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Green Logistics Performance: The Role of Digital Human Capital and Sustainable Supply Chain Practices in Emerging Agri-Food Hubs
Evidence from Morocco's Souss-Massa Region

Hassan BATRICH
(Professor–researcher) Laboratoire d'études et recherches en économie et management appliqué (LEREMA) Faculty of Legal, Economic and Social Sciences, Agadir, Morocco.

Mohamed EL BIACHE*
(PHD Student) Laboratoire d'études et recherches en économie et management appliqué (LEREMA) Faculty of Legal, Economic and Social Sciences, Agadir, Morocco,

Abstract: *Green logistics performance (GLP) is increasingly critical in emerging agri-food economies facing dual pressures of export competitiveness and environmental sustainability. Despite growing policy emphasis on sustainable supply chains in North Africa, empirical evidence linking digital human capital (DHC), sustainable supply chain practices (SSCP), green organizational culture (GOC), and carbon footprint management capabilities (CFMC) to GLP in agri-food logistics SMEs remains sparse. This study addresses this gap through a cross-sectional survey of 120 agri-food logistics firms in Morocco's Souss-Massa region the country's largest agri-food export hub administered during March–April 2026. Data were analysed through Pearson correlation and multiple ordinary least squares (OLS) regression via SPSS 26. Reliability was confirmed by Cronbach's alpha (α = 0.801–0.851 across constructs). Multiple regression ($R^2 = 0.600$, $F(4,115) = 43.08$, $p < 0.001$) confirms three of four hypotheses: DHC ($\beta = 0.185$, $p < 0.01$), GOC ($\beta = 0.406$, $p < 0.001$), and CFMC ($\beta = 0.185$, $p < 0.01$) significantly predict GLP, with GOC emerging as the dominant predictor. SSCP shows significant bivariate correlation with GLP ($r = 0.541$, $p < 0.001$) but loses significance in the full model, suggesting its effect is channelled through green organizational culture, a mediation effect warranting future exploration. Findings contribute novel evidence to the nexus of green logistics, digital human capital, and sustainable supply chain management, with direct implications aligned with SDG 8 (decent work and economic growth), SDG 12 (responsible consumption and production), and SDG 13 (climate action).*

Keywords: green logistics performance; digital human capital; sustainable supply chain; green organizational culture; carbon footprint management; agri-food logistics; emerging economies; Morocco; SDG 12; SDG 13

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1. Introduction

The logistics sector accounts for approximately 5.5% of global greenhouse gas emissions, with road freight alone responsible for 35% of transport-related CO_2 output [1]. In the context of emerging economies, this environmental footprint is compounded by rapid commercialisation growth, insufficient regulatory enforcement, and limited access to green technologies [2]. Against this backdrop, green logistics performance (GLP) defined as the capacity of logistics systems to simultaneously achieve environmental efficiency and operational competitiveness has attracted increasing scholarly attention [3,4]. Yet empirical evidence on its determinants in Southern Mediterranean agri-food contexts remains scattered and methodologically fragmented [5].

Morocco's Souss-Massa region presents a particularly compelling empirical setting. As Morocco's largest agri-food export hub, the region annually exports over 800,000 tonnes of fresh produce primarily tomatoes, peppers, strawberries, and citrus fruits, to European markets, generating export revenues exceeding EUR 1.5 billion [6]. The logistics SMEs underpinning this trade face a double imperative: they must comply with increasingly stringent EU environmental standards embedded in export certifications (GlobalGAP, BRC Food), while competing on cost and lead time against established European logistics operators [7]. The January 2023 implementation of the EU Carbon Border Adjustment Mechanism (CBAM) adds a further layer of urgency: Moroccan agri-food exporters that cannot document their carbon footprint management capabilities risk losing preferential market access [8].

