

Enhancing Carbon Trading Mechanisms through Innovative Collaboration: Case Studies from Developing Nations

Highlights

- Carbon trading intermediaries enhance market efficiency in developing countries.
- Digital platforms facilitate real-time trading and resource allocation.
- Trust and transparency are key to stakeholder engagement strategies.
- Innovative practices address market challenges and promote collaboration.

Abstract

Against a backdrop of global climate change mitigation efforts, carbon trading has emerged as a critical mechanism, yet developing countries often lack the necessary infrastructure and collaborative frameworks. The research investigates how intermediaries facilitate stakeholders and employ innovative practices to foster effective carbon trading markets. Methodologically, it employs a qualitative approach, conducting in-depth case studies of four intermediaries through 32 semi-structured interviews and archival document. Findings underscore the pivotal role of digital platforms in enabling real-time trading, rigorous standardization processes to ensure market credibility, and multi-stakeholder engagement strategies that promote inclusive participation. This research contributes to the theoretical understanding of carbon trading by illustrating how digital platforms and technological integration enhance resource acquisition and allocation. It emphasizes the significance of standardization and verification processes in building trust among stakeholders, crucial for effective supply chain collaboration. Practically, the study highlights the benefits of these approaches in enhancing market efficiency and transparency. It also underscores the importance of multi-stakeholder engagement strategies and strategic alliances for creating resilient and inclusive carbon trading markets, offering actionable insights for stakeholders and policymakers alike.

Keywords: carbon trading intermediaries, innovation practices, resource dependence theory, standardization and verification.

1. Introduction

The global push to mitigate climate change has elevated carbon trading as a critical mechanism for reducing greenhouse gas emissions (Lin & Huang, 2022; Hao et al., 2020). Carbon trading systems, which allow countries and companies to buy and sell carbon credits, are designed to incentivize emission reductions and promote sustainable practices (Shi et al., 2022; Zhang et al., 2020). By assigning a monetary value to carbon emissions, this market-based approach provides economic incentives for organizations to minimize their carbon footprint, thereby aligning economic activities with global climate goals (Duan et al., 2023). In developed countries, robust frameworks and networks have been established to support carbon trading, characterized by advanced technological infrastructures, comprehensive regulatory environments, and effective stakeholder collaborations (Ma et al., 2020). These systems enable efficient and transparent trading of carbon credits, fostering trust and participation across various sectors. However, developing countries, despite their significant carbon-neutral potential, often lack the collaborative regimes necessary for effective participation in this market (Jia & Lin, 2020). The absence of well-structured systems, coupled with limited technological and financial resources, poses substantial barriers to their full engagement in carbon trading.

The disparity between developed and developing nations in terms of carbon trading infrastructure highlights the critical need for innovative practices and collaborative efforts to build and sustain effective carbon trading markets in developing regions (Duan et al., 2024; Shi et al., 2022). Developing countries often face unique challenges, such as inadequate regulatory frameworks, limited access to technology, and insufficient institutional capacity to implement carbon trading mechanisms effectively. These barriers hinder their participation in global carbon markets, which can negatively impact the achievement of broader climate goals (Zhang et al., 2024). Intermediaries, including brokers, exchanges, and certification bodies, play a pivotal role in bridging the gap between policy and practice. They help mitigate these challenges by facilitating transactions, ensuring the credibility of carbon credits, and promoting transparency and trust among stakeholders (Shi et al., 2022). By overcoming these obstacles, developing countries can contribute more effectively to global climate change mitigation efforts, aligning with the objectives of the Sustainable Development Goals (SDGs), particularly Goal 13: Climate

Action (Oke et al., 2024; Tian et al., 2024). Strengthening carbon markets in these regions not only fosters environmental sustainability but also supports socio-economic development through capacity building and international cooperation (Hou et al., 2024; Shen, 2015). This research aims to address the existing gaps by exploring the innovation practices of carbon trading intermediaries that facilitate the carbon trading practices in developing countries. Thereby, this study will address two key research questions:

RQ1. How do carbon trading intermediaries enhance market efficiency, transparency, and collaboration in newly established carbon trading markets in developing countries?

RQ 2. What innovation practices do carbon trading intermediaries use to foster and maintain effective collaboration among all stakeholders within the carbon trading market?

In understanding the innovation practices of carbon trading intermediaries, this study adopts the Resource Dependence Theory (RDT) as its main theoretical lens. RDT examines the interdependencies and power dynamics in organizational collaborations, highlighting how organizations rely on external resources they do not control, necessitating inter-organizational relationships to manage these dependencies (Hillman et al., 2009; Johnson, 1995). While alternative frameworks such as Transaction Cost Economics and Institutional theory could analyze efficiency in resource exchanges, or Institutional Theory might explain normative pressures in market standardization, RDT offers a more comprehensive view of how intermediaries navigate resource dependencies and mitigate risks to ensure market stability and sustainability (Drees & Heugens, 2013). RDT facilitates a deeper understanding of how these intermediaries manage resource dependencies, foster collaborative networks, secure critical resources, mitigate risks, and maintain market stability (Drees & Heugens, 2013; Johnson, 1995). It also provides insights into the power dynamics influencing strategic alliances and the mechanisms through which intermediaries enhance transparency and trust, crucial for the credibility and sustainability of carbon trading markets in developing countries.

This research adopts a qualitative methodology, focusing on in-depth case studies (Yin, 2021; Gibbert et al., 2008) of four carbon trading intermediaries that actively engage with stakeholders to facilitate carbon credit trading in developing countries. *Each case was*

selected based on its active role in market dynamics and collaboration with a diverse set of stakeholders. These intermediaries were chosen to provide varied perspectives on how different actors navigate and sustain carbon trading markets. A qualitative approach allows for a nuanced understanding of complex organizational dynamics and practices (Gibbert & Ruigrok, 2010). This method enables the exploration of the innovation practices and collaborative efforts that these intermediaries employ to support the development and sustainability of carbon trading markets. The study involves conducting semi-structured interviews with 32 managers and experts within these intermediaries, providing rich, detailed insights into their strategies and operations. The semi-structured interview format allows for flexibility in probing specific areas of interest while maintaining consistency across cases. Our research makes two key contributions. First, it provides theoretical insights into how digital platforms and technological integration enhance resource acquisition, allocation, and trust-building in carbon trading markets through standardization and verification processes. Besides, this study offers practical contributions by highlighting how multi-stakeholder engagement strategies and strategic alliances strengthen market efficiency, transparency, and resilience. The research findings offer actionable insights for policymakers and stakeholders to develop inclusive and sustainable carbon trading markets.

The structure of this manuscript is organized into six sections, each serving a distinct purpose in the overall study. Section 2 offers a comprehensive discussion of the theoretical background, establishing a foundation for understanding carbon trading and its significance to carbon trading intermediaries. Section 3 details the research methodology employed, including the research approach, case study design, data collection and analysis. Section 4 presents an in-depth examination of the results from the case studies, providing empirical evidence to support the research objectives. Building on these results, Section 5 discusses the research findings, interpreting the data in the context of existing literature. Finally, Section 6 outlines the theoretical and practical contributions of the study, identifies its limitations, and suggests potential avenues for future research in this domain.

2. Theoretical Background

2.1 Carbon Trading Market

Carbon trading, also known as emissions trading, is a market-based approach to controlling pollution by providing economic incentives for achieving reductions in the emissions of pollutants (Abbasi & Choukolaei, 2023). In this system, a limit (or cap) is set on the total amount of certain greenhouse gases that can be emitted by all participating entities. Companies or countries that need to increase their emission allowance must buy credits from those who pollute less, thus incentivizing the reduction of overall emissions (Ghosh et al., 2020; Asl et al., 2022). This mechanism is crucial in contemporary environmental policy as it not only helps in mitigating climate change but also promotes sustainable economic practices by integrating environmental costs into market dynamics (Jia & Lin, 2020; Shi et al., 2022). Globally, carbon trading has become a cornerstone of efforts to combat climate change. In developed countries, carbon trading systems are highly advanced, characterized by stringent regulatory frameworks and standardized practices. The European Union Emissions Trading System (EU ETS) is a prime example, operating on a cap-and-trade principle that mandates emission caps and allows trading of emission allowances (Sato et al., 2022). This system includes rigorous monitoring, reporting, and verification (MRV) processes that ensure transparency and compliance, thereby fostering a reliable market environment (Zhang et al., 2020; Abbasi & Choukolaei, 2023). In North America, initiatives such as the Western Climate Initiative (WCI) and the Regional Greenhouse Gas Initiative (RGGI) have also demonstrated the effectiveness of structured carbon trading systems (Sousa & Aguiar-Conraria, 2015; Hou et al., 2024). These programs incorporate allowance auctioning and strict MRV protocols, which have successfully driven down emissions and encouraged investments in green technologies.

In contrast, carbon trading markets in developing countries are still in their formative stages (Hao et al., 2020; Yu et al., 2021). Despite the considerable potential for achieving carbon neutrality, these regions often lack the robust technological infrastructure, regulatory frameworks, and financial resources necessary for effective market participation. Challenges such as insufficient institutional capacity, inadequate policy enforcement, and limited access to capital impede the development of comprehensive carbon trading systems (Sousa & Aguiar-Conraria, 2015; Duan et al., 2023). The disparity between developed and developing countries underscores the critical need for targeted development efforts in the latter. [Among the various strategies to bolster these markets, the role of carbon trading](#)

intermediaries is paramount (Lin & Huang, 2022; Hou et al., 2024). These intermediaries, which include brokers, exchanges, and certification bodies, are essential in bridging the gap between policy and practice. They facilitate transactions, ensure the credibility of carbon credits through rigorous verification processes, and promote transparency and trust among market participants (Abbasi & Choukolaei, 2023; Ma et al., 2020). Furthermore, intermediaries are instrumental in fostering organizational collaborations among a diverse range of stakeholders, including governments, non-governmental organizations, and private sector entities (Weng & Xu, 2018; Munnings et al., 2016). By providing platforms and networks for carbon trading activities, intermediaries help standardize protocols and create market mechanisms tailored to the specific needs and conditions of these regions. Their efforts are crucial in addressing existing gaps and enhancing the efficacy and credibility of carbon trading markets.

