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ORIGINAL ARTICLE

Wine marketing strategies with AI for resilience of small and medium-sized enterprises

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Abstract

This study investigates the application of Artificial Intelligence (AI) in the wine sector for marketing-related processes, with a specific focus on its implications for marketing analytics. Adopting the PRISMA protocol, a Systematic Literature Review (SLR) was conducted, leading to the identification and analysis of 31 scientific contributions. The findings reveal that AI applications are predominantly concentrated in technical and production-related domains, such as quality control, traceability, and process optimization, mainly relying on machine learning and data-driven approaches. In contrast, a more limited body of research addresses AI in marketing contexts, where consumer data is used to support marketing analytics functions, including segmentation, personalization, and demand prediction. The results highlight a structural gap in literature: despite the widespread adoption of AI technologies across the wine system, their integration into marketing analytics remains limited. A conceptual framework is proposed that distinguishes between direct and indirect AI-driven data pathways in marketing analytics. Implications for Small and Medium-sized Enterprises (SMEs) and ethical considerations related to AI use are also acknowledged. These findings suggest important directions for future research aimed at bridging the gap between technological capabilities and marketing analytics applications.

Keywords Artificial intelligence · Marketing analytics · Wine sector · Systematic literature review · Research gaps · Data-driven marketing

Introduction

Artificial intelligence is redefining marketing paradigms, offering transformative capabilities that enable companies to offer highly personalized and data-driven experiences. By leveraging Machine Learning (ML), Natural Language Processing (NLP) and predictive analytics, AI applied to marketing makes it possible to optimize operations, discover hidden information about consumers and create targeted campaigns with unprecedented precision (Huang & Rust 2021). These advances allow companies to interact with their audience in previously unimaginable ways, thus reshaping traditional marketing practices (Haleem et al. 2022). The integration of AI in marketing encompasses a wide range of applications: the automation of repetitive tasks (such as customer segmentation and email campaigns), the ability to implement dynamic pricing strategies, and interacting with customers in real time through AI-based chatbots. These innovations not only improve business performance but also foster deeper connections between brands and their consumers, offering hyper-personalised

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experiences (Jarek & Mazurek 2019). Most of the AI applications in marketing nowadays employ Machine Learning to personalize product suggestions, to assist customers in discovering the most successful promotion channels, to estimate customer churn rate or lifetime value and create superior customer groups. For example, some authors examined the impact of AI-based recommendations and interactions at every stage of the online shopping experience (Tairov et al. 2024; Al-Otaibi 2024). Other authors proposed a new AI system that provides real-time insights into tourist preferences and experiences, enabling targeted interventions and improvements (Alzahrani et al. 2025).

AI is also a powerful tool for Marketing, as it can process large sets of data from various sources and use them to generate insights into future customer behavior, suggest more personalized content, and identify patterns that marketers can act on. Here are some examples of how companies are using AI to achieve their marketing goals: Content generation (generative AI from OpenAI, ChatGPT); Audience segmentation; Customer service chatbots; Programmatic advertising; Search engine optimization (SEO); E-commerce; Digital marketing; and more (Haleem et al. 2022). AI marketing is the process of using artificial intelligence technologies, such as NLP and ML, to provide customer insights and automate critical marketing decisions (Haefner et al. 2021). Today, AI technologies for Marketing are mostly used to generate content, improve customer experience, and deliver more accurate results.

When choosing an AI tool for Marketing, businesses should thoroughly explore the different types of AI applications available, see how they are used by other companies, and analyze the opportunity to choose over others, basing choices on various factors, including the type of business and its size. However, as the literature shows, AI is reshaping today's marketing (Rosário & Raimundo 2025), with a particular focus on small and medium-sized enterprises, which are increasingly subject to greater competitive pressures (Le Dinh et al. 2025), in various sub-research areas such as sustainability (Agarwal et al. 2025; Kumar et al. 2025).

In digital marketing, AI has revolutionized engagement strategies by driving hyper-personalized content, chatbot integration, and automated advertising campaigns. Personalized recommendations and voice-assistant technologies further enhance customer experiences, aligning with individual preferences (Dumitriu & Popescu 2020; Mele et al. 2026). Particularly, AI influencers, also known as virtual influencers, are revolutionizing marketing communication by leveraging AI technologies like machine learning and natural language processing (Ingrassia et al. 2022; 2020; Forrai et al. 2026). However, they also present challenges related to authenticity, transparency, and ethical considerations (Güzel 2025).

However, despite its numerous benefits, ethical considerations must be considered, such as data privacy, transparency, and potential biases in AI algorithms, need to be addressed to ensure responsible usage (Davenport et al. 2020). Furthermore, the integration of AI into marketing requires substantial investments in infrastructure and training, along with overcoming resistance to change among stakeholders (Gupta et al. 2025).

Literature review

The Wine industry faces increasing competition, and rapidly evolving consumer preferences that compel businesses to adopt innovative technologies to remain competitive (de Oliveira et al. 2021; Niu et al. 2024). Therefore, in this sector, the application of AI's algorithms is expanding rapidly and transforming various aspects of wine supply chain, such as production, distribution and consumption. AI's ability to analyse vast amounts of data in real-time provides critical insights into market trends, consumer behaviour, and supply chain dynamics, enabling wine companies to create tailored marketing strategies (Dash et al. 2025). For example, AI-powered predictive analytics can anticipate seasonal demand fluctuations, optimize resource allocation, and identify emerging market opportunities (Rajawat et al. 2025).

This sector deserves special attention because it contributes positively to the economic development of the sector worldwide with a high turnover and great attractiveness from consumers (OIV 2023; Bao et al. 2025). Wineries must innovate internal processes in order to cope with global challenges and survive in the global marketplace. Thus, AI is potentially suitable to be used to improve the management of many phases of the supply chain, from vineyard management, to processing, oenological processes, marketing, distribution, and partner/customer loyalty. The following are some examples of application of AI in a winery: 1. Vineyard management and precision agriculture; 2. Vinification and quality control; 3. Supply chain and logistics; 4. Marketing and consumer; 5. Traceability and certifications; 6. Sustainable and smart agriculture. In fact, there are different types of AI algorithms that can be designed, developed, customized and adapted specifically for wineries, depending on the specific process or sector of application (Chinnici et al. 2025). If we leave out the discussion of the need for AI application in the part of the process involving agricultural

production and winery processing and look at distribution, sales and consumer, it becomes obvious how AI is necessary for wine marketing. AI could be used to meet consumer preferences, enhance customer personalization, and target market segments (Mariyappan et al. 2025). Moreover, AI may help to develop dynamic pricing strategies or to implement interaction with wine consumers in real-time.

