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Waste to Wealth: A Study on Effectiveness of Tech-Enabled Business Models for Sustainability (Bmfs) Of Solid Waste Management Enterprises in India

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Abstract: Indian Startups and Enterprises play a pivotal role in addressing the sustainability challenges specially in 'Waste Management' sector. Literature provides theoretical to little understanding on their business models, technologies role, effectiveness and stakeholders' perspective from Indian context. Existing business models are either excessively focussed on producing economic value or profits and not enough value for environment and society or their focus is more on dry waste processing. Startups don't have enough resources for business model experimentation and established Enterprises constrained/confined by their pre-existing business models, organization cultures and routines. Moreover, the entrepreneurs are ahead in practice exploring and exploiting business models compared to academic knowledge about them. Therefore, improving our understanding of the Business Models for Sustainability (BMfS) and the effectiveness of tech-enabled business models would thus contribute to academic; practice and managers becomes focus of this research. Towards that, a detailed literature review to identify research gaps and opportunities are identified and presented in this research article.

Keywords: Business Models for Sustainability, Entrepreneurship, Circular Economy, Waste Management, Technology.

Introduction:

According to the Ministry of Environment, Forest and Climate Change, India currently generates 62 million tons of waste (both recyclable and non–recyclable) every year, with an average annual growth rate of 4%. Solid waste, plastic waste and E-waste are the principal waste materials. Only about 23% of the total generated waste is being processed/treated (33,215 tons/day) while 72% is land-filled (1.22 lakh tons/day). Hyderabad residents

generate the highest per capita waste in India - 570 gm per day. Bengaluru comes second with a per capita waste of 440gm a day. Even the national capital of Delhi has a lower per capita waste generation of 410 gm than Hyderabad.

According to startup India website, Enterprises such as Banyan Nation, Recykal, Bintex, Waste ventures, Srichakra Polymers, Sahas Zerowaste, Ramky Enviro Engineers, EurotecIndia are some of the innovative ventures focusing in solving the Waste Management issues. They combine closed-loop business models (Recycle, Regenerate) with Community Platforms, and technologies such as mobile platforms, artificial intelligence, analytics to tackle the national problem. However, we don't know much about on how their business models are actually contributing to the economy, ecology and society and the role of technology in creating expected outcomes and also whether these start-ups' ability to scale up solutions.

Understanding the role of business models, business model innovation and effectiveness of technology in amplifying the desired outcomes would contribute to Literature, Entrepreneurs, Managers, Customers and Policy Makers is of utmost importance.

Background:

1.1. Waste Management

In academic terms, 'Waste' may be vary depending on the field of study, generally speaking based on Central Pollution Control Board (CPCB | Central Pollution Control Board, **n.d.**) , waste is divided into six categories viz., Hazardous Waste, Municipal Solid Waste, Biomedical Waste, Plastic Waste, E-Waste, Construction and Demolition Waste. With respect to Sustainability, four classes of Waste were proposed by (Pongrácz et al., 2004) firstly, un-wanted things; secondly, things with a finite purpose becomes useless after fulfilling it, things with not acceptable performance due to a flaw in structure or stat and lastly things with acceptable performance, but their use fail to use them for their intended purpose. Based on the analysis of these attributes Pongrácz et al., (2004) defines "waste is a thing that has no purpose; or is not able to perform with respect to its purpose". Further proposes the possibility of waste being turned into non-waste and emphasizes being waste is a temporary failing that needs to remediate. However, as per World Bank Report (Kaza et al., 2018), waste generation in India is at 1.44kg/capita/day with only 13 cities able to do 100%

waste collection with low amount of recovery. Waste Management encompasses the collection, transport, recovery, and disposal, with an ultimate goal of protecting human health, the environment, and conserving resources. This aligns with the European Council Directive on Waste, which emphasizes these key stages alongside proper oversight and aftercare of disposal sites (V Popov et al., 2012).

Early waste detection and sorting significantly increases the recovery of recyclables, minimize environmental contamination, and also will prevent the waste of valuable resources (Abdu & Mohd Noor, 2022). Only 23% of the plastic waste gets recycled as per Central Pollution Control Board reports of 2020-2021 (The Hindu, 28 July 2024).