While the carbon trading mechanisms such as cap-and-trade and MRV have shown significant potential in developed markets, their application in developing countries is met with several limitations. The effectiveness of MRV processes, for example, is often hampered by limited technological infrastructure and inconsistencies in regulatory enforcement (Oke et al., 2024; Ouyang et al., 2024). Although these systems are designed to enhance transparency and ensure compliance, in many developing nations, the lack of institutional support and technical expertise poses challenges to their full implementation. Moreover, the high costs associated with setting up MRV systems and participating in carbon trading markets can restrict smaller firms and underfunded projects, thus reducing the inclusivity of these mechanisms. Nevertheless, the flexibility of cap-and-trade systems allows for potential adaptation to local contexts, offering opportunities for policymakers in developing countries to experiment with hybrid models that incorporate both mandatory and voluntary participation (Tian et al., 2024). By addressing these structural weaknesses, developing nations can better integrate carbon trading into their broader sustainability agendas and contribute more effectively to global climate goals such as the UN SDGs.

2.2 Theoretical Framing

The Resource Dependence Theory (RDT) provides a robust framework for understanding how organizations navigate their dependencies on external resources. Developed by Pfeffer

and Salancik (1978), RDT posits that organizations are inherently interdependent with their environments due to their need for resources, leading to a web of inter-organizational relationships that shape their behaviors and strategies (Biermann & Harsch, 2017; Drees et al., 2013). This theory is particularly relevant to the context of carbon trading intermediaries, which must manage complex stakeholder networks to secure necessary resources, foster collaboration, and ensure market stability. RDT has been successfully applied in various industries and contexts to examine how organizations manage resource dependencies and navigate power dynamics. For instance, it has been used in the energy sector to study inter-firm collaborations aimed at securing scarce resources (Hillman et al., 2009), in the healthcare industry to explore partnerships between hospitals and suppliers to reduce operational risks (Casciaro & Piskorski, 2005), and in technology sectors where firms rely on external innovation networks for critical resources (Wry et al., 2013). In these cases, RDT highlights how strategic alliances and dependency management are crucial for organizational survival and competitiveness, which parallels the challenges faced by carbon trading intermediaries in developing countries. Thus, by employing RDT, this study aims to elucidate the motivations behind collaborative behaviors and the innovative strategies that intermediaries use to construct effective carbon trading systems.

RDT emphasizes the paramount importance of acquiring and effectively allocating resources to mitigate uncertainties and dependencies (Hillman et al., 2009; Jiang et al., 2023). In carbon trading, intermediaries must secure financial, technological, and human resources to facilitate market operations. These intermediaries play a crucial role in resource acquisition by leveraging digital platforms and advanced technologies to streamline trading processes. Such platforms enhance market efficiency and accessibility, especially in developing countries where resource constraints are more pronounced. For instance, intermediaries can implement real-time trading systems that enable efficient transactions and improve market liquidity, thereby lowering the barriers to participation for various stakeholders.

Inter-organizational networking is another critical component of RDT, highlighting the necessity for organizations to establish and maintain robust relationships with key stakeholders (Johnson Jr, 1995; Ozturk, 2021). Effective networking allows intermediaries to build trust, foster cooperation, and enhance market credibility, these networks are vital

for managing dependencies and securing necessary resources (Asl et al., 2022; Ghosh et al., 2020). In the context of carbon trading, intermediaries must engage a diverse array of stakeholders, including businesses, investors, government agencies, and NGOs. By doing so, they create cohesive market environments that facilitate effective trading and ensure compliance with regulatory standards.

Managing dependencies is central to RDT, as organizations must navigate power dynamics and resource dependencies to maintain stability and sustainability (Biermann & Harsch, 2017; Pfeffer & Salancik, 1978). In carbon trading markets, intermediaries face dependencies on regulatory bodies for certification, project developers for carbon credits, and financial institutions for funding. To manage these dependencies, intermediaries can employ various strategies, such as risk assessment frameworks and resource optimization practices (Duan et al., 2023; Shen, 2015). By proactively addressing potential risks and dependencies, intermediaries can mitigate market volatility and enhance the reliability of carbon trading systems, which is particularly crucial in the volatile environments of developing countries.

Strategic alliances and partnerships are fundamental to RDT, providing mechanisms for organizations to pool resources, share capabilities, and enhance their competitive advantage (Jiang et al., 2023; Hillman et al., 2009; Drees & Heugens, 2013). In the context of carbon trading, intermediaries form alliances with other market participants to expand their reach and improve operational efficiency (Lin & Huang, 2022; Hou et al., 2024). These strategic alliances facilitate knowledge transfer, technological innovation, and market expansion. For example, intermediaries may collaborate with international organizations to harmonize standards and ensure the global credibility of carbon credits. These partnerships are vital for overcoming resource limitations and achieving the scale necessary for effective market operations.

3. Methodology

3.1. Research Design and Sampling

The methodology employed in this research adopts an interpretive approach and utilizes a multiple-case research design, drawing empirical insights from four distinct carbon trading

intermediaries operating within a developing country context. This approach is grounded in the principles outlined by Stake (2013) and Yin (2017), aiming to uncover nuanced details and rich data that elucidate the roles of intermediaries in shaping and supporting carbon trading markets. Each of the selected cases provides unique insights into how carbon trading intermediaries facilitate market dynamics and collaborate with stakeholders such as businesses, standard setters, and investors involved in carbon credit trading. These cases were chosen based on specific criteria, including the intermediaries' active role in different developing countries, their engagement with diverse stakeholders, and their implementation of innovative practices to foster transparency and credibility in carbon markets. This diversity not only enriches the empirical evidence but also ensures that the selected cases represent broader collaborative practices essential for effective market operations (Ishaq et al., 2024; Gibbert et al., 2008). By focusing on these criteria, the study explores how intermediaries manage stakeholder networks, dependencies, and sustainability within emerging carbon trading markets.

Employing a multiple-case design enhances the robustness of this study's findings by facilitating comparison and contrast across different contexts (Yin, 2011; Gibbert & Ruigrok, 2010). This comparative analysis not only validates the consistency of findings but also uncovers contextual nuances that influence intermediary strategies and market outcomes. By investigating the innovation practices of these intermediaries, this research aims to provide a comprehensive understanding of how they leverage technological advancements, regulatory knowledge, and strategic partnerships to overcome challenges and optimize market performance. Furthermore, integrating RDT into this interpretive, qualitative design allows for a deeper exploration of how intermediaries manage external dependencies and power imbalances within stakeholder networks. The interpretive approach aligns with RDT by focusing on how intermediaries perceive, interpret, and respond to resource dependencies in complex market environments. As such, this study offers empirical insights into the operational strategies of carbon trading intermediaries, contributing to the broader discourse on carbon trading mechanisms in developing countries.

Table 1. Background of case studies

Cases	Established year	Number of Employees	Technologies Used	Stakeholders Involved	Operation Narratives
Case A	2018	100+	Digital marketplace, real-time trading systems, blockchain	Businesses, investors, project developers, regulatory partners	Case A offers a digital marketplace for carbon offsets and collaborates extensively with various stakeholders to enhance market transparency and efficiency. Their mission is to accelerate the transition to a low-carbon economy by making the carbon market more accessible and efficient. Case A leverages technology to create a digital platform that enables businesses to easily purchase high-quality carbon credits, partnering with businesses to offer standardized carbon offset contracts. This approach facilitates the reduction of businesses' net carbon footprints and promotes investment in sustainability projects worldwide.
Case B	2011	300+	Advanced digital tools, real-time	Business, investors, project developers,	Case B develops and trades carbon credits and other environmental commodities, such as renewable energy certificates (RECs), and provides consulting services related to carbon

			tracking systems	carbon trading marketplace	management. Their mission is to contribute to sustainable development by facilitating the transition to a low-carbon economy. Case B collaborates with project developers to identify, evaluate, and develop carbon offset projects that adhere to strict verification standards, trading these credits on various carbon exchanges. Their activities finance critical sustainability projects, including renewable energy generation and forest conservation, thus reducing greenhouse gas emissions.
Case C	2007	180+	Certification and auditing platforms, blockchain	Businesses, regulatory agencies, standard-setting bodies	Case C is a non-profit organization that sets standards and verification methodologies for voluntary carbon markets, ensuring the environmental integrity of carbon offset projects. Their mission is to build a future where sustainable development becomes standard business practice. Case C develops rigorous methodologies for different types of carbon reduction projects, which include detailed criteria for project design, implementation, and monitoring. These standards provide businesses with the confidence that the carbon credits they purchase

					are legitimate and effective in reducing emissions.
Case D	2017	100+	Transparent reporting systems, blockchain, mobile app	Retailers, consumers, carbon trading marketplace	Case D is a non-profit organization that integrates carbon offsetting into consumer purchases, thereby raising awareness and empowering individuals to offset their carbon footprints. Their mission is to enable individuals to take action against climate change through everyday purchases. Case D partners with retailers to offer consumers the option to add a carbon offset contribution to their purchases, which is then used to fund sustainable development projects. This approach promotes consumer-driven sustainability efforts and encourages businesses to offer more sustainable options.

