Harnessing knowledge ecology management perspective in green microfinance through critical discourse analysis

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Abstract

Purpose – *Green microfinance, a growing subset of microfinance, has several challenges and gaps that require academic attention. The purpose of this study is to decipher the power dynamics between various stakeholders of green microfinance by harnessing knowledge management perspective towards the perceptions and attitudes of the beneficiaries and how well green microfinance acts as a tool to create awareness among the masses about its benefits and in achieving the goal of financial inclusion through knowledge ecology management (KEM).*

Design/methodology/approach – *This study uses a qualitative method to explore the various dimensions of green microfinance, including its aims & scope, drivers, outcomes and prospects, as explained through the lens of ecological theory of knowledge management. A critical discourse analysis, which facilitates discourse through linguistic analysis of recordings and texts, has been used on 178 newspaper articles, policy documents and videos from 2019 to 2023.*

Findings – *This study found four prominent aims of green microfinance, its five key drivers, and five outcomes of reliance on this source of finance from knowledge ecology management (KEM) perspective. It also sheds light on the future outlook of sustainable investments and financing.*

Practical implications – *This study provides a bird's-eye view and a thorough examination of the aspects of green microfinance within the KEM framework, thereby providing valuable decision-making insights for financial institutions, policymakers and small borrowers.*

Originality/value – *The proposed enhanced ecological knowledge management framework illustrates a conceptual framework representing the thematic discourses undertaken and the elements that play a crucial role in achieving valuable outcomes of green microfinance.*

Keywords *Green microfinance, Financial inclusion, Microfinance institutions, Sustainable finance, Knowledge ecology management, Critical discourse analysis*

Paper type *Research paper*

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1. Introduction

Microfinance institutions (MFI) have become a vital means for providing various types of financial services (such as loan facilities, savings accounts, and others) to individuals who do not have access to traditional banking services (Forcella and Hudon, 2014). Governments across various countries have advocated MFIs to help lower-income individuals and small business owners start or expand their businesses and manage their finances (Nugroho *et al.*, 2017). Through poverty alleviation and enhancement of self-sufficiency among the citizens, MFIs also contribute to the development of the economy (Chirkos, 2014).

Increasing consciousness of the environment and a shift in favour of sustainable financial services have led to the development of a new subset of microfinance, i.e. green microfinance. The prime focus of green MFIs is to provide easy access to individuals and

businesses involved in socially responsible activities (Archer and Jones-Christensen, 2011). This, in turn, aids in sustainable development and building a resilient and environmentally conducive society. However, to leverage this sustainable competitive advantage, knowledge management (Vo-Thai and Tran, 2024) and knowledge application aligned with government policy are required (Nguyen *et al.*, 2024).

Green microfinance contributes to nation-building in several ways. First, green MFIs help mitigate the adverse impact of climate change by funding only those individuals and institutions that are involved in environmentally sustainable projects, such as organic farming, renewable energy, and sustainable forestry, leading to the reduction in carbon emissions (Aslam Mia *et al.*, 2020; Lanzavecchia *et al.*, 2021). Second, it provides an impetus for livelihood improvement by offering customized financial services, which can empower the masses and break their vicious cycle of poverty (Khan, 2014). Third, green microfinance fosters innovation and entrepreneurship by collaborating with small businesses and promoting new sustainable business methods using technology adoption and resilient business models (Chirambo, 2017). Such green innovations are accredited to knowledge flows because of a firm's green activities within knowledge management (Xiong *et al.*, 2024) and its ecology.

While the domain of green microfinance is at a nascent stage, the limited research in this area has investigated the outcomes of the firms supported by green MFIs and identified the factors that foster them in complying with sustainable, environment-friendly practices (Allet, 2013; Chiu, 2015). Additionally, studies have explored the possibilities of scaling green microfinance activities by delving into the opportunities and challenges (Huybrechs *et al.*, 2019). Despite the gradual growth in the green microfinance literature, several challenges and gaps need attention. Firstly, there is no standardized methodology for measuring the impact and outcome of green microfinance activities (García-Pérez *et al.*, 2020), and most of the evaluations undertaken by firms are based on self-reported data, which can be largely biased (Prince *et al.*, 2020). Secondly, the impact of green microfinance activities can be witnessed in the long run. Therefore, it is important to identify the factors that can act as barometers for sustainable development, which remains missing (Tran *et al.*, 2020). Thirdly, the impact of green microfinance is likely to vary from region to region (García-Pérez *et al.*, 2020). Therefore, it is essential to recognize the context or region-specific elements that can be improved for advancing sustainable development. Fourthly, the challenge of scalability and integration of green microfinance with the strategies of the firm is yet to be explored, which, if undertaken, can lead to the enhanced effectiveness of green microfinance as a tool for economic and social development (Huybrechs *et al.*, 2019). Finally, to achieve this strategic integration, the missing knowledge-based view is required to assess the credit behaviour of small and micro enterprises to decide if they need more formal or informal information channels to provide loans (Liu *et al.*, 2022) to the target communities.

Based on the prior literature and research gaps, examining and exploring the various dimensions of green microfinance is pertinent to advance the discussion and contribute to this domain. Further, the ecology theory of knowledge management articulates the flow of knowledge for human interactions and learning communities. Through its theoretical lens, it intends to explain green microfinance's aims & scope drivers, outcomes, and prospects.

The current study uses a qualitative method of critical discourse analysis (CDA) to answer the research questions below:

RQ1. What are the aims and scope of green microfinance within the ambit of knowledge ecology management?

RQ2. What are the drivers of green microfinance complemented by knowledge ecology management?

RQ3. What are the outcomes of green microfinance as explained by knowledge ecology management?

RQ4. What are the prospects of green microfinance as aligned with knowledge ecology management?

While previous studies have focused on various quantitative aspects of green microfinance (Atahau *et al.*, 2021; Beisland *et al.*, 2022), this paper aims to enhance the understanding of the concept through a qualitative approach and spell out the hidden dynamics of the domain which could not be explored through previous quantitative analysis (Jacobs and Tschötschel, 2019). By doing so, this study would be a pioneer in exploring green microfinance through a qualitative discourse through the knowledge ecology management (KEM) theory and shall offer valuable contributions.

Primarily, the study shall decipher the power dynamics between various green microfinance stakeholders and help them understand the initiatives they took to advance their objectives. This helps improve any shortcomings that paved the way for them to achieve their objectives smoothly. Subsequently, the study shall help integrate the dual objectives of poverty alleviation and environmental sustainability by directly linking the two and suggesting the activities that can be undertaken. Furthermore, the study shall also throw light on the perceptions and attitudes of the beneficiaries and how well green microfinance has acted as a tool to create awareness among the masses about its benefits and in achieving the goal of financial inclusion through addressing the knowledge management dilemmas, e.g. bridging the demand-supply gap in rural financial knowledge within the dimension of knowledge ecology (Yang *et al.*, 2022). In addition, the study shall discover the future scope in the domain of green microfinance, along with the steps that policymakers can take to further the goal of sustainable development through green microfinance.

In the following sections, we review the literature and background on green microfinance and its alignment with KEM, followed by the details of the research methodology employed in the study. We then highlight the results of our analysis, followed by discussions on the findings, providing justifications for them, and laying down a conceptual framework. The last section ends with policy implications, conclusions, limitations, gaps, and questions for further research. This study is novel attempt to align KEM perspective to the aspects and outcomes of green microfinance.

2. Literature review and background

The globe has been witnessing a massive debate on transforming the context of sustainability with the help of green finance, and the same has been promoted by the United Nations Sustainable Development Goals (United Nations, 2015). Green finance fosters environmental objectives and caters to financial and social goals (Lee and Lee, 2022). Moreover, environmental management and control are the core of propagating green microfinance activities (Arrive and Feng, 2018). The relationship between environmental management and financial performance has been explored from various angles (Ayayi and Wijesiri, 2022; Velte, 2023; Li and Ramanathan, 2020). Prior studies have looked into the cultural (Esposito *et al.*, 2022), human rights (Idemudia *et al.*, 2020) and financial disclosure regulation (Cosma *et al.*, 2023) aspects concerning the environment and social performance.

Green finance has emerged as a vital tool for promoting financial products and services that can enhance the quality and quantity of environmental sustainability (Verma *et al.*, 2023). The broader perspective is to enhance sustainable investments and stimulate green initiatives by the firms, which shall lead to achieving social, environmental and economic objectives. This would also intensify the quantum of environment-friendly practices in the community (Zhang *et al.*, 2021). One of the integral elements of green finance is microfinance, which focuses on providing various kinds of financial services and loans to needy individuals and small institutions for their business growth and better economic

outcomes. These MFIs act as facilitators for achieving sustainable development goals (United Nations, 2015).

By ensuring financial inclusions, green MFIs aim to encapsulate both economic and environmental goals (Sohail and Din, 2023). Considering that these services are knowledge-intensive and innovative institutions and firms are pivotal in a knowledge-driven economy (Duan *et al.*, 2023), such MFIs should align knowledge management perspectives into their activities with a thorough understanding of KEM. The existing relationship between financial knowledge and the credit practices of small and medium enterprises can be harnessed for the expansion of green microfinance and to address the issues of credit constraints and low participation to further financial inclusion (Liu *et al.*, 2022).