1.2. Business Modles

Sustainability innovations require a business model to achieve desired outcomes towards triple bottom line (Lüdeke-Freund, 2020). Different types of Sustainable Business Models (SBM) exist such as, types, ideal types, archetypes, pattern typologies and other forms (Lüdeke-Freund et al., 2018). While implementing the business idea, founders may use one or more business model patterns or archetype to attain differentiation (Lüdeke-Freund et al., 2018; Schroedel, 2023).

In the context of Waste Management, the focus is on ‘Create value from Waste”, “Maximise Material and Energy Efficiency” or ‘Closing the Loop’ (Circular business models) patterns that also combine other patterns such as community platforms (Bocken et al., 2014; Lüdeke-Freund et al., 2018; Schroedel, 2023). The Circular business models identified by theory (Sehnem et al., 2019) include but not limited to

- 3R reduction, reuse and recycling
- 4R reduction, reuse, recycling and recovery
- 5R reduce, reuse, refurbish, repair and recycle
- 9R refuse, rethink, redefine, reuse, reform, remanufacture, redefine, recycle and Recover
- Resolve: regenerate, share, optimize, loop, virtualize and exchange
- Platforms of sharing: promote a platform for collaboration between users of the product, be it individuals or organizations

Startups or established businesses deploy the single or multiple archetypes across the waste hierarchy value chain (Dijkstra et al., 2020) for generating effective outcomes.

Nevertheless, the effectiveness of these pursuits is under studies in Indian context and establishing empirical evidence on the value produced across society, environment is focus of our research.

1.3. Technology enabled BMfS

Technological capabilities have enabled organizations to create opportunities to support their competitive advantage(Heredia et al., 2022). Technology enablement for Business Models is a broad term and theme covering digital or technological assets usage in the value creation process. Theory suggests, technology in business models can act as both as a mediator and as a moderator, depending on the specific context and how we are analysing its role. In case of certain business models use of technology amplifies the effect and expected results including realization of business models. Extant literature believes through digital technologies (digital, internet or embedded), one can gain greater acceptance of circular business models(Schroedel, 2023).

Literature Review:

1.4. General Definitions:

Sustainability: The concise definition or the essence of sustainability, which is to balance the economic, social, and environmental dimensions of human development in a way that ensures long-term well-being for all. It involves responsibly managing resources, minimizing negative impacts on the environment, and for ensuring equitable and inclusive practices.

Sustainable Development: Sustainable development is a concept that meets the needs of the present without compromising future generation's ability to meet their own needs.

Business Model: A business model describes on how an organization creates, delivers, and captures value. It explains how the organization will generate revenue and profitability, and what resources and capabilities, it needs to do so.

Business Model Innovation: Business Model Innovation refers to the process of creating, altering, or refining the fundamental structure and approach of a business in order to deliver value, capture market share, and achieve sustainable growth.

Circular economy: The Circular Economy is an economic model and framework that aims to de-couple economic growth from the consumption of finite resources and environmental degradation. It is based on the principles of sustainability, efficiency, and reducing waste.

Linear economy: In (traditional model) Linear economy, resources are extracted, processed, used, and then discarded as waste. In contrast, a circular economy seeks to keep finite resources in use for as long as possible, extracting maximum value from them, and then recovering and regenerating products and materials at the end of their life cycle.

Business Model for Sustainability: "A business model for sustainability helps describing, analysing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries" (Schaltegger et al., 2016)

Business Model Patterns: "A sustainable business model pattern describes an ecological, social, and/or economic problem that arises when an Organisation aims to create value, and describes the core of a solution to this problem that can be repeatedly applied in a multitude of ways, situations, contexts, and domains. A sustainable business model pattern also describes the design principles, value-creating activities, and their arrangements that are required to provide a useful problem- solution combination"(Lüdeke-Freund et al., 2018).

1.5.Business Models for Sustainability (BMfS)

Researchers have applied the lens of management and strategy, entrepreneurship, marketing and consumer behaviour etc., (Mignon & Bankel, 2023; Schaltegger et al., 2016). Multiple authors found inconsistencies in definitions, current literature as unorganized, theoretical and practical gaps in the extant literature scope, methods, focus and findings. (Mignon & Bankel, 2023; Nosratabadi et al., 2019; Schaltegger et al., 2016; Silvia & Truzzi, 2020). An influential work was discussed in the next paragraph.