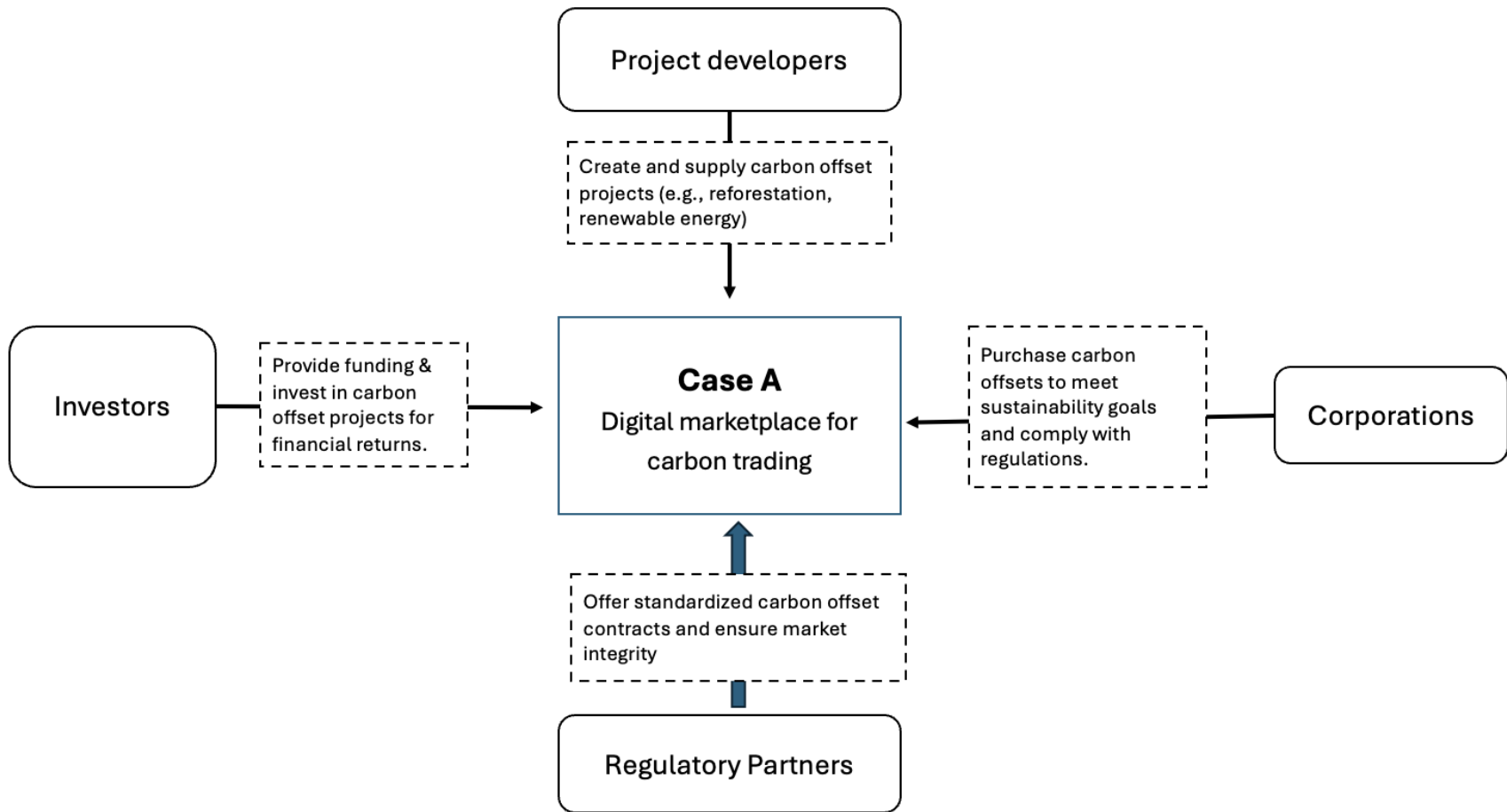


Figure 1. Case A's operation narrative

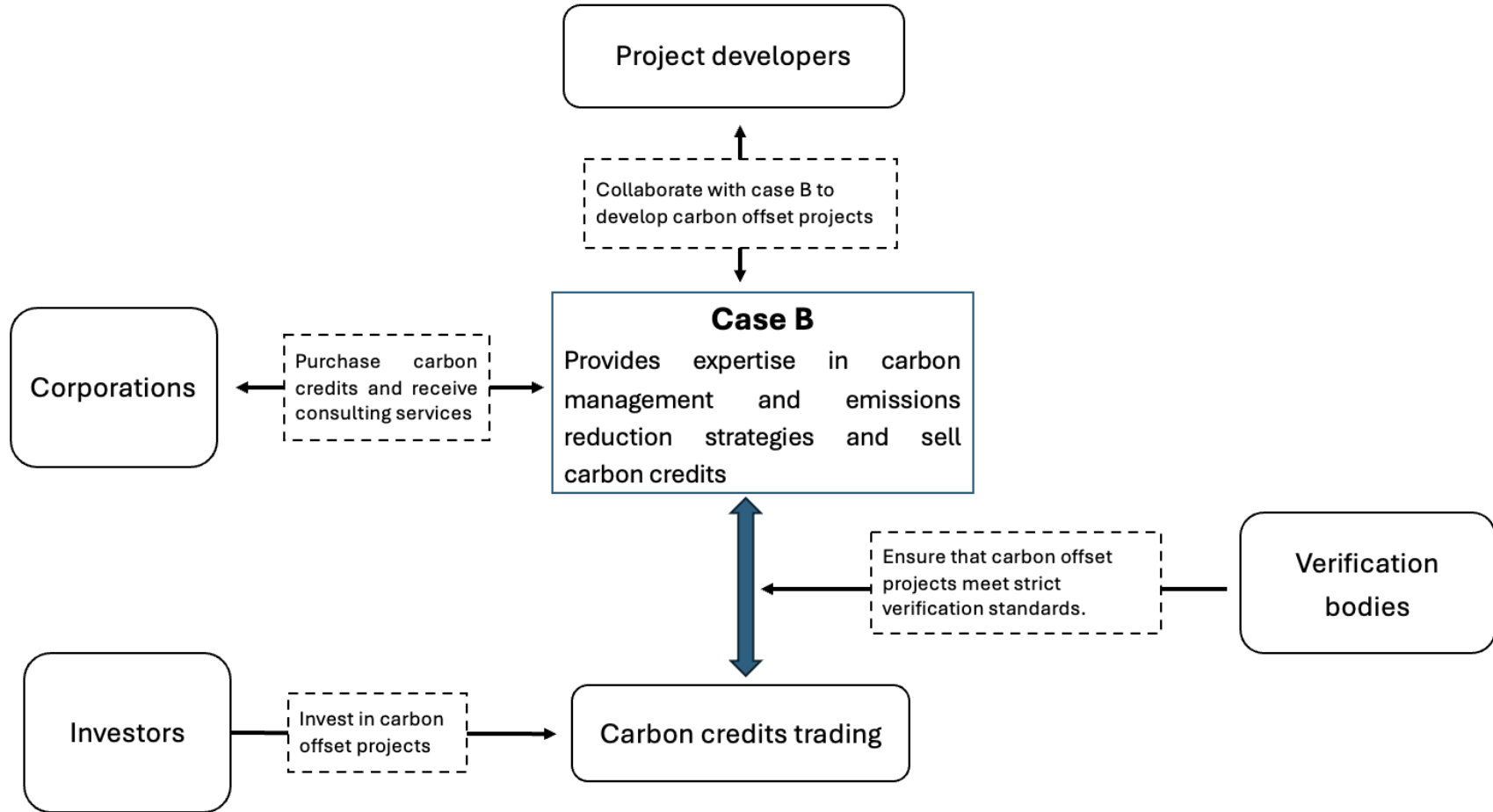


Figure 2. Case B's operation narrative

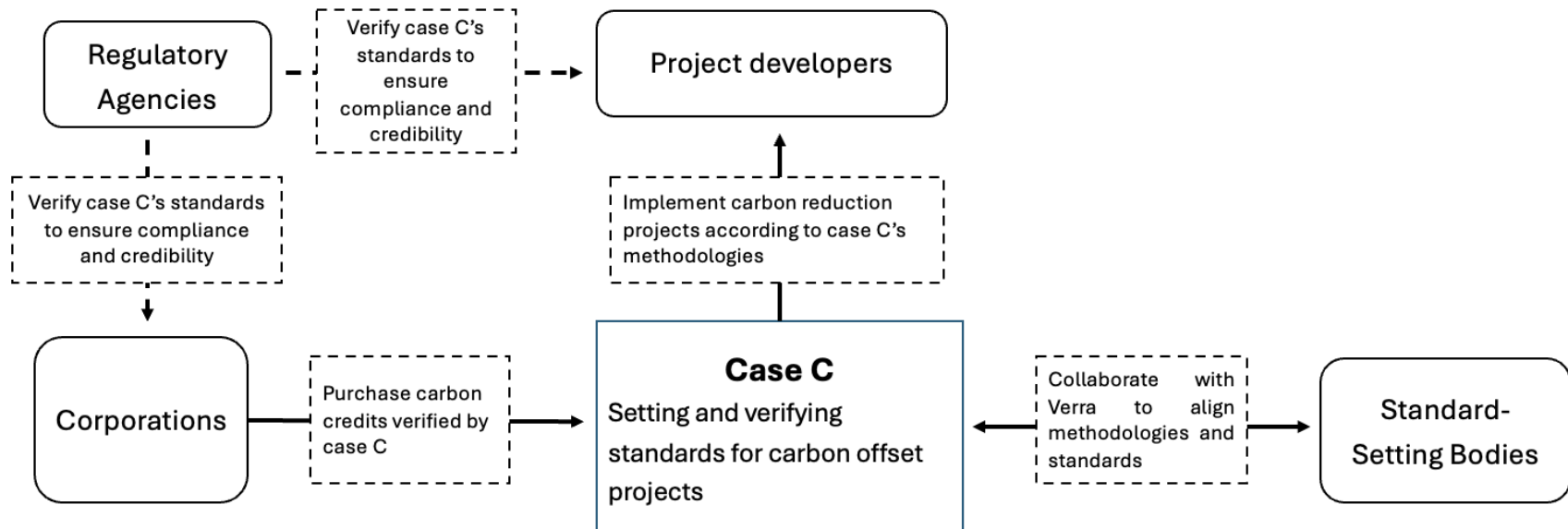


Figure 3. Case C's operation narrative

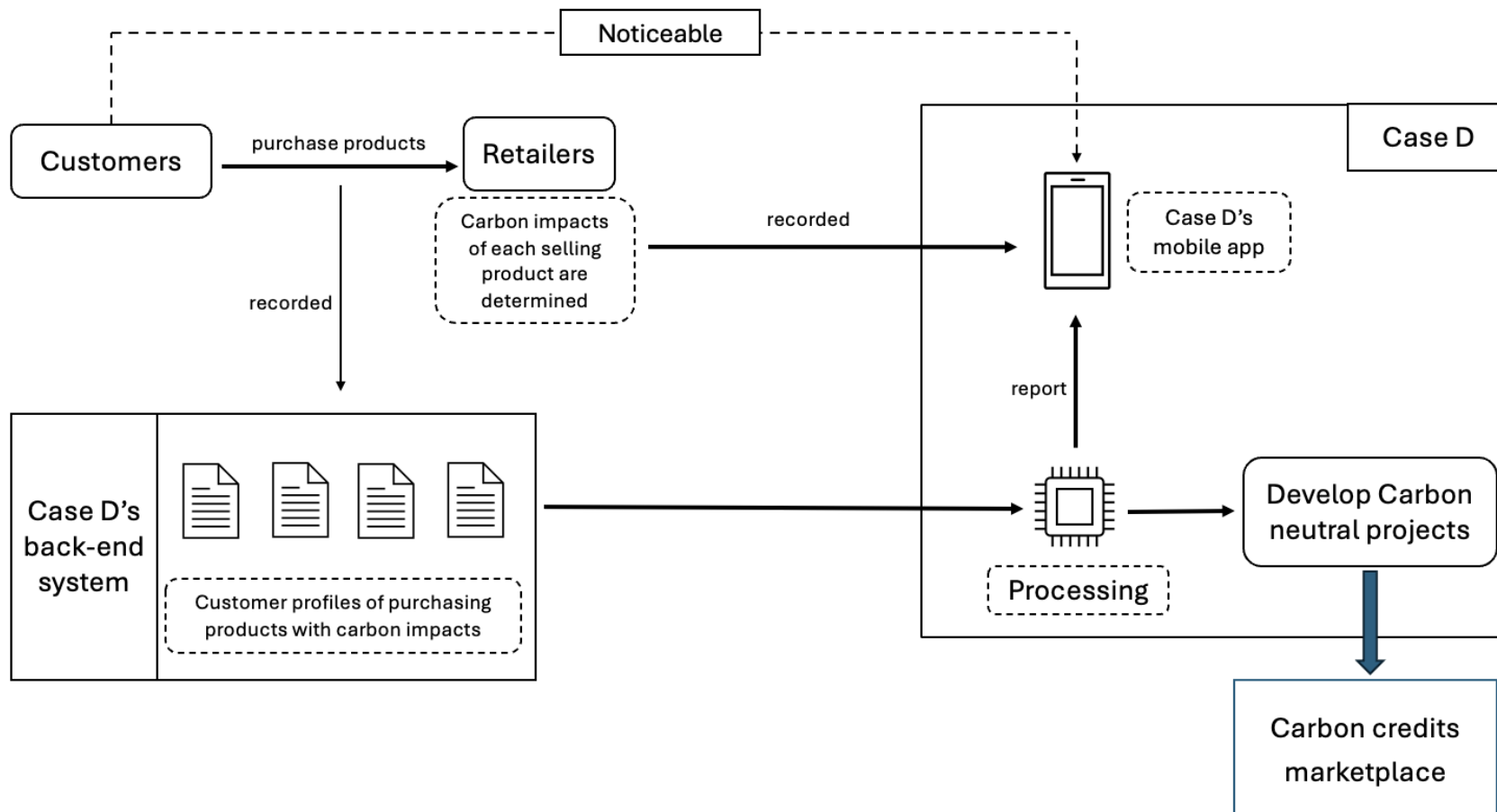


Figure 4. Case D's operation narrative

3.2. Data collection

The data collection process for this research began with the initial outreach to senior managers of the targeted case organizations to assess their interest and willingness to participate. The lead researcher introduced the study's objectives, highlighting the significance of their contributions in enhancing our comprehension of circular practices within the carbon trading sector. The enthusiastic responses from these managers indicated a strong willingness to engage, thereby paving the way for an effective data collection process. Following this initial engagement, the second phase of data collection involved a series of virtual meetings and discussions with managers and staff from various departments within the four selected firms. These conversations were instrumental in gathering initial insights into the organizations' operational transitions, the challenges they faced, and the strategies they employed. Moreover, these interactions helped evaluate the organizations' potential to provide rich, relevant data, ensuring that the study would yield meaningful and valid results.

The third and most intensive phase of data collection comprised semi-structured interviews with key personnel across the case organizations. Over a period of several months, a total of 32 interviews were conducted, involving leaders, senior managers, and middle managers who were directly involved in the innovative practices and collaborative efforts of these intermediaries. These interviews targeted individuals who played crucial roles in decision-making and operational processes, thereby ensuring that the data collected was both rich and detailed. The focus was on understanding how carbon trading intermediaries facilitate other stakeholders and the innovative practices they employ to foster effective collaboration.

To further enrich the data collection process, the research employed a snowball sampling technique (Gioia et al., 2013; Harley & Cornelissen, 2022). Initially, senior managers who were critical to the case studies were interviewed and subsequently asked to recommend additional interviewees who could provide valuable insights into the innovative and collaborative practices within the organizations. This approach was particularly effective in identifying key stakeholders and decision-makers, thereby ensuring a comprehensive and diverse set of perspectives. The data collection spanned from July 2023 to March 2024, utilizing various online communication platforms such as MS Teams and Skype to conduct

the interviews. Each session lasted between 60 to 100 minutes, allowing participants ample time to articulate their experiences and perspectives. The semi-structured format of the interviews facilitated a balance between guided questions and the exploration of emergent themes, providing a holistic understanding of the topics under investigation. Throughout the interview process, an open and non-directive approach was maintained. This strategy encouraged participants to freely share their insights and experiences without being steered in any particular direction. By fostering an environment conducive to candid and authentic responses, the researchers were able to capture a deeper and more nuanced understanding of the intermediaries' roles and the innovative practices they employ in the carbon trading market. Furthermore, data saturation was carefully monitored throughout the interview process. Saturation was achieved when new interviews no longer yielded novel themes or insights, ensuring that the data collected was comprehensive and reflective of the broader landscape of carbon trading intermediaries.

Appendix 1. Interview guide

To enhance and corroborate the insights obtained from the initial interviews, follow-up engagements were conducted with several participants via emails and phone conversations. These additional interactions allowed the researchers to clarify ambiguities, delve deeper into specific topics, and capture any further valuable information that might have been overlooked during the primary interviews. This iterative process ensured a comprehensive and nuanced understanding of the subjects under study. Each interview was meticulously recorded with the explicit consent of the participants, ensuring an accurate and thorough capture of their responses. The recordings were subsequently transcribed, and detailed notes were taken to facilitate a structured and systematic data analysis process. This methodical approach helped in organizing the data effectively and identifying key themes and patterns.