2.1 Green microfinance and environmental practices

Green microfinance has often been used to reduce environmental degradation as funds are provided to institutions that are socially and environmentally responsible (Allet and Hudon, 2013). For instance, in the Indian context, deforestation has declined due to access to green microfinance, and the quantum of afforestation has significantly improved. Moreover, it also leads to providing necessary funds for renewable and clean energy services (Barua and Aziz, 2022) and the creation of shared value in social enterprises that address not just the societal aspects but also the environmental concerns as a result of their enhanced knowledge absorptive capacity (Campos-Climent and Sanchis-Palacio, 2017).

Green microfinance provides funds and ensures financial strength and resilience to individuals and institutions by mitigating risks (Ullah and Khan, 2017). Research evidence suggests that borrowers of green microfinance funds are highly aware of environmental issues and inclined towards undertaking sustainable activities as well (Miled and Landolsi, 2023). Knowledge elicitation on climate matters by including tacit stakeholder inputs (Nikas *et al.*, 2017) can also contribute to the green microfinance ecosystem.

Studies have also advocated a direct and positive linkage between economic development and environmental conservation (Agboola *et al.*, 2021). Green microfinance programs are also linked to the promotion of bio-diversity land use as these are involved in a combination of activities such as credit facilities, technical supervision, and economic incentivization (Bastiaensen *et al.*, 2015), as has been witnessed in the case of such programs in Nicaragua. Climate change is a cause of global concern, and financial institutions, along with other non-financial organizations, are doing their best to tackle these challenges by offering much-needed financial products and services to those who support the agenda of environmental protection (Park and Kim, 2020).

2.2 Green microfinance and inclusive development

Microfinance has long been recognized as a powerful tool for empowering women in developing countries. It facilitates women's small-scale enterprises' access to capital, technology, and other resources.

Green microfinance has seen a new dimension of growth concerning the relationship between green energy and women's empowerment through a stream of research studies (Hermawati *et al.*, 2023; Atahau *et al.*, 2021). These studies have found that access to funds through green microfinance has led to steady growth in the degree of women's empowerment and a fall in gender inequality (Atahau *et al.*, 2021). Since there exists an ample number of small-scale organizations as well as self-help groups that are owned and controlled by women in rural areas, access to funds acts as a catalyst for their independent growth and development. Women often use these funds for their business activities and to install clean and renewable energy, fostering environmentally sustainable activities (Manko and Watkins, 2021). These funds are substantially granted for purchasing sustainable

machines such as solar panels, wind turbines, water harvesting, water filtration systems and more (Jindo *et al.*, 2023; Chirambo, 2019). These large-scale benefits can also be seen in improved living standards and health conditions.

This evidence is sufficient to highlight the critical role played by green microfinance in improving societal and sustainable development (Pal *et al.*, 2021). Still, further exploration is required to identify the untapped potential of these initiatives and remove any obstacles in promoting sustainable business activities.

2.3 Knowledge ecology management and green microfinance

The ecology perspective of knowledge management suggests the management of personal, formal, and informal sharing of information across actors, organizations (Värk and Reino, 2020) and communities. Green MFIs emphasize more formal channels of knowledge sharing among their employees and departments due to the positive impact of knowledge management on organizational performance (Matawali, 2018). Effective processes for sharing the vision and cooperation in micro-enterprises can help reduce the understanding gap about high-tech microfinance while enhancing the explicability of tacit knowledge, leading to cognitive trust and better risk management (Rowe *et al.*, 2010). MFIs, being the entities of collaboration, are leading microfinancing service providers that require inter-organizational knowledge sharing to achieve their strategic objective of sustainable development (Taifi and Gharbi, 2016).

The imperfect knowledge environment consisting of weak knowledge sharing, poor knowledge updation process and slow knowledge flows are the issues in accessing and disbursing rural finance that can be addressed with the help of KEM (Yang *et al.*, 2022). Since microfinance is a crucial source to fulfil the financial needs of micro-enterprises, it requires innovative ways such as artificial intelligence (AI) for effective knowledge sharing and management among their stakeholders (Nurjannah *et al.*, 2023). To maintain the sustainable competitiveness of the financial sector, business process reengineering is explained by adaptability, knowledge creation and sharing aspects of knowledge management in MFIs (Nkurunziza *et al.*, 2018). Knowledge management aspects such as learning methods, learning support and learning category can impact microfinance lending through formal MFIs rather than leaving the asset-less borrowers at the mercy of loan sharks charging high interest rates (Thampradit and Fongsuwan, 2014). Hence, the management of explicit and implicit knowledge under KEM, where the term ecology refers to the information systems drawing heavily on social networks for creating, sharing, using and managing knowledge and information (Saeedi, 2018), can help MFIs to perform on the financial indicators, social indicators (Akter *et al.*, 2021) as well as environmental indicators. Thus, KEM can be crucial in knowledge dissemination by creating stakeholder awareness.

3. Research methodology

3.1 Selection of methods

This research aims to gain a more comprehensive understanding of green microfinance by establishing a broader perspective on the subject. The study focuses on answering various questions related to green microfinance, which can help stakeholders make better decisions and formulate policies.

CDA has been used to address the proposed research inquiries and accomplish the research objectives. Simply put, CDA is a scholarly instrument that facilitates the revelation of the latent intentions underlying speeches, news articles, videos, and other forms of media publications (Machin and Mayr, 2023; Petintseva, 2022). In addition, it facilitates an exploration of those complex elements that would otherwise remain undetected in a typical situation (Jain *et al.*, 2024). While its initial purpose was to analyse political speeches and

debates, CDA has since been applied to numerous disciplines, including health (Yu *et al.*, 2022), finance (Evans *et al.*, 2021) and marketing (Eriksson and Kenalemang, 2023), among others, to conduct a variety of analyses.

The justification for selecting this methodology is that the field of green microfinance is in its infancy, and language-based text analysis will be the most appropriate approach to comprehend the diverse dynamics of the subject (Fairclough, 2023) while at the same time avoiding researcher bias (Butson *et al.*, 2024). Furthermore, given the extensive social and economic ramifications of green microfinance, it can be used to illuminate social discourses that support the development and implementation of policies that can foster financial inclusion (Gleasure *et al.*, 2019).

3.1.1 Sources of data. CDA is a practical methodology that facilitates discourse employing linguistic analysis of recordings and texts. When selecting the data, we relied on three primary sources – newspaper articles, policy documents and videos. Compared to conventional media sources, these elements facilitate the dissemination of information more rapidly (Mitchelstein and Boczkowski, 2009). Furthermore, policy documents and newspaper articles offer a written discourse that can be used to analyse narratives, language and the structuring of texts (Mendes *et al.*, 2022). Applying these would facilitate examining word selection, metaphors and additional aspects to reveal concealed frameworks (Zibin, 2022). Similarly, examining the videos helps discern the speech intonation, non-verbal signals and sound effects, among other elements, to decipher the overarching message and discourse (Joye and Maeseele, 2022).

3.1.2 Method of data analysis. The methodology used for the analysis was inductive, as the data collected was qualitative. To accomplish the research objectives, we employed the inductive content analysis method to decipher the meanings, concepts and constructs derived from the categorization of the extensive data set (Sheydayi and Dadashpoor, 2023; Lookingbill, 2022). The inductive content analysis was carried out utilizing the Gioia approach (Gioia *et al.*, 2012), which places significant importance on the production of inductive codes that may prove beneficial in deriving meaning and data from the analysis of unstructured texts (Magnani and Gioia, 2023). The approach, which has been extensively integrated with grounded theory, has been the subject of numerous recent studies in various fields (Dhir *et al.*, 2023).

3.2 Collection of data

The data for this study were obtained from widely circulated media outlets between November 2019 and September 2023. The selection of 2019 as the cutoff time is predicated on the notion that the concept of green microfinance attracted the attention of the scholarly community and society at large during this time (Zaby, 2019). The information was obtained from various news sources, including prominent institution websites (NASDAQ, Ernst & Young, Deloitte), news platforms, and newspaper articles (*Live Mint, Economic Times, The Independent* and more). Policy documents and reports from reputable organizations such as the United Nations Environment Programme, International Science Council and other similar organizations were gathered. Data was collected from diverse sources to obtain a more comprehensive range of information and viewpoints from the previous two years (2022 and 2023). The inquiry was conducted with the primary keyword "Green Microfinance," which retrieved 178 files, including policy documents/reports, videos and newspaper articles.