Three research gaps motivate this study. First, while digital human capital (DHC) has been linked to firm performance in manufacturing [9] and e-commerce [10] contexts, its specific contribution to GLP in agri-food logistics SMEs of emerging economies remains unexamined. Second, sustainable supply chain practices (SSCP) have been extensively studied in developed-country contexts [11,12], but evidence from North African agri-food hubs where institutional pressures, resource constraints, and skill endowments differ significantly is lacking. Third, the role of green organizational culture (GOC) as a potential channel through which SSCP translates into GLP has not been empirically tested in this context.

This study addresses these gaps through a cross-sectional survey of 120 agri-food logistics SMEs in Morocco's Souss-Massa region. Building on the Dynamic Capabilities Theory [13], the Natural Resource-Based View [14], and the TOE framework [15], we formulate and test four hypotheses. Our findings reveal that GOC is the dominant predictor of GLP ($\beta = 0.406$, $p < 0.001$), while SSCP though significantly correlated with GLP at the bivariate level ($r = 0.541$, $p < 0.001$) loses significance in the full model, suggesting a mediation pathway through GOC that is novel to the literature. These results carry significant implications for sustainability managers, policymakers designing Morocco's National Logistics Plan 2030, and scholars studying the SDG-logistics interface in emerging economies.

2. Literature Review and Hypothesis Development

2.1. Green Logistics Performance (GLP): Concept and Measurement

Green logistics performance encompasses both environmental and operational dimensions of logistics activity. Srivastava [16] defines green supply chain management as "integrating environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life." Within this broader construct, GLP specifically captures the operational output of green logistics investments: carbon emission reduction, energy efficiency in transport and warehousing, waste minimisation in packaging, and reverse logistics effectiveness [17,18].

In agri-food supply chains, GLP carries additional dimensions tied to cold chain integrity, post-harvest waste reduction, and compliance with phytosanitary and food safety digital traceability systems [19]. The Moroccan regulatory context adds specificity: logistics SMEs operating in the Souss-Massa region must comply with ONSSA traceability requirements, GlobalGAP certification standards, and increasingly with the digital documentation demands of EU importers operating under the Farm-to-Fork Strategy [20]. GLP in this context is therefore not merely an environmental ideal but a competitive necessity.

2.2. Digital Human Capital (DHC) and GLP

Digital human capital refers to the stock of skills, knowledge, and competencies that enable individuals to effectively deploy digital technologies for value creation in organisational contexts [21]. Grounded in Becker's [22] human capital theory, DHC distinguishes between general digital skills (technical tool mastery) and specific analytical capabilities (data interpretation and process reconfiguration in uncertain conditions) a distinction that has been operationalised in supply chain contexts by Derwik and Hellström [23], who found analytical competencies to be stronger predictors of supply chain performance than operational tool mastery.

The application of DHC to green logistics is theoretically grounded in the Dynamic Capabilities Theory [13]: digital competencies enable the sensing of environmental performance signals, the seizing of green optimisation opportunities, and the reconfiguring of logistics processes for improved sustainability outcomes. Empirically, Abbas et al. [24] demonstrated a positive link between digital skills and supply chain sustainability in Pakistani manufacturing SMEs. Khan et al. [25] confirmed that digital human capital mediates the relationship between Industry 4.0 adoption and firm-level environmental performance. We therefore hypothesise:

Hypothesis 1 (H1): Digital human capital has a positive and significant effect on green logistics performance in agri-food logistics SMEs.

2.3. Sustainable Supply Chain Practices (SSCP) and GLP

Sustainable supply chain practices refer to the strategic integration of environmental and social criteria throughout procurement, production, distribution, and reverse logistics processes [11]. The literature consistently identifies green procurement, eco-design, green transportation, and sustainable supplier development as core SSCP dimensions [26,27]. In agri-food contexts, SSCP additionally encompasses cold chain optimisation to reduce energy waste, sustainable packaging adoption (reduced single-use plastics, recyclable materials), and collaboration with certified green transporters [19].

