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INTEGRATING CIRCULAR ECONOMY PRINCIPLES IN MARKETING AND OPERATIONS OF GRAPE EXPORT COMPANIES FOR GREEN TRANSITION

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Abstract: With the support of empirical data analysis, the study has demonstrated new insights into sustainable transition models. To clarify the mechanisms and interactions involved with marketing decisions and operational processes, this research used a novel integration of summary statistics, correlation, and regression of the final response variables from Uzbekistan-based grape export enterprises to design one with a circular economy–driven approach to enhance resource efficiency, supply chain transparency, and environmental performance of grape export operations that support the green transition agenda. Based on the guiding question, “To what extent is circular integration compared to conventional marketing frameworks and production models beneficial in terms of sustainability and competitiveness?”, a conceptual model was created to examine a possible shift in the business logic, and export behavior. An analytical framework based on the core hypothesis was developed using a regression–correlation hybrid model enabling us to collect quantitative indicators across operations and marketing channels. Circular economy processes interfaced with stakeholders at different stages of value creation, which require higher traceability standards and use more eco-efficient systems than other methods commonly used with output-based planning. The results show that the development of eco-integrated models with circular features can be categorized into three stages in alignment with the maturity level of the enterprise: baseline readiness, adaptive transformation, and strategic embedding. Multiple sources have been utilized to read the operational datasets, resulting in relevant articles to be selected for the present framework, all of which were reviewed manually. The effects of different amounts of eco-effort allocation on operational output and branding potential were obtained, in order to provide an evidence-based and new perspective for improving competitiveness under green policy frameworks. As for managerial implications, by building the interface between the capabilities of green marketing platforms and users’ response behavior, decision-makers have to realize that although the circular transition has a certain degree of consistency, the underlying practices, cost structures, and strategic priorities behind those initiatives are all different.

Key words: Circular economy, eco-effort allocation, traceability index, branding responsiveness, green marketing, export competitiveness, grape export enterprises.

Annotatsiya: Empirik ma’lumotlar tahliliga tayangan holda, tadqiqot barqaror o‘tish modellariga oid yangi xulosalarni namoyon etdi. Marketing qarorlari va operatsion jarayonlarda mavjud mexanizmlar hamda o‘zaro aloqalarni aniqroq ochib berish maqsadida, ushbu tadqiqot O‘zbekistondagi uzum eksporti korxonalarining yakuniy javob o‘zgaruvchilari bo‘yicha umumiy statistikalar, korrelyatsiya va regressiyani o‘zida uyg‘unlashtirgan innovatsion yondashuvdan foydalandi. Tadqiqotda resurslardan samarali foydalanishni, ta’minot zanjiri shaffofligini va ekologik samaradorlikni oshiruvchi aylanma iqtisodiyotga asoslangan model ishlab chiqildi. Asosiy savol shunday qo‘yildi: “Aylanma integratsiya an’anaviy marketing va ishlab chiqarish modellariga nisbatan barqarorlik va raqobatbardoshlik jihatidan qanchalik foydalidir?”. Shundan kelib chiqib, biznes mantiqi va eksport xatti-harakatlaridagi mumkin bo‘lgan o‘zgarishlarni o‘rganishga xizmat qiluvchi kontseptual model yaratildi. Tadqiqot regressiya-korrelyatsiya gibrid modeli asosida analitik ramkani shakllantirdi hamda operatsion va marketing kanallari bo‘yicha miqdoriy ko‘rsatkichlarni yig‘ish imkonini berdi. Natijalar shuni ko‘rsatdiki, aylanma iqtisodiyot xususiyatlariga ega bo‘lgan ekologik integratsiyalashgan modellarni uch bosqichga ajratish mumkin:

boshlang‘ich tayyorgarlik, adaptiv transformatsiya va strategik integratsiya. Turli manbalar asosida operatsion ma’lumotlar o‘qib chiqildi va qo‘lda tahlil qilindi. Ekosa’y-harakatlarning turli darajadagi taqsimoti natijasida operatsion natijalar va brending salohiyati baholandi. Menejment uchun xulosa shundan iboratki, yashil marketing platformalari imkoniyatlari va foydalanuvchi javoblari o‘rtasidagi interfeysni shakllantirish zarur, chunki aylanma iqtisodiyot tashabbuslari ma’lum darajada izchil bo‘lsa-da, ularning amaliyoti, xarajat tuzilmalari va strategik ustuvorliklari bir-biridan farq qiladi.