3.3 Data analysis

To conduct the data analysis, the preliminary step was to pool the data in a folder where a set of 178 files were collated. These files included media reports, articles, videos, blogs and other similar sources. Individual coding was done for each of the sample files conducted

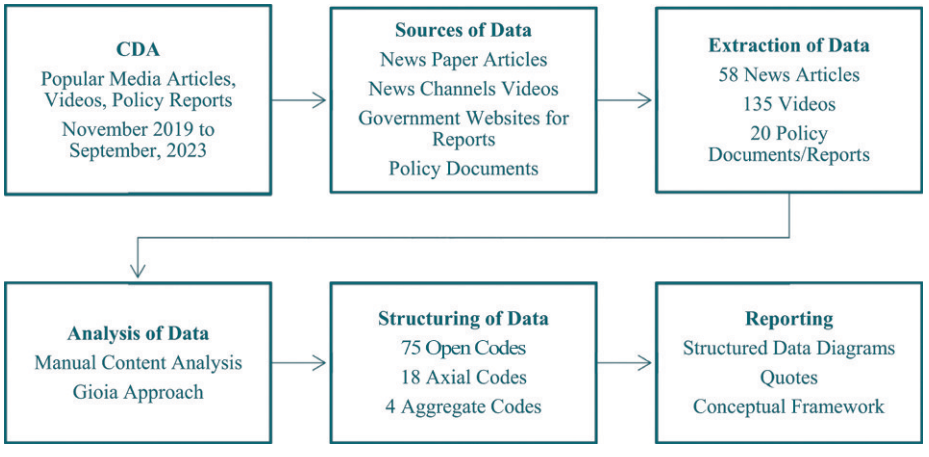
independently. A separate Excel sheet was also maintained, and the bibliographic details of these files were saved for cross-verification. After organizing these demographic details, the video files were transcripted and converted into a text file for interpretation purposes (Jacobsen *et al.*, 2021). On similar lines, the media articles and blogs were also converted into Word files so that they could be independently read and themes could be identified. The past literature warrants a systematic and scientific approach for identifying the themes in the CDA; thus, Gioia's approach was chosen for the same (Magnani and Gioia, 2023; Murphy *et al.*, 2017). Two authors read these files word by word and allotted independent codes to the themes and elements they found relevant to the research questions. Once the independent coding was conducted, the entire team held a brainstorming and discussion session to finalize the suitable themes based on the understanding of the literature. Multiple discussions followed involving a few experts in the domain to validate the generated themes (Patrick *et al.*, 2011). After detailed discussions and finalization, 75 open codes were identified. To establish inter-coder reliability and validation, these finalized codes went through the validation process by the experts through Zoom meetings. These open codes were studied in detail for classification, leading to 18 axial codes (Schreieck *et al.*, 2022). In the final stage of analysis, these 18 axial codes led to the determination of four aggregate codes related to the study's research questions (Rheinhardt *et al.*, 2018; Pratt *et al.*, 2020). Figure 1 provides a summary of the research methodological steps that have been undertaken to conduct the study.

4. Findings

Through analysing the videos, policy documents, and news articles, we sought answers to the four research questions: *RQ1*. What are the aims and scope of green microfinance within the ambit of knowledge ecology management? *RQ2*. What are the drivers of green microfinance complemented by knowledge ecology management? *RQ3*. What are the outcomes of green microfinance as explained by knowledge ecology management? *RQ4*. What are the prospects of green microfinance as aligned with knowledge ecology management?

The analysis was conducted in three stages: identifying first-order constructs, categorizing them into second-order constructs and creating aggregate coding categories. We derived each aggregate coding category using first and second order constructs.

Figure 1 Overview of methodology



Source: The authors'

Furthermore, theoretical linkages of KEM theory with each of these aggregate dimensions of microfinance and their corresponding axial codes are presented, refer to Table 1. Moreover, this section presents the findings from our analysis, illustrated through data structure diagrams (Figures 2–5).

4.1 Aims and scope of green microfinance

In business, knowledge management by transforming data into information and information into knowledge is the quintessential aesthetic; however, knowledge ecology is human-centric in nature and argues for the strategic use of information in a networked information-driven organization (Petrides and Guiney, 2002). To attain sustainable practices, eco-friendly project funding, renewable energy investments and low-income community focus, MFIs can harness knowledge ecology for sustainable development. Refer to Appendix Table A1 to find the theoretical linkage of KEM to the aims and scope of green microfinance, along with the mapped quoted text extracted from the sample data files.

4.1.1 Sustainable practices. The first aim of green microfinance is to promote sustainable practices. While the scope of green microfinance is still nascent, it builds the power of the global spread of MFIs to promote sustainable practices (García-Pérez *et al.*, 2018) that improve the lives of people with low incomes. To ensure the smooth and efficient undertaking of sustainable business practices by the green MFIs (Ab Rahman *et al.*, 2015), the incorporation of low-carbon pathways (Dowla, 2018), integration of pro-climate strategies (Budiman *et al.*, 2016), promoting climate resilience (Chirambo, 2017) and developing green products and services (Allet and Hudon, 2013; Awan *et al.*, 2021) have become essential components.

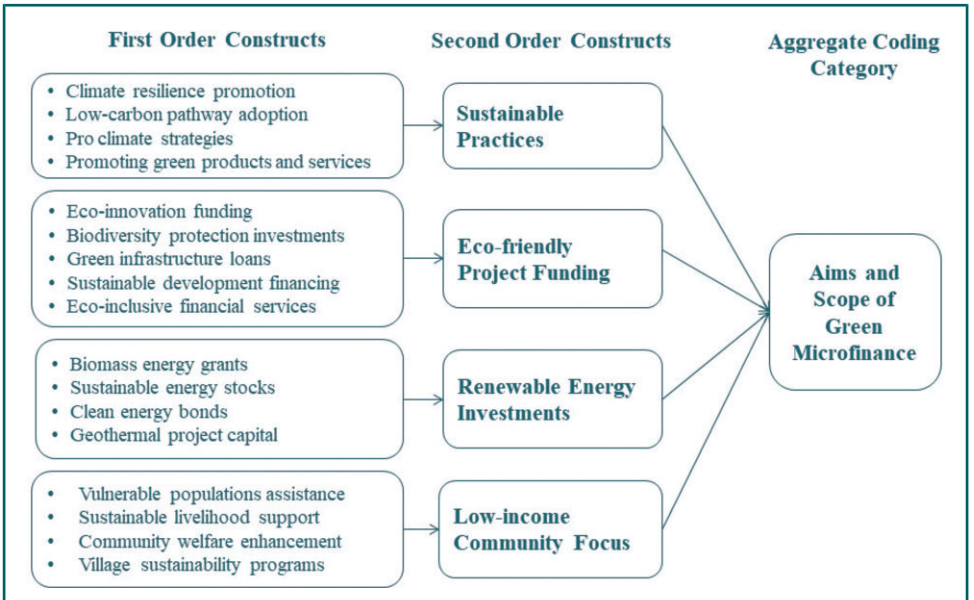
4.1.2 Eco-friendly project funding. MFIs play an important role in providing financial assistance (Corrado and Corrado, 2017) and funding to take forward green projects specifically for small businesses, small farmers and vulnerable societies among others, which lack the

Table 1 Knowledge ecology management (KEM) aspects as a link between green microfinance aggregate dimensions and corresponding axial codes

S. no.	*Green microfinance aggregate dimension*	*Knowledge ecology management (KEM) perspective*	*Green microfinance axial codes*
1.	Aims and scope of green microfinance	Knowledge management by transforming data into information Strategic use of information in a networked information-driven organization Human-centric approach under knowledge ecology management	Sustainable practices Eco-friendly project funding Renewable energy investments Low-income community focus
2.	Drivers of green microfinance	Leveraging stakeholders' awareness levels by microfinance institutions (MFIs) Value addition in information exchange in an innovative way under knowledge ecology Application of information technology in collecting, managing and disseminating information Engagement with digital technologies for explicit (rules and guidelines) information sharing in a social network	Climate change awareness Alternative energy demand Green policy incentives Sustainable tech advancements Government regulatory support
3.	Outcomes of green microfinance	Experience-based knowledge when personalized and shared directly in an interpersonal manner across hardwired social networks, it enhances business outcomes KEM a social process for business improvement	Energy efficiency improvement Natural resource conservation Pollution control measures Agricultural productivity Socio-Economic upliftment
4.	Future prospects of green microfinance	Healthy knowledge ecology through the interaction of humans, technology, values, practices and organizational environment advances green microfinance through a defined the structure of knowledge, value addition and distribution	Digital finance collaboration Emerging market expansion Innovative financing models Environment-centric policy