The relationship between SSCP and GLP is theoretically grounded in the Natural Resource-Based View (NRBV) of Stuart and Frooman [14]: firms with more advanced environmental strategies develop pollution prevention, product stewardship, and sustainable development capabilities that translate into competitive advantage. Zailani et al. [28] confirmed positive SSCP–GLP relationships in Malaysian manufacturing, while Asgari et al. [29] found consistent effects across a meta-analysis of 87 empirical studies. We hypothesise:

Hypothesis 2 (H2): Sustainable supply chain practices have a positive and significant effect on green logistics performance in agri-food logistics SMEs.

2.4. Green Organizational Culture (GOC) and GLP

Green organisational culture refers to the set of shared values, beliefs, norms, and behavioural expectations within an organisation that prioritise environmental responsibility, sustainable innovation, and ecological mindfulness [30]. It operationalises Schein's [31] cultural framework in the environmental domain: top management environmental commitment, shared ecological values among employees, green knowledge-sharing practices, and tolerance for sustainability-oriented experimentation all constitute GOC dimensions [32].

Theoretical grounding comes from both the Dynamic Capabilities perspective GOC enables organisational sensing of environmental risks and reconfiguring of green capabilities [13] and from Senge's [33] learning organisation theory, which establishes that cultures of collective environmental learning accelerate green performance improvement. Empirically, Chang [34] found GOC to be the strongest predictor of green innovation performance in Taiwanese electronics firms. Lam et al. [35] confirmed GOC's dominant role in predicting environmental supply chain performance across 218 Chinese manufacturers. Based on these foundations, we hypothesise:

Hypothesis 3 (H3): Green organisational culture has a positive and significant effect on green logistics performance in agri-food logistics SMEs.

2.5. Carbon Footprint Management Capabilities (CFMC) and GLP

Carbon footprint management capabilities refer to an organisation's capacity to measure, reduce, offset, and report its carbon emissions encompassing emissions measurement systems, carbon accounting practices, decarbonisation planning, and stakeholder communication of carbon performance [36]. In the logistics sector, CFMC specifically includes fleet electrification planning, route optimisation for emission reduction, warehouse energy management, and cold chain CO_2 monitoring [37].

CFMC is theoretically anchored in the NRBV [14] as a pollution prevention capability that both reduces environmental impact and lowers operating costs through energy efficiency gains. In the Moroccan context, the National Energy Efficiency Programme (PROSOL Industrie) provides financial incentives for energy-efficient logistics investment, creating an institutional environment supportive of CFMC development. The EU's CBAM which will progressively require Moroccan exporters to document their carbon credentials further amplifies CFMC's strategic relevance [8]. We therefore hypothesise:

Hypothesis 4 (H4): Carbon footprint management capabilities have a positive and significant effect on green logistics performance in agri-food logistics SMEs.

3. Materials and Methods

3.1. Study Context and Research Design

The study focuses on Morocco's Souss-Massa region (25°55′N–31°08′N, 7°42′W–12°18′W), which concentrates over 40% of Morocco's fresh produce exports. The region hosts approximately 847 logistics SMEs (10–200 employees) specialising in refrigerated transport, export conditioning, cold storage, and customs logistics [38]. This context is particularly relevant for green logistics research because these firms operate under simultaneously high environmental exposure (energy-intensive cold chain operations), strong institutional pressure (EU certification requirements), and limited green resources (SME budget constraints) precisely the conditions under which the determinants of GLP are most theoretically interesting.

We adopted a positivist epistemological positioning and a cross-sectional quantitative research design. This approach aligns with the study's confirmatory objectives and is consistent with established methodologies in green supply chain performance research [11,28]. The unit of analysis is the agri-food logistics SME; respondents are logistics directors, supply chain managers, or HR/training managers in positions of informed knowledge about the firm's logistics and sustainability practices.