In addition to the primary data collected through interviews, a range of archival documents was also gathered. These included published reports, presentations, and other publicly accessible materials relevant to the organizations and the carbon trading market. By incorporating these secondary sources, the researchers were able to triangulate the data, comparing and validating the interview findings against documented evidence. This

triangulation process was crucial in enhancing the reliability and credibility of the study's outcomes, as it allowed for the cross-verification of information from multiple sources. To ensure a clear presentation of the data collection process and the interview details, Table 2 summarizes the key aspects of the interviews, including the number of participants, their roles, and the duration of each interview. This summary provides a concise yet comprehensive overview of the data collection efforts, illustrating the depth and breadth of the research.

Table 2. Interview details

Interviewee's code	Interviewees' positions	Experience (years)	Education	Interview time (min)
Case A				
A1	Chief Operations Officer (COO)	22	MA	70
A2	Chief Technology Officer (CTO)	17	MBA	90
A3	Head of Carbon Market Operations	18	BA	90
A4	Director of Strategic Partnerships	20	BA	80
A5	Senior Manager of Business Operation	13	BA	60
A6	Lead Network Engineer	10	MA	70
A7	Regulatory Compliance Manager	15	BA	70
A8	Innovation and Development Manager	17	MA	80
A9	Director of Trading Operations	17	MA	60
Case B				
B1	Chief Executive Officer (CEO)	19	MBA	70
B2	Director of Strategic Partnerships	21	MA	100
B3	Lead Network Engineer	17	BA	90
B4	Carbon Credits Verification Lead	15	BA	70
B5	Business Intelligent Manager	19	MA	60
B6	Project Finance Manager	22	BA	80
B7	Market Research Analyst	16	MA	70
Case C				
C1	Chief Operations Officer (COO)	20	MA	60
C2	Quality Assurance Manager	15	MA	70
C3	Research and Innovation Lead	21	BA	100

C4	Global Programs Coordinator	17	MBA	80
C5	Manager of Environmental Standards	14	BA	70
C6	Head of Certification Programs	15	BA	90
C7	Communications and Outreach Manager	10	BA	90
Case D				
D1	Chief Executive Officer (CEO)	20	BA	90
D2	Head of Blockchain Integration	18	MA	90
D3	Carbon Offset Program Manager	10	MBA	70
D4	Partnership Development Director	15	BA	100
D5	Community Relations Manager	18	BA	90
D6	Transparency and Reporting Specialist	15	MBA	80
D7	Technology Integration Lead	16	BA	60
D8	Product Development Manager	14	MA	70
D9	Innovation and Development Manager	15	MA	60

3.3. Data analysis

The data analysis process in this research was grounded in a systematic and rigorous deductive approach, ensuring the extraction of meaningful insights from the collected data. Following the guidelines of Gioia et al. (2013), the study combined in-depth interviews with an examination of archival documents to explore the processes involved in the development and implementation of innovative practices by carbon trading intermediaries. The thematic analysis technique was employed to discern recurring ideas, concepts, and perspectives from both the interview transcripts and archival materials (Gioia et al., 2013; Yin, 2017). Initially, the researchers meticulously reviewed the data to identify common themes and sub-themes that encapsulated the experiences and viewpoints of the participants. This thorough examination facilitated a comprehensive understanding of the dynamics at play within carbon trading markets in developing countries. By focusing on key themes, the study was able to highlight the characteristics and components of the intermediaries' innovative practices, as well as the factors influencing their successful implementation. The themes were systematically organized to provide a clear and structured analysis. This organization allowed for an insightful examination of various aspects, including the roles of intermediaries in facilitating market operations, the design and development of collaborative practices, and the critical factors driving the success of these initiatives. This categorization enabled a nuanced exploration of the innovation practices employed by carbon trading intermediaries and their impact on market dynamics.