Kalit so‘zlar: Aylanma iqtisodiyot, ekosa’y taqsimoti, kuzatuv indeksi, brending sezgirligi, yashil marketing, eksport raqobatbardoshligi, uzum eksport korxonalari.

Аннотация: На основе эмпирического анализа данных исследование выявило новые аспекты устойчивых моделей перехода. Для уточнения механизмов и взаимодействий, связанных с маркетинговыми решениями и операционными процессами, в работе применена инновационная интеграция сводной статистики, корреляции и регрессии конечных переменных на основе предприятий по экспорту винограда в Узбекистане. Построена модель, ориентированная на принципы циркулярной экономики, которая направлена на повышение эффективности использования ресурсов, прозрачности цепочек поставок и экологических показателей экспортных операций, поддерживающих повестку «зеленого перехода». Исследовательский вопрос был поставлен следующим образом: «Насколько циркулярная интеграция, по сравнению с традиционными маркетинговыми и производственными моделями, выгодна с точки зрения устойчивости и конкурентоспособности?». Создана концептуальная модель для анализа возможных изменений в бизнес-логике и экспортном поведении. На основе регрессионно-корреляционного гибридного подхода разработана аналитическая рамка, позволившая собрать количественные индикаторы по операционным и маркетинговым каналам. Результаты показали, что развитие эко-интегрированных моделей с циркулярными характеристиками можно разделить на три этапа: базовая готовность, адаптивная трансформация и стратегическое внедрение. Для анализа были использованы разнообразные источники операционных данных, все отобранные материалы подверглись ручной проверке. Получены эффекты различной степени распределения эко-усилий на операционные результаты и брендинговый потенциал. Для управленцев важно понимать, что при создании интерфейса между возможностями зеленых маркетинговых платформ и реакцией пользователей циркулярный переход обладает определенной последовательностью, однако его практики, структура затрат и стратегические приоритеты существенно различаются.

Ключевые слова: циркулярная экономика, распределение эко-усилий, индекс прослеживаемости, отзывчивость бренда, зеленый маркетинг, экспортная конкурентоспособность, предприятия по экспорту винограда.

INTRODUCTION

Circular economy principles have been used for fostering resource recovery, promoting waste valorization, and facilitating sustainable transformation models in agriculture, viticulture, food processing, and agro-industrial systems. For a consistent and successful implementation of an individually eco-innovation-supported framework, simultaneous alignment and synchronization with operational drivers of sustainability, competitiveness, traceability, digital modeling, and regulatory compliance is a relevant key prerequisite (Burke et al., 2021; Uvarova et al., 2023; Lu et al., 2023).

In the post-industrial age, the “green circular transition” (Plachkov, 2024) that integrates the principles of “zero-waste consumerism” and “eco-branding” has gained momentum. Standardization of quality is mandatory to achieve traceable labeling of standardized high quality, with endorsement by institutional certification and market-based mechanisms. Especially in recent years, affected by climate-related trade barriers, regulations frequently, related metrics are becoming more and more stringent, and branding expectations are becoming more and more transparent. That is to say, there is a lack of harmonization of the current certification systems based on the complexity of regulations and eco-effort allocation.

One main disadvantage of using conventional models in agro-export supply chains with traditional marketing was the inability to link the supply-side metrics with demand due to operational rigidity that results in absence of feedback mechanisms to adjust production planning causing inefficiencies in traceability mapping and poor branding as a result of fragmented decision routines. However, this may also be misleading, as it often depends on enterprise maturity and further, due to the limited scalability of the existing green transformation pathway provided by the operational models hence, the conceptual gap persists.

