changes and economic landscape of the Indian economy: 2000-2019. *Review of Development Economics*, 27(1), 395-422.
 14. Joshi, A. N. (2017). *Study of appropriate models of woman entrepreneurship with special reference to self-help groups, joint liability groups and urban community development in Pune city* (Doctoral dissertation, Tilak Maharashtra Vidyapeeth).
 15. Mondal, S. (2023). The nexus between green entrepreneurship and sustainable development: An econometric study. *Global Business Review*, 09721509231157009.
 16. Mohapatra, S., & Pohit, S. Charting the path to a developed India: Viksit Bharat 2047.
 17. Ministry of Micro, Small and Medium Enterprises. (2016). *All India report of sixth economic census*. Ministry of Micro, Small and Medium Enterprises, Government of India.
 18. Pathak, D. K., Verma, A., & Kumar, V. (2024). GSCM barriers to sustainable development in Indian manufacturing organisations: a mixed-method approach. *International Journal of Logistics Systems and Management*, 47(3), 388-410.
 19. Ramya, U., Pushpa, A., & Ghosh, N. (2024). Women Entrepreneurship—A Way Towards Sustainability. In *The Framework for Resilient Industry: A Holistic Approach for Developing Economies* (pp. 281-299). Emerald Publishing Limited.
 20. Shailaja, R. (2000). Women, energy and sustainable development. *Energy for Sustainable Development*, 4(1), 45-64.
 21. Srinivasan, A., Ling, F., & Mori, H. (2012). Climate smart development in Asia. *Abingdon, England: Routledge*.
 22. Swaiss, A. (2024). The World Bank's Goal of Universal Financial Access & Financial Inclusion is Achievable by 2020 and can Provide a Catalyst for Growth, Stability, Equality and a Reduction of Poverty in the Developing Countries; a Critical Evaluation. *Stability, Equality and a Reduction of Poverty in the Developing Countries*.

23. Quaranta, D. (2024). Strategies to improve the carbon footprint of industrial zones and their competitiveness: Implications of the adoption of an ESG framework to measure performances of industrial zones and identify potential interventions. A study of two industrial zones in Morocco.