Foundation and seminal research:

Different types of SBMs exist such as types, ideal types, archetypes, pattern typologies and other forms (Lüdeke-Freund et al., 2018). Emerging theories suggest that companies

developing and implementing SBMs increase the likelihood of being financially viable and enhance their ability to create multiple forms of value beyond economic value. (Lüdeke-Freund et al., 2018). It is important to understand the seminal work and most cited BMfS which was elaborated in next paragraph.

The seminal work of Stubbs and Cocklin,(Stubbs & Cocklin, 2008) referred based on "ideal type" of sustainability-oriented business model due to nature in which this case based research provided traits and normative principles of SBMs (Schaltegger et al., 2016). This research work was built based on two case studies namely Interface Inc, United States and Bendigo Bank, Australia, based on the fact that they did not treat sustainability as add-on to their businesses and pursued sustainability as their core business strategy. These case studies illuminated core business, culture, purpose, organization routines, leadership, concepts of true SBMs. This research findings emphasise that Organizations adopting a SBM must develop structural, cultural capabilities to achieve firm level sustainability and collaborate with key stakeholders to achieve sustainability(Stubbs & Cocklin, 2008). Based on Interface and Bendigo bank study, the characteristics of Sustainability Business Model using Economic, Environmental, Social and Multidimensional characteristics were captured from Structural attributes and Cultural attributes perspective. A representation of system based SBM proposed by Stubbs and Cocklin (2008) is shown below:

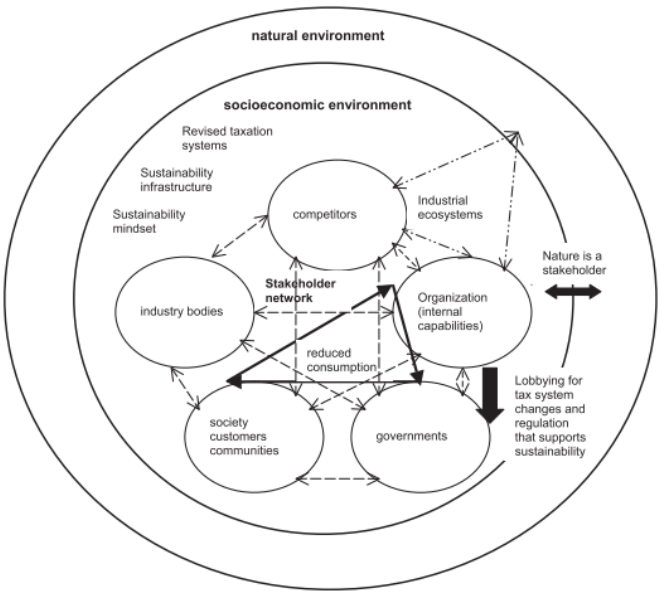

Image Source: (Stubbs & Cocklin, 2008)

Archetypes and Patterns:

Several authors have built archetypes and BM patterns to provide theatrical and empirical understanding of SBMs. Subsequent research on SBMs included (REMANE et al., 2017) the first-ever database of business model pattern database with 182 patterns did not however fully aimed at BMfS. On the other hand, Geissdoerfer et al., (2018) proposed, 4 types of SBMs viz. Circular business models, Social enterprises, Bottom of pyramid solutions, and product-service-systems and discusses SBM strategies and discusses challenges for innovation towards SBM. Highly cited works includes Bocken et al., (2014) – recommended SBM archetypes - "1. Maximise material and energy efficiency 2. Create value from 'waste' 3. Substitute with renewables and natural processes 4. Deliver functionality, rather than ownership 5. Adopt a stewardship role 6. Encourage sufficiency 7. Re-purpose the business for society/environment 8. Develop scale-up solutions". Using the pattern database approach (Lüdeke-Freund et al., 2018) created about BMfS pattern taxonomy with 45 patterns. In similar reign, however citing reasons that this pattern database did not consider empirical cases, Schroedel, (2023) developed Sustainable Business Model Database with 92 Patterns. Nevertheless, based on the review of 87 empirical (Mignon & Bankel, 2023)cases found four recurrent BM types namely "1) focussed on improvements towards efficiency 2) based on new ways to make the business sustainable, 3) got a stronger orientation towards society or environment or 4) born sustainable" (Mignon & Bankel, 2023, p. 1360). The key challenge with these patterns is they were identified based on existing companies practising them, its efficiency, performance, antecedents, organizational considerations are not known.