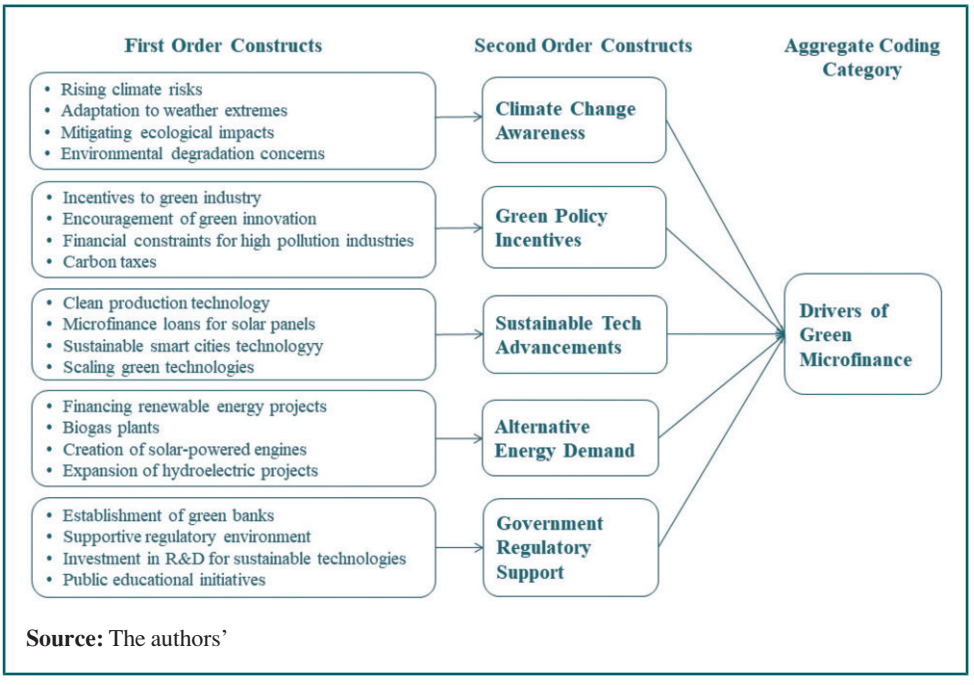
Source(s): The authors'

Figure 2 Aims and scope of green microfinance



Source: The authors'

Figure 3 Drivers of green microfinance



Source: The authors'

proper financial strength to innovate (Pansera and Owen, 2013) and build green products and services (Abdur Rouf, 2012). This financial assistance empowers the borrowers to invest in sustainable production processes such as renewable energy solutions (Srinivasan, 2007), eco-friendly products and services (Teki, 2016) and green infrastructure (Brears, 2022). Moreover, green microfinance contributes to safeguarding biodiversity (Mandel *et al.*, 2009) through

Figure 4 Outcomes of green microfinance

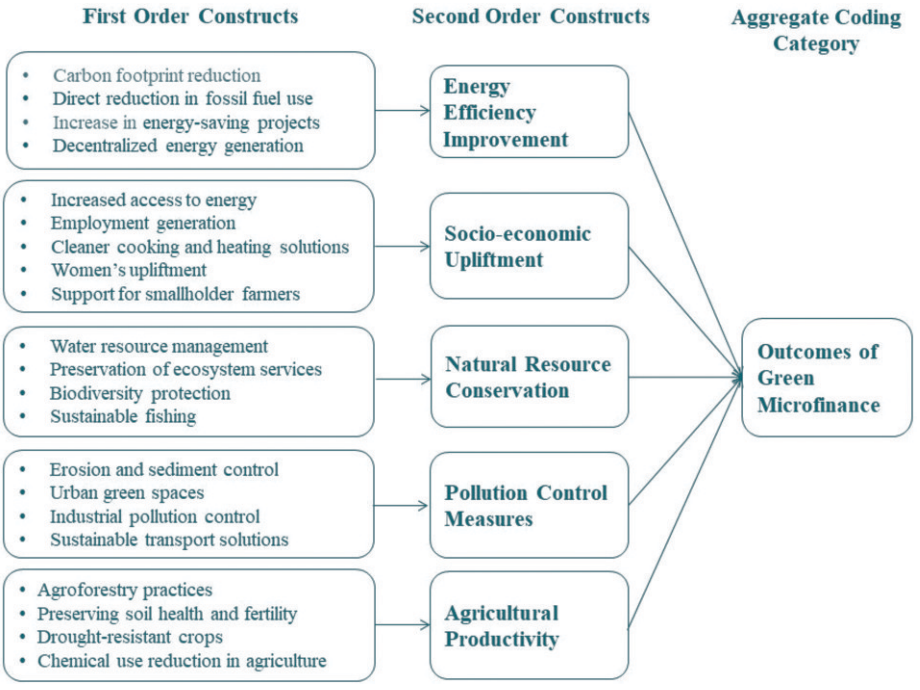


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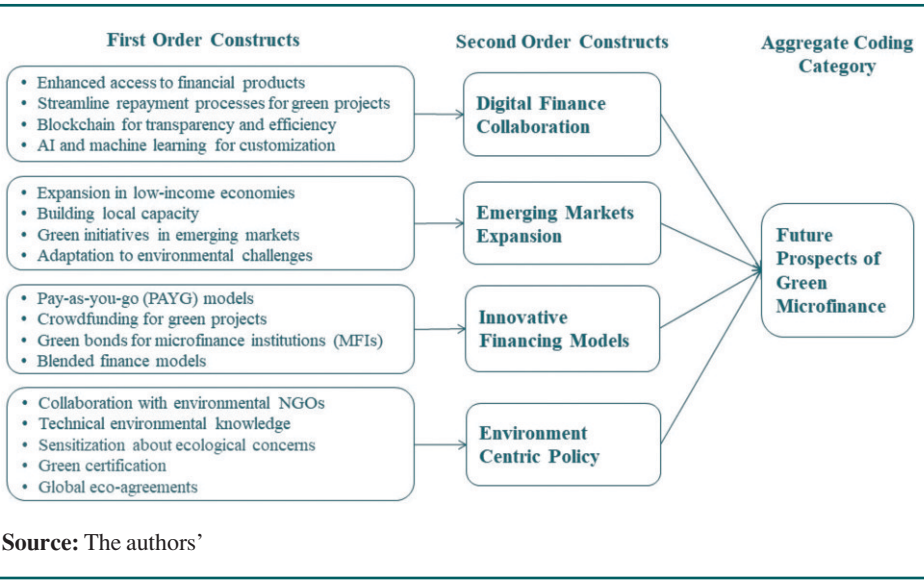
Figure 5 Future prospects of green microfinance



Source: The authors'

various initiatives such as decarbonization, funding reforestation projects and global waste management.

4.1.3 Renewable energy investments. Investments by microfinance in renewable energy facilitate the development of green and sustainable energy practices, further reducing

reliance on fossil fuels, mitigating the negative climate change (Srinivasan, 2007; Chirambo, 2017), and stimulating economic growth as well as employment generation in the clean energy sector. Renewable energy investments are encouraged due to a variety of factors, such as periods of strengthened economic growth and high fluctuations in fossil fuel prices (Gatto, 2023), which have raised issues about energy security. Furthermore, the introduction and promotion of financial products such as biomass energy grants (Rippey, 2011), sustainable energy stocks (García-Pérez *et al.*, 2017) and clean energy stocks (Carillo, 2013), among others, provide opportunities for investors to invest in green investments.

4.1.4 Low-income community focus. One of the significant aims driving green MFIs is the development and encouragement of employment or empowerment for vulnerable populations, underprivileged villages and low economies, as well as ensuring gender diversity (Ullah and Khan, 2017). This inclusiveness ensures that the benefits of adopting green practices are not limited to the higher classes but spread across communities, leading to sustainable living for all and welfare enhancement (Tchouassi, 2011). Furthermore, green MFIs also promote village sustainability programs (Atahau *et al.*, 2020) by providing financial assistance and awareness sessions on how to have a sustainable lifestyle along with economic well-being (Uddin *et al.*, 2021), thus acting as catalysts for economic welfare and empowerment.

4.2 Drivers of green microfinance

To push green microfinance, MFIs must generate and leverage their stakeholders' awareness levels on climate change, green policy incentives, adaptation of sustainable technologies, alternative energy demand and government policy and support. Here, applying information technology in collecting, managing and disseminating information to add value in information exchange is an innovative way under knowledge ecology (Petrides and Guiney, 2002). This engagement with digital technologies for information sharing in a social network is assumed an affordance under Gibson's ecological perspective to knowledge management (Jarrahi *et al.*, 2019), which can help the MFIs to create and leverage the awareness levels of its clients. Refer to Appendix Table A1 to find the theoretical linkage of KEM to the drivers of green microfinance, along with the mapped quoted text extracted from the sample data files.

4.2.1 Climate change awareness. Many incidents, such as rising temperatures, weather-related uncertainties, droughts, floods, forest fires and heat waves, contribute to climate risks (Dowla, 2018). These risks have a heightened impact on MFI clients vulnerable to climate change (Chirambo, 2017) as they have limited resources to protect themselves from such uncertainties. Moreover, their income is dependent on seasonal weather, making them insecure and unstable during such climate change, pushing them further into poverty. Green MFIs are needed to facilitate awareness and financial aid to these communities (Römer and Musshoff, 2017), combat climate risk, mitigate pollution and promote waste management (Abdur Rouf, 2012).

4.2.2 Green policy incentives. The green microfinance program is developed to take forward the concept of being biodiversity-friendly through various financial tools such as credit provision, incentives to the green industry (Allet and Hudon, 2013), and subsidies to encourage green innovation (Moser and Gonzalez, 2016), providing technical assistance (Garcia and Lensink, 2019), executing carbon taxes to industries generating high pollution, and conditional economic incentives (Sadiq *et al.*, 2023). These drivers of green microfinance differentiate it from microfinance, thus allowing a focus on financial assistance to communities to undertake green practices.