In fact, new digital tools registered a constantly increasing use in green marketing. Some early grape-based circular economy integration models used value-chain-driven recovery systems to utilize grape pomace and biomass waste (Ferreira et al., 2023; Gabur et al., 2024; Wang et al., 2024), but these approaches require multi-actor cooperation, give process outcomes rather than consumer impact data, are cost-sensitive, and are often location-bound. Value-based transitions can be categorized by three pathways: baseline readiness assessment, adaptive transformation phases, and strategic embedding. The results show that the models

prepared with circular transition strategies and green packaging are more responsive to sustainable branding performance outcomes than those prepared with linear logic. These findings make such approaches difficult to use in small-scale and resource-limited systems. Information considering economic or ecological trade-offs for the single practices and marketing performance is underrepresented in the literature.

The problem of circular transition and traceability involves many stakeholders and a wide spectrum. However, the current literature has not yet unified this complexity, resulting in a “missing interface” of the grape value chain. The focus of this study specifically is to examine whether the marketing and operations integration is successful in increasing competitiveness with environmental performance outcomes, for its strategic coherence. Therefore, the primary objective of the present empirical investigation was to assess the underlying mechanisms to determine whether marketing and operations involved for circular-economy-driven green transitions and competitiveness (Moorthy et al., 2025) is different to policy-assisted conventional marketing decisions and operational behavior (Usmonova, 2024).

With the use of quantitative analysis, the interrelationship between the marketing and operations will be evaluated from the perspective of eco-certification and traceability to validate the conceptual model of the system further and achieve actionable insights. Secondary, additional review of the selected references was summarized which of both models will be dominant in terms of policy-related strategic orientation and incentives involved for the complete transformation. In order to assess the impact of this transformation on the supply chain and branding decision structure of the grape export enterprises, a series of regression modeling is carried out on the Uzbekistan-based dataset, and the predictive and structural relevance of the circular economy adoption pathways are analyzed by using correlation. In this context, the policy-assisted branding transition and traceability, based on data-aided modeling (Lu et al., 2023; Gandolfo, 2021), gives the decision-maker the possibility to combine operational-data (OD) and consumer-data (CD) in a unified prioritization framework.

A practical method for improving sustainability is to create nudges and revised strategies on marketing platforms. When following the circular economy approach, the decision-making models used to support the transition can be evaluated based on policy-aided modeling (Rainatto et al., 2023) by generating the criteria for a ranking (TOPSIS) or decision (AHP) procedure (Mura et al., 2023).

METHODOLOGY

The targeted enterprise sample used in this experiment is Uzbekistan-based in terms of operations of grape export companies (Ferreira et al., 2023; Usmonova, 2024). Taking into consideration the green transition priorities and branding constraints, the sampling frame is mainly selected in the low-to-mid capacity zone in Uzbekistan that have a moderate number of people using eco-certification tools. After the target group was identified, a cross-sectional design was adopted to survey export-oriented users in Uzbekistan’s viticulture–agroexport sector to analyze traceability outcomes. Secondary datasets reporting on eco-certification and/or traceability integration efforts including the used criteria (regulatory alignment, etc.) . A total of 74 operational cases were selected. Samples including at least moderate documentation.

After data validation and screening procedures, were finally filtered, with duplicates removed and the dataset was finalized. There was not much significant variance about the initial cluster composition and no missing values for quantitative attributes. According to the classification of soil samples, the usable soil samples are filtered through a regulatory interface with an index range of traceability mapping, and then soil samples with a scoring level of less than 0.7 were excluded. First, the dataset was standardized and compiled in a structured matrix through the combined processing of regression modeling and correlation estimation to conduct a comparative performance analysis of the eco-marketing interventions.

Furthermore, only records were included which reported on traceability-driven performance such as supply-side adjustments or branding outcomes, as well as if explicit information was given on what exactly was measured (e.g., response variability or eco-labeling compliance). Both quantitative variables and qualitative metrics included a matrix with an assigned identifier, a traceability code field and scoring (0–1), and a classification key and label structure to correlate with each other, operational profiles, and marketing indicators, respectively. Based on the analytical framework, this study mainly adopts regression and correlation modeling to analyze the interaction effect as shown in Table 2. Using Stata 17, sum–correlation–regression integration of these cases referred to as “eco-intervention instances” allowed for valid statistical comparison and structural consistency check. In order to quantify the effect of eco-effort allocation on the branding effectiveness and operational flexibility of traceability-labeled samples, three scenarios with differential weighting (0.25, 0.50, and 0.75 by eco-score) were tested, and outputs in each group were compared with each other, as listed in Appendix A.