Unifying all the three cases and patterns in terms of definitions, cases studies can be useful exercise, the primary author is not able to take up in this scope due to resource constraints. However, a table view of the combined taxonomy pattern groups and patterns (Outcomes) based on 45 (Lüdeke-Freund et al., 2018) patterns and 92 patterns(Schroedel, 2023)synthesized by the authors listed below.

Sources	4 Recurring types based on 87 empirical cases	Similarities with 45 Patterns with examples	Similarities with 92 Patterns based on Case Studies	Similarities with 8 Archetypes of SBM
Authors	(Mignon & Bankel, 2023)	(Lüdeke-Freund et al., 2018)	(Schroedel, 2023)	(Bocken et al., 2014)

1	Efficiency orientation	Maximize material and product efficiency	Products are optimised for sustainability during their development process	Maximize material and energy efficiency
2	News ways to make business sustainable	Product oriented services, result oriented services etc.,	Product-services systems	Deliver functionality rather than ownership;
3	Society or environment orientation	Social Mission patterns	Repurpose for Society or the environment	Substitute with renewables and natural processes or Repurpose for Society or the environment
4	Born sustainable	Renewable and natural process, Social mission	Social enterprises, encourage Sufficiency	Create value from waste;

In reality, no single pattern will provide competitive advantage as per Schroedel, (2023) rather the business model innovation and business model adaptation strategies differ for Startups and Established (Incumbents) firms. However, there is little to no empirical evidence on the effectiveness of these BMfS with regards to the social and environmental outcomes except findings on business models on plastic recycling observes from 44 business cases, 100% cases reported positive environmental impacts and only 32% business cases report social benefits (Dijkstra et al., 2020).

1.6.Challenges in BM adaptation

Recent studies categorized challenges in implementing SBMs as Institutional; Organizational Culture; Markets and Sales; Innovation; research and development; Supply chain, operation and logistics(Nunes et al., 2022). In another reach conducted on Sustainable Entrepreneurship in India reveals lack of market and customer awareness; no proper support

from Government; insufficient funds and lack of capital; unable to justify the economic value with social and environmental value (Yedama et al., 2022).

The challenges for creation of SBMs outlined (Evans et al., 2017; Geissdoerfer et al., 2018) are

1. Achieving profits, social good and environmental sustainability together, and balancing them, makes transitioning to sustainable business models a complex task (Triple Bottom Line)
2. Trapped in a mental cage of familiar benchmarks and procedures, firms can find it daunting to unlock the potential of transformative business models (Mind-set)
3. Investing in and adapting to new business models faces resistance due to resource allocation barriers (Resources)
4. Integrating Technology breakthroughs with reinvented business structures is a complex, multi-layered challenge(Technology Innovation)
5. Extensive stakeholder interplay and environmental awareness necessitate additional commitment (External relationships)
6. Existing business model tools and methods are few and not extended for Sustainability (Methods and tools)
7. Establishing product/service awareness, adoption and go to market strategies require enourmous resources (Marketing/Sales)

1.7.Stakeholder perspectives for BMfS

Stakeholders defined as Internal, External and Interconnecting (Lozano, 2018) based on the research works of widely cited authors (Bocken et al., 2014; Boons & Lüdeke-Freund, 2013; Stubbs & Cocklin, 2008; Upward & Jones, 2016). Cohesion of this notion only found for Internal and External stakeholders. Sustainable organizations break free from shareholder silos, embracing a stakeholder ecosystem. Success blossoms through collaboration with communities, suppliers, partners, employees, and customers. Stakeholder engagement is the bedrock of sustainable business models(Stubbs & Cocklin, 2008). In addition, the same research proposes, not just resource extraction, sustainable businesses see nature as a partner. They turn to renewable options, minimize waste with cutting-edge tech, and advocate for mindful consumption, striving to shrink their footprint and even repair environmental harm.