However, despite AI applications imply a faster development, the application of this technology implies higher costs for enterprises which, in certain cases, may not have sufficient availability of funds to access this technology. Moreover, the wine sector is predominantly characterized by Small and Medium-sized Enterprises (SMEs) (Altamore et al. 2024). In Italy, for instance, the average Utilized Agricultural Area (UAA) per winery amounted to only 2.2 hectares in 2021. In such a context, where a high-value industry is largely composed of SMEs, it becomes evident that technological innovation must not result in overly costly or inaccessible solutions (Bellia et al. 2022b; Chironi et al. 2020). Increasing globalization and competitive pressures have already led to the exit of numerous firms from the market. In this scenario, AI can represent a strategic tool for wine SMEs, enabling them to enhance their competitiveness and strengthen their ability to remain in the market. For this reason, the high potential of the AI application in the wine sector is as important as its development in the form of open innovation for wineries and for the wine sector in general (Chesbrough 2004; Potwora et al. 2024). And thus, the application of AI in the wine marketing sector as open innovation may represent a paradigm shift for modern wine marketing, transforming it into a collaborative process rather than a competitive one to cope with the marketing and export difficulties due to the globalization of markets (Prasetyo et al. 2024; Sun et al. 2025). In fact, this approach would not only improve the ability of companies to create value but also allow them to strengthen their connection with consumers and other stakeholders.

In the Wine System, despite companies considering AI-based marketing innovations desirable, due to their numerous advantages and high potential, AI has not yet been fully applied to Wine Marketing, nor is there any satisfactory scientific literature on the subject. Scientific literature shows that there are still preliminary studies investigating the topic, but they are still in the exploratory phase (Rialti and Zollo 2023; Tian 2024). Wine companies, mainly consisting of SMEs and always focused on sustainability, are the main candidates for adopting these innovations in order to cope with the ever-increasing difficulties of the market. Preliminary exploratory studies have already been conducted, and it can be reasonably assumed that, as in other research domains, the advent of artificial intelligence will play a pivotal role in shaping the future of the sector and serve as a critical resource for the survival of enterprises (Rialti and Zollo 2023).

Therefore, it seemed useful to explore the current research framework on the topic of AI for Wine Marketing. In order to provide valuable knowledge and contribute to fill existing gaps, the existing scientific literature on the use of AI for Wine Marketing was collected and analyzed. Specifically, this Systematic Literature Review (SLR) wants to collect, summarize, and critically evaluate the scientific evidence on this topic, with the following research questions (RQs):

- RQ1: What types of AI-driven analytical capabilities are currently applied within the wine system, and how are they distributed across different domains?
- RQ2: To what extent do existing AI applications support core marketing analytics functions (e.g., consumer prediction, segmentation, personalization, recommendation, pricing)?
- RQ3: What structural and analytical gaps limit the development of AI-driven marketing analytics in the wine sector, particularly for SMEs?

These findings will contribute to the knowledge in this topic of researchers and scholars, but also entrepreneurs and stakeholders, for the global benefit of the Wine System since they provide elements for developing critical thinking as a whole and suggesting ways and strategies for solving problems and improving the competitiveness of the SMEs and entire system at a global level. In the context of the wine sector, product value is not only determined by market dynamics but also by other quality attributes such as intrinsic quality, origin, and traceability. These elements are closely linked both to the territorial dimension and to the structure of the supply chain, the integration of data-driven tools may be particularly relevant for supporting both production and marketing decisions of wineries.

Methodology

Similarly to other SLR (Reitano et al. 2024; Trabelsi et al. 2023; Usman et al. 2024), the PRISMA protocol was applied to extract relevant documents from scientific database through specific steps, extraction rules and results' validation for the replicability of the method (Veroniki et al. 2025).

The Elsevier-Scopus and the Clarivate-Web of Science (WoS) databases were used. The combination of these two databases helped to increase the probability of identifying all relevant scientific contributions in the chosen topics and the quality of searching and selection procedure (Bellia et al. 2022a). Moreover, the choice to combine more databases significantly reduces bias in the selection of data sources. Based on previous literature on Marketing, specific keywords were selected to carry out a targeted search of the available scientific literature on the topics "Artificial Intelligence" and "Marketing/Consumer Sciences". Particularly, the keywords selected were "ARTIFICIAL INTELLIGENCE"; "AI"; "WINE"; "MARKETING"; "CONSUMER. This final set of thematic keywords was used to develop the query for the documents' search on the Elsevier-Scopus database, that was the following:

TITLE-ABS-KEY: ("AI" OR "ARTIFICIAL INTELLIGENCE") **AND** ("WINE") **AND** ("CONSUMER" OR "MARKETING").

Differently, the query identified and used for the search on the Clarivate-Web of Science database was the following: TOPIC ("ARTIFICIAL INTELLIGENCE" OR "AI") AND TOPIC ("WINE") AND TOPIC ("CONSUMER" OR "MARKETING").

All the documents up to and including 2025 (up to the date of completion of the study) were considered for this review. It was not applied to any geographical or temporal exclusion criteria, but rather, apart from duplicates and out of scope, the only exclusion criterion was the language used. The selection was limited to scientific documents in English because they were considered potentially disseminable beyond the borders of different national languages, an important feature in relation to the objective of this study.