3.2. Sampling and Data Collection

A stratified random sampling procedure was applied using the CCIS Agadir (2023) register of logistics firms as the sampling frame. Stratification was performed across four sub-sectors: refrigerated transport (30%), export conditioning (25%), cold storage (25%), and customs logistics (20%). The target sample of $n = 120$ was determined based on the requirements for multiple regression with four predictors at power = 0.80 ($\alpha = 0.05$, medium effect size $f^2 = 0.15$) per Cohen's [39] guidelines, yielding a minimum required n of 103. A sample of $n = 120$ thus exceeds the minimum threshold and ensures adequate statistical power.

Data were collected through a self-administered structured questionnaire distributed in-person at respondent firms between March and April 2026. A total of 152 questionnaires were distributed; 127 were returned (83.6% response rate); 120 were retained after exclusion of 7 incomplete responses (usable response rate: 78.9%). Non-response bias was assessed by comparing early and late respondents on all key variables; no significant differences were identified ($p > 0.05$), following the approach of Armstrong and Overton [40].

3.3. Measurement Instrument

All constructs were measured using multi-item reflective scales on a five-point Likert scale (1 = Strongly Disagree; 5 = Strongly Agree). Scales were adapted from validated instruments in the existing literature and modified for the agri-food logistics context following expert review by two academic specialists and two logistics practitioners. Table 1 presents the construct sources and reliability statistics.

Table 1. Construct definitions, item counts, sources, and reliability statistics.

Construct	Abbrev.	Items	Source(s)	Cronbach's α
Digital Human Capital	DHC	6	[21,23,25]	0.832
Sustainable Supply Chain Practices	SSCP	7	[11,26,28]	0.851
Green Organisational Culture	GOC	5	[30,32,34]	0.847
Carbon Footprint Management Capabilities	CFMC	5	[36,37]	0.801
Green Logistics Performance	GLP	6	[3,4,17]	0.839

All Cronbach's α values exceed the threshold of 0.70 recommended by Hair et al. [41], confirming adequate internal consistency.

3.4. Validity Assessment

Convergent validity was assessed through average variance extracted (AVE). AVE values ranged from 0.512 to 0.571 across constructs, exceeding the 0.50 threshold recommended by Fornell and Larcker [42]. Discriminant validity was confirmed by the Fornell–Larcker criterion: the square root of each construct's AVE exceeds its correlations with all other constructs. Common method bias was assessed using Harman's single-factor test [43]: the first unrotated factor explained 31.2% of total variance (below the 50% threshold), indicating no critical common method bias.

3.5. Statistical Analysis

Data were analysed through Pearson bivariate correlation and multiple OLS regression using SPSS 26 (IBM Corp., Armonk, NY, USA). Regression assumptions were verified: residuals were normally distributed (Shapiro–Wilk test, $p > 0.05$), homoscedasticity was confirmed via Breusch–Pagan test ($p > 0.05$), and multicollinearity was assessed through variance inflation factors (VIF < 2.0 for all predictors see Table 3). The Durbin–Watson statistic (1.94) confirmed the absence of autocorrelation. Standardised beta coefficients (β_std) are reported to enable comparisons of relative predictor strength.

4. Results

4.1. Sample Profile

Table 2 presents the sample demographic and organisational profile. The sample is dominated by firms in the 50–99 employee range (34.2%), consistent with the mid-size structure of the Souss-Massa logistics sector. Refrigerated transport (31.7%) and export conditioning (28.3%) are the most represented sub-sectors. Respondents are predominantly male (74.2%), with 71.7% holding a Bachelor's or Master's degree, and an average tenure in the logistics sector of 7.4 years.

Table 2. Sample profile (n = 120).

Characteristic	Category	n	%
Firm size (employees)	10–49	41	34.2
	50–99	41	34.2
	100–149	27	22.5
	150–200	11	9.2
Sub-sector	Refrigerated transport	38	31.7
	Export conditioning	34	28.3
	Cold storage	28	23.3
	Customs logistics	20	16.7
Respondent education	Baccalaureate or BTS	34	28.3
	Bachelor	46	38.3
	Master	40	33.3
Respondent gender	Male	89	74.2
	Female	31	25.8
Logistics experience	< 5 years	36	30.0
	5–10 years	52	43.3
	> 10 years	32	26.7

Source: Survey data, March–April 2026.

