CRITICAL SUCCESS FACTORS FOR THE ADOPTION OF THE CARBON MARKET IN THE INDIAN DAIRY INDUSTRY

Satish Jangra[a,b], Anupama Panghal[a,*]
National Institute of Food Technology Entrepreneurship and Management (NIFTEM-K),
Kundli (Sonepat), Haryana, India

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ABSTRACT

Climate change mitigation requires a transition to low carbon food production systems and carbon markets provide a financial mechanism to support this transition. Despite global acceptance and potential, the Indian dairy sector has yet to integrate into the carbon markets. The study aimed to identify the critical success factors influencing the adoption of carbon trading among dairy producers in Haryana a leading state in India in terms of per capita milk production. The study drew its basis from the Technology Organisation Environment (TOE) and the Resource Based View (RBV) to identify six factors: Tangible Benefits, Technology, Cost, Government Policy and Regulations, Infrastructure, and Management's Inclination. Data were collected from 394 dairy producers using a structured questionnaire and analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The structural model was able to confirm that all five critical constructs significantly influence the management's intention in the adoption of carbon trading in the Indian dairy sector and the tangible benefits and technology had the strongest effect. The study's robustness was confirmed using parameters such as indicator reliability, composite reliability, average variance extracted and a check on common method bias. The research provides insights into the inclination of Indian dairy producers towards engagement in carbon trading and provides key enablers for an effective policy framework. The study contributed to the knowledge base on carbon trading in dairy production systems and provided valuable and actionable insights for policymakers, industry stakeholders, entrepreneurs and service providers to adopt a carbon trading driven transition to sustainable production systems.

Keywords*:* Carbon market, partial least squares (PLS-SEM), dairy industry, climate change, NetZero carbon

Introduction

The world is aiming to reduce carbon emissions to tackle the disastrous ill effects including global warming. The carbon market incentivises Greenhouse Gas (GHG) reduction by allowing the trading of carbon credits. The carbon trading operates primarily under two types: the compliance market (cap and trade) and the voluntary market. The compliance market aims to meet regulatory emission norms established by various governments to fulfil the commitments of the Kyoto Protocol and the Paris Agreement by nations. The voluntary market enables businesses and individuals to offset their emissions, allowing them to become carbon neutral or even carbon negative. The carbon credits, each equivalent to one metric ton of CO_2 equivalent reduced or removed, are generated through projects that reduce or remove emissions such as renewable energy, afforestation, reforestation, and carbon sequestration (locking carbon into the soil). The open market for carbon credits not only incentivizes emissions reduction by assigning it economic value but also pushes innovation and investment in sustainable practices across industries.

India is the third largest emitter globally and accounts for 7.8% of global GHG emissions. Of these emissions, 20.3% is Methane (Crippa *et al*., 2024). In South Asia, particularly India, the primary sectors responsible for methane emissions are livestock, paddy fields and solid waste (Samal *et al*., 2024). A major source of Methane emissions in India originates from livestock.

The Indian livestock sector considerably contributes to greenhouse gas emissions accounting for around 55% of the nation's overall agricultural emissions with enteric emissions from ruminants as the primary source (FAO, 2019). The dairy industry with approximately 300 million bovines produces substantial methane emissions, a potent greenhouse gas with 28-34 times the global warming potential of carbon dioxide (Samal *et al*., 2024). Furthermore, inadequate management of waste, pasture and feed exacerbates environmental degradation. In contrast to developed countries with extensive dairy systems, India's primarily smallholder driven production model poses both a challenge and an opportunity for emissions reduction.

India's pledge to decrease the emission intensity of its GDP by 45% by 2030 as part of its Nationally Determined Contributions (NDCs) facilitates sector specific carbon measures including those in the dairy sector. The government of India has laid down the layout for its national carbon credit trading scheme (compliance market) which may initially cover large industrial emitters such as power generation and power intensive industries but eventually it will expand to the agricultural and livestock sector to fulfil the NDCs. This provides entrepreneurs with the opportunity to venture into carbon credit trading in high emission sectors such as dairy.

Through the inclusion of various techniques in dairy farming such as nutrition/feed management, methane capture and manure management, the sector can reduce carbon emissions and thus move towards sustainability (FAO, 2019). Simultaneously, these reduced emissions can be traded in the form of carbon credits in global carbon markets. Aligning dairy production with the carbon market mechanism creates an additional income stream for dairy producers, reduces

[a]National Institute of Food Technology Entrepreneurship and Management (NIFTEM-K), Kundli (Sonepat), Haryana, India; [b]Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar, Haryana, India; *Corresponding authors, Email: anupamaniftem@gmail.com

environmental impact and aids in sustainable practices within dairy production. However, a thorough understanding of the driving factors is required for the successful integration of carbon markets into dairy production. This study tried to investigate such factors using the PLS-SEM approach.

