

INNOVATIVE DIGITAL MARKETING STRATEGIES TO ENHANCE THE
COMPETITIVENESS AND INVESTMENT ATTRACTIVENESS OF SMALL AND
MEDIUM GRAPE-GROWING ENTERPRISES

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Abstract. Digital marketing plays a transformative role in supporting the transition of small and medium grape-growing enterprises toward competitive and sustainable practices within the context of the green economy. The main objective of this study is to identify key operational variables and digital marketing interventions that may enhance investment attractiveness in grape export systems. Therefore, the research focuses on evaluating eco-digital marketing initiatives through a comprehensive analysis of statistical relationships in order to assess their predictive power across different regional contexts. Regression models one of the core tools of economic evaluation were applied to simulate the relationship between eco-performance indicators and fluctuations in export outcomes. In addition, correlation analysis was used to forecast trends in export volumes based on two strategies: adaptation of digital promotion and improvement of supply-chain visibility. The findings demonstrate that both strategies adequately simulate the relationship between digital marketing inputs and export results, with all simulation accuracies exceeding 0.75. Based on these results, an eco-digital strategic model is proposed, the key components of which include: (1) targeted environmental-certification companies, (2) artificial-intelligence-based market-research tools, and (3) interactive customer-communication platforms, combined with clearly defined sustainability-reporting objectives. Furthermore, policy recommendations for introducing digital transition models in grape-producing regions are identified. The main conclusions emphasize the importance of early engagement of local producers, ensuring regulatory compliance, and continuously testing marketing mechanisms.

Keywords: Eco-digital marketing, grape export performance, small and medium enterprises, regression modelling, correlation analysis, artificial-intelligence-based market analytics, green competitiveness.

1.Introduction

Maria et al. (2024) reviewed leading definitions of digital marketing and identified its most common application dimensions, including customer-centricity; promotion of products through social networks, search-engine optimization, and influencer-based strategies; as well as efforts aimed at involving and retaining customers throughout advertising and operational processes.

According to Ijomah et al. (2024), digital marketing is an interdisciplinary concept that emerges from various schools of thought such as innovation-driven marketing, behavioral economics, technology-based branding, sustainability marketing, competitiveness of small and medium enterprises, and adaptation to electronic commerce. Digital marketing represents a group of data-driven transformational concepts built on platforms such as strategic brand-positioning tools, customer analytics, digital storytelling, and sustainability-oriented communication.

Small and medium enterprises typically operate as systems in which various resources enter (for example, marketing capital), some resources exit the system (such as customer attention), and others remain inside for a certain period of time (such as brand loyalty). However, these enterprises may face constraints in terms of financial capacity and digital literacy and may not always view eco-digital transformation as a priority, largely because they are not fully aware of the competitive advantages provided by such ecosystems. This means that maintaining sustainability transitions is difficult to achieve through the isolated efforts of a single grower, exporter, or value-chain participant.

In this context, misalignment of objectives and inefficiencies in implementation create tangible risks that hinder the introduction of eco-digital marketing (Putri & Sari, 2025). As marketing tools continue to expand, grape-based small and medium enterprises experience challenges such as lack of continuous communication with customers, dependence on seasonal production, fluctuations in demand, and the need to comply with sustainability requirements — all of which make implementation particularly complex and inflexible under resource constraints.

2.Methodology

The data-collection process was carried out through qualitative interviews with three groups of stakeholders in Uzbekistan exporters, marketing officers, and regional advisers

combined with field observations in eco-certified vineyards and the compilation of secondary data from government reports and small-enterprise databases.

Over a four-month research period, part of the team worked for six weeks in the Samarkand grape cluster (covering four districts). As a result, the dataset included in the analysis represents a purposive, stratified sample ($n = 38$), while extreme outliers and non-cooperative respondents were intentionally excluded.

The first workshop involved 12 participants from the research team, while the second included 8 participants. A total of 20 sector experts were invited to the semi-structured interview cycle, and 17 agreed to participate (an acceptance rate of 85 %). Interviews were conducted in Uzbek and English and lasted between 45 and 90 minutes.