To ensure the trustworthiness and credibility of the findings, several validation techniques were employed. The constant comparison method was used throughout the analysis to identify similarities and differences across the cases, thereby enhancing the rigor and depth of the analysis. Peer debriefing sessions were conducted regularly, allowing multiple researchers to critically review and validate the data analysis process. These sessions fostered constructive discussions and feedback, ensuring the accuracy and coherence of the interpretations. Furthermore, member-checking was an integral part of the validation process. Participants were invited to review the initial findings and provide feedback, ensuring their perspectives were accurately represented. This step not only enhanced the credibility of the conclusions but also reinforced the participants' engagement in the research process. By adhering to these rigorous data analysis procedures and involving multiple researchers in the validation process, the study bolstered the credibility and

validity of its outcomes. The combined use of thematic analysis, constant comparison, peer debriefing, and member-checking ensured a robust and trustworthy analysis, providing a solid foundation for the subsequent interpretation and discussion of the research findings. Figure 5 visually represents the data structure of the paper.

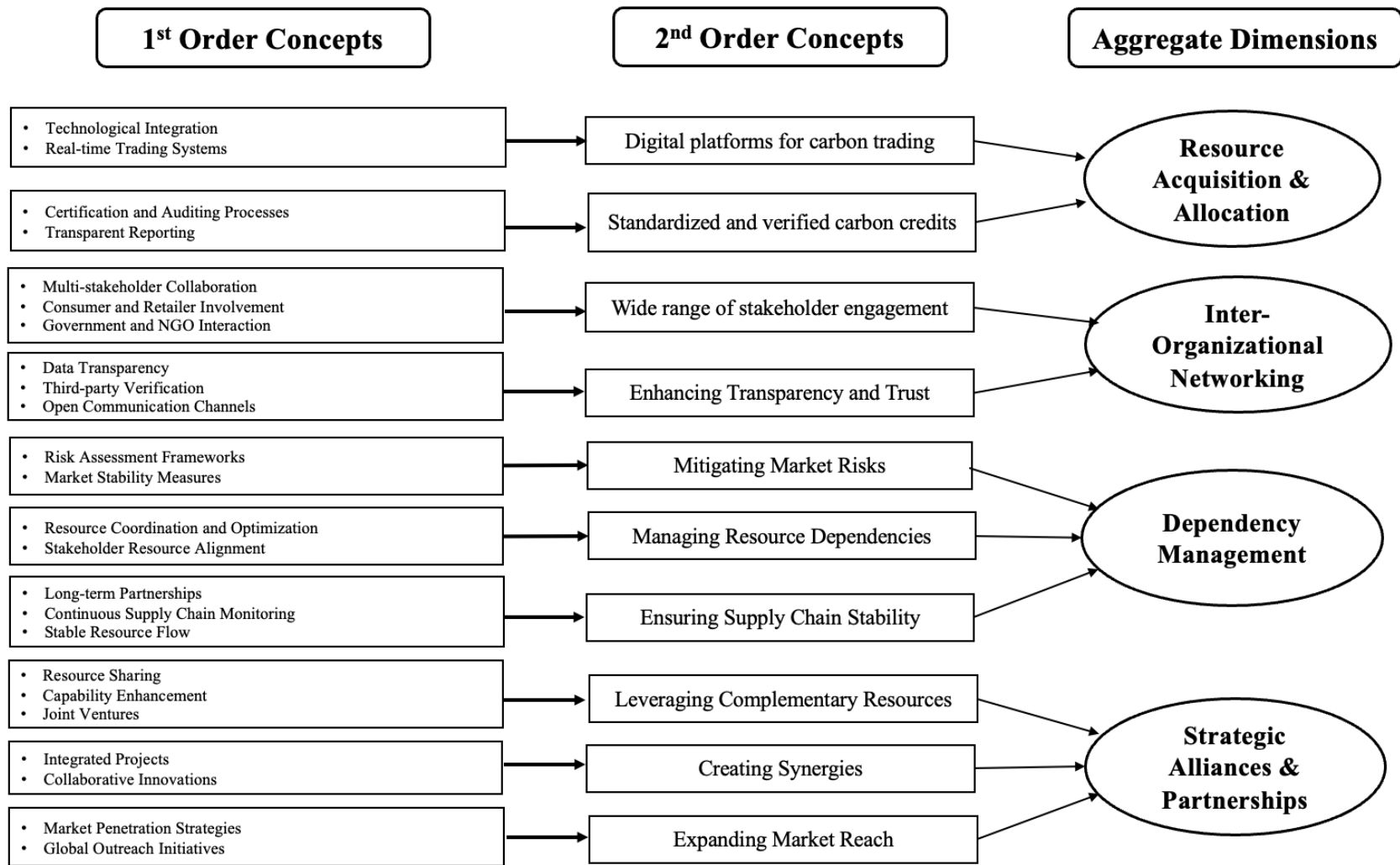


Figure 5. Data structure

4. Research findings

4.1. Resource Acquisition & Allocation

This section examines the crucial role that carbon trading intermediaries play in facilitating stakeholders in newly established carbon trading markets. The findings highlight two key mechanisms: digital platforms for carbon trading and standardized and verified carbon credits. These mechanisms are essential for streamlining operations, ensuring transparency, and fostering trust among stakeholders.

In the Case A, the development of a sophisticated digital marketplace has significantly enhanced the transparency and efficiency of carbon trading operations. By leveraging advanced data analytics, Case A enables businesses to easily locate and purchase high-quality carbon credits. One interviewee from Case A described, "*our platform uses cutting-edge data analytics to provide real-time insights into market trends, helping stakeholders make informed decisions*" (A1). This integration allows for a seamless trading experience, reducing barriers for businesses looking to engage in carbon trading. Similarly, Case C utilizes technological tools to meticulously track the progress of carbon offset projects, ensuring strict compliance with established standards. This not only enhances the credibility of the carbon credits traded on their platform but also builds trust among stakeholders. The use of technological integration illustrates a common trend among carbon trading intermediaries in utilizing digital tools to streamline resource acquisition and allocation processes in developing countries' carbon markets.

Real-time trading systems have emerged as a critical innovation practice among carbon trading intermediaries. Case A's platform exemplifies this with its real-time trading functionalities, which enable immediate transactions of carbon credits. This feature significantly reduces the lag time between transactions, enhancing the efficiency and responsiveness of the carbon trading market. Meanwhile, Case B also employs real-time systems in its trading platform. This allows them to respond quickly to market demands and offer immediate access to carbon credits. An Case B's representative mentioned, "*our real-time trading system is designed to match buyers and sellers instantly, ensuring that market participants can act swiftly*" (B2). These systems are crucial in developing countries

where market infrastructure might be less developed, providing a reliable and efficient mechanism for carbon trading.

The establishment of standardized and verified carbon credits is another critical function of carbon trading intermediaries. Case C's role in developing rigorous methodologies for different types of carbon reduction projects is a prime example. These methodologies include detailed criteria for project design, implementation, and monitoring, ensuring that the carbon credits generated are legitimate and effective in reducing emissions. Case B collaborates with project developers to ensure that carbon offset projects adhere to strict verification standards. This collaboration helps ensure the integrity of the credits they trade and provides confidence to buyers in the market. Case D also emphasizes rigorous certification processes. They integrate certification into their consumer-facing carbon offset programs, ensuring that the offsets offered through retail partners meet high standards. An interviewee from case D noted, "*every offset option we provide through our retail partners is certified and audited to ensure it meets our quality standards*" (D3). These rigorous certification and auditing processes are essential for maintaining the credibility of the carbon market.

Transparent reporting is a crucial element in the standardization and verification of carbon credits. Both Case A and Case C emphasize the importance of transparency in their operations. Case A's digital marketplace includes robust reporting features that provide detailed information on each carbon credit transaction, enhancing accountability and trust among stakeholders. A participant from Case A noted, "*our platform's reporting tools allow stakeholders to see every detail of their transactions, which is essential for building trust*" (A5). Case C, on the other hand, ensures transparency through its comprehensive project documentation and reporting requirements. This transparency ensures that stakeholders can verify the authenticity and impact of the carbon credits being traded. Case D's approach to transparent reporting includes providing consumers with detailed information on how their contributions are used. An interviewee from Case D mentioned, "*we ensure that consumers know exactly where their money is going and how it's helping to offset carbon emissions*" (D5). This transparency helps build trust and encourages more consumers to participate in their offset programs.

Table 3. Summary of within-case and cross-case findings on resource acquisition & allocation

Finding themes	Within case findings	Cross case comparison
Digital Platforms for Carbon Trading	<p>In Case A, the intermediary developed a digital platform equipped with real-time trading capabilities and data analytics to enhance both transparency and market efficiency.</p> <p>Case C used technology to track carbon offset projects and ensure compliance with established standards, which improved the credibility of carbon credits.</p>	<p>Across the cases, the use of digital platforms enhances transparency, market efficiency, and project credibility.</p>
Standardized and Verified Carbon Credits	<p>In Case B, the intermediary collaborates with project developers to ensure that verification standards are consistently met, which contributes to maintaining high standards for carbon credits.</p> <p>Case C takes an active role in creating certification methodologies that govern the design and monitoring of carbon offset projects.</p> <p>In Case D, all carbon credits in consumer-facing programs are audited and certified to ensure transparency and credibility.</p>	<p>The commitment to standardization and verification is evident across all cases.</p>

4.2. Inter-Organizational Networking

The study reveals the importance of inter-organizational networking in facilitating stakeholders within newly established carbon trading markets in developing countries. Two

key concepts emerged: wide-ranging stakeholder engagement and enhancing transparency and trust. These elements are essential for building robust networks that support effective collaboration and cooperation among various market participants.