To explore the key drivers of carbon market adoption in the Indian dairy industry, the study aimed to find answers to the following research questions:

RQ1: What factors influence the decision making of dairy producers in adopting carbon trading?

RQ2: How do the factors influence the decision of dairy producers to adopt carbon trading?

Critical Success Factors

Based on a review of existing literature and studies on sustainability adoption models, six critical success factors were identified for this research: Tangible Benefits, Technology, Cost, Government Policy and Regulations, Infrastructure and Management's indication. These factors have a significant impact on the adoption of carbon trading and work in integration with each other influencing the decision to adopt carbon trading.

The majority of previous studies were conducted on various factors including government regulatory push, pricing and pricing mechanisms as well as their interaction with carbon trading. Fewer studies have examined the management's inclination and its interaction with the other factors. Management attitude has a significant influence on the adoption of any technology or process. It is essential to note that various factors including tangible benefits, government policies and incentives, cost, technology, and infrastructure availability influence the management's inclination. This study tried to interrelate the factors and management's inclination towards the adoption of carbon trading.

1. Theoretical background and hypotheses development

This study examined the factors influencing the adoption of carbon market mechanism in the Indian dairy sector using the established theories that explain innovation and sustainability adoption in an organisational context. The Technology Organisation Environment (TOE) framework (Tornatzky *et al*., 1990) and the Resource Based View (RBV) of the firm (Barney, 1991) provided the basis for conceiving the interrelations between the key constructs.

1 .1 Theoretical framework

The Technology Organisation Environment (TOE) framework tries to explain the adoption of innovation through the three perspectives. The perspectives include technological context (perceived tangible benefits and technological readiness), organisational context (management's support or management's inclination and cost of implementation) and environmental context (government regulation, policy and infrastructure). These dimensions are relevant to the adoption of carbon trading in the Indian dairy industry where management's decision making is deeply influenced by government policy and support, the internal readiness of the firm and technological suitability. The TOE framework is complemented by the Resource Based View (RBV) theory which asserts that implementation of new practices is influenced by the internal resources and capabilities both tangible ones such as infrastructure and cost efficiency and intangible ones such as management's inclination. This study tried to blend the two theories, TOE and RBV, to build a theoretical framework to explain how the critical success factors such as tangible benefits, regulatory environment, cost, technology and infrastructure contribute to management's inclination to adopt carbon trading in the Indian dairy industry. The dual theory approach encompassed both external and internal factors to constitute the model that explains the adoption of carbon trading. Based on these theories, relevant factor based hypotheses were developed to direct this study.

The hypothesised model was tested in the unique context of Indian dairy where the majority of dairy producer units are small scale and thus, the decision making is carried out by the owner. The larger farms such as gaushalas or cooperative models also exist where decision making is entrusted to an elected president. The Management's inclination refers to the decision making intent of the dairy producer who can be the president or owner of the dairy unit, the elected leader of the cooperative organisation or the head of the corporation.

1.2 Hypotheses development

The TOE and RBV theories together provided the basis for a hypothesised model wherein the five critical success factors tangible benefits, technology, cost, government policy, regulations and infrastructure influence the management's intention to adopt the carbon train in the Indian dairy industry.

1.2.1 Tangible benefits

The acceptance of innovations such as carbon trading among communities and consumers is significantly influenced by the extent of perceived direct and indirect benefits of these innovations (Loh and Hassan, 2021). Perceived tangible benefits such as increased revenue stream, improved productivity and cost saving are key motivators for the adoption of carbon trading. Dairy producers are expected to adopt carbon trading programmes more vigorously when the returns are visible and monetisable. This aligns with the theory of planned behaviour suggesting that financial benefits have a significant influence on attitudes (Ajzen, 1991; Scheller *et al*., 2023). When the benefits outweigh the perceived barrier or costs, the impact is carried over to the perceived behaviour control. Accordingly, the following hypothesis was postulated:

H1: Measurable direct benefits have a positive and significant impact on management's inclination towards carbon trading adoption.

1.2.2 Technology

Technology is the key enabler for making carbon trading work in practice. A carbon accounting system, a tracking platform and an emissions dashboard are some of the tools that allow participation in carbon trading and facilitate compliance (Bhatia *et al*., 2024). Employing these technologies increases corporate value by optimising the supply chain, managing the digital footprint, measuring and monitoring carbon emissions and offsetting carbon credits. Digital technologies enable stakeholders to monitor their carbon footprints in real time allowing executives to integrate carbon management into a comprehensive corporate strategy (Bhatia *et al*., 2024).