4.2. Descriptive Statistics and Correlation Analysis

Table 3 presents descriptive statistics and Pearson correlations for all study constructs. All construct means are above 3.0, indicating moderate to moderately high levels of DHC (M = 3.450), SSCP (M = 3.242), GOC (M = 3.117), CFMC (M = 2.983), and GLP (M = 3.375). Notably, CFMC has the lowest mean (M = 2.983), suggesting that carbon footprint management capabilities represent the least developed dimension among the sampled firms consistent with the nascent state of carbon management in Moroccan agri-food SMEs. All correlations among predictors are moderate ($r = 0.342–0.557$, all $p < 0.001$), confirming the absence of multicollinearity.

Table 3. Descriptive statistics and Pearson correlation matrix (n = 120).

Variable	Mean	SD	1	2	3	4	5
DHC	3.450	0.939					
SSCP	3.242	1.000	0.515 ***				
GOC	3.117	0.993	0.418 ***	0.542 ***			
CFMC	2.983	0.983	0.342 ***	0.377 ***	0.557 ***		
GLP	3.375	0.895	0.513 ***	0.541 ***	0.710 ***	0.566 ***	

**** p < 0.001. DHC = Digital Human Capital; SSCP = Sustainable Supply Chain Practices; GOC = Green Organisational Culture; CFMC = Carbon Footprint Management Capabilities; GLP = Green Logistics Performance. All diagonal entries represent within-construct correlations ( ).*

4.3. Multiple Regression: Hypothesis Testing

Table 4 presents the OLS multiple regression results. The full model explains 60.0% of GLP variance ($R^2 = 0.600$, $R^2\_adj = 0.586$, $F(4,115) = 43.08$, $p < 0.001$), indicating satisfactory explanatory power. VIF values range from 1.431 to 1.809, confirming no problematic multicollinearity. The Durbin–Watson statistic (1.94) indicates no serial autocorrelation.

Table 4. Multiple OLS regression results Dependent variable: GLP (n = 120).

Predictor	B	SE	β_std	t	p	VIF	Decision
Intercept	0.570	0.235		2.43	0.0166		
DHC	0.185	0.067	0.194	2.74	0.0071	1.431	H1 Supported **
SSCP	0.108	0.068	0.121	1.59	0.1152	1.657	H2 Not Supported
GOC	0.406	0.072	0.451	5.68	0.0000	1.809	H3 Supported ***
CFMC	0.185	0.065	0.203	2.83	0.0056	1.486	H4 Supported **

*$R^2 = 0.600$, $R^2\_adj = 0.586$, $F(4,115) = 43.08$, $p < 0.001$, Durbin–Watson = 1.94. *** $p < 0.001$; ** $p < 0.01$; ns = not significant. B = unstandardised coefficient; SE = standard error; β_std = standardised coefficient; VIF = variance inflation factor.*

H1 is supported: DHC positively and significantly predicts GLP (B = 0.185, β_std = 0.194, p = 0.0071). This result is consistent with Abbas et al. [24] and Khan et al. [25], confirming that digital competencies in agri-food logistics including data analytics, WMS mastery, and digital traceability capabilities translate into measurable green performance gains.

H2 is not supported: SSCP does not significantly predict GLP in the full model (B = 0.108, β_std = 0.121, p = 0.1152). Notably, however, SSCP shows a strong and highly significant bivariate correlation with GLP (r = 0.541, p < 0.001) and its correlation with GOC (r = 0.542, p < 0.001) is among the highest in the correlation matrix. This pattern strongly suggests that SSCP's effect on GLP is channelled through green organisational culture an indirect effect that the current bivariate regression cannot isolate but that warrants formal mediation testing in future research.

H3 is strongly supported: GOC is the dominant predictor of GLP (B = 0.406, β_std = 0.451, p < 0.001). This finding represents the most important empirical result of the study: in agri-food logistics SMEs of the Souss-Massa region, the internal green cultural environment not the formal adoption of sustainable practices or digital tools is the primary driver of green logistics performance. This is consistent with Chang [34] and Lam et al. [35] in different industrial contexts.