4.2.3 Sustainable tech advancements. Green microfinance provides a secure environment to research and develop technical advancements combating sustainability issues (Pollinger *et al.*, 2007). Affordable loans allow firms and individuals to install clean production technologies (Hsu *et al.*, 2021), such as solar panels and hydropower plants. It also supports

initiatives and practices leading to the development of sustainable smart cities (Papa and Rossi, 2022), such as waste management, using biomass in cooking, and intelligent transportation systems (Jeyasheela Rakkini and Geetha, 2021). Scaling these green technologies through MFIs' initiatives may allow economic growth and resilience in the future (Kang *et al.*, 2019) by addressing various environmental problems (Ashfaq *et al.*, 2023).

4.2.4 Alternative energy demand. The public's awareness is increasing regarding the utilization of alternative energies such as solar (Khan *et al.*, 2019), biogas and waste-to-energy (Rao *et al.*, 2009). With this awareness comes the demand for such alternative energies (Srinivasan, 2007). Since these are expensive or unapproachable for everyone to consume, they often lead to the usage of unsustainable energies (Allet, 2013). Green MFIs, with their vast network, focus on bringing such renewable energy projects into existence through financial support and guidance. Partnering with various organizations (Reeves and Sabharwal, 2013), MFIs have the power to set up biogas plants, create solar-powered engines and expand hydroelectric projects.

4.2.5 Government regulatory support. The initiatives to promote sustainable development and green practices are only possible to execute when the government provides stable regulatory support (Purkayastha *et al.*, 2020). Central banks, government and financial regulatory authorities are accountable for undertaking major investment decisions, and with the absence of stricter ESG rules, promoting sustainable green finance becomes a crucial step towards green transition (Huybrechs *et al.*, 2019). However, stakeholder pressures and regulatory evolutions are leading to ESG integration in bank credit departments and the need for a knowledge-based, sustainability-oriented strategic approach to financing (Saviano *et al.*, 2024.)

By collaborating with MFIs and building a supportive environment (Brears, 2022), the government may mitigate the issues of climate change (Chirambo, 2017) and environmental degradation (Allet and Hudon, 2013). Investment in research and development in sustainable technologies (Ghani *et al.*, 2018) becomes an important step towards this growth. Furthermore, the government may support the MFIs by providing public awareness programs on a mass level, reaching each tier of society. One example is making the public aware of the benefits, incentives and facilities that MFIs provide for undertaking sustainable practices.

4.3 Outcomes of green microfinance

Knowledge management is a social process for business improvement. Knowledge supersedes information and is explicit when codified, e.g. rules and guidelines, and implicit when it cannot be codified, e.g. experience (Tzortzaki and Mihiotis, 2014). The outcomes of green microfinance, namely., energy efficiency improvement, socio-economic upliftment, natural resource conservation, pollution control measures and agricultural productivity, can be enhanced through knowledge of ecological management. This experience-based knowledge is personalized, and when shared directly in an interpersonal manner across hardwired social networks, it enhances business outcomes. The size, the *locus* of the forum, and the diversity of social networks are the qualifiers to access the knowledge resources. For example, periodic meetings can be held for experience sharing among executives in informal ways to learn from each other (Hahn and Subramani, 2000) to enhance green microfinance outcomes. To find the theoretical linkage of KEM to the outcomes of green microfinance, along with the quoted text extracted from the sample data files mapped to the corresponding axial codes, refer to Appendix Table A1.

4.3.1 Energy efficiency improvement. The provision of low-cost micro-loans (Kusum Mukherjee, 2014) has allowed individuals, firms, entrepreneurs, and diverse communities to implement energy-efficient infrastructure, reduce the usage of fossil fuels and invest in energy-saving projects (Baird *et al.*, 2017). Moreover, the awareness provided by the MFIs

allowed the public to respond to incorporating green practices in their day-to-day operations, thus making them a source for decentralized energy generation.

4.3.2 Socio-economic upliftment. Green microfinance is a powerful instrument to achieve positive societal impacts by providing access to capital in low-income economies (Hermes, 2014), which can improve the livelihoods of populations at the bottom of the pyramid, enabling them to build assets, increase incomes and reduce their vulnerability to economic and environmental stress (Cull and Morduch, 2017). With loan facilities at cheaper rates, MFIs have uplifted various communities by providing employment and empowerment to vulnerable low-income families, empowering women and generating income for neglected communities with the least resources (Pretes, 2002). This has further allowed access to renewable energy and undertaking green practices such as cleaner cooking and heating solutions.

4.3.3 Natural resource conservation. Funding projects that allow the preservation of natural resources (Murali, 2006) is one of the prime goals of green MFIs. By providing financial assistance to conserve natural resources such as water resource management (Suvarna, 2006), ecosystem, biodiversity (Araya and Christen, 2004), and healthy sustainable fishing, green MFIs attempt to bring about positive changes in the environment such as enhanced livelihood, reduced climate change effects and lowered environmental degradation (Arora and Singh, 2022).

4.3.4 Pollution control measures. Green microfinance has the power to reduce industrial pollution emissions (Abdur Rouf, 2012) by funding industrial structure upgradation and green technology innovation (Kang *et al.*, 2019) showcasing it is more effective in protecting the environment while bringing economic growth. It has helped develop sustainable transport solutions (Jeyasheela Rakkini and Geetha, 2021) and urban green spaces, leading to the establishment of smart cities (Papa and Rossi, 2022). Moreover, it allows erosion and sediment control in agricultural activities (Lal and Israel, 2006) by promoting innovation in agricultural practices.

4.3.5 Agricultural productivity. Agriculture, the primary income source for many developing nations, has become a paramount area of operation for MFIs (Lal and Israel, 2006). MFIs, through financial assistance, awareness programs, and technological education, bring about a massive difference in the lives of small-scale farmers (Dossou *et al.*, 2020). It helps bring innovation in agroforestry practices, preserving soil health and fertility, and farming drought-resistant crops (Dhakal, 2016). MFIs encourage farmers to undertake organic farming (Harper, 2007), leading to reduced chemical usage and more green agricultural practices.

4.4 Future prospects of green microfinance

The knowledge ecology in organizations is a combination of humans, technology, values, practices, and organizational environment that defines the structure of knowledge, value addition and distribution (Chen and Liang, 2016). The prospects of green microfinance, i.e. digital finance collaboration, emerging market expansion, innovative financing models and environment-centric policy, can be leveraged through KEM in a MFI. These interacting individuals, organizations and communities in their given environments are an extended reference to ecology as a metaphor in knowledge management ecology (KME) (Cheng and Leong, 2017). Hence, maintaining a healthy knowledge ecology through the interaction of these elements is important for knowledge management in an organization (Chen *et al.*, 2010), aiming to advance green microfinance. Refer to Appendix Table A1 to find the theoretical linkage of KEM to the prospects of green microfinance, along with the mapped quoted text extracted from the sample data files.

4.4.1 Digital finance collaboration. Green microfinance has enabled access to financial products and services (Jalil, 2021) that promote sustainability. Moreover, it has allowed the

streamlining of repayment processes for green projects, making it easier for borrowers to opt for micro-loans (Thomas and Hedrick-Wong, 2019). Further, by harnessing the power of blockchain for transparency and machine learning for customization (Jeyasheela Rakkini and Geetha, 2021), MFIs can build an effective payment and banking system apart from developing innovative green products through nurturing knowledge-based employee capabilities (Biscotti *et al.*, 2018).

4.4.2 Emerging markets expansion. As MFIs build a more green and inclusive financial system, the most fruitful progression is observed in emerging markets (Berger, 2000). Green microfinance has allowed people from emerging nations to participate in green initiatives and bring eco-friendly solutions to their environmental challenges (Jones, 2006). Moreover, the availability of loans and financial assistance in these economies has built a local capacity for small-scale entrepreneurs (Omoro and Omwange, 2013) to operate at a much larger scale and build a bigger production plant through sustainable means.

4.4.3 Innovative financing models. Various innovative blended funding models (Casasnovas and Chliova, 2020) are working in MFIs, enabling individuals to invest in sustainable projects with ease of payment. One such example of these financial models is the Pay-as-you-go (PAYG) model (Guajardo, 2021), where the companies allow rural and low-income communities to access modern clean energy solutions. Similarly, crowdfunding for green projects (Baird *et al.*, 2017) has widened the funding opportunities for entrepreneurs to build green projects (Hermawati *et al.*, 2023). Moreover, investors can invest in green bonds or sustainable stocks (Clapp and Pillay, 2017) through MFIs, building a more sensitized community towards sustainable development and a greener world.

4.4.4 Environment-centric policy. To achieve a broader spectrum of market share, MFIs must collaborate with environmental NGOs, government agencies and other organizations to work towards the same goal of achieving a greener tomorrow (Tanin *et al.*, 2019). These collaborations will allow a widened spread of innovations and opportunities for the right targeted population of low-income households. Furthermore, there is a need to technically educate low-income economies and sensitize them about ecological concerns, allowing them to understand and move towards green production systems (McGuire, 1999) and green product innovation (Khan *et al.*, 2021). MFIs promoting environmental-centric policies (Nugroho *et al.*, 2017) should also set standards for green projects and develop eco-agreements with global institutions for greater impact and economic growth.