Management showed reluctance to confront domains

characterised by insufficient technology. This reluctance stemmed from concerns about reputational risk and a lack of internal knowledge to address regulatory matters (Fernando *et al*., 2021). The capability to assess, monitor, report and forecast emission data using the digital tools validates the data within and outside the organisational hierarchy (Qamar *et al*., 2022; Zeng *et al*., 2022). Access to technology enhances the management's confidence in the adoption process and their commitment towards adoption. Following the literature, the hypothesis was postulated:

H2: Accessible technology facilitates management's inclination towards carbon trading adoption.

1.2.3 Cost

The new technology or process even a sustainable one comes with a cost of adoption. In undeveloped and underdeveloped countries and areas cleaner production is not a common or favoured practice among most producers because of the prohibitive costs and lack of investment in green technologies (Wang *et al*., 2023). The low cost of adoption and economic benefits from carbon trading reduce the perceived risk, therefore encouraging the businesses to commit to it (Schulte *et al*., 2021). The dairy producer can participate if the cost of adopting these technologies is covered either by government subsidies or absorbed by the participating companies. Subsidising operational expenses will incentivise businesses to participate in carbon emission reduction initiatives (Wang *et al*., 2023). Likewise, when the carbon trading firms are inclined to absorb the trading costs for the participants, the willingness of participants such as local communities increases to participate in carbon initiatives (Zhang and Feng, 2022; Zhao *et al*., 2018). The lower cost of adopting carbon trading plays a critical role in shaping managerial intentions for adoption. The hypothesis was formulated to empirically validate the hypothesised concept:

H3: The perceived lower adoption costs have a positive impact on management's inclination towards carbon trading adoption.

1.2.4 Government policy and regulations

Government Policy and Regulation play a pivotal role in moulding the management's inclination towards carbon trading. The government monitors, controls and promotes carbon trading through its regulatory framework to incorporate sustainability into enterprises. The government encourages investment in green systems by establishing emission limits. As the government's limit for emission reduction increases, investments in emission reduction will take priority (Wang *et al*., 2023). Many experts contend that environmental legislation can enhance firms' innovation in green technology. Prudent environmental regulation can augment firms' capacity for innovation by generating a compensatory effect (Hu *et al*., 2023). Market based regulations have resulted in improved corporate environment performance as businesses invest in adopting innovation to become compliant with regulatory requirements (Li *et al*., 2025).

Government policies in the form of environmental taxes and green subsidies are effective in promoting the appropriate behaviour among corporations (Li *et al*., 2022). Likewise, additional incentives are required to foster innovation in enterprise green technologies. The integration of environmental legislation with government subsidy schemes can successfully stimulate green technology innovation (Hu *et al*., 2023). Regulatory restrictions, environmental compliance, and policy measures such as economic and other incentives are mechanisms that the government uses to encourage corporations to invest in and adopt sustainable practices, as well as participate in the carbon market. In light of the above insights, the hypothesis was proposed:

H4: Supportive government policy and regulations positively influence the management's inclination towards the adoption of carbon trading.

1.2.5 Infrastructure

In the context of carbon trading, infrastructure in the form of a digital trading platform, a carbon credit registry, standard protocols, third party verification services, data communication networks, a data pool for emission baselines and sector wise carbon intensity, human resource training facilities and financing is critical to support and operate the carbon market.

Carbon trading begins with the operational core of a digital trading platform. It supports the exchange of credits, price identification and transparency. However, many emerging economies still lack access to digital trading platforms which undermines trust in the system and increases transactional costs (Tanveer *et al*., 2024). A block chain based system can enhance traceability, automate verification and remove intermediaries from the transactional chain thereby strengthening the carbon market operations (Abiodun *et al*., 2025). The central carbon credit registry tracks the issuance, ownership, transfer, and retirement of carbon credits and mitigates fraud and market inefficiencies. However, poor data communication networks and a lack of financing reduce the overall efficiency of the carbon markets (Woo *et al*., 2021). Verification fosters confidence in the system as seen in agricultural carbon trading where third party auditors are crucial in authenticating emission reduction assertions especially in decentralised frameworks (Khurana *et al*., 2024). The literature indicated that a well integrated infrastructure consisting of the trading platform, registry, standardised protocols, verification systems, third parties, financing and data networks is necessary for the implementation of the carbon trading. The availability of infrastructure significantly influences management's willingness to engage in the carbon market regardless of its necessity for carbon trading implementation. Accordingly, the hypothesis was formulated:

H5: Supporting infrastructure has a positive and significant impact on management's inclination towards adopting carbon trading.