The perspectives proposed include value network perspective (example. Customers, Distributors, Partners and Suppliers, Employees, Environment, Community, Government) and systemic perspective (Bocken et al., 2014). By adopting a systemic perspective, businesses can better understand the complex interactions and dependencies within the value network, leading to more sustainable and resilient business models. Profit isn't the sole motive for organizations adopting an Environmental Modernization (EM) perspective. They seek financial success intertwined with improved stakeholder lives and a lighter environmental touch. (Stubbs & Cocklin, 2008). An example can be, when resources extracted by paper manufacturing company balancing out emissions with carbon credits or tree-planting projects. In this process, they even find out other ways to manufacture paper from sustainable raw materials. Integrating or partnering with multiple Stakeholders beyond firm boundaries concerning value proposition and value creation/delivery generates significant impact (Matzembacher et al., 2020). Empirical research shows that balancing the focus among economical, environmental and social is not that easy and the startups does tilt more towards on economic dimension or environmental than social(Dijkstra et al., 2020). It would be worthy of research to evaluate the impact on the BMfS from Stakeholder perspective leading to Business Model Innovation after gaining initial financial success.

Conclusion and Further research:

The primary author plans to embark on empirical research to address multiple research calls from past research to establish the role of Business Models (BMfS) in Indian Solid Waste Management Industry(Lüdeke-Freund et al., 2018; Mignon & Bankel, 2023; Schroedel, 2023); The role of technology in driving the BMfS outcomes; Are the enterprises able to drive and evaluate the effectiveness of the outcomes between Social, Economic and Ecology (Lüdeke-Freund et al., 2018); What are different perspectives of the stakeholders of BMfS (Matzembacher et al., 2020). A list of research gaps identified in the existing literature reviews provided in the annexure1 for aspiring research enthusiasts to pursue. More publications in the context of Indian Solid Waste Management Industry and Business Models, Technology space would contribute to both business and academia.

References:

1. Abdu, H., & Mohd Noor, M. H. (2022). A Survey on Waste Detection and Classification Using Deep Learning. *IEEE Access*, *10*(November), 128151–128165. https://doi.org/10.1109/ACCESS.2022.3226682
2. Bocken, N. M. P., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production*, *65*, 42–56. https://doi.org/10.1016/j.jclepro.2013.11.039
3. Boons, F., & Lüdeke-Freund, F. (2013). Business Models for Sustainable Innovation: State of the Art and Steps Towards a Research Agenda. *Journal of Cleaner Production*, *45*, 9–19. https://doi.org/10.1016/J.JCLEPRO.2012.07.007
4. Dijkstra, H., van Beukering, P., & Brouwer, R. (2020). Business models and sustainable plastic management: A systematic review of the literature. *Journal of Cleaner Production*,