Some thematic fields of research were chosen to refine the search, since the objective is to research the scientific literature about the application of AI for the Marketing in the Wine System. The branches or thematic fields chosen are those related to Agriculture and Economic-Social Sciences. These branches of research consisted of different selection rules on the Elsevier-Scopus database and on the Clarivate-Web of Science database. Specifically, for Elsevier, the search was limited to the following thematic areas: "Agricultural and Biological Science", "Business, Management and Accounting", "Decision Science", "Economics, Econometrics and Finance", "Psychology" and "Social Sciences". Instead, for the selection in the WoS database the search was limited the following thematic areas: "Agriculture", "Food Science Technology", "Business Economics", "Biotechnology Applied Microbiology", "Nutrition Dietetics", "Science Technology Other Topics", "Area Studies", "Communication", "Psychology" and "Social Science Other Topics".

The search strategy was intentionally designed to balance specificity and coverage. While the use of a focused set of keywords ensured relevance to the intersection between AI and wine marketing, the inclusion of multiple subject areas and two major databases helped mitigate potential selection bias and improve the comprehensiveness of the review.

In addition to database filtering and duplicate removal, a manual screening process was conducted to ensure the relevance of the selected studies to the research objectives. In particular, 9 records were excluded at the final stage because they were considered off-topic. A study was classified as off-topic when artificial intelligence applications were not directly related to the wine system or when the focus was not connected, even indirectly, to marketing, consumer behavior, or decision-making processes. The relevance assessment was conducted through a full-text review of each article. Studies were included only if they contributed to at least one of the following dimensions: (i) AI applications with direct implications for marketing activities, (ii) AI applications affecting consumer perception or behavior, or (iii) AI-driven processes within the wine system with potential strategic or marketing relevance. This additional screening step ensured alignment between the final sample and the research questions, while reducing the risk of including technically relevant but conceptually misaligned studies.

After this "exclusion/inclusion" process the total selected documents were N = 31 (Fig. 1). Figure 1 shows the inclusion and exclusion criteria applied using the PRISMA protocol.

Data extraction and analytical evaluation

To enhance the analytical rigor and replicability of the review, a structured data extraction and coding process was implemented. Each of the 31 selected studies was systematically analyzed according to a set of predefined dimensions derived from the research questions. In particular, the following variables were extracted:

- Type of study (empirical vs. conceptual)
- Domain of application within the wine system (e.g., marketing, production, quality control)
- Relevance to marketing activities

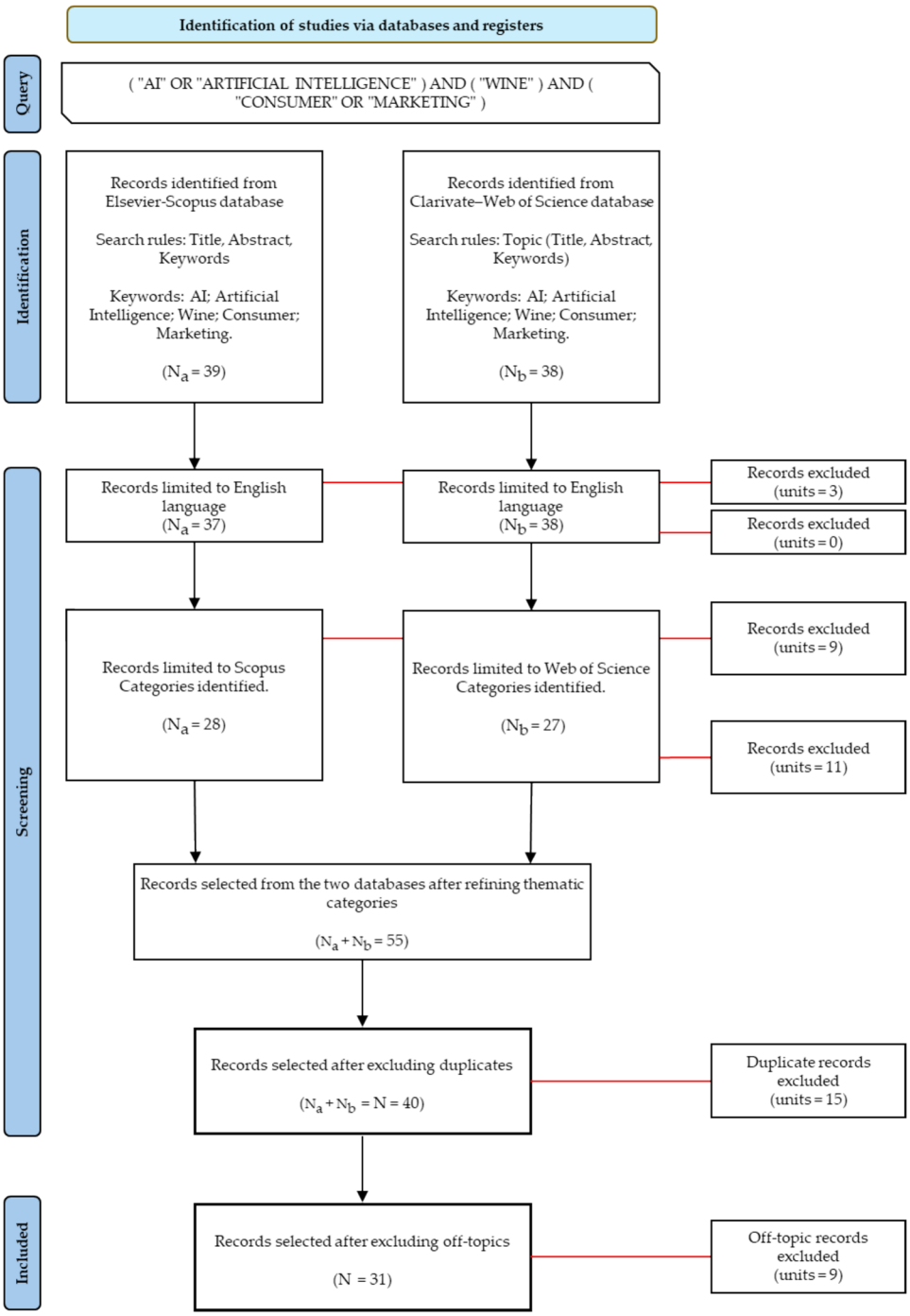

Fig. 1. Inclusion and exclusion criteria using PRISMA protocol

- Type of AI application (e.g., recommendation systems, predictive analytics)
- Type of data and analytical approach used (e.g., experimental data, survey data, simulation models)