Practical data covered the years 2013–2023 - the longest period for which regional performance records were available. The number of participants is comparable to groups observed in previous studies on green-transition models and included actors involved in export supply chains (small and medium enterprises, cooperatives, and logistics managers). However, only those who explicitly reported environmental-marketing activities and possessed the required operational indicators were included in the advanced search for statistical modelling of eco-digital branding strategies.

Python, Stata and NVivo were selected as the main analytical tools to ensure model replicability. The modelling process was implemented using NVivo 14, a qualitative-coding program that supports data classification and thematic exploration. The search included root variables and dependent indicators. Queries were organized by clusters or themes relating to:

- (a) digital marketing and associated eco-performance;
- (b) green branding and terms such as “conversion,” “visibility,” “traceability,” “compliance,” or “sustainability”;
- (c) artificial-intelligence tools and synonyms such as “market intelligence,” “forecasting algorithms,” or “pattern recognition.”

Information from stakeholder interviews was analyzed using an explanatory–sequential mixed-methods design. The two data sources worked well together and achieved high coverage of observed behaviors ($n = 85$). In addition, detailed analyses were conducted using extended search terms such as “eco-certification and investor trust,” “artificial-intelligence tools and SME readiness,” “green marketing and digital traceability,” and “regulation or compliance.”

The model-building framework consisted of three stages:

Stage 1: constructing a baseline model using regional variables and eco-indicators to be included in the predictive system. **Stage 2:** selecting regression — a regularized method suitable

for small-sample contexts — as the primary modelling technique. **Stage 3:** applying several simulation algorithms to model the relationship between digital intervention and export-performance outcomes.

To reduce measurement error, a calibrated prediction threshold was used and applied under controlled conditions. Both expert workshops were divided into two parts:

- **Workshop 1** focused on answering the question: “What are the current limitations of eco-digital strategies?” and was dedicated to evaluating and refining the initial model.

- **Workshop 2** addressed the question: “Which variables should be prioritized for competitiveness?” and aimed to co-develop evaluation indicators.

The choice of simulation technique was expected to reflect the sensitivity of the dataset. During the workshops, all results were shared with participants and final responses were recorded. Accordingly, the methodological approach is fully reported in this article. No additional data emerged during the validation stages, indicating thematic saturation (Lincoln & Guba, 1985).

Empirical evidence from interview sessions was transcribed verbatim, and coding trees were created to identify observed behaviors and evaluation criteria, following the predefined structure. Based on the three-stage modelling analysis, regression effectively addressed potential multicollinearity among predictive variables and could be used to simulate relationships between eco-indicators and export potential.

In developing a roadmap for eco-digital implementation, coding groups identified thematic clusters for each category of readiness and challenge: operational preparedness, technological gaps, behavioral inertia (resistance to change), and inconsistencies in regulatory compliance. The coding framework was developed using notes from semi-structured interviews and from expert-validation sessions, including workshop transcripts and strategy-alignment documents. (Djasurovna, S. (2020)., (Ergashxodjaeva, S. J. and et.al).

Raw observations collected during the workshops were analyzed using a thematic matrix. Qualitative data from the workshops were coded through a constant-comparison process (Strauss & Corbin, 1998). Empirical evidence from interviews was documented through analytical nodes that highlighted themes and cross-regional distinctions, aligned with the dimensions previously defined.

Once coding was completed, materials were reviewed by the research committee to identify categories and intersections, resulting in a validated framework. Coding was carried

out in NVivo 14, which supports iterative analysis and thematic mapping. Empirical data were examined using hybrid content analysis based on the Bengtsson model.

Full-text searches were performed separately across all documents and then combined using Boolean operators. The materials were also categorized according to the Organisation for Economic Co-operation and Development classification of green capability, highlighting potential policy pathways. (Tursunov, B. O., Uktamov, K. F., & Tukhtamuratova, A. (2022, December).

To address the limitations of other methods, regression forecasting functions and correlation-adjustment functions were used to incorporate a machine-learning component into the econometric analysis. Although retrospective discussions are relatively uncommon, they can provide additional insight into convergence issues or previously unidentified data (Bryman, 2016). In this way, gaps in the complete capture of eco-metrics can be minimized.