H4 is supported: CFMC positively and significantly predicts GLP (B = 0.185, β_std = 0.203, p = 0.0056). Despite CFMC having the lowest mean (M = 2.983), its regression coefficient confirms that carbon management capabilities, where developed, generate significant green performance gains. This is particularly noteworthy given the nascent state of carbon management in Moroccan SMEs and the increasing EU pressure for carbon documentation under CBAM [8].

Table 5. Summary of hypothesis testing results.

Hypothesis	Bivariate r (p)	β_std	t-stat (p)	Decision
H1: DHC → GLP	0.513 (p < 0.001)	0.194	2.74 (p = 0.0071)	✓ Supported
H2: SSCP → GLP	0.541 (p < 0.001)	0.121	1.59 (p = 0.1152)	✗ Not Supported (MR)
H3: GOC → GLP	0.710 (p < 0.001)	0.451	5.68 (p < 0.001)	✓✓ Supported ***
H4: CFMC → GLP	0.566 (p < 0.001)	0.203	2.83 (p = 0.0056)	✓ Supported

*MR = Multiple Regression. H2 is not supported in the full model despite significant bivariate correlation, suggesting mediation through GOC. *** = dominant predictor (β_std = 0.451).*

5. Discussion

5.1. Theoretical Contributions

This study makes three theoretical contributions to the green logistics and sustainable supply chain literature. First, it provides the first large-sample empirical evidence of the DHC–GLP relationship in an agri-food logistics SME context in a Southern Mediterranean emerging economy. By grounding DHC in Becker's [22] human capital theory and Teece's [13] dynamic capabilities framework, we demonstrate that digital analytical competencies are not merely operational enablers but genuine dynamic capabilities that generate measurable green performance outcomes.

Second, the finding that GOC emerges as the dominant predictor of GLP (β_std = 0.451) enriches the NRBV [14] with a cultural mechanism: green organisational culture acts as an amplifying context within which both DHC and CFMC generate stronger GLP returns. This suggests a theoretical extension of the NRBV's capability-based logic environmental capabilities generate performance gains not as independent resources but as culturally embedded capacities whose expression depends on organisational context.

Third, the SSCP finding contributes a novel nuance to the supply chain sustainability literature. The contrast between SSCP's strong bivariate correlation with GLP ($r = 0.541$, $p < 0.001$) and its non-significance in the full model ($p = 0.115$) indicates that SSCP's contribution to GLP is not direct but operates through green organisational culture. This mediation pattern consistent with the theoretical primacy of culture in organisational capability development [31] suggests that firms adopting green practices without building an underlying cultural foundation are unlikely to realise their full green performance potential. This finding partially challenges the practice-centric focus of much green SCM research [11,26,27] by showing that cultural foundations are not merely facilitators but may be causal mechanisms.

5.2. Sustainability Implications and SDG Alignment

The study's findings carry direct implications for sustainable development in the Moroccan agri-food sector, aligning with three UN Sustainable Development Goals:

SDG 8 (Decent Work and Economic Growth): The DHC–GLP relationship (H1 supported) demonstrates that investment in digital skills training for logistics workers produces measurable performance improvements. This provides empirical grounding for Morocco's Plan Logistique National 2030, which should integrate digital competency development particularly green logistics analytics into its OFPPT curriculum reform agenda.

SDG 12 (Responsible Consumption and Production): The finding that SSCP operates through GOC rather than directly (H2 not supported) implies that regulatory mandates for SSCP adoption are insufficient without parallel cultural change interventions. Moroccan institutions (AMDL, EACCE) should complement their certification incentive programmes (GlobalGAP, BRC) with organisational culture development support specifically, green knowledge-sharing platforms and leadership training for SME owners.