The coding process was conducted through a manual review of each article, ensuring consistency in classification. In cases of ambiguity, studies were assigned based on their primary research objective and dominant contribution. This structured approach enabled the identification of recurring

Table 1 Analytical classification of the reviewed studies based on domain of application, methodological approach, AI techniques, data types, and impact on marketing analytics

Refs.	Authors (Year)	Primary domain of application	Type of study	AI Technique Used	Type of data used	Marketing relevance	Impact on marketing analytics
1	Festa et al. (2025)	Marketing	Empirical	Generative AI	Experimental/survey data	Primary	Direct
2	Ma et al. (2025)	Production / Traceability	Conceptual	Machine Learning	Not applicable	Secondary	Indirect
3	Hans et al. (2025)	Production / Quality	Conceptual	Not specified	Not applicable	Secondary	Indirect
4	Zanchin et al. (2025)	Production / Quality	Empirical	Computer Vision	Production/technical data	Secondary	Indirect
5	Sigurdsson et al. (2025)	Marketing	Empirical	Generative AI	Experimental/survey data	Primary	Direct
6	Aman et al. (2024)	Marketing	Conceptual	Machine Learning	Not applicable	Primary	Direct
7	Tian (2024)	Marketing	Empirical	Machine Learning	Consumer data	Primary	Direct
8	Aiello & Tosi (2024)	Production / Quality	Empirical	Machine Learning	Production/technical data	Secondary	Indirect
9	Frigerio et al. (2024)	Production / Quality	Conceptual	Computer Vision	Not applicable	Secondary	Indirect
10	Wang & Jeffery (2024)	Production / Quality	Empirical	Machine Learning	Production/technical data	Secondary	Indirect
11	Ibáñez-Jiménez & Palomo-Zurdo (2024)	Mixed / Indirect marketing relevance	Conceptual	Blockchain+AI	Not applicable	Secondary	Indirect
12	Lu et al. (2024)	Marketing	Empirical	AI Service Robots	Experimental/survey data	Primary	Direct
13	Kurtanjek (2024)	Production / Quality	Empirical	Machine Learning	Production/technical data	Secondary	Indirect
14	Geetha et al. (2024)	Production / Quality	Empirical	Deep Learning	Production/technical data	Secondary	Indirect
15	Fuentes et al. (2024)	Marketing	Empirical	Computer Vision	Experimental/survey data	Primary	Direct
16	John et al. (2024)	Production / Quality	Empirical	Machine Learning	Production/technical data	Secondary	Indirect
17	Wang et al. (2024)	Marketing	Empirical	Recommendation System	Experimental/survey data	Primary	Direct
18	Melas et al. (2024)	Marketing	Empirical	Generative AI	Experimental/survey data	Primary	Direct
19	Rialti & Zollo (2023)	Marketing	Empirical	Machine Learning	Experimental/survey data	Primary	Direct
20	Kucherenko (2023)	Mixed / Indirect marketing relevance	Conceptual	Blockchain+AI	Not applicable	Secondary	Indirect
21	Abi-Rizk et al. (2023)	Production / Quality	Conceptual	Machine Learning	Not applicable	Secondary	Indirect
22	Carlson et al. (2023)	Marketing	Empirical	NLP	Consumer data	Primary	Direct
23	Monaco & Sacchi (2023)	Marketing	Conceptual	Metaverse / VR	Not applicable	Primary	Direct
24	Ramšak (2022)	Marketing	Conceptual	AR/VR+AI / Wearable Tech	Not applicable	Primary	Direct
25	Mu et al. (2022)	Marketing	Empirical	Recommendation System	Consumer data	Primary	Direct
26	Gayialis et al. (2021)	Production / Quality	Conceptual	Blockchain+IoT	Not applicable	Secondary	Indirect
27	Taghikhah et al. (2021)	Marketing	Empirical	Machine Learning	Experimental/survey data	Primary	Direct
28	Zhang et al. (2020)	Production / Quality	Empirical	Machine Learning	Production/technical data	Secondary	Indirect
29	Viejo et al. (2019)	Mixed / Indirect marketing relevance	Conceptual	Computer Vision	Not applicable	Secondary	Indirect
30	Ting et al. (2014)	Production / Quality	Empirical	Machine Learning	Production/technical data	Secondary	Indirect
31	Latorre-Biel et al. (2013)	Production / Quality	Empirical	Machine Learning	Production/technical data	Secondary	Indirect

patterns and the development of thematic clusters, which emerged inductively from the data. Additionally, the distinction between empirical and non-empirical contributions allowed for assessing the extent to which existing research provides robust evidence on AI-driven marketing applications in the wine sector.

The results of this coding and classification process form the basis of the subsequent analysis and are used to address the research questions in a structured and evidence-based manner.

Key findings

Table 2 in the Appendix shows an overview of the thirty-one extracted documents with information about year of publication, objective and key findings. To improve the understanding of the documents, Table 1 provides a detailed overview of the selected studies, reporting key information on the domain of AI application, the type of AI techniques employed, the methodological approach (empirical or conceptual), the type of data used, and the impact on marketing analytics.

From the systematic analysis of the scientific documents two interesting findings emerged. The first finding shows how the wine system includes all the phases of the agri-food chaIn from agricultural production to processing, from logistics to communication and distribution on the market. The first finding is that AI is applied in a wide variety of sectors, from primary production (agriculture) to quality control, from predictive models for risk management or market forecast, to logistics. However, it was more widely developed and applied concerning technological aspects of agriculture and transformation processes (production, transformation, oenological processes, quality control, etc.) and less for the purely economic-financial aspects of businesses. Different types of AI have been used to support in the stages of production such as improvement of the intrinsic quality characteristics of products (both objective-intrinsic and subjective-consumer preferences), streamlining of business processes, quality control, and, to some extent, also in management and risks' prediction in the decision-making stage.