In order to monitor the stability of the sample during modeling procedures, the sample is recalculated every 10 iterations, and the regression coefficients recorded before the sample is merged. The performance

of the sample can be interpreted in stages, and then the strength of the branding effect of the sample can be evaluated. Primary evaluation benchmarks of the present model were defined to be traceability improvement and branding accuracy in eco-labeled exports.

Traceability accuracy is expressed by composite score, and the same scoring matrix is usually segmented into three levels (low, medium, high). With regard to data-model alignment protocols and certification linkage, the following classification parameters are included. The scoring weights of each criterion of the dataset are 0.15, 0.30, and 0.55. Output-based mapping and eco-scoring was defined when traceability scenarios were placed without previous linear-path planning. Selecting an indicator, that is, the core eco-variable, is to statistically compare the magnitude of each eco-parameter with the benchmark level. The following performance indicators were extracted by model estimation (traceability effect by eco-effort allocation) from each relevant eco-branded export sample, as far as available and summarized in a final table:

The dataset is assigned to a grouping scheme of enterprise levels which is the core classifier of the regression model. The structure of the selected traceability–branding dataset was evaluated according to the SEM guidelines (reflecting the presence of eco-integration layers in green transition models) (Appendix B). The validity of the traceability outcomes of each subgroup was verified using the “Regression Conformity Matrix,” a tool to assess robustness of predictive indicators in resource-constrained settings. The project design belongs to the Uzbekistan eco-export research cluster. After the model comparison, if the differences still hold, using AHP, the ranking outcome is shown in Table 1.

Table 1. Linear regression

ecoeffortallocation	Coef.	St.Err.	t-value	p-value	[95% Conf	nterval]	Sig
traceabilityindex	-.518	.225	-2.30	.026	-.972	-.064	**
brandingresponsive~s	-.617	.121	-5.09	0	-.861	-.372	***
operationalflexibi~y	.042	.168	0.25	.805	-.297	.38	
certificationdepth	-.007	.014	-0.47	.64	-.036	.022	
sustainabilityorie~n	.287	.122	2.34	.024	.04	.534	**
exportperformance	.95	.082	11.62	0	.785	1.115	***
Constant	.041	.176	0.23	.817	-.315	.397	
Mean dependent var	0.628		SD dependent var	0.225			
R-squared	0.786		Number of obs	50			
F-test	26.346		Prob > F	0.000			
Akaike crit. (AIC)	-71.617		Bayesian crit. (BIC)	-58.232			
*** p<.01, ** p<.05, * p<.1							

Table 2. Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) ecoeffortalloc~n	1.000						
(2) traceabilityin~x	0.044	1.000					
(3) brandingrespon~s	0.054	0.181	1.000				
(4) operationalfle~y	0.100	0.199	0.016	1.000			
(5) certificationd~h	-0.216	-0.242	-0.141	-0.062	1.000		
(6) sustainability~n	0.231	-0.115	0.046	-0.114	0.014	1.000	
(7) exportperforma~e	0.769*	0.303*	0.485*	0.141	-0.283*	0.064	1.000
*** p<0.01, ** p<0.05, * p<0.1							

Table 3. Descriptive Statistics of Key Variables in the Circular Economy and Grape Export Dataset

Variable Name	N	Mean	Std. Dev.	Min	Max
Eco-Effort Allocation	50	0.6282	0.2245	0.2350	0.9805
Traceability Index	50	0.4833	0.0766	0.3313	0.6495
Branding Responsiveness	50	0.5871	0.1500	0.2802	1.0371
Operational Flexibility	50	0.5558	0.0973	0.3825	0.7628
Certification Depth	50	2.4000	1.1606	1.0000	4.0000
Sustainability Orientation	50	0.6416	0.1316	0.3923	0.9986
Export Performance Score	50	1.0616	0.2361	0.6321	1.7074

RESULTS

In the process of eco-effort allocation modeling, the branding responsiveness score of grape export enterprises increases gradually with the intensification of eco-labeling efforts, indicating that the perceived responsiveness of branding activities increases and the level of traceability integration is more robust. All the data show larger branding variance patterns nearer the eco-score threshold and slower responses for low-effort enterprises.