SDG 13 (Climate Action): The CFMC–GLP relationship (H4 supported, β_std = 0.203) confirms that carbon management capabilities, where developed, deliver significant green performance gains even in emerging economy SMEs with limited resources. Given the approaching mandatory carbon documentation under EU CBAM [8], Moroccan agri-food exporters who invest in CFMC now will not only comply with future requirements but will gain a measurable competitive advantage in European markets an outcome aligned with the Paris Agreement targets to which Morocco has committed.

5.3. Managerial Implications

For logistics SME managers in emerging agri-food hubs, three actionable recommendations emerge from this study. First, investment in green analytical skills development not merely WMS/TMS operational training yields measurable GLP returns (H1). Managers should move beyond tool-adoption towards competency development in green logistics data analytics: energy consumption monitoring, cold chain temperature optimisation, and carbon emission tracking.

Second, the dominant role of GOC (H3, $\beta\_std = 0.451$) implies that sustainability managers should prioritise building green cultural foundations before deploying formal SSCP programmes. Cultural interventions leadership environmental commitment signalling, green knowledge-sharing rituals, sustainability-oriented performance management are prerequisites for formal practices to generate performance returns.

Third, the nascent state of CFMC (M = 2.983, the lowest mean of all constructs) represents both a vulnerability under EU CBAM pressure and an opportunity. Early CFMC adopters in Souss-Massa's logistics sector will be better positioned to retain European export market access and may build first-mover advantages in an increasingly carbon-sensitive trade environment.

5.4. Limitations and Future Research

This study has several limitations that open future research directions. First, the cross-sectional design precludes causal inference; longitudinal panel data tracking GOC and CFMC investments over 24–36 months would allow stronger causal claims about their effects on GLP. Second, the geographic restriction to Souss-Massa limits generalisability; comparative studies across Morocco's Casablanca-Settat, Tanger-Tétouan-Al Hoceima, and Marrakech-Safi regions would test the contextual robustness of our findings. Third, the mediation of SSCP through GOC should be formally tested using structural equation modelling (SEM) with a larger sample ($n \geq 200$) to produce reliable path coefficients. Fourth, additional boundary conditions firm size, export market concentration, EU certification status should be tested as moderators of the GOC–GLP relationship.

6. Conclusions

This study investigated the determinants of green logistics performance in 120 agri-food logistics SMEs in Morocco's Souss-Massa region. Multiple OLS regression ($R^2 = 0.600$, $F(4,115) = 43.08$, $p < 0.001$) confirmed three of four hypotheses: digital human capital ($\beta\_std = 0.194$, $p < 0.01$), green organisational culture ($\beta\_std = 0.451$, $p < 0.001$) the dominant predictor and carbon footprint management capabilities ($\beta\_std = 0.203$, $p < 0.01$) all positively predict GLP. Sustainable supply chain practices, while strongly correlated with GLP at the bivariate level ($r = 0.541$, $p < 0.001$), lose significance in the full model, suggesting a mediation pathway through green organisational culture that represents the study's most novel contribution.

These findings carry direct policy implications for Morocco's sustainable logistics transition, aligned with SDG 8, SDG 12, and SDG 13. They confirm that green logistics performance in emerging agri-food hubs is not primarily a question of formal practice adoption but of cultural and capabilities development a conclusion that should fundamentally reorient both institutional support programmes and firm-level sustainability strategies in the Souss-Massa region and comparable emerging economy contexts.

Abbreviations:

APC: Article Processing Charge
AVE: Average Variance Extracted
CBAM: Carbon Border Adjustment Mechanism
CFMC: Carbon Footprint Management Capabilities
DHC: Digital Human Capital
GLP: Green Logistics Performance
GOC: Green Organisational Culture
NRBV: Natural Resource-Based View
OLS: Ordinary Least Squares
SDG: Sustainable Development Goal
SME: Small and Medium-Sized Enterprise
SSCP: Sustainable Supply Chain Practices
TOE: Technology-Organisation-Environment (framework)
VIF: Variance Inflation Factor

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