More specifically, the analysis shows that most of the research, which focuses primarily on production processes, quality control, and traceability, predominantly adopts ML and DL techniques for classification, prediction, and optimization tasks (Aiello and Tosi 2024; Wang and Jeffery 2024; Kurtanjek 2024; Geetha et al. 2024; John et al. 2024; Zhang et al. 2020), as well as computer vision systems for monitoring and quality assessment (Zanchin et al. 2025; Frigerio et al. 2024; Viejo et al. 2019). In addition, blockchain-based and hybrid technologies are widely adopted for traceability and supply chain transparency (Ma et al. 2025; Ibáñez-Jiménez and Palomo-Zurdo 2024; Kucherenko 2023; Gayialis et al. 2021).

These contributions mainly rely on production and technical data (e.g., chemical, sensory, and process-related data) and are associated with indirect impacts on marketing analytics, as their primary objective is to improve product quality, authenticity, and process efficiency rather than to directly support marketing decision-making. A similar pattern emerges in conceptual and review-based studies (Hans et al. 2025; Abi-Rizk et al. 2023), where artificial intelligence is discussed in relation to quality enhancement and technological innovation without direct implementation of marketing analytics functions.

In contrast, a more limited number of studies explicitly focuses on marketing-related applications of artificial intelligence. These contributions typically employ consumer data and experimental or behavioral approaches and adopt techniques such as recommender systems, natural language processing, and generative artificial intelligence (Sigurdsson et al. 2025; Lu et al. 2024; Wang et al. 2024; Melas et

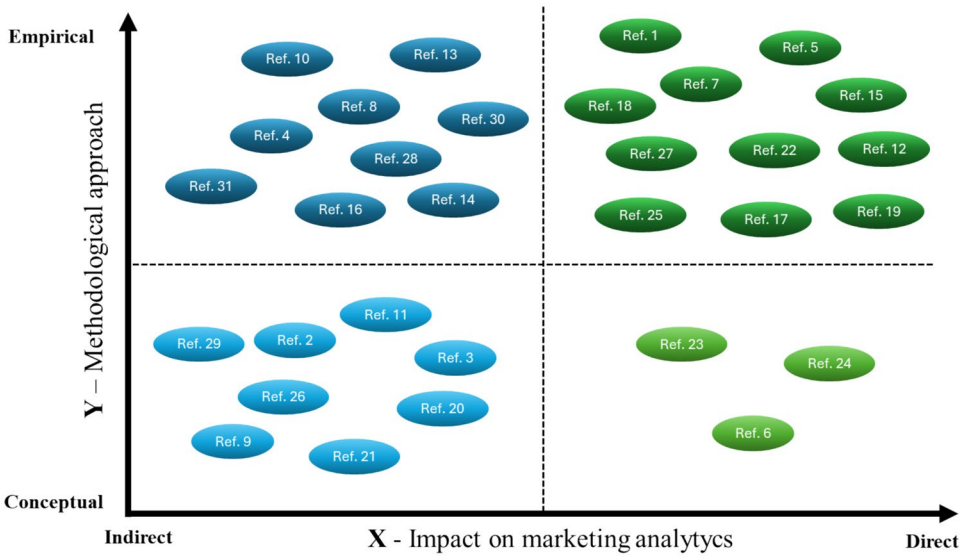

Fig. 2 Distribution of the reviewed studies based on marketing analytics impact (direct vs. indirect) and methodological approach (empirical vs. conceptual), supporting the identification of two research clusters. Authors' elaboration

al. 2024; Carlson et al. 2023; Mu et al. 2022). These studies are associated with direct impacts on marketing analytics, as they address functions such as personalization, recommendation, consumer preference analysis, and decision support. Additional contributions investigate consumer behavior and perception through machine learning models and experimental designs (Tian 2024; Fuentes et al. 2024; Taghikhah et al. 2021), further supporting the application of AI in marketing contexts.

Based on this information, Fig. 2 presents the distribution of the 31 reviewed studies according to two analytical dimensions: the impact on marketing analytics (horizontal axis), distinguishing between indirect and direct contributions, and the methodological approach (vertical axis), differentiating between conceptual and empirical studies. The positioning of the studies reveals a heterogeneous distribution across the four quadrants. A substantial number of contributions are located in the upper-left quadrant, indicating empirical studies with indirect implications for marketing analytics, primarily associated with production, quality, and traceability applications. At the same time, a smaller group of studies is positioned in the upper-right quadrant, combining empirical approaches with direct contributions to marketing analytics.

Although the query was carefully structured to limit the analysis toward studies on marketing in the wine sector, the results show a core of contributions indirectly related to marketing and mainly focused on the technological aspects of the wine supply chain. Marketing, on the other hand, appears in most cases as a secondary element. This evidence confirms that scientific research is still mainly oriented towards quality and production, while the application of artificial intelligence to marketing and consumer sciences is still marginal. The limited presence of articles specifically focused on the topic investigated, despite the use of targeted keywords, suggests that this area of research is emerging and not yet consolidated.

Indeed, the second finding concerns the aim of application of AI: results show that AI is frequently used to improve the product and/or process quality, through sustainability (Pizzol et al. 2021), with the final aim of consumer satisfaction. Specifically, some authors suggest that AI is an effective technology to improve quality in the wine system through sustainability for marketing purposes or consumer satisfaction (Table 1, Sigurdsson et al. 2025; Aman et al. 2024; Tian 2024; Monaco and Sacchi 2023; Ting et al. 2014). Therefore, considering that there are very few documents specifically dealing with AI for marketing (Table 1, Festa et al. 2025; Sigurdsson et al. 2025; Aman et al. 2024; Tian 2024; Wang et al. 2024; Melas et al. 2024; Rialti and Zollo 2023; Monaco and Sacchi 2023), it is understandable that the authors focused their studies on wine quality for consumers and marketing purposes. This result highlights that AI-based technological innovations for wine quality are aimed at wine marketing. Quality and sustainability are the words most frequently used by authors when discussing the application of artificial intelligence for marketing and consumers preferences.