Carbon trading intermediaries like Case A actively foster multi-stakeholder collaboration by bringing together project developers, investors, and corporations on a single platform. This approach ensures a diverse range of participants can engage in carbon trading, enhancing market robustness. Similarly, Case B engages with multiple stakeholders by offering consulting services and facilitating the development of carbon offset projects. Case C also emphasizes multi-stakeholder collaboration through its standards development process, which involves input from various industry experts and stakeholders. An interviewee from Case C official explained, "*we involve a wide range of stakeholders in our standards development to ensure our methodologies are comprehensive and widely accepted*" (C4).

Case B also engages with consumers by promoting renewable energy certificates (RECs) and other environmental commodities. Case D integrates carbon offsetting into consumer purchases, thereby involving both consumers and retailers in the carbon trading process. This approach promotes consumer-driven sustainability efforts and encourages businesses to offer more sustainable options. An interviewee from Case D stated, "*by integrating carbon offsets into everyday purchases, we empower consumers to contribute to sustainability and encourage retailers to support these initiatives*" (D3).

Case D collaborates with NGOs to fund sustainable development projects, ensuring that their carbon offset initiatives have a meaningful impact. Case C's role as a standard-setting organization involves significant interaction with government bodies and NGOs to harmonize methodologies and ensure regulatory compliance. This interaction is crucial for maintaining the credibility and acceptance of carbon credits in the market. An Case C representative mentioned, "*our work with government agencies and NGOs ensures that our standards are aligned with regulatory requirements and global best practices*" (C6).

Case A leverages its digital platform to provide comprehensive data transparency, offering detailed information about each carbon credit transaction. This transparency helps build

trust among stakeholders and ensures accountability. Similarly, Case C ensures data transparency through its rigorous reporting requirements, which include public access to project documentation. An Case C official explained, "*we provide detailed project data to the public, ensuring transparency and accountability in our carbon offset projects*" (C3).

Case C’s certification process involves third-party verification to ensure the integrity of carbon credits. This practice is essential for maintaining the credibility of the voluntary carbon market. Case B also employs third-party verification to validate its carbon offset projects, ensuring they meet stringent standards. An case B representative mentioned, "*we work with independent auditors to verify our projects, ensuring they deliver real and measurable emission reductions*" (B4).

Case A also prioritizes open communication with its stakeholders, offering clear and accessible information about its trading processes and market trends. Case D emphasizes open communication channels with consumers and partners, providing regular updates on the impact of their carbon offset initiatives. This transparency helps build trust and encourages ongoing participation. An interviewee from Case D stated, "*we maintain open lines of communication with our consumers and partners, providing regular updates on the progress and impact of our projects*" (D4).

Table 4. Summary of within-case and cross-case findings on inter-organizational networking

Finding themes	Within case findings	Cross case comparison
Wide Range of Stakeholder Engagement	Case A facilitates multi-stakeholder collaboration through its digital platform, which involves developers, investors, and corporations, enabling broad participation in carbon trading markets. In Case B, the intermediary provides consulting services and promotes renewable	Across all cases, intermediaries emphasize diverse stakeholder involvement, including businesses, consumers, NGOs, and governments, fostering

	<p>energy credits (RECs) and related sustainability projects.</p> <p>Case C develops standards with input from diverse industry experts, ensuring broad-based stakeholder engagement.</p> <p>Case D integrates consumers and retailers into its carbon offset programs, working with NGOs to fund sustainability projects.</p>	<p>collaboration and market participation.</p>
<p>Enhancing Transparency and Trust</p>	<p>In Case A, transparency is achieved through a digital platform that provides real-time transaction data on carbon credits.</p> <p>Case B ensures trust by employing third-party verification of carbon offset projects.</p> <p>Case C promotes transparency through public project reporting and independent third-party verification.</p> <p>Case D fosters trust through open communication with stakeholders, providing regular updates on the impacts of its carbon offset initiatives.</p>	<p>All cases underscore the use of transparent communication, third-party verification, and data access to build trust and ensure accountability in carbon trading processes.</p>

4.3. Dependency Management

The study identifies dependency management as a crucial factor in facilitating stakeholders within newly established carbon trading markets in developing countries. Three key concepts emerged: mitigating market risks, managing resource dependencies, and ensuring supply chain stability. These elements are vital for maintaining a stable and effective carbon trading ecosystem.

Carbon trading intermediaries such as Case C implement comprehensive risk assessment frameworks to evaluate and mitigate potential risks associated with carbon offset projects. This proactive approach ensures that projects are robust and resilient to market fluctuations.

Case B also employs rigorous risk assessment practices, focusing on the verification and validation of carbon credits to minimize market risks. An representative from case B stated, *"our risk assessment processes are designed to ensure that all carbon credits we trade are thoroughly verified, reducing the likelihood of market disruptions"* (B7).

Case A contributes to market stability by offering standardized carbon offset contracts in partnership with business partners, which provides a regulated and stable trading environment. This approach reduces volatility and enhances investor confidence. Case D also implements market stability measures by integrating carbon offsetting into consumer purchases, creating a steady demand for carbon credits. An interviewee from Case D highlighted, *"by incorporating carbon offsets into everyday transactions, we create a consistent demand that helps stabilize the market"* (D3).

Case B optimizes resource coordination by collaborating with project developers to ensure that carbon offset projects are efficiently managed and meet high standards. This coordination is crucial for the success of these projects. Case C aligns resources through its certification processes, ensuring that project resources are effectively utilized to achieve maximum impact. An Case C's participant noted, *"our certification processes are designed to align resources with project goals, ensuring that each project delivers significant emission reductions"* (C2).

Case A facilitates resource alignment among stakeholders by providing a digital platform that connects various market participants, allowing them to coordinate and optimize their resources effectively. Case D aligns resources by partnering with retailers and consumers to fund sustainable development projects, ensuring that resources are directed towards impactful initiatives. An interviewee from Case D stated, *"we work with retailers and consumers to channel resources into projects that have a real impact on sustainability"* (D9).

Case B also emphasizes long-term partnerships with businesses and investors, fostering a stable and dependable supply chain. Case C establishes long-term partnerships with project developers and verification bodies to ensure a stable supply chain for carbon credits. These partnerships are essential for maintaining the credibility and reliability of carbon offset

projects. An Case C’s representative explained, *"our long-term partnerships with developers and verifiers ensure that our projects are consistent and reliable, which is crucial for market stability"* (C7).

Case A employs continuous supply chain monitoring through its digital platform, providing real-time data and analytics to track market trends and supply chain activities. This monitoring enhances market transparency and stability. Case D ensures a stable resource flow by integrating carbon offset contributions into consumer purchases, creating a consistent and predictable stream of funding for sustainable projects. An interviewee from Case D mentioned, *"by embedding carbon offsets into consumer purchases, we create a stable flow of resources that supports ongoing sustainability efforts"* (D1).

Table 5. Summary of within-case and cross-case findings on dependency management

Finding themes	Within case findings	Cross case comparison
Mitigating Market Risks	<p>In Case A, standardized carbon offset contracts are used to provide market stability, thereby reducing volatility for investors.</p> <p>Case B employs a rigorous risk assessment and validation process for carbon credits, minimizing exposure to market risks.</p> <p>Case C implements comprehensive risk assessment frameworks to ensure that projects remain robust and resilient to fluctuations in the market.</p> <p>Case D creates market stability by generating steady demand for carbon credits through consumer purchases integrated into everyday transactions.</p>	<p>Across all cases, risk mitigation involves rigorous assessment frameworks, validation, and standardized contracts, contributing to market stability and reduced volatility.</p>

<p>Managing Resource Dependencies</p>	<p>In Case A, the intermediary’s digital platform enables efficient coordination of resources across market participants, optimizing their use.</p> <p>Case B collaborates closely with project developers to ensure that resources are used efficiently and sustainably.</p> <p>Case C uses certification processes to align resources with project goals, maximizing impact.</p> <p>In Case D, partnerships with retailers and consumers help to channel resources effectively into sustainable development projects.</p>	<p>All cases emphasize resource alignment through collaboration with stakeholders, platforms for coordination, and certification, ensuring optimized resource allocation.</p>
<p>Ensuring Supply Chain Stability</p>	<p>In Case A, the intermediary ensures supply chain stability by continuously monitoring the carbon trading supply chain using real-time data analytics.</p> <p>Case B relies on long-term partnerships with businesses and investors to ensure the reliability of the supply chain.</p> <p>Case C forms partnerships with developers and verification bodies to maintain consistency in carbon offset projects.</p> <p>Case D secures a predictable flow of resources through consumer contributions, which are integrated into their purchasing behaviors.</p>	<p>Across all cases, long-term partnerships and continuous monitoring are key to maintaining a stable and reliable supply chain for carbon credits and sustainability projects.</p>

4.4. Strategic Alliances & Partnerships

Strategic alliances and partnerships play a crucial role in the carbon trading market, particularly in developing countries where such collaborations can significantly enhance market effectiveness. The study identifies three key concepts in this area: leveraging complementary resources, creating synergies, and expanding market reach. These elements are pivotal for fostering innovation and ensuring effective collaboration among stakeholders.

Case A leverages complementary resources through its partnership with business partners, sharing technological and financial resources to offer standardized carbon offset contracts. This collaboration enhances the overall market infrastructure and provides stability. Case B also engages in resource sharing by collaborating with project developers and businesses. These partnerships allow Case B to access diverse project portfolios and technical expertise, enhancing their capability to develop high-quality carbon credits. An Case B representative stated, "*by sharing resources with our partners, we can access a wide range of expertise and projects, which strengthens our overall offerings*" (B2).

Case C enhances its capabilities through strategic alliances with other standard-setting bodies and verification organizations. These partnerships enable Case C to develop rigorous methodologies and ensure the credibility of carbon credits. Case D enhances its capabilities by partnering with retailers and consumers to integrate carbon offset contributions into everyday purchases. This collaboration expands Case D's reach and impact. An interviewee from Case D explained, "*by partnering with retailers, we enhance our ability to reach consumers and integrate carbon offsetting into their daily activities*" (D4).