3.Results

The next section discusses the regression-based findings related to key eco-indicators and digital-marketing factors that support performance improvement. These three groups of predictive variables may help small and medium enterprises and cooperatives maintain competitive advantage despite systemic constraints — limited digital and financial resources and fragmented regulatory environments (Putri & Sari, 2025).

The main findings are as follows: a set of predictive variables has been identified that could be useful when introducing an eco-digital branding model into grape-export systems. Within the identified eco-strategy clusters and model categories, simulation analysis shows that artificial-intelligence-based interventions cover all dimensions of eco-digital competitiveness visibility, engagement, resilience and compliance (Ijomah et al., 2024).

Table 1. Linear Regression Results

Variable	Coef	Std. Error	t-Statistic	p-Value	95% Confidence Interval	Si g.
Artificial-intelligence engagement index	0.544	0.103	5.30	0.000	[-0.751 ; 0.337]	**

Green-certification scale	- 0.976	1	0.14 6.91	- 0	0.00	[- 1.261 ; - 0.691]	** *
Interactiv e-campaign coverage	- 0.510	9	0.21 2.33	- 4	0.02	[- 0.952 ; - 0.069]	**
Traceabili ty (blockchain) score	- 0.588	1	0.12 4.84	- 0	0.00	[- 0.833 ; - 0.343]	** *
Supply-chain resilience	- 0.845	3	0.17 4.88	- 0	0.00	[- 1.194 ; - 0.496]	** *
Export-performance index	1.87 7	1	0.23 2	8.1 0	0.00	[1.4 11 ; 2.344]	** *
Constant	11.6 74	11.2 49	1.0 4	0.30 5		[- 11.011 ; 34.359]	

Model statistics:

Average dependent variable = 47.745

Standard deviation = 9.337

R-squared = 0.687

Observations = 50

F-test = 15.750 (p = 0.000)

Akaike criterion = 320.157

Bayesian criterion = 333.541

*** p<0.01, ** p<0.05, * p<0.1

Interview findings revealed structural barriers and adaptive capacities that may help design targeted marketing interventions. The number of traceability-related campaigns remained relatively stable during 2013–2017 but grew continuously from 2018 onward, reaching 106.23 in blockchain score by 2023.

The number of countries covered by eco-digital-strategy categories, along with the share of countries demonstrating investment interest, is summarized in Table 3. For example, in Uzbekistan, more than one thousand simulated forecast values were significantly higher than observed values.

Table 2. Pairwise Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Eco-brand visibility score	1.00						
(2) AI engagement index	0.110	1.0000					
(3) Green certification	-0.126	-0.231	1.000				
(4) Interactive campaigns	0.107	-0.173	0.054	1.0000			
(5) Traceability (blockchain)	0.333*	-0.159	0.173	-0.027	1.000		
(6) Supply- chain resilience	0.227	0.065	-0.008	-0.267	0.300*	1.000	

(7)	0.5	0.	0.3	0.	0.6	0.5	1.
Export performan ce	56*	272	46*	030	85*	64*	000

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

From the perspective of stakeholder readiness, field observations indicate that local producers believe exporters need stronger access to digital-intelligence tools in order to better interpret investor signals. Survey responses align with the group considered medium-priority within the eco-digital roadmap.

Table 3. Descriptive Statistics of Key Eco-Digital Marketing Variables (N = 50)

Variable	Obs.	Mean	Std. Dev.	Min	Max
Eco-brand visibility score	50	47.75	9.34	30.40	68.52
AI engagement index	50	70.27	13.11	30.70	93.47
Green- certification scale	50	39.69	8.12	24.65	59.71
Interactive- campaign coverage	50	30.42	4.47	22.43	43.60
Traceability (blockchain) score	50	61.81	13.10	35.70	106.23
Supply-chain resilience	50	44.85	7.56	22.31	59.93
Export- performance index	50	108.02	10.03	88.82	133.18

Firms also recognized that, regardless of whether they apply formal market-segmentation tools, traceability scores strongly influence the overall eco-performance index. A further reason for growth was that some clusters unintentionally included non-numeric components for example, simple product labeling was recorded as green certification.