Conceptual studies are distributed across both indirect and direct impact areas, although they are more concentrated in the lower-left quadrant, reflecting indirect marketing relevance. Overall, the distribution highlights a clear distinction between studies that directly address marketing analytics and those that focus on upstream or technical domains with indirect marketing implications. Based on this distribution, two main clusters can be identified:

- Cluster 1—*Artificial Intelligence solutions for Wine Marketing*;
- Cluster 2—*AI-based innovations for Quality in the Wine System*.

A more detailed discussion of these clusters is presented in the following sections.

Artificial Intelligence solutions for wine marketing

The first cluster includes studies in which artificial intelligence is directly applied to marketing-related processes, generating primary and direct impacts on marketing analytics. As reported in Table 1, these contributions are characterized by a marketing-oriented domain of application, a prevalence of empirical approaches, and the use of consumer-related data, including behavioral, experimental, and survey-based information.

From a technological perspective, this cluster is marked by the adoption of a heterogeneous set of AI techniques, including machine learning models for consumer behavior analysis (Tian 2024; Taghikhah et al. 2021), recommender systems for personalized suggestions (Mu et al. 2022), natural language processing and content generation tools for managing and synthesizing online reviews (Carlson et al. 2023), and generative artificial intelligence for visual and branding applications (Sigurdsson et al. 2025; Melas et al. 2024). In addition, some studies explore AI-enabled service and interaction technologies, such as AI-powered robots and immersive environments, to influence consumer experience

and decision-making processes (Lu et al. 2024; Monaco and Sacchi 2023; Ramšak 2022).

In terms of marketing analytics, these studies primarily support functions related to personalization, recommendation, and consumer preference analysis. Several contributions employ AI to predict consumer preferences and enhance brand positioning and appeal (Aman et al. 2024; Tian 2024), while others focus on the analysis of consumer perceptions, trust, and behavioral responses to AI-driven stimuli, such as labels, images, and service interfaces (Sigurdsson et al. 2025; Fuentes et al. 2024; Wang et al. 2024; Melas et al. 2024). Additional studies address decision support in consumer-facing contexts, including recommendation systems and digital platforms aimed at improving customer experience and reducing decision complexity (Lu et al. 2024; Mu et al. 2022; Carlson et al. 2023).

At a broader level, some contributions analyze the role of artificial intelligence within digital transformation processes and marketing innovation strategies, particularly in the context of SMEs and evolving paradigms such as Marketing 5.0 (Rialti and Zollo 2023; Festa et al. 2025). These studies highlight the integration of AI within marketing systems, although often at a conceptual or strategic level rather than through fully operationalized analytics models.

Overall, this cluster represents the subset of the literature in which artificial intelligence is directly linked to marketing analytics processes through the use of consumer data and AI-driven techniques. However, as indicated by the distribution of studies in Table 1, this group remains relatively limited in size compared to the broader body of research focused on production and quality-related applications.

AI-based innovations for quality in the wine system

The second cluster includes studies in which artificial intelligence is primarily applied to production, quality control, and traceability processes within the wine system, generating secondary and indirect impacts on marketing analytics. As shown in Table 1, these contributions are predominantly associated with technical and operational domains and are mainly based on empirical approaches relying on production and process-related data, including chemical, sensory, and supply chain information.

From a technological perspective, this cluster is characterized by the widespread adoption of machine learning and deep learning techniques for classification, prediction, and optimization tasks (Aiello and Tosi 2024; Wang and Jeffery 2024; Geetha et al. 2024; John et al. 2024; Zhang et al. 2020; Latorre-Biel et al. 2013), as well as computer vision systems and sensor-based technologies for quality monitoring and assessment (Zanchin et al. 2025; Frigerio et al. 2024; Viejo et al. 2019; Abi-Rizk et al. 2023). In addition, blockchain-based and hybrid solutions are frequently employed to enhance traceability, authenticity, and transparency along the wine supply chain (Ma et al. 2025; Ibáñez-Jiménez and Palomo-Zurdo 2024; Kucherenko 2023; Gayialis et al. 2021).

In terms of application, these studies focus on improving both product quality (e.g., intrinsic, chemical, and sensory characteristics) and process quality (e.g., production efficiency, traceability, and logistics optimization). Several contributions emphasize the role of AI in fraud detection, authenticity verification, and quality certification, supporting branding and consumer trust through enhanced transparency and objective differentiation (Ma et al. 2025; Aiello and Tosi 2024; Wang and Jeffery 2024). Other studies address sensory quality and perception, using AI-driven models to optimize product attributes and align them with consumer preferences (Kurtanjek 2024; Geetha et al. 2024; Viejo et al. 2019).

Despite these contributions, the impact of these studies on marketing analytics remains indirect. While several authors explicitly link quality improvements to potential marketing outcomes, such as branding, consumer trust, and product differentiation (Hans et al. 2025; Ting et al. 2014), the underlying AI applications do not directly support core marketing analytics functions such as segmentation, personalization, recommendation, or consumer prediction. Instead, marketing implications are inferred from improvements in product quality and supply chain transparency rather than derived from consumer-level data and analytical models.

Overall, this cluster represents the dominant body of literature in which artificial intelligence is applied to optimize technical and operational aspects of the wine system. However, as indicated in Table 1, these applications remain largely disconnected from marketing analytics processes, highlighting the prevalence of indirect rather than direct contributions to marketing decision-making. This disconnection is particularly relevant for the wine sector, where production data (e.g., quality indicators, traceability information, vineyard characteristics) represent a strategic asset that could be leveraged to enhance product valorization and support more informed marketing decisions.