258, 120967. https://doi.org/10.1016/j.jclepro.2020.120967

5. Evans, S., Vladimirova, D., Holgado, M., Van Fossen, K., Yang, M., Silva, E. A., & Barlow, C. Y. (2017). Business Model Innovation for Sustainability: Towards a Unified Perspective for Creation of Sustainable Business Models. *Business Strategy and the Environment*, *26*(5), 597–608. https://doi.org/10.1002/bse.1939
6. Geissdoerfer, M., Vladimirova, D., & Evans, S. (2018). Sustainable business model innovation: A review. *Journal of Cleaner Production*, *198*, 401–416. https://doi.org/10.1016/j.jclepro.2018.06.240
7. Heredia, J., Castillo-Vergara, M., Geldes, C., Carbajal Gamarra, F. M., Flores, A., & Heredia, W. (2022). How do digital capabilities affect firm performance? The mediating role of technological capabilities in the "new normal." *Journal of Innovation and Knowledge*, *7*(2), 100171. https://doi.org/10.1016/j.jik.2022.100171
8. Holzmann, P., & Gregori, P. (2023). The promise of digital technologies for sustainable entrepreneurship: A systematic literature review and research agenda. *International Journal of Information Management*, *68*(October 2022), 102593. https://doi.org/10.1016/j.ijinfomgt.2022.102593
9. Kaza, S., Yao, L. C., Bhada-Tata, P., & Van Woerden, F. (2018). *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1329-0
10. Lozano, R. (2018). Sustainable business models: Providing a more holistic perspective. *Business Strategy and the Environment*, *27*(8), 1159–1166. https://doi.org/10.1002/bse.2059
11. Lüdeke-Freund, F. (2020). Sustainable entrepreneurship, innovation, and business models: Integrative framework and propositions for future research. *Business Strategy and the Environment*, *29*(2), 665–681. https://doi.org/10.1002/bse.2396
12. Lüdeke-Freund, F., Carroux, S., Joyce, A., Massa, L., & Breuer, H. (2018). The sustainable business model pattern taxonomy—45 patterns to support sustainability-oriented business model innovation. *Sustainable Production and Consumption*, *15*(July), 145–162. https://doi.org/10.1016/j.spc.2018.06.004
13. Lüdeke-Freund, F., Carroux, S., Joyce, A., Massa, L., & Breuer, H. (2018). The sustainable business model pattern taxonomy—45 patterns to support sustainability-oriented business model innovation. *Sustainable Production and Consumption*, *null*, null. https://doi.org/10.1016/J.SPC.2018.06.004
14. Matzembacher, D. E., Raudsaar, M., de Barcellos, M. D., & Mets, T. (2020). Business models' innovations to overcome hybridity-related tensions in sustainable entrepreneurship. *Sustainability (Switzerland)*, *12*(11), 1–17. https://doi.org/10.3390/su12114503
15. Mignon, I., & Bankel, A. (2023). Sustainable business models and innovation strategies to realize them: A review of 87 empirical cases. *Business Strategy and the Environment*, *32*(4), 1357–1372. https://doi.org/10.1002/bse.3192
16. Nosratabadi, S., Mosavi, A., Shamshirband, S., Kazimieras Zavadskas, E., Rakotonirainy, A., & Chau, K. W. (2019). Sustainable Business Models: A Review. *Sustainability*, *11*(6), 1663. https://doi.org/10.3390/su11061663
17. Nunes, A. K. da S., Morioka, S. N., & Bolis, I. (2022). Challenges of business models for sustainability in startups. *RAUSP Management Journal*, *57*(4), 382–400. https://doi.org/10.1108/RAUSP-10-2021-0216
18. Pongrácz, E., Phillips, P. S., & Keiski, R. L. (2004). Evolving the theory of waste management: Defining key concepts. *Waste Management and the Environment II*, 471–480.
19. REMANE, G., HANELT, A., TESCH, J. F., & KOLBE, L. M. (2017). The Business Model Pattern Database-A Tool For Systematic Business Model Innovation. *International Journal of Innovation Management*, *21*(1), 1750004. https://doi.org/10.1142/S1363919617500049
20. Schaltegger, S., Hansen, E. G., & Lüdeke-Freund, F. (2016). Business Models for Sustainability: Origins, Present Research, and Future Avenues. *Organization and Environment*, *29*(1), 3–10. https://doi.org/10.1177/1086026615599806
21. Schroedel, S. (2023). The Sustainable Business Model Database: 92 Patterns That Enable

Sustainability in Business Model Innovation. *Sustainability (Switzerland)*, *15*(10), 8081. https://doi.org/10.3390/su15108081

22. Sehnem, S., Campos, L. M. S., Julkovski, D. J., & Cazella, C. F. (2019). Circular business models: level of maturity. *Management Decision*, *57*(4), 1043–1066. https://doi.org/10.1108/MD-07-2018-0844
23. Silvia, C., & Truzzi, S. (2020). Sustainable Business Models: Literature Review of Main Contributions and Themes. *International Journal of Business and Management*, *15*(5), 11. https://doi.org/10.5539/ijbm.v15n5p11
24. Stubbs, W., & Cocklin, C. (2008). Conceptualizing a "Sustainability Business Model." *Organization & Environment*, *21*, 103–127. https://doi.org/10.1177/1086026608318042
25. Upward, A., & Jones, P. H. (2016). An Ontology for Strongly Sustainable Business Models. *Organization & Environment*, *29*, 123–197. https://doi.org/10.1177/1086026615592933
26. Yedama, N., Madhavi, S., PrudhviRaj, K., & Raju, P. (2022). Sustainable Entrepreneurship Innovation and its challenges in India. *International Journal of Mechanical Engineering and Mechatronics* , *7*(0974–5823). https://www.researchgate.net/publication/359158659

Annexure1 - Research Gap found from the literature reviews:

Year	APA Reference	ABDC Rank/SJR	Domain	Research Gap or Further Research
2018	(Neumeyer & Santos, 2018)	A	Business Model	Future research proposed by Authors on 4 components namely 1) Sustainable ecosystem components, 2) Norms and Values sustainable entrepreneurial ecosystems 3) success factors and measurement 4) Digitization and online resources of sustainable entrepreneurship ecosystems
2023	(Schroedel, 2023)	Q1	BM Patterns	1) Thus, the present publication can stimulate sustainable business model innovations; nonetheless, how well this works is still the subject of future research. 2) Further research is needed on how to increase the effectiveness of pattern-based innovation 3) there are publications that show that circular business models gain greater acceptance through digital technologies [122]. Whether this effect can also be observed in the context of sustainable pattern-based business model innovations needs to be explored 4) However, a well-founded evaluation and quantification of the positive influence is still pending
2021	(Süß et al., 2021)	Q1	Business Model	For example, a systematic procedure model or the use of life cycle assessment should be considered as possible starting point in future research toward a methodology of integrated sustainability

				evaluation
2020	(Schneider & Clauss, 2020)	A	Business Model	Future studies could reveal additional insight by integrating a different variety of data sources (e.g., thinking-aloud protocols, observations, meeting protocols) to further strengthen the identified decision patterns' validity
2020	(Lüdeke-Freund et al., 2020)	NA	Business Model	An important question that was only indirectly discussed in this paper and calls for further research is whether and how value creation as such, i.e. the processes needed to satisfy certain stakeholder needs, can be designed in more sustainable ways. How can value creation – from a process perspective – become more sustainable?
2019	(Groot et al., 2019)	A	Business Model	Future research should seek to validate the above findings through larger samples, covering other Indian states and countries
2019	(Nosratabadi et al., 2019)	Q1	Business Model	An in-depth analysis of processes of transition from a traditional business model to a sustainable business model in different industries is recommended for future research. Utilizing a quantitative methodology to study the restrictive factors inhibiting businesses from implementing a sustainable business model and their effects on the social and environmental performance of the business is also recommended for future research.
2019	(Bocken, Boons, et al., 2019)	A	Business Model	Future work can expand on the frameworks and processes explored in this paper to develop better business models with a wider positive societal and environmental impact. This calls for further research on sustainable business model design and experimentation taking a systems-level perspective
2018	(Lüdeke-Freund et al., 2018)	Q1	BM Patterns	which also points to an important area for future research relates to the assessment of SBMs. assessing the actual sustainability performance of such business models requires methods and metrics that capture the ecological, social, and eco-

				nomic performance of SBMs Furthermore, literature reviews and empirical case studies are needed to explore the strengths, weaknesses, and contingency factors that influence the sustainability performance of SBMs and associated patterns.
2016	(Roome & Louche, 2016)	A	Business Model	What is clear is that more research on these processes, their antecedents, and their constituent parts is needed
2016	(Schaltegger et al., 2016)	A	Business Model	more research on business models for sustainability is needed to further develop more integrative theories of sustainability management that can effectively contribute to sustainable development of the economy and society
2016	(Upward & Jones, 2016)	A	Business Model	This position could be strengthened by considering whether additional business model factors required for strongly sustainable outcomes could create stronger business cases
2016	(Abdelkafi&Täuscher, 2016)	A	Business Model	First, a database of BMfS case studies can be constructed to investigate in a systematic way the mechanisms by which the environmental value proposition, value to the customer, and captured value can reinforce each other. Second, due to the importance of the decision makers' cognition in the development of BMfS, it can be insightful to study the mental models of entrepreneurs and managers that operate in businesses that strive for achieving a positive impact on society, the economy, and the natural environment. Research should identify how these decision makers construct their mental models about the environment, how they update their current beliefs, and how these beliefs translate to specific behaviors.
2023	(Schroedel, 2023)	Q1	Business Model	Further research is needed on how to increase the effectiveness of pattern-based innovation. there are publications that show that circular business models gain greater acceptance through digital technologies [122]. Whether this effect can also be observed

				in the context of sustainable pattern-based business model innovations needs to be explored. Thus, the present publication can stimulate sustainable business model innovations; nonetheless, how well this works is still the subject of future research