5. Discussion of findings

With the government and policymakers fostering the objective of financial inclusion with the help of MFIs, the need for a more specific framework and sustainable financing has increased the dimensions of green microfinance (Mushtaq and Bruneau, 2019). This has led to research being conducted in the domain of green microfinance. However, the same is still considered an under-researched area (Jayaram and Singh, 2020), especially from the perspective of KEM. In this study, we conducted a CDA to answer various research questions with the help of 178 data files comprising videos, news media articles and policy reports. The broad objectives of the study were the identification of the aims and scope of green microfinance (*RQ1*), the prominent drivers of green microfinance (*RQ2*), the expected outcomes of green microfinance (*RQ3*) and the major prospects of green microfinance (*RQ4*) as aligned to the KEM under the knowledge management theory.

For the first research question, the study identified four prominent aims and scopes under green microfinance: sustainable practices, eco-friendly project funding, renewable energy investments and low-income community focus. For instance, the primary aim of green microfinance is to ensure that firms follow practices that lead to minimum environmental destruction (Uddin *et al.*, 2021). This can be achieved by promoting renewable energy use and waste management. Similarly, green microfinance is also directed towards providing

funds to entities investing in sustainable and environment-friendly ventures for long-term growth (Sadiq *et al.*, 2021). These institutions also take major initiatives towards fostering the usage of renewable energy sources such as solar and wind energy (Chirambo, 2020) since implementing such practices would automatically reduce carbon emissions and ecological footprint. In the past, multiple dimensions such as diversity effects and alliances (Meschi and Norheim-Hansen, 2019), corporate governance (Muktadir-Al-Mukit and Bhaiyat, 2023) and supply chain decarbonization (Hettler and Graf-Vlachy, 2023) have been linked to the reduction of carbon emission. The final aim and scope have been derived from building MFIs linked to providing finances to individuals in the underprivileged sections of society (Bharti and Malik, 2021). Access to financial services will further promote the mission of enhancing financial inclusion and financial literacy (Lyons and Kass-Hanna, 2019). Here, human-centric KEM (Petrides and Guiney, 2002) has a prominent role to play by bridging the financial knowledge gap in the network inside and outside the organization, e.g. rural populations (Yang *et al.*, 2022).

The second research question identified key drivers of green microfinance: climate change awareness, green policy incentives, sustainable tech advancements, alternative energy demand and government regulatory support. The individuals and various other stakeholders have become highly aware of the harmful effects of climate-based changes (Mapfumo *et al.*, 2015), which puts pressure on MFIs to take necessary actions in this regard. At the same time, the government is initiating measures that can promote environmentally sustainable activities through various policy actions such as tax concessions and subsidies (Zatti, 2020). These act as a prominent catalyst driving green microfinance activities. The major bottlenecks for complying with sustainable practices were manual workload and monitoring tasks (Rane, 2023). However, with the advancement of technology, all of these can be conducted with the help of machines for which these MFIs provide financing. KEM can contribute innovatively to this information exchange through technology (Petrides and Guiney, 2002) across the MFI's social networks (Jarrahi *et al.*, 2019).

Furthermore, the increased demands for alternate energy sources have created requisite financial instruments offered by these institutions, further driving the financing of various activities (Qadir *et al.*, 2021). Moreover, the government is also acting in the best interest of these firms/institutions by providing necessary regulatory support that can motivate the firms to promote green financing (Falcone, 2020).

The third research question was aimed at exploring the various outcomes desired out of the green MFIs, and they were found to be energy efficiency improvement, socio-economic upliftment, natural resource conservation, pollution control measures and enhanced agricultural productivity. When firms are established in any economy, they direct their efforts toward achieving specific goals and outcomes, and one of their major expectations is that they ensure energy efficiency (Manko and Watkins, 2021). The MFIs provide funding to those enterprises that follow an environmentally friendly production approach (Aslam Mia *et al.*, 2020), thus leading to energy efficiency in the long-run. Since most of this funding goes to underprivileged borrowers, it also uplifts the disadvantaged sections of society by providing them a source of livelihood (Agarwala *et al.*, 2022). Here, knowledge management, a social process (Tzortzaki and Mihiotis, 2014), helps to enhance business outcomes (Hahn and Subramani, 2000) of green microfinance through sharing knowledge in social networks.

The degradation of the environment is leading to the devastation of flora and fauna. MFIs also contribute to the conservation of resources by avoiding the usage of fossil fuels and various other non-renewable resources (Udeagha and Ngepah, 2023). By providing funding for agricultural activities, such that farmers can make use of new high-yielding innovative products, agricultural productivity is also enhanced as one of the outcomes (Nakano and Magezi, 2020), and measures towards controlling pollution in the environment

are also undertaken by preventing the usage of instruments which aggravates pollution (Zhou *et al.*, 2023).

The fourth research question focused on identifying prospects that can be explored in the future and that can be beneficial in further promoting green MFIs supported by knowledge of ecology management. The analysis helped us identify four prominent themes: digital finance collaboration, emerging markets expansion, innovative financing models and environment-centric policy. The world is witnessing a technological revolution where AI is making every transaction effective and efficient (Tyagi *et al.*, 2020). In the same parlance, instruments using such technologies can be adapted for further improvements in the service in the domain of green microfinance.

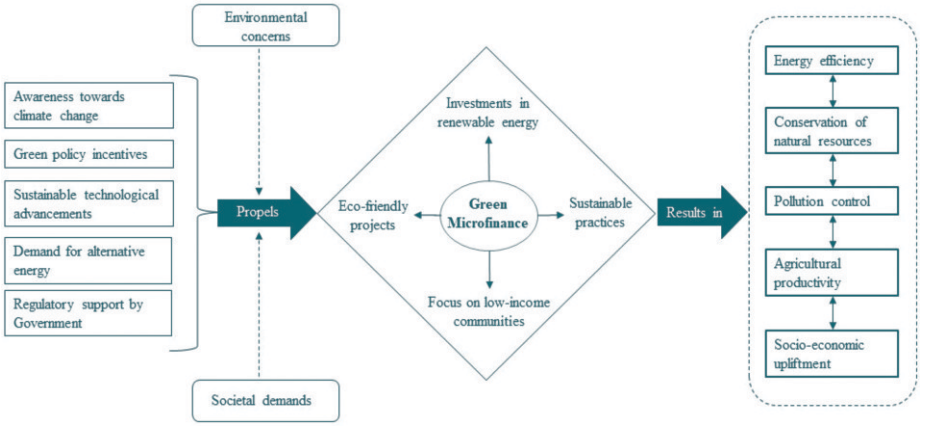
Though the MFIs are widely appreciated for reaching the economically weaker sections of society and promoting financial literacy, there is further scope for expanding markets and reaching broader markets (Tanin *et al.*, 2019). The existing financing models need further development by integrating innovative financial instruments and models that can provide ease in financing (Huybrechs *et al.*, 2019). These models could incorporate novel instruments such as green bonds and loans. The government can further take measures to enhance the degree of environment-centric policy, which can be linked to the financing services by these institutions (Temesgen, 2021). A healthy knowledge ecology (Chen *et al.*, 2010) enhances the interaction between individuals, organizations and communities (Cheng and Leong, 2017) to advance green microfinance.

Finally, through the application of KEM knowledge-based view on human interactions and learning communities in and outside the organization approaches microfinance credit advancement and MFI's strategic view to explain the aim, scope, drivers, outcomes and prospects of green microfinance through its theoretical lens. Refer to Appendix Table A1 to find the theoretical linkage of KEM to the aims and scope, drivers, outcomes and prospects of green microfinance, along with the mapped quoted text extracted from the sample data files.

5.1 Conceptual framework

The conceptual framework depicted in Figure 6 represents the thematic discourses undertaken to uncover the elements that play a crucial role in achieving valuable outcomes of green microfinance.

Figure 6 Conceptual framework on green microfinance



Source: The authors'

The three major components of the framework are a) the propellers that push the activities of green microfinance by the MFIs, b) the ambit of activities that have to be undertaken, and c) the resultant consequences that facilitate sustainable growth and development. The framework further encompasses *environmental concerns and societal demands*, which further reinforce the scope of green microfinance activities.

The drivers, such as awareness of climate change, green policy incentives, sustainable technological advancements, demand for alternate energy and regulatory support by the government, encourage MFIs to follow sustainable practices towards the environment Atahau *et al.*, 2020). These drivers also help firms promote environmentally friendly machinery and raw materials, which will help reduce carbon emissions (Böttcher and Müller, 2013). Moreover, the elements of environmental concerns related to pollution, carbon emission and resource depletion further reinforce firms' need to adopt sustainable activities (Chevrollier *et al.*, 2023). The firms have to comply with such environmental aspects for their survival in the long run. Furthermore, the growing consciousness among the various stakeholders enhances their expectations from the institutions (Chowdhury and Shumon, 2020). Consumers prefer financial services from firms that consider the environment and showcase commitment towards sustainability by reducing carbon emissions (Lewandowski, 2017; Brouwers *et al.*, 2018).