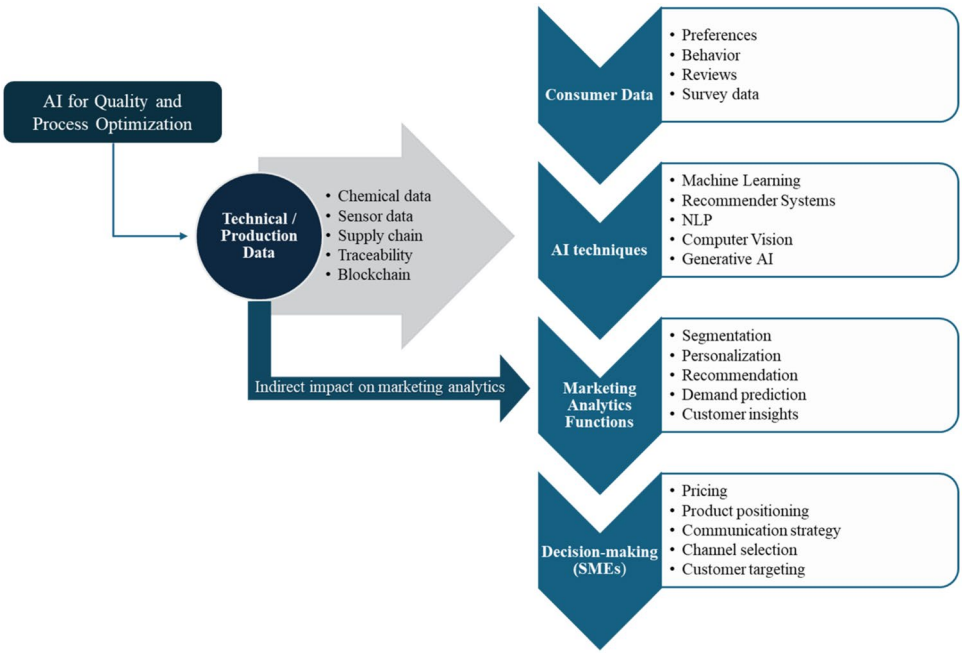

Fig. 3 Conceptual framework of AI-driven marketing analytics in the wine sector. Authors' elaboration

Discussion

The results of this SLR provide a structured understanding of how AI is currently applied within the wine sector, with particular reference to marketing analytics. The analysis highlights a clear asymmetry between the technological development of AI applications and their effective integration into marketing decision-making processes.

First, according to Adamashvili et al. (2024), the findings show that the majority of contributions focus on the use of AI in technical and production-related domains, such as quality control, traceability, and process optimization, with a primarily rely on machine learning, computer vision, and sensor-based data to enhance product and process quality. However, their implications for marketing analytics remain largely indirect, as improvements in quality are assumed to translate into better consumer satisfaction and, consequently, improved market performance.

In contrast, a more limited subset of studies explicitly addresses AI applications in marketing contexts. These contributions mainly employ consumer-level data, such as preferences, behavioral data, reviews, and survey data; and apply AI techniques including recommender systems, natural language processing, and generative AI to support core marketing analytics functions, such as segmentation, personalization, and demand prediction. These studies demonstrate a more direct connection between AI and marketing decision-making, particularly in areas such as pricing, communication strategies, and customer targeting.

This distinction is further conceptualized in Fig. 3, which synthesizes the main findings of the review into an integrated marketing analytics framework. The figure identifies two distinct pathways through which AI contributes to decision-making processes in the wine sector. The first is a direct pathway, in which consumer data are processed through AI techniques to support marketing analytics functions and inform managerial decisions. The second is an indirect pathway, in which technical and production data are analyzed using AI primarily to improve product quality and operational processes, with only a limited and indirect integration into marketing analytics.

Figure 3 builds on the empirical evidence presented in Fig. 2 by providing a conceptual interpretation of the identified patterns. Together, Figs. 2 and 3 provide complementary evidence of a structural misalignment between AI applications and marketing-oriented data use.

At this stage, AI plays an analytical and predictive support role, helping to optimize key parameters and ensure high standards (Khalafyan et al. 2025). However, the value generated by these applications does not stop with the product itself. Indeed, improving wine quality has a direct impact on consumers' perception of quality, a key element in building brand value. The figure highlights how these technical outputs become strategic inputs for marketing. Higher perceived quality strengthens the brand, improves

communication and fuels consumer loyalty dynamics. From an agri-food economics perspective, the limited integration of AI into marketing analytics represents a missed opportunity to fully exploit the economic value embedded in production-related data. In the wine sector, where quality, origin, and production practices are central to competitiveness (Bellia et al. 2022b; Depetris Chauvin et al. 2024), the ability to transform technical data into market-oriented insights is crucial for enhancing value creation along the supply chain.

This positive cycle is further strengthened by the use of AI in marketing as well. The perception of quality generated in consumers, along with the same data generated by consumer interactions (feedback, preferences, reviews, purchase behavior) can be analyzed with AI techniques to predict consumer trends, better understand market segments, and develop personalized and data-driven marketing strategies (Chatterjee et al. 2021). In summary, Fig. 3 represents an integrated, circular vision in which AI not only improves the objective quality of wine, but also enables new positioning and communication opportunities, with increasing impact across the value chain.

The political and economic decisions of individual countries will have a substantial influence on how AI is developed and applied in the various wine sectors in each nation. Certainly, the adoption of AI will require substantial investments in infrastructure and training (Gupta et al. 2025) and new skills from workers and managers to manage new processes and activities. However, these ongoing processes should be accompanied by support for the development of these new skills to prevent social disparities and job losses in the most affected sectors, such as services and marketing.

In this context, the results of this review identify a relevant finding: despite the increasing availability and diversity of AI technologies, their application to marketing analytics in the wine sector remains limited. This suggests that the current stage of AI adoption can be interpreted as transitional, where technological experimentation has not yet been fully translated into structured marketing analytics practices.

Overall, the analysis indicates that AI in the wine sector is predominantly data-driven, but not yet fully market-driven. While advanced analytical techniques are increasingly employed, their application remains largely confined to improving product and process quality, rather than supporting integrated marketing analytics processes. This opens up significant opportunities for future research aimed at bridging the gap between technological capabilities and marketing decision-making.