1.2.6 Inclination of management

The business's decision to adopt a sustainable activity such as carbon trading is largely shaped by the inclination and interpretation of its management or decision makers (in the instant case, the dairy producer). The decision making on the adoption of carbon trading is dependent on the perceived benefits and priority assigned to it by the leadership. The activities undertaken in a firm are contingent upon the specific concerns and solutions that managers prioritise (Ocasio, 1997).

The stakeholders' vision and expression of prioritising sustainability efforts strongly impact management's inclination to implement carbon trading in the business. The perspectives and dispositions of stakeholders regarding environmental issues may influence the impact of CTS on a company's green technology innovation (Hu *et al*., 2023). As stakeholders envision carbon trading as a path to decarbonisation and sustainability, it lends credibility to the mechanism and reinforces management's conviction and commitment to its adoption.

Furthermore, regulatory compliance also makes a compelling case for management to consider and adopt carbon trading. The regulatory requirement for reducing emissions leads to the reallocation of resources for this purpose. This influences not only the financial burden, asset composition and potential decrease in emissions but also the company's readiness and management's inclination to address emission (Wang *et al*., 2023).

Materials and Methods

This study aimed to identify and evaluate the critical success factors influencing the adoption of the carbon market by dairy producers in India.

The objectives of the study may be stated as:

1. To identify critical success factors that are significant for the adoption of carbon trading in the Indian Dairy industry.
2. To develop a conceptual framework linking critical success factors to the dairy producers'/management's inclination towards the adoption of carbon trading.
3. To furnish actionable insights for policymakers, participants, businesses and other stakeholders in furthering sustainable adoption of carbon trading in the Indian dairy sector.

The current study employed a quantitative and cross sectional research design to investigate the critical success factors influencing the adoption of carbon trading in Indian dairy. The primary objective of the study was to analyse how the five independent critical success factors-Tangible benefits, technology, Cost, Government Policy and regulations infrastructure affect the Management's Inclination toward the adoption of the carbon market using the structural equation modelling. The proposed theoretical model of the study is represented in Figure 1.

A questionnaire was developed to aid in data collection from the respondents. The questionnaire used to collect data consisted of three sections. The first section included demographic information such as name, age, educational qualification, village, district, contact details, animals and land owned. The second section included screening questions about whether the farmers were aware of carbon trading, had experience with it or were engaged in any sustainable activities. The third section included the challenges faced in the adoption of carbon trading. It comprised 31 items assessed on a 5 point Likert scale with anchors from Strongly Disagree to Strongly Agree.

The study's sample was drawn through a combination of cluster and purposive sampling. The Veterinarians of the Department of Animal Husbandry, Government of Haryana provide last mile veterinary services to dairy producers. They act as a connecting link between the dairy producers and the government machinery. The Veterinarians of each district in the state of Haryana were approached and requested to meet with the progressive and innovative dairy producers within their jurisdiction. The dairy producers were then approached individually and in groups and made aware of the carbon trading. After that, they were interviewed using a questionnaire. The data was collected from 4-8 villages in each district.

Data was collected from a total of 556 respondents. However, on scrutiny, 394 responses were finally retained after eliminating the incomplete answers. The respondents included dairy producers viz. dairy farmers and senior management of gaushalas and organised dairy units.

The PLS-SEM approach was deployed to analyse the relationship between management's inclination and other critical success factors. The PLS-SEM is considered more suitable for handling smaller datasets and data with concerns