Based on these prominent drivers, the scope of activities by MFIs is enlarged, and firms are inclined to promote more and more such activities. The primary scope of green microfinance activities extends to investments in renewable energy, eco-friendly projects, sustainable practices and a focus on low-income communities (Zhang *et al.*, 2023). MFIs provide financial support for using renewable-based solutions such as financing solar power plants and small-scale hydropower projects. They also promote many eco-friendly initiatives such as organic farming and waste disposal. The basic premise of green microfinance has always been focused on providing low-cost funding to the underprivileged and low-income earnings communities (Cunha *et al.*, 2021). These loans are provided on the condition that the funds shall be used to promote sustainable activities.

The rationale for advocating these sustainable activities is clear, and they would undoubtedly lead to consequences such as achieving energy efficiency in the operations. Since the firms that receive funding use pro-environment machines and equipment, it shall also lead to conserving natural resources (Kautto, 2006). With the conservation of natural resources, the pollution level shall be mitigated. This shall further improve agricultural productivity as low pollution would cause minimal crop impact (Adegbeye *et al.*, 2020). The improved level of agricultural productivity shall provide better standards of living, which would propagate the socio-economic upliftment of the communities (Mukhlis *et al.*, 2022). The framework highlights that the outcomes are interrelated to each other as they amplify each other for better and productive overall outcomes enhanced through KEM. Refer to Appendix Table A1 to find the theoretical linkage of KEM to the aims and scope, drivers, outcomes, and prospects of green microfinance, along with the mapped quoted text extracted from the sample data files.

6. Conclusion

The theme of green microfinance is still in the development stage, with limited research undertaken in this domain (Allet and Hudon, 2013). The current study attempts to understand and comprehend various dimensions of green microfinance in light of KEM. The study uses 178 sample files comprising videos, newspaper articles and policy reports. It follows a systematic qualitative inquiry with the help of CDA to answer several research questions. These questions are directed toward understanding the aims and scope, key drivers, expected outcomes and prospects of green microfinance.

The study uses a systematic approach, namely the Gioia approach (Gioia *et al.*, 2012), to identify various themes in generating codes (75 open codes, 18 axial codes and 4 aggregate codes). The study shall be considered a pioneer in exploring the theme of green microfinance through various verticals, thereby contributing widely to the existing literature and the ecology theory of knowledge management. The usage of CDA in evaluating these media data files not only throws light on the concepts relevant to green microfinance but also expresses the beliefs and opinions that the media and society hold towards the development of this novel concept (Yu *et al.*, 2022; Alexander *et al.*, 2021).

6.1 Theoretical implications

The study offers four significant theoretical implications. First, since the theme of green microfinance is in the development phase, the study shall act as a pioneer in looking into the qualitative aspects of green microfinance and contribute to a better understanding of the domain while making valuable contributions to the existing literature on microfinance through the theoretical lens of KEM. Second, it is very pertinent to gauge the perception of the media as well as their expectations from the government (Bouvier and Machin, 2020). With the help of media articles, videos, and reports, the study expresses the individuals' opinions through the media lens. This will help policymakers in identifying the areas requiring improvements. Third, the study also offers methodological contributions by using a novel method in the form of CDA (Sahmeni and Afifah, 2019). The method provides robustness to the qualitative inquiry and the results being obtained. Fourth, the study highlights the comprehensive nature of green microfinance and identifies a set of future research prospects that researchers can explore. By identifying prominent research gaps and potential research questions, the study can contribute immensely towards building scholarly literature in the context of green microfinance within the theoretical perspective of KEM, which is still evolving.

6.2 Practical implications

The study has some relevant practical implications as well. First, the outcomes of the study help identify the prominent drivers that facilitate the scope for enhancing the level of green microfinance. The government and policymakers can use these drivers to incentivize the institutions further to advance green financing. The drivers shall act as a catalyst for the firms on a hunt to adopt green policies and integrate them throughout their operations. Second, the outcomes expected under the purview of green microfinance shall also help these institutions build a better vision and strategy for achieving these outcomes. This shall impact the degree of achievement of the goals of these institutions. Outcomes of any policy incentivize the institutions/organization to adopt better practices, and these outcomes shall also serve similar purposes for the relevant organizations. Third, the government is keen on promoting sustainability-based financing, where firms that adhere to environmental safety are provided access to funding at low costs. Based on such outcomes, the government may also come up with further regulatory and scheme-based measures that would promote the scope of sustainable development. Finally, the conceptual framework defined in the study sets a roadmap for understanding the pathway towards sustainability-based outcomes. It provides better direction for the firms' planning and implementation of strategies for achieving the desired objectives with the help of KEM by gathering, processing and disseminating information through its social network-based environment both formally and informally.

6.3 Limitations and future research avenues

Though the study has made a valuable contribution to the literature, future researchers can explore and address some inherent limitations. Primarily, the theme of green microfinance is not widely researched; therefore, the sample used for the analysis is 178 files. Though the

Table 2 Gaps in the literature and potential research questions

Themes	*Gaps*	*Research questions*
Technology adoption	*Gap 1:* Though technological advancements have increased in every sphere of business, the extant literature does not highlight their actual use in green microfinance *Gap 2:* Technological adoption from the perspective of users and stakeholders is also a prominent domain but has not received wide attention	*RQ1:* How does technological adoption in the form of Blockchain and Artificial Intelligence facilitate green microfinance? *RQ2:* What major technology-oriented solutions can fintech firms provide to advance green microfinancing? *RQ3:* What are the significant challenges with technological adoption regarding green microfinance? *RQ4:* What are the effective ways and methods to improve users' technological adoption of green microfinance?
Market expansion	*Gap 3:* The markets are ever-changing and expanding, and extant literature has identified the factors that facilitate market expansion, but the role of innovative financial products in green microfinance is underdeveloped	*RQ5:* What are the major innovative financial products that encompass ESG-related financing aspects? *RQ6:* What are the major strategies that can facilitate expansion without the cost of enhancing the risks of these microfinance institutions? *RQ7:* What are some of the scalability-based models that can be adopted under various geographical and cultural contexts?
Environmental sustainability and financial inclusion	*Gap 4:* There is no dearth of literature on financial inclusion; however, a gap still exists regarding how financial inclusion can be promoted through the lens of environmental sustainability	*RQ8:* How does green microfinance lead to financial inclusion through environmental sustainability? *RQ9:* What major initiatives can be adopted to promote financial inclusion while maintaining climate resilience?
Risk management	*Gap 5:* Risk management has been explored in multiple aspects, such as corporate governance, financial performance, etc. However, effective risk management strategies that can improve green microfinance have yet to be explored	*RQ10:* What are the significant risk management strategies that can advance the degree of green microfinance? *RQ11:* What innovative models/methods exist to measure risk management through the lens of long-term sustainability?
Theoretical underpinning (KEM)	*Gap 6:* Though research on green microfinance is nascent, the theoretical underpinning of its aspects through knowledge ecology theory is a novel attempt that future studies can extend through an integrated conceptual framework	*RQ12:* How a knowledge ecology integrated conceptual model implementation can reduce the risks associated with green microfinance apart from driving and enhancing its outcomes?

Source(s): The authors'

volume of data is sufficient to conduct a robust analysis, future researchers can base their analysis on a larger pool of data to enhance the generalizability of the results. Furthermore, the analysis of the study is based majorly on media reports and articles, and it has been found that media houses are influenced by various prominent corporate houses and political parties to address their profitable agendas (Wessel *et al.*, 2023). This leads to biased outcomes, which have been represented in these reports and articles. Therefore, the profound bias can be addressed in future research. Finally, though qualitative inquiries can reveal those hidden dynamics that are not represented by quantitative exploration, these may lead to some degree of interpretation issues due to the subjectiveness of the researcher (Shufutinsky, 2020). Despite the above-mentioned limitations, the contributions made by the study are still relevant. They will act as a base for conducting research in the future and extending the KEM theory.

Moreover, to help future researchers unveil the intricacies of green microfinance and explore it better, this study identified certain gaps and research questions that can be addressed in this domain by future research scholars. Table 2 provides the details of the same.