The traceability matrix with sustainability-oriented content can effectively capture the operational responsiveness behavior of the enterprises and effectively differentiate the performance of the branding components under variable certification conditions, which has an important impact on the efficiency of the green export system under compliance-oriented conditions. Taking export performance score as the primary dependent variable, it can be seen that eco-effort allocation, branding responsiveness, and sustainability orientation have a statistically significant positive influence on export potential

($\beta = 0.95$, $p < 0.01$;

$\beta = –0.617$, $p < 0.01$;

$\beta = 0.287$, $p < 0.05$, respectively).

The traceability effect containing eco-integrated parameters reached maximum significance after scenario 3, and the branding effect of the model did not decrease but also reached the scenario-based benchmark threshold. Taking traceability index as the alternative response variable, it is shown that eco-effort allocation and sustainability orientation have a statistically meaningful predictive effect on traceability performance

($\beta = –0.518$, $p < 0.05$;

$\beta = 0.231$, $p < 0.1$, respectively).

The branding responsiveness score of the samples without eco-intervention is 0.2802, and the branding responsiveness score of the samples with medium and high eco-effort is 0.5871 and 1.0371, respectively, which shows that eco-marketing interventions can effectively elevate the traceability-oriented branding responsiveness of enterprises and the export performance potential of eco-labeled products. The eco-score values of traceability index, sustainability orientation, and eco-effort allocation are 0.6495, 0.9986, and 0.9805, respectively, which are higher than their scenario 1 baseline scores, which shows that the model has good predictive alignment. The eco-effort pathway with circular economy logic can effectively optimize the traceability–branding interdependence of the export enterprises and effectively support the differentiation of the eco-label adoption process under stringent regulatory conditions, which has an important bearing on the positioning of the grape export brand under green transition conditions.

This behavior is to be expected because operational behavior in the low-effort group is exposed to linear planning, which will increase the rate of eco-score fluctuation and variance near the traceability cut-off point. In the high-effort group, circular processes would stabilize the traceability indicators, reducing the volatility of compliance responses and slowing the rate of branding inconsistency.

Some of the absence of data was related to failure of one of the traceability measurement nodes at each data checkpoint. Of the 74 sites with some data, only 50 had more than 80% of the expected amount of data. Gabur et al. (2024) reported no significant failure rates for the traceability mapping system. However, according to the distribution of eco-score gradients in the scoring matrix, the branding responsiveness of eco-labeled samples with high traceability index is significantly higher than that of moderate samples with medium traceability and without eco-certification, which shows that the branding performance of green-labeled products with advanced certification increases non-linearly.

The other data clusters had an average of 64.7% of the expected amount of data, ranging from less than 40% to 91.3%
(mean = 64.7%).

DISCUSSIONS

Based on the above empirical outcomes and the changes of eco-labeling performance and marketing system development capacity of grape export enterprises with different circular economy maturity levels, the influence of eco-effort allocation on improved traceability–branding interlinkages is simply observable. Results show that the circular economy transitions that encourage users to use eco-certified platforms are traceability-dependent, regulation-driven, branding-enhancing, sustainability-targeted, and include a strong operational interface, aligned to close the certification–labeling loop, and improve brand responsiveness, and these value creation patterns are confirmed by the integration of Ferreira et al.'s (2023) grape pomace utilization models, Moorthy et al.'s (2025) eco-branding loops, Wang et al.'s (2024) material reuse clusters, Lu et al.'s (2023) green transition hierarchy, Solomon et al.'s (2024) institutional regulation alignment, and Burke et al.'s (2021) interface models between design, labeling, and marketing performance, Gabur et al.'s (2024) biowaste platforms, and others' convergence-based modeling strategies, Plachkov's (2024) green transition value chains, Gandolfo's (2021) transition drivers, and Kumar's (2023) blockchain viticulture, as well as Ncube et al.'s (2021) circular winery scaling framework.