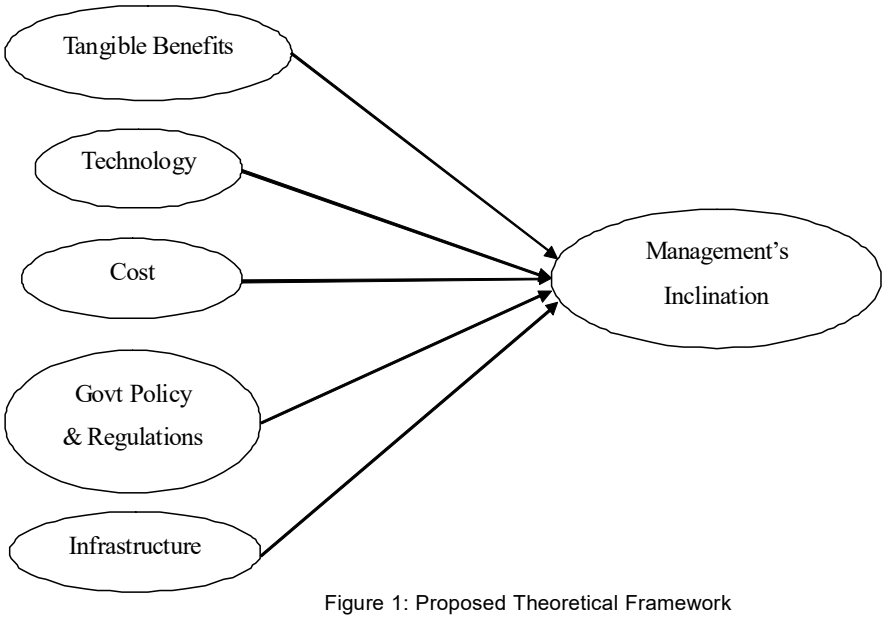

Figure 1: Proposed Theoretical Framework

related to distribution (Hair *et al*., 2018). Given the current data from 394 respondents with diverse educational and economic backgrounds the PLS-SEM is found to be more suitable. Furthermore, the PLS-SEM technique has greater predictive relevance (Sarstedt *et al*., 2016). The current study aimed to predict the effect of critical success factors on the adoption of carbon trading. Thus, PLS-SEM can also be helpful in making managerial decisions.

Results and Discussion

The current section presents insights into the findings derived from PLS-SEM analysis. The results include the respondents' profiles, measurements and structural model assessment providing insights into the relationship between critical success factors and management's inclination to adopt carbon trading.

Demographic profile of respondents

The demographic characteristics of 394 respondents offer a brief insight into the composition of the sample population. The majority (69.79%) of respondents were from the age group of 26-45 years with 97.97% being male and a quarter of respondents (24.11%) being graduates and postgraduates. Respondent population demographics are presented in Table 1.

1. Common method bias

Table 1: Demographic characteristics of the respondent population

Demographic Feature	Frequency	Percentage
Age (in years)		
upto 25	30	7.61%
26-35	124	31.47%
36-45	151	38.32%
46-55	67	17.01%
56-65	19	4.82%
66 & above	3	0.76%
Gender		
Female	8	2.03%
Male	386	97.97%
Education		
Matriculate	146	37.06%
Senior Secondary	153	38.83%
Graduate	84	21.32%
Post-graduate	11	2.79%

Torule out common method bias a full collinearity assessment was conducted. The inner Variance Inflation Factor (VIF) values were tested against a random exogenous variable. If the value for the given data set is above the threshold value of 3.3 for inner VIF, it is considered that CMB is nonexistent (Kock, 2015). In the instant case, the inner VIF for all the variables was found to be above 3.3.

2. Measurement model assessment

The measurement model assessment was conducted by measuring the reliability of the constructs, as well as their convergent and discriminant validity.

Construct reliability and convergent validity

All constructs demonstrated robust internal consistency with Cronbach's alpha values ranging from 0.831 to 0.918 and composite reliability values ranging from 0.899 to 0.933. Moreover, the Average Variance Extracted (AVE) values for all constructs surpassed the 0.50 criterion validating convergent validity (Table 2). Convergent validity denotes the degree to which multiple items measuring a construct are correlated with each other.

Table 2: Reliability and validity analysis

Factors	Items	Item Loadings	Cronbach's alpha	Composite reliability	Average Variance extracted
Tangible Benefits	TB1 TB2 TB3 TB4 TB5 TB6 TB7 TB8	0.783 0.783 0.779 0.848 0.778 0.827 0.762 0.819	0.918	0.933	0.636
Technology	T1 T2 T3 T4	0.834 0.885 0.842 0.824	0.868	0.910	0.717
Cost	C1 C2 C3 C4 C5 C6	0.866 0.798 0.774 0.722 0.841 0.879	0.900	0.922	0.664
Government Policy and Regulation	GP1 GP2 GP3 GP4 GP5 GP6	0.795 0.848 0.802 0.832 0.813 0.793	0.898	0.922	0.663
Infrastructure	I1 I2 I3	0.866 0.883 0.844	0.831	0.899	0.747
Management's Inclination	MI1 MI2 MI3 MI4	0.889 0.861 0.865 0.888	0.899	0.929	0.767

Discriminant validity

Discriminant validity was assessed via the FornellLarcker criterion and the Heterotrait Monotrait (HTMT) ratio. All constructions satisfied the FornellLarcker criterion since the square root of each construct's Average Variance Extracted (AVE) surpassed its innerconstruct correlations. Moreover, all HTMT values were below the 0.85 threshold thus reinforcing the discriminant validity (Table 3, 4).