Unexpectedly, all regional advisers agreed on the need for a central digital-support unit capable of attracting investors aligned with sustainability-driven values. Nevertheless, predicted export volumes were not equally stable across all years. Overall, regression-based simulations can accurately forecast eco-brand-visibility trends.

4. Discussion

The empirical model demonstrates that eco-digital marketing helps enhance both the competitiveness and investment attractiveness of small and medium grape-growing enterprises. Moreover, this study contributes to the digital-sustainability literature by providing operational insights necessary to integrate eco-digital transition into agricultural-export systems (Ijomah et al., 2024; Diyora, 2023, 2024; Sudiantini et al., 2024).

Based on predictive simulations and qualitative findings, we argue that flexible machine-learning applications and mixed-method approaches should be incorporated more actively into the development of eco-innovations among agricultural small and medium enterprises. Through the triple interaction among enterprises, regulators, and investors, digital analytics can expand eco-digital export models by offering new branding approaches and data-driven solutions.

Semi-structured interviews identified structural barriers and adaptive factors that may support targeted digital-marketing interventions and encourage eco-transition implementation. Green procurement may significantly influence competitiveness scores, whereas push-and-pull dynamics such as declining digital readiness, regulatory uncertainty, and resource asymmetries can create feedback loops that constrain performance.

With regard to stakeholder readiness, field observations showed that regional advisers believe exporters must improve access to artificial-intelligence-based market-intelligence tools in order to interpret investor-signal patterns more effectively. Consistent with workshop discussions, it is also important to integrate feedback loops into the roadmap so that outcomes of targeted interventions can be continuously measured.

Simulation analysis indicates that predictive accuracy varies considerably across years, ranging between 0.70 and 0.88. Therefore, when examining the marginal effect of digital-branding activity on export variability, it is crucial to apply econometric adjustments. Superficial digital practices do not automatically increase overall eco-performance (Silva et al., 2022; Putri & Sari, 2025).

Although green certification has been central to policy debates in terms of cost reduction, in practice the scalability of such digital systems appears limited. Existing strategic frameworks are often fragmented and non-iterative, which reduces effectiveness at the end-user level.

Selected national programs typically prioritize a single marketing function, and therefore attempt to relieve pressure only in specific parts of the ecosystem (Maria et al., 2024; Rusdana & Nugroho, 2022).

Despite the strong indications provided by regression results about operational-modelling needs for eco-digital interventions, these findings cannot be applied uniformly in all contexts. Kano et al. (2022) emphasize that one of the main reasons for resistance to artificial-intelligence tools is the early stage of technology-adoption processes and the limited interpretative capacity among local actors.

5. Conclusion

The presented evidence shows that eco-digital marketing innovation plays a crucial role in stimulating systemic transformation aimed at increasing export competitiveness and accelerating the adoption of green-transition models consistent with recent advancements in digital-sustainability and agricultural-export readiness research.

The hybrid model proposed in this study reflects empirical modelling results and stakeholder perspectives within Uzbekistan's grape-export ecosystem, where structural constraints and adaptive opportunities coexist in distinctive ways.

Predictive econometric modelling and machine-learning analyses incorporating traceability metrics and artificial-intelligence-driven engagement variables may help close the widening gap between investor expectations and actual performance indicators in international markets. Furthermore, ridge-regression outcomes and correlation-simulation matrices highlight the need for continuous refinement of targeted digital interventions and for assessing the true impact of eco-digital strategies on export volatility and brand competitiveness.

Because acceptance levels and policy alignment may differ across exporting regions depending on their operational maturity, additional studies are needed to explore inter-regional differences. A widely accepted roadmap for evaluating eco-digital transitions in small and medium export enterprises has not yet been achieved. This calls for stronger transnational cooperation models and public-private partnerships to secure the necessary conditions, including artificial-intelligence infrastructure, regulatory harmonization, compliance with green certification, and investor-confidence mechanisms.

In addition, periodic validation and comparative monitoring of existing eco-digital models are essential for determining whether artificial-intelligence-powered marketing systems genuinely improve sustainable export performance and under which conditions such improvements can be achieved.

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