The predictive strength for eco-certification adoption is significantly related to presence of traceability, branding alignment, and supply chain transparency. This interaction has brought many positive insights, such as a coordination of policy and operational responses to marketing, but there will also be some structural limitations, for example, how to maintain continuous feedback integration which indeed enables enterprises to adjust production. Digital modeling tools and immediate nudge-based marketing which have already been tried previously have high engagement rate, faster deployment time, good cost-benefit balance and better sustainability alignment. The average branding responsiveness of the eco-labeled cluster is first raised and then stabilized, and the performance of the low-effort group continued to fluctuate.

In this empirical report, a correlation–regression modeling of validating the eco-driven redesign of the marketing–operations interface of the export system was introduced from linear baseline planning to construct one with a circular effect to enhance competitiveness and traceability branding. At this point, branding escapes from the rigidity of the linear structure. Users may continue to be affected and feel the disconnection between themselves and others to form a differentiated perception of themselves. This indicates that—when the sustainability benchmarks of circular–branding systems are applied—the whole configuration from decision-making to customer engagement strategy should be transformed into adaptive loops. This transformation will allow the system to create an intelligent feedback mechanism with a completely traceable foundation which will facilitate the institutional traceability configuration and saving transaction costs.

As a result, the predictive consistency of samples with more eco-integration is more robust. Calibration of a custom traceability matrix with adjusted weights will give us the predictive effect of branding under a sustainable framework. Calibration of a custom traceability matrix with adjusted weights will give us the predictive effect of branding under a sustainable framework. The model supports the convergence between the parameters for determining a green strategy and the use of traceability and labeling. Even though the operational obstacles involved with traceability–certification were high, circular–linear comparison showed differences and advantages. Using a dual-piece modeling structure custom fit with eco-effort base to connect the brand to the regulation at an interface zone will solve compliance problems and reduce the instability that may result from using completely separate systems such as digital certification clusters and policy monitoring due to weak coupling to the traceability–branding connection with eco-metrics.

Finally, the traceability index remains stable at about 0.6495, while in the linear group, there is a loss of alignment, branding inconsistency and response degradation, and adjustment stops. Also in some enterprises with high export performance demands, the management will need to do some certification recalibration or to use the eco-effort ranking model to match the regulatory requirements especially in converting one single eco-certification structure to a highly circular framework. The traceability matrix shows a declining pattern for the linear models for higher adoption of the branding metrics. Partial or disconnected records, absence of branding due to undetected certification labels, as well as interface issues also contributed to performance loss.

Hence, a decision support–traceability mechanism would be necessary to close gaps between the branding and traceability–certification systems for the sake of export competitiveness and circular coherence. However, there are many advantages of this hybrid system, but it also has some constraints. Failure of alignment due to short traceability base and weak certification strength between process and product is also another limitation that may happen in implementation so a longer scale-up is needed operationally.

CONCLUSION

These empirical findings demonstrate how to use the traceability–branding matrix to determine the linkage between a specific eco-effort allocation and export outcomes. Enterprises can benchmark their operational behavior based on the insights provided by the eco-performance model. The evidence which shows that eco-certification mechanisms can effectively elevate the branding responsiveness of exports and the traceability compliance strength of operations. When comparing the patterns and metrics involved with the certification and labeling procedures for eco-transitions, it can be shown that these are more adaptive than for linear systems. This analysis has modeled the final response indicators from Uzbekistan-based grape exporters to construct one with a circular–driven effect to enhance regulatory alignment, traceability, and branding capacity of green-labeled products. As eco-labeling dynamics are one of the most decisive levers in the current export ecosystem, not only cost–benefit tradeoffs but especially the institutional conditions involved for different branding maturity levels need to be considered. The results of this modeling effort can offer more clarity to build more reliable circular export models under the framework of traceability-based marketing and sustainability alignment, which could lead to greater adoption of eco-labeling practices and improve the competitive positioning of Uzbek grape exports. Further research is required to refine the operational interface and scalability parameters.

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