Collinearity assessment

The Variance Inflation Factor (VIF) values for all indicators were below the conservative threshold of 3.3 signifying the lack of multicollinearity among the reflective factors.

3. Structural model assessment

The significance of path coefficients in the structural model was assessed using the 95% bias corrected and accelerated

Table 3: Discriminant validity (HTMT Criterion)

Variables	1	2	3	4	5	6	VIF
Tangible Benefits							1.512
Technology	0.587	0.814					1.617
Cost	0.323	0.234					1.110
Government Policy and regulation	0.250	0.359	0.070				1.171
Infrastructure	0.452	0.562	0.207	0.384			1.414
Management's Inclination	0.746	0.799	0.126	0.689	0.602		

Table 4: Discriminant validity (FornellLarcker Criterion)

	Tangible Benefits	Technology	Cost	Government Policy and Regulation	Infrastructure	Management's Inclination
Tangible Benefits	**0.798**					
Technology	0.526	**0.846**				
Cost	-0.303	-0.212	**0.815**			
Government Policy and regulation	0.234	0.319	-0.066	**0.814**		
Infrastructure	0.398	0.481	-0.179	0.332	**0.864**	
Management's Inclination	0.680	0.706	-0.123	0.545	0.597	**0.876**

Table 5: Determinants of Management's inclination for carbon trading adoption

Hypothesised Paths		Standardised beta coefficients	STDEV	Bootstrap t value	Bias corrected Confidence interval 5%, 95%
H1	Tangible Benefits→ Management's Inclination	0.392*	0.033	11.840	0.338, 0.446
H2	Technology→Management's Inclination	0.335*	0.032	10.624	0.284, 0.387
H3	Cost→ Management's Inclination	0.123*	0.0274	4.540	0.084, 0.168
H4	Government Policy and Regulation→ Management's Inclination	0.285*	0.028	10.174	0.238, 0.330
H5	Infrastructure → Management's Inclination	0.208*	0.031	6.747	0.155, 0.256

(BCa) bootstrap confidence intervals with 5000 resamples. The bootstrapping indicates that the direct impacts of all five factors on management's inclination are significant as evidenced by the absence of zero in the 95% BCa bootstrap confidence interval for the relationship between constructs (Table 5). Since the confidence interval does not contain the value of zero, the path coefficient is statistically significant.

The tangible benefits had the strongest influence on the management's inclination (β = 0.392). The Technology (β= 0.335) and Government policy and regulations(β= 0.285) also had a significant effect on management's inclination. Although cost hadthe lowest coefficient (β = 0.123), it remained statistically significant indicating that it influenced management's inclination.

Furthermore, the R^2 of the endogenous variables was 0.767 indicating that the independent variables accounted for 76.7% of the variance in management's inclination.

On closer examination, the standardised beta coefficients revealed that tangible benefits had a significant influence on Management's inclination to adopt carbon trading (β = 0.392, t-value = 11.840, p <0.05). It wasthus deduced that H1 wassupported. Moreover, as anticipated the technology positively influenced management's propensity for carbon trading (β = 0.335, t-value = 10.624, p<0.05).Therefore, H2 waslikewise endorsed.Moreover, the Cost substantially adversely affectedmanagement's inclination towards carbon trading (β = 0.123, t-value = 4.540, p <0.05) as hypothesised by H3.Therefore, H3 waslikewise endorsed.The H4 asserted that governmental policies and regulations affect the implementation of carbon trading which was further corroborated (β=0.285, t-value = 10.174, p<0.05).Consequently, the H4 waslikewise regarded as sustained.Similarly, infrastructure impactedthe adoption of carbon trading (β = 0.208, t-value = 6.747, p< 0.05) thereby reinforcing H5 (Figure 2).