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Table A1 Quoted excerpts from data sample files indicating KEM aspects as a link between green microfinance aggregate dimensions and axial codes

S. no.	*Green microfinance aggregate dimension*	*Knowledge ecology management (KEM) perspective*	*Green microfinance axial codes*	*Corresponding excerpt from the sample data files*
1.	Aims and scope of green microfinance	Knowledge management by transforming data into information	Sustainable practices	*V006: "Our aim is to mobilize private finance to reduce carbon emissions by attracting $400 million of private finance and a reduction of carbon emissions of 25 million tonnes"* *B013: "MFIs' need to revitalize their role in promoting sustainable development through robust green microfinancing case is based on two fronts. First, studies have shown that poor households, who constitute most microfinance clients, heavily rely on natural ecosystems as they do not have strategies to mitigate their vulnerability to climate. Therefore, they suffer the most from climate change effects. Secondly, micro-entrepreneurs and small traders also participate in activities that are relatively polluting the environment because they lack adequate finances to make their businesses 'sustainable'. As such, the burden of finances has forced them to adapt to hazardous production ways"*
		Strategic use of information in a networked information-driven organization	Eco-friendly project funding	*V95: "Our commercial climate smart lending system is designed to help commercial lenders, particularly lenders to smallholder farmers, include requirements for sustainable climate smart agriculture into loan terms, and then incorporating verification of compliance into farmer credit scores"* *V100: "…proving that green microfinance can help boost portfolio growth. 5000 Microloans has helped his clients insulate their homes and reduce their energy consumption. Not only do they now have more efficient and cleaner heating, it is also easier to use by developing a new home energy credit line for their customers and setting up a risk management system for these loans".*
			Renewable energy investments	*N036: "The government, alive to green finance opportunities globally, is reportedly working on the issuance of 'Nature Bonds', in essence linking concessionary funding with the achievement of environmental goals"* *V095: "The huge investment needs and infrastructure represent green investment opportunities and potential for further growth in the green bond market. Technological developments in green technology are changing the landscape, and one example of this is the rapid development in wind turbines as seen here"*
		Human-centric approach under knowledge ecology management	Low-income community focus	*B007: "ADA encourages vulnerable people to adopt environmentally friendly practices. ADA designs green loans with its MFI partners to finance eco-responsible activities such as housing improvements or more sustainable agricultural practices"* *B010: "By providing over 200 million poor people with access to financial services, microfinance has constituted a revolution allowing populations previously excluded to become entrepreneurs, save, and manage the risks of often difficult lives"*

(*continued*)

Table A1

S. no.	*Green microfinance aggregate dimension*	*Knowledge ecology management (KEM) perspective*	*Green microfinance axial codes*	*Corresponding excerpt from the sample data files*
2.	Drivers of green microfinance	Leveraging stakeholders' awareness levels by microfinance institutions (MFIs)	Climate change awareness	*B007: "Considering climate risks is especially important for ensuring the sustainability of development policies and programs. It has become indispensable to adapt and to mitigate climate change, pollution and waste"*
				B013: "Effective microfinancing calls upon MFIs to adopt climate mitigation and adaptation efforts. To this end, German Sparkasse Stiftung Eastern Africa (DSIK), under their #SustainabilityDecember2020 campaign, encourages the Microfinance landscape in Eastern Africa, which includes Deposit-Taking Microfinance (DTMs) institutions, Microfinance Banks, Credit only MFIs, and SACCOs to continue embracing 'green microfinancing' for their clients and members"
			Alternative energy demand	*B012: "Through partnering with local MFIs, Energizing India aims to provide loans to individuals and microenterprises for environmentally sustainable energy systems, including solar, hydro, wind, and biofuel systems, all on an individual or village scale. Currently, an estimated 75 million families and two-thirds of all rural households in India are not on the national grid. In 2001, this population consumed 180 million tons of firewood and unknown amounts of oil and kerosene. Energizing India is part of a larger initiative, Energizing Microfinance, formed by Green Microfinance and Micro Energy in 2007"*
		Value addition in information exchange in an innovative way under knowledge ecology	Green policy incentives	*N006: "Green and inclusive finance focuses on all instruments, products, and services that address climate change: mitigation and adaptation; solutions for waste, water, and sanitation management; land management and ecosystem conservation; organic farming; access to clean and reliable energy; and energy efficiency. It also applies housing microfinance practices with housing microfinance innovations"*
		Application of information technology in collecting, managing and disseminating information	Sustainable tech advancements	*N017: "Tamweely Microfinance has obtained the first license for green microfinance; the new license mainly focuses on financing solar power projects that feed industrial and service activities, especially for agricultural workers, where the production of solar energy will be financed to help them dig agricultural wells instead of relying on diesel polluting the environment and higher costs"*
		Engagement with digital technologies for explicit (rules & guidelines) information sharing in a social network	Government regulatory support	*N015: "The Government of Cambodia has prioritized climate mitigation and adaptation as one of the top priorities in its national development strategy. The funding needed to achieve these goals is substantial"*

(*continued*)

Table A1

S. no.	*Green microfinance aggregate dimension*	*Knowledge ecology management (KEM) perspective*	*Green microfinance axial codes*	*Corresponding excerpt from the sample data files*
3.	Outcomes of green microfinance	Experience-based knowledge when personalized and shared directly in an interpersonal manner across hardwired social networks, it enhances business outcomes	Energy efficiency improvement	*B013: "As an organization, microfinance providers should also commit themselves to reduce their internally ecological footprint. Provide non-financial services to its customers, such as training programs on environmentally friendly practices and environmental awareness campaigns"* *B016: "Since many small-scale agricultural entrepreneurs rely on microfinance to access capital, with sustainability to incentivize a loan, they will be further inclined to purchase equipment that is more energy and water-efficient"*
			Natural resource conservation Pollution control measures	*V004: "We see financing of renewable energy technologies, also financing of energy efficiency measures. Moreover, rather low in lower scale to clean drinking water solutions and waste management, cleaner transportation, sanitation facilities, and efficient and clean biomass stoves"*
			Agricultural productivity	*N025: "Faulu Microfinance Bank and Deutsche Gesellschaft für International Zusammenarbeit (GIZ) have partnered to allow smallholder farmers in the dairy and horticulture value chains to access green financing. By providing green financing solutions, this partnership will unlock access to modern renewable energy technologies and climate-smart practices that improve farmers' livelihoods, reducing greenhouse gas emissions and their farming activities becoming resilient to climate change"* *B014: "Droughts, floods, and other extreme climate events are shrinking or even eliminating the revenues of smallholder farmers"*
		KEM a social process for business improvement	Socio-economic upliftment	*B005: "India has already started its journey towards financial inclusion for women by recognizing the importance of digital access as a fundamental right and in establishing a thriving DPI ecosystem. Gender intentionality needs to be at the heart of the efforts to bridge the digital divide and ensure that every citizen has equal opportunities to participate in the digital realm"* *N022: "By providing women with access to capacity building programs, governments can further help young Moroccan women of the present and future develop the skills and knowledge needed to adapt to the changing environment"*

(*continued*)

Table A1

S. no.	*Green microfinance aggregate dimension*	*Knowledge ecology management (KEM) perspective*	*Green microfinance axial codes*	*Corresponding excerpt from the sample data files*
4.	Future prospects of green microfinance	Healthy knowledge ecology through the interaction of humans, technology, values, practices, and organizational environment advances green microfinance through a defined the structure of knowledge, value addition, and distribution	Digital finance collaboration	B015: "*Green lending can also lower clients' risk profiles. Clean energy and other green products can improve air and water quality, strengthening client health, well-being, and ability to repay loans. Along with green financing's risk-reducing contributions to health, it also can reduce clients' risk profiles in areas with energy instability and price volatility*"
			Emerging market expansion	*B016: "Microfinance fosters financial inclusion by providing low-interest microloans and micro-insurance products which help reduce poverty and promote socio-economic development, allowing people to earn a living sustainably, and prevent severe poverty and malnourishment which results in people pillaging their surroundings in search of natural resources for food and housing"* *N005: "The market size is huge, rapidly growing and rich in untapped opportunities with 5.5 million families and beneficiaries expected to reach 10 million by 2030. That is why all five stakeholders must join efforts to incentivize products and attract more and more beneficiaries to adopt or transform into green for the benefit of the environment, the people, and the economy"*
			Innovative financing models	*B001: "Microfinance bonds can provide relief. Microfinance institutions have not only survived through the pandemic, but their hefty balance sheets and the way they maintain closer, more personalized relationships with their clients — have helped them absorb the shock in a better way than expected. Promoting microfinance and issuing a microfinance bond might just be the magic pill that is needed"* *B009: "A recent (albeit still modest) growth in attention to climate change and sustainability is opening doors for a more active role for inclusive finance in sustainable development. This shift is mostly based on the idea that targeted financial and other support services can lift barriers to adopting more environmentally friendly techniques (such as solar energy, energy efficiency, or agroforestry) or taking climate adaptation measures (such as water pumps for irrigation or certain drought-resistant crops)"*
			Environment-centric policy	*B018: "Collaborations between microfinance institutions, government agencies, and development partners can further enhance the effectiveness and reach of green microfinance interventions"*

(*continued*)

Table A1

S. no.	*Green microfinance aggregate dimension*	*Knowledge ecology management (KEM) perspective*	*Green microfinance axial codes*	*Corresponding excerpt from the sample data files*
				N003: "This collaborative approach, with a focus on the best interests of the rural communities, is set to unlock new opportunities and innovative solutions, ultimately leading to a more sustainable and climate-resilient Eastern Province" *N020: "At the programme launch, the EBRD presented its holistic approach to supporting green investments through financing, investment grants and technical assistance for partner financial institutions and end clients through the EBRD GEFF programme"*

Source(s): The authors'