Case B participates in joint ventures with investors and project developers to finance and implement large-scale sustainability projects. These joint ventures enable Case B to leverage financial and technical resources effectively. An Case B's representative highlighted, "*our joint ventures with investors and developers allow us to undertake large-scale projects that have a significant impact on reducing emissions*" (B3).

Case C creates synergies by integrating various carbon reduction projects under a unified standard, ensuring that different initiatives work together to achieve greater environmental

impact. Case A also creates synergies by providing a digital marketplace that integrates various stakeholders, enabling them to collaborate more effectively. An Case A executive noted, *"our platform brings together diverse stakeholders, creating synergies that enhance the overall effectiveness of carbon trading"* (A9).

Case D drives collaborative innovations by working with retailers to develop new ways for consumers to offset their carbon footprints through everyday purchases. This innovative approach encourages widespread participation in carbon offsetting. Case B fosters collaborative innovations by working with project developers to create new and improved carbon reduction methodologies. These innovations help in developing more effective and verifiable carbon credits. An Case B's representative explained, *"our collaborative efforts with developers result in innovative methodologies that enhance the quality and effectiveness of carbon credits"* (B5).

Case A employs market penetration strategies by partnering with major corporations and investors, thereby expanding its influence and reach within the carbon trading market. Case B expands its market reach by participating in various carbon exchanges and establishing a presence in multiple geographic regions. This strategy allows Case B to access a broader range of projects and customers. An Case B's representative stated, *"we expand our reach by participating in different carbon exchanges and targeting diverse geographic areas"* (B1).

Case C undertakes global outreach initiatives by collaborating with international organizations and participating in global forums, promoting their standards and methodologies worldwide. Case D expands its market reach through global outreach initiatives by partnering with international retailers and promoting carbon offsetting on a global scale. An interviewee from Case D mentioned, *"we work with international retailers to bring our carbon offsetting solutions to consumers around the world, enhancing our global impact"* (D1).

Table 6. Summary of within-case and cross-case findings on strategic alliances & partnerships

Finding themes	Within case findings	Cross case comparison
Leveraging Complementary Resources	<p>In Case A, the intermediary leverages complementary resources by partnering with business partners, allowing them to share both technological and financial resources, which enhances market infrastructure and stability.</p> <p>Case B demonstrates resource-sharing by collaborating with project developers and businesses, which provides access to diverse project portfolios and technical expertise.</p> <p>Case C enhances its capabilities by forming alliances with other standard-setting bodies and verification organizations to ensure the credibility of carbon credits.</p> <p>Similarly, Case D leverages partnerships with retailers and consumers to integrate carbon offset contributions into everyday purchases, thus expanding its impact.</p>	<p>All cases leverage complementary resources by forming partnerships with different stakeholders, sharing technological, financial, and technical expertise to strengthen market infrastructure.</p>
Creating Synergies	<p>Case A creates synergies through its digital platform, which integrates various stakeholders, allowing them to collaborate more effectively.</p> <p>Case B engages in joint ventures with investors and project developers to finance large-scale sustainability projects, which leads to enhanced financial and technical collaboration.</p> <p>In Case C, synergies are generated by integrating various carbon reduction projects under unified standards, resulting in a coordinated and more impactful approach.</p>	<p>Synergies are created by integrating diverse stakeholders and projects under a unified system or through collaborative innovations, maximizing environmental and market impact across all cases.</p>

	Case D fosters synergies by collaborating with retailers to develop new ways for consumers to offset their carbon footprints through everyday purchases, encouraging widespread participation.	
Expanding Market Reach	<p>In Case A, market reach is expanded through strategic partnerships with major corporations and investors, which enables the intermediary to increase its influence in the carbon trading market.</p> <p>Case B expands its market reach by participating in various carbon exchanges and establishing a presence in multiple geographic regions, thereby accessing a broader range of projects and customers.</p> <p>Case C focuses on global outreach initiatives by collaborating with international organizations and promoting their standards worldwide.</p> <p>Case D extends its market reach by partnering with international retailers and promoting carbon offsetting on a global scale.</p>	All cases use strategic alliances to expand market reach, either through regional participation, global outreach, or partnerships with international retailers and organizations.

5. Discussion

5.1. How do carbon trading intermediaries enhance market efficiency, transparency, and collaboration in newly established carbon trading markets in developing countries?

This study elucidates how carbon trading intermediaries facilitate stakeholders in newly established carbon trading markets and underscores the importance of intermediaries in enhancing market efficiency, transparency, and collaboration. In terms of resource

acquisition and allocation, the literature emphasizes the importance of technological infrastructure in enhancing market efficiency and accessibility (Kou & Xu, 2022; Wang et al., 2023; Asl et al., 2022). The findings from this study corroborate this view, showing that intermediaries like Case A and Case B facilitate the acquisition and distribution of resources through digital platforms for carbon trading. For instance, Case A's digital marketplace integrates advanced technologies to provide a seamless trading experience, while Case B leverages real-time trading systems to ensure efficient transactions. These practices are critical in developing countries, where technological adoption can significantly impact market accessibility and efficiency. Furthermore, the standardization and verification of carbon credits are essential for market credibility, as noted in the literature (Hao et al., 2020; Lin & Huang, 2022; Shi et al., 2022). This study's findings reveal that intermediaries like Case C and Case D play a crucial role in this aspect. Case C's rigorous certification and auditing processes ensure the integrity of carbon credits, and Case D's transparent reporting mechanisms provide stakeholders with reliable information. These practices build trust and confidence among stakeholders, which is vital for the sustainability of carbon trading markets in developing countries.

Regarding inter-organizational networking, existing studies underscore the significance of multi-stakeholder engagement in complex market systems (Duan et al., 2023; Ghosh et al., 2020; Lin & Huang, 2022). This study highlights that intermediaries engage a wide range of stakeholders, including businesses, investors, project developers, governments, and NGOs. For instance, Case A collaborates with stakeholders to engage various market participants, while Case B partners with project developers to foster collaborative relationships. These engagements are crucial for creating a cohesive market environment that facilitates effective collaboration among stakeholders. Enhancing transparency and trust is also highlighted in the literature as a key factor in market effectiveness (Ma et al., 2020; Shi et al., 2022; Zhang et al., 2020). The findings from this study show that intermediaries like Case C and Case D prioritize transparency through data sharing, third-party verification, and open communication channels. Case C's use of third-party verification and Case D's commitment to open communication exemplify how transparency is maintained in the market. This transparency ensures that stakeholders can make informed decisions, which is essential for the stability and growth of carbon trading markets in developing countries.

In terms of dependency management, the literature emphasizes the need for proactive measures to manage uncertainties and dependencies in emerging markets (Duan et al., 2023; Zhang et al., 2020). This study finds that intermediaries implement various strategies to manage dependencies and mitigate market risks. For example, Case A employs risk assessment frameworks to protect stakeholders from market volatility, and Case B implements resource coordination and optimization strategies. These practices help ensure a stable supply chain and reduce the risks associated with market dependencies.

Finally, strategic alliances and partnerships are crucial for leveraging complementary resources and expanding market reach, as highlighted in the literature (Yu et al., 2021; Asl et al., 2022). The findings from this study reveal that intermediaries form strategic alliances to enhance their capabilities and market presence. For instance, Case B's joint ventures with investors and Case C's collaborations with international organizations illustrate the effectiveness of these alliances in creating synergies and expanding market reach. These partnerships are particularly important in developing countries, where resources and capabilities may be limited.

5.2. What innovation practices do carbon trading intermediaries use to foster and maintain effective collaboration among all stakeholders within the carbon trading market?

This study addresses the innovative practices employed by carbon trading intermediaries to foster and maintain effective collaboration among stakeholders within the carbon trading market. The findings, drawn from the four cases highlight key practices that enhance collaboration and supply chain management.

5.2.1. Technological Integration for Enhanced Collaboration

A critical innovation practice identified is the use of advanced digital platforms to facilitate collaboration and streamline supply chain management in carbon trading (Kou & Xu, 2022; Wang et al., 2023). Case A's digital marketplace exemplifies how technological integration can enhance stakeholder collaboration by providing real-time trading systems that enable

seamless interactions between businesses, investors, and project developers. This improves efficiency and builds trust among participants by ensuring transparency and reliability in transactions. In comparison to traditional supply chain management practices, which often involve manual processes and limited transparency, these digital platforms represent a significant advancement (Munnings et al., 2016; Weng, Q., & Xu, 2016; Shi et al., 2022). They offer an integrated approach where all stakeholders can participate actively and efficiently. Similarly, Case B employs digital tools to manage and track carbon credits, ensuring that project developers and investors have up-to-date information, thereby enhancing collaboration.

5.2.2. Standardization and Verification for Trust and Transparency

The standardization and verification of carbon credits are essential for building trust and ensuring transparency in the carbon trading market. Case C's rigorous certification and auditing processes ensure that carbon credits are credible and meet high environmental standards, fostering collaboration as stakeholders need assurance that the credits they trade are legitimate and effective in reducing emissions. The literature emphasizes that trust and transparency are fundamental for effective supply chain collaboration in carbon trading (Wang & Wu, 2021; Ghosh et al., 2021). The findings from this study corroborate this, showing how standardized and verified carbon credits can enhance market integrity. Case C's approach ensures that all stakeholders, including investors and project developers, can collaborate with confidence. Additionally, Case D's transparent reporting practices, which include detailed disclosures about the impact of consumer contributions on carbon offset projects, further illustrate the importance of transparency in fostering stakeholder trust.