This study analysed the factors influencing the management's inclination to adoptcarbon trading in the Indian dairy industry. Empirical findings from the SEM approach revealed that tangible benefits significantly affected management's inclination to adopt carbon trading and thus

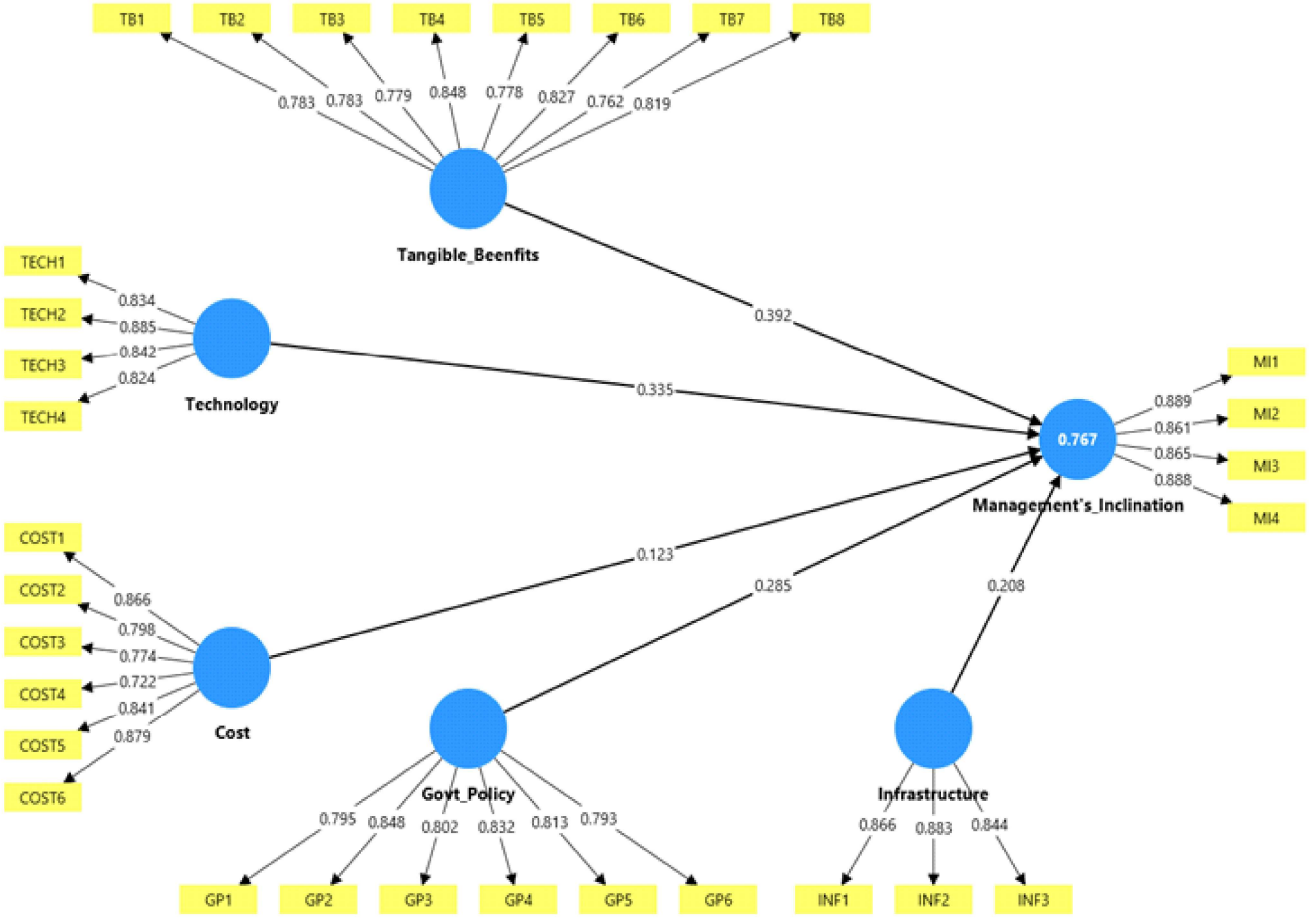

Figure 2: SEM Results (Item loadings and β values)

H1 was supported. The results suggested that the greater tangible benefits such as enhanced income and productivity improvements were correlated with a deeper inclination among management towards the adoption of carbon trading in the dairy industry. The studies corroborate with the existing studies conducted (Harrison *et al*., 2021; Lu and Qiao, 2024; Swallow and Barkemeyer, 2024).

The impact of technology on the management's inclination to embrace carbon trading was evident and substantial, hence upholding H2. The findings indicated that dairy producers were more inclined towards adopting carbon trading when the technology was accessible and easy to use. The study concurred with the preceding studies (Swallow and Barkemeyer, 2024; Wang *et al*., 2023).

The third hypothesis investigated whether the cost associated with adoption adversely affected the implementation of carbon trading. The standardised beta coefficients of the structural model indicated that H3 was supported suggesting that the associated cost influenced management's inclination to adopt carbon trading. The outcome demonstrated that the cost incurred in adopting a sustainable practice had a strong influence on the decision making process (Bansal *et al*., 2022). Like any new process, the cost incurred in switching is always considered a barrier to adoption.