5.2.3. Multi-Stakeholder Engagement Strategies

Engaging a wide range of stakeholders is another innovative practice that significantly enhances collaboration. Case B's strategy involves collaborating with government bodies, NGOs, and local communities to ensure that their projects align with broader sustainability goals. This inclusive approach ensures that various perspectives are considered, leading to more comprehensive and effective carbon trading initiatives. The literature highlights the importance of multi-stakeholder engagement in creating resilient and inclusive supply

chains (Ghosh et al., 2020; Lin & Huang, 2022; Abbasi & Choukolaei, 2023). The findings from this study extend this understanding by showing how such engagement can be effectively implemented in carbon trading markets. Case B's approach ensures that diverse stakeholder needs are addressed, fostering a more collaborative and supportive trading environment. Case A also engages a broad range of stakeholders, including project developers and investors, through its digital platform, facilitating a collaborative environment where information and resources are readily shared.

5.2.4. Strategic Alliances and Partnerships

Forming strategic alliances and partnerships is crucial for leveraging complementary resources and capabilities, creating synergies, and expanding market reach. These alliances allow intermediaries to pool resources and expertise, enhancing their ability to support stakeholders effectively. Case D's partnerships with retailers integrate carbon offsetting into consumer purchases, raising awareness and promoting sustainable practices among consumers. The literature underscores that strategic alliances are essential for enhancing supply chain management and expanding market reach (Wang & Wu, 2021; Zhang et al., 2020; Duan, et al., 2023). The findings from this study illustrate how such alliances can be operationalized in the context of carbon trading. Case D's strategy not only engages consumers but also encourages businesses to adopt more sustainable practices, thereby fostering a more collaborative and extensive market. Similarly, Case C's alliances with other standard-setting bodies and verification organizations ensure harmonized methodologies and robust standards, supporting effective collaboration across the market.

6. Concluding remark

This study provides a comprehensive analysis of how carbon trading intermediaries in developing countries employ innovative practices to overcome market challenges and facilitate stakeholder engagement. The integration of digital platforms, rigorous verification processes, and strategic alliances are central to enhancing market efficiency and transparency. Our research emphasizes the crucial role intermediaries play in navigating resource dependencies and fostering collaboration across diverse stakeholders. By expanding Resource Dependence Theory and highlighting the importance of

technological and collaborative frameworks, the findings offer both theoretical advancements and actionable insights for improving the effectiveness of carbon trading systems in emerging markets.

6.1. Theoretical contributions

This research contributes significantly to the current literature on the innovation practices of carbon trading intermediaries and their role in enhancing collaboration and supply chain management in newly established carbon trading markets in developing countries. Firstly, the study expands the understanding of RDT (Biermann & Harsch, 2017; Drees et al., 2013) by illustrating how digital platforms and technological integration are critical for resource acquisition and allocation in carbon trading markets. The findings demonstrate that intermediaries use advanced technological solutions to facilitate real-time trading and efficient resource distribution. This extends the existing literature (Asl et al., 2022; Hao et al., 2020; Lin & Huang, 2022) by providing empirical evidence on the effectiveness of digital platforms in emerging markets, emphasizing the need for technological infrastructure to enhance market efficiency and accessibility.

Secondly, the research highlights the importance of standardization and verification processes in building trust and transparency among stakeholders. By focusing on the rigorous certification and auditing practices of carbon trading platforms (Jia & Lin, 2020; Ma et al., 2020; Shi et al., 2022), the study reinforces the theoretical understanding that trust and transparency are foundational for effective supply chain collaboration. This aligns with existing studies that underscore the need for credibility and reliability in market transactions, particularly in the context of carbon trading where the legitimacy of carbon credits is crucial for stakeholder confidence.

Thirdly, the study contributes to the literature on multi-stakeholder engagement strategies (Ghosh et al., 2020; Wang & Wu, 2021) by showing how inclusive approaches can foster collaboration in complex market systems. The engagement strategies employed by carbon trading intermediaries, which involve collaboration with a broad range of stakeholders including governments and consumers, provide an approach for enhancing stakeholder involvement. This finding supports and extends existing theories that advocate for multi-

stakeholder engagement as a means to create resilient and inclusive supply chains (Abbasi & Choukolaei, 2023; Zhang et al., 2020; Hou et al., 2024).

Finally, the research provides insights into the formation and management of strategic alliances and partnerships (Wang & Wu, 2021; Duan et al., 2023; Shen, 2015). Case D and Case C illustrate how strategic alliances can leverage complementary resources, create synergies, and expand market reach. These findings align with and extend the literature on strategic management (Sato et al., 2022; Kou & Xu, 2022; Wang & Wu, 2021), demonstrating that such alliances are not only beneficial but essential for the growth and stability of carbon trading markets, especially in developing countries where resources may be limited.

6.2. Practical implications

The findings of this research offer several practical implications for stakeholders involved in newly established carbon trading markets in developing countries, including intermediaries, businesses, investors, and policymakers. Firstly, the study underscores the importance of technological integration for market participants. Intermediaries have demonstrated that digital platforms and real-time trading systems significantly enhance market efficiency and stakeholder collaboration. Businesses and investors should prioritize adopting and integrating advanced technological solutions to streamline transactions, improve transparency, and facilitate real-time communication. Policymakers could support these efforts by creating favorable regulatory environments that encourage technological innovation and infrastructure development. Secondly, the emphasis on standardization and verification highlights the need for robust certification and auditing processes. Our cases' practices provide a blueprint for ensuring the credibility of carbon credits. Stakeholders should implement rigorous verification standards to build trust and attract investment. This can be achieved through third-party auditing and transparent reporting mechanisms. Policymakers can aid by endorsing standardized methodologies and encouraging the adoption of international best practices, thus enhancing the market's overall credibility.

Thirdly, multi-stakeholder engagement strategies are crucial for fostering an inclusive and collaborative market environment. The inclusive approaches of intermediaries illustrate the

benefits of involving a broad spectrum of stakeholders, including governments, NGOs, and local communities. Businesses should adopt similar engagement strategies to ensure diverse perspectives are considered, leading to more comprehensive and sustainable carbon trading initiatives. Policymakers can facilitate this by promoting platforms for stakeholder dialogue and collaboration. Finally, the importance of strategic alliances and partnerships is evident in the success of intermediaries like carbon trading intermediaries in this research. These alliances enhance the capabilities of market participants by leveraging complementary resources and creating synergies. Businesses and investors should actively seek and form strategic partnerships to expand their market reach and enhance their operational capabilities. Policymakers can support this by fostering an environment that encourages partnerships and cooperation among market participants.

6.3. Limitations and future research direction

This study employs a qualitative research approach based on four cases of carbon trading intermediaries and utilizes semi-structured interviews. While this methodology offers rich, detailed insights into the practices and strategies of these intermediaries, several limitations must be acknowledged. Firstly, the small sample size of four carbon trading intermediaries may limit the generalizability of the findings. The insights derived from these specific cases may not fully represent the broader spectrum of intermediaries operating in diverse contexts. **Future research should consider expanding the sample size to include a more extensive and varied range of intermediaries to enhance the robustness and generalizability of the results.** Secondly, the study's contextual specificity might restrict the applicability of its findings to different organizational cultures and regulatory environments. The cases examined are situated within specific developing countries, and the practices and strategies observed may not be directly transferable to other regions with different cultural, economic, or regulatory conditions. Future research could address this by conducting comparative studies across various geographical and regulatory contexts to better understand how different factors influence carbon trading practices. The use of semi-structured interviews also presents limitations in terms of the depth of exploration. While this method allows for flexibility and depth in understanding participants' perspectives, it might not capture the full extent of the complexities and dynamics within the carbon trading market. **Future studies could benefit from adopting a mixed-methods approach, combining qualitative**

interviews with quantitative data from surveys or performance metrics. This approach would provide a more comprehensive understanding of the practices and outcomes associated with carbon trading intermediaries.

To enhance the knowledge generated, future research could consider the following directions. Firstly, conducting larger-scale studies with diverse samples, including other stakeholders in the carbon trading market, such as investors, corporations, and standard setters, would improve the generalizability and richness of the findings. Engaging these multi-stakeholder perspectives can offer a more comprehensive view of the challenges and opportunities within the market. Additionally, a mixed-methods approach that integrates qualitative and quantitative data would provide a more holistic view of the intermediaries' impact and effectiveness. Quantitative data could include performance metrics, market trends, and survey responses, which would complement the qualitative insights obtained from interviews. Finally, exploring the multi-stakeholder perspectives in greater detail could yield valuable insights into the collaborative dynamics within the carbon trading market. Understanding the interactions and relationships between intermediaries, investors, corporations, and regulatory bodies would help identify key factors that drive successful collaboration and market stability.

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Appendix 1. Interview guide

1. Resource Acquisition & Allocation

1.1. What types of resources (financial, technological, human) are critical for your organization's operations in the carbon trading market?

1.2. How does your organization allocate resources to various projects and initiatives within the carbon trading market?

1.3 What strategies or technologies do you use to optimize resource allocation?

1.4 How do you ensure that resources are efficiently utilized to achieve your organization's goals?

2. Inter-Organizational Networking

2.1. Who are the key stakeholders your organization collaborates with in the carbon trading market?

2.2. How does your organization engage with these stakeholders to build trust and foster cooperation?

2.3. Can you describe any successful inter-organizational networking practices your organization has implemented?

2.4. How do these networking practices enhance market credibility and facilitate effective carbon trading?

3. Dependency Management

3.1. What are the main dependencies your organization faces in the carbon trading market (e.g., regulatory bodies, project developers, financial institutions)?

3.2. How does your organization manage these dependencies to ensure stability and sustainability?

3.3. What measures are in place to mitigate risks and maintain the reliability of your operations?

4. Strategic Alliances & Partnerships

4.1. What criteria does your organization use to form strategic alliances and partnerships in the carbon trading market?

4.2. Can you describe some key partnerships your organization has formed and their impact on your operations?

4.3. How does your organization leverage partnerships to enhance its capabilities and market reach?

4.4. Can you provide examples of how partnerships have facilitated knowledge transfer, technological innovation, or market expansion?

5. General and Innovation Practices

5.1. What innovative practices has your organization implemented to foster collaboration and enhance the carbon trading market?

5.2. What are the main challenges your organization faces in the carbon trading market?

5.3. How does your organization address these challenges?

5.4. How do you see the role of intermediaries evolving in the context of carbon trading, particularly in developing countries?