Furthermore, government policy and regulations favourably affected management's inclination to adopt carbon trading as examined in H4. The SEM approach demonstrated that the government policy and regulation influence the management's inclination. The findings suggested that the government's role was powerful as management was keen to adhere to the policy and regulations established by the government. The results authenticate the findings of past studies.

Additionally, the infrastructure was considered crucial in the adoption process. The infrastructure instils confidence among the dairy producers and reduces the risks. Thus, the H5 was defended. This connection was evident as infrastructure reduces production costs, enhances participants' confidence and mitigates the risk of loss. Furthermore, it unites all the players on a common platform for mutual collaboration.

Notably, among the five relationships assessed, tangible benefits emerged as the most significant predictor of management's inclination to adopt carbon trading. It was succeeded by technology, government policy and regulation and infrastructure. Lastly, the cost of adoption influenced the management's inclination to adopt carbon trading. Although the influence of tangible benefits and technology was the most significant of all.

4. Implications

The study has multiple implications for various fields from academic to managerial and policy. These are discussed in

the following subsections.

4.1 Academic contribution

This study contributed to the academic literature and validated a comprehensive model that integrates the tangible benefits, technology, government policy, infrastructure and cost as the precursors to management's inclination in the decision making process for adoption of carbon trading. The high explanatory power (R^2 = 0767) illustrated the robustness of the suggested model, supporting and augmenting the existing theories.

This research established robust convergent and discriminant validity providing a reliable measure for future probes into managerial attitudes and strategic behaviour. It laid the groundwork for comparative studies across industries and geographies, facilitating cros scultural validation and longitudinal investigation.

4.2 Managerial usage

This study highlighted the critical role of tangible benefits in shaping managerial decisions. Decision makers were more inclined to endorse an initiative when the results such as increased income, enhanced productivity and reduced costs were categorically evident and verifiable. The insight encourages organisations to adopt fact backed strategies that can quantify the potential benefits offered by a new initiative or investment.

Moreover, the significance of technology and government policy indicated that managers prioritise the ease of adopting a new technology and wanted to be compliant with the regulatory environment. The government may prioritise the development of infrastructure and ensure that the development process aligns with the policy factors, such as incentives and standards.

4.3 Policy and regulatory implications

The impact of government policy and regulations on the managerial decision making process hints that policymakers play a vital role in shaping organisational preferences. Financial incentives such as tax holidays, subsidies or compliance relaxations can directly encourage businesses to implement the desired technology or practices. This also signals that an inconsistent and ambiguous policy environment may hinder the managerial support for change or innovation.

Therefore, the policy design process should be inclusive and incorporate input from all stakeholders. The policy environment should not be essentially an enforcement oriented one instead it should aim to create an enabling environment through financial incentives, transparent, and easy to access information. The policy should offer long term stability to ensure managerial commitments towards investment and compliance.

Conclusion

The analyses reported in papers lead to the conclusion that tangible benefits, technology, government policy and regulation were the primary drivers followed by the infrastructure and cost for the management's inclination towards carbon trading adoption through structural equation modelling (SEM). The model demonstrated good reliability, validity and explanatory power offering both theoretical and practical insights. The study offers indispensable academic and practical implications for the adoption of carbon trading in the Indian dairy industry. The adoption was primarily influenced by the decision makers or the management's inclination towards carbon trading. The higher the perceived benefits and ease of adoption for management the greater the chances of adoption of carbon trading. Overall, in view of the thin profit margin for the dairy sector, primarily due to the small size of operations and the lower level of mechanisation and the humongous potential for the generation of carbon credits, the Indian dairy sector is at a point where the adoption of carbon trading may promote both profitability and sustainability. The carbon trading promises to help the government fulfil its targets of sustainable development goals viz. poverty alleviation and sustainable production. The state of Haryana possesses the second highest per capita milk productivity and ranks among the states with the highest per capita GDP. The state's dairy producers are among the nation's progressive agriculturalists. Consequently, the state possesses all the necessary components to spearhead the implementation of carbon trading. A more extensive study utilising data from all principal milk producing states can facilitate the development of a more effective approach for encouraging carbon trading adoption among dairy enterprises. The regulations regarding carbon trading are still evolving in India specifically and globally and are influenced by numerous political events that alter global perspectives. The study also lacked focus on the inclusion of digital technologies in promoting carbon trading among the farmers. The proliferation and adoption of ICT tools among farmers alongside the influence of digital technologies like blockchain, IoT and big data in facilitating carbon trading, necessitate research in this domain.

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Conflict of interest

The authors declare that they have no competing interests.

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