Implications to AI use for marketing by wine SMEs

Although AI is often associated with large enterprises with high technological capabilities, SMEs in the wine industry can also benefit significantly from adopting AI tools for marketing. In particular, AI-based software-as-a-service (SaaS) solutions offer cheaper and more flexible access to advanced technologies, enabling SMEs to automate customer relationship management activities, email marketing, predictive sales analytics, and personalized recommendations (Wamba-Taguimdje et al. 2020; Akter et al. 2023). For example, many CRM platforms already integrate machine learning capabilities to dynamically segment customers and suggest targeted actions based on purchasing behavior (Chatterjee et al. 2021). Evidence from the reviewed studies suggests that wine SMEs face structural challenges in adopting advanced digital and AI-based technologies, primarily due to limited financial resources and lack of technical expertise (Rialti and Zollo 2023). However, the adoption of more advanced technologies, such as blockchain, AI, and IoT, may still pose economic and infrastructural challenges, potentially leading to asymmetries between large firms and smaller producers (Ibáñez-Jiménez and Palomo-Zurdo 2024). At the same time, the increasing availability of cloud-based services, big data analytics, and outsourced AI solutions may lower these barriers and enable wine SMEs to access advanced marketing tools and customer relationship management systems.

According to Bag et al. (2021) the big data-driven artificial intelligence impact on different dimensions of knowledge creation (customer, user, and external market) and they enhancing rational decision-making in B2B marketing to improve firm performance. Intelligent chatbot tools based on NLP are also finding increasing application in smaller wineries, improving the user experience in online commerce and providing 24/7 personalized assistance (Gao et al. 2025). In addition, AI-based technologies enable wine SMEs to monitor brand and product perceptions on social media, identify emerging consumer preferences, and adapt wine communication and market positioning accordingly (Jamalpur et al. 2025).

Additional contributions highlight how decision-support systems and optimization models can support small wineries in improving operational efficiency and planning processes (Latorre-Biel et al. 2013). Similarly, the scalability and cost-efficiency of AI-based traceability and authentication systems remain critical factors for their adoption among SMEs (Frigerio et al. 2024).

Other solutions, such as predictive systems for analyzing sales data, can support more informed decisions about

promotional campaigns, pricing or choice of distribution channels. The phased approach, based on modular and scalable solutions, proves essential to enable wine SMEs to face the digital transition while safeguarding economic sustainability and territorial identity (Heussner & Hanf 2025). The adoption of AI by wine SMEs, if guided by well-defined strategies and accompanied by a minimum investment in digital skills, can therefore be an enabling factor for smart and differentiated growth in the global wine market. Despite the positive potential associated with the adoption of innovative technologies, a significant barrier remains in the form of financial constraints, which is particularly pronounced in the case of SMEs (Heussner & Hanf 2025).

From an agri-food economics perspective, wine SMEs often face structural constraints in accessing advanced and costly digital technologies; however, their competitive advantage typically lies in product quality, strong territorial embeddedness, and closer relationships with consumers. In this context, the integration of AI into marketing analytics can enable these firms to transform such intrinsic attributes into strategic levers of competitiveness, enhancing value creation and resilience across the supply chain, with marketing acting as a key catalyst in this process.

The results of this study indicate that wine SMEs may currently benefit from AI marketing analytics primarily through indirect applications, such as improvements in product quality, traceability, and operational processes. At the same time, the limited number of studies addressing direct marketing analytics applications suggests that wine SMEs may not yet fully exploit AI-driven capabilities related to segmentation, personalization, and consumer prediction. This highlights a potential area for future development, where the integration of accessible AI tools with usable consumer data could support more advanced marketing analytics practices to enhance the competitiveness of small and medium size wine firms in the global market.

Ethical concerns

The implementation of artificial intelligence in marketing raises several ethical concerns (Radanliev 2025). They are particularly relevant in sectors such as wine, where consumer trust, authenticity, and tradition play a central role in brand awareness and purchase decisions; for this reason, require careful consideration.

While AI enables more accurate consumer segmentation, personalized offerings, and efficient data utilization, it also entails significant risks related to privacy, transparency, and the potential manipulation of consumer behavior (Wang et al. 2025). A central issue is the use of personal data, often collected and processed without consumers being fully aware of its scope and purpose. A higher personalization can decrease privacy protection and perceived security if data is used without authorization or is subject to breaches (Du & Xie 2021).

In particular, issues related to consumer trust, privacy, and information disclosure emerge as central concerns. For instance, the perceived anthropomorphism of AI systems can increase trust and decision confidence, while simultaneously reducing users' willingness to share personal data due to heightened privacy concerns (Wang et al. 2024). Similarly, the use of AI in service interactions, such as recommendation systems or robotic assistants, raises context-dependent trust dynamics and potential discomfort in consumer experiences (Lu et al. 2024).

Closely related is the challenge of algorithmic transparency, since many AI systems operate as "black boxes," making it difficult to understand the logic behind automated recommendations and decisions. This lack of clarity may undermine trust and raise concerns about fairness (Park and Young Yoon 2025). Increasing the explainability of AI systems is essential to preserve consumer confidence and to ensure that firms remain accountable for the outputs of their algorithms. For example, AI-generated reviews may be perceived as authentic human experiences, potentially misleading consumers (Carlson et al. 2023), while generative AI can be used to create fictitious sustainability signals, increasing the risk of "machinewashing" practices in wine marketing (Sigurdsson et al. 2025).

Moreover, AI-driven hyper-personalization risks crossing the boundary between legitimate customization and the exploitation of consumers' psychological vulnerabilities (Mohan et al. 2025). At the same time, biased datasets can reinforce existing stereotypes or exclude specific consumer groups, thereby raising questions of inclusivity and social justice (Kreutzer et al. 2025).

From a broader perspective, several studies also emphasize issues of inclusion, access, and regulatory frameworks. The adoption of advanced technologies such as AI, blockchain, and digital platforms may create structural inequalities, potentially excluding small producers due to high implementation costs (Ibáñez-Jiménez and Palomo-Zurdo 2024). Similarly, the rapid development of digital environments, such as the metaverse, raises concerns related to data protection, cybersecurity, and unequal access to digital infrastructures (Monaco and Sacchi 2023).

These findings indicate that the integration of AI into marketing-related processes must be accompanied by careful consideration of ethical and regulatory dimensions, particularly in relation to consumer trust, transparency, and equitable access to technological innovation.

Future prospects for AI development in marketing analytics

The findings of this study also provide indications for future developments in the application of AI within the wine sector. In particular, the limited number of studies applying AI to core marketing analytics functions suggests that future research could further explore the use of AI for segmentation, personalization, and consumer behavior prediction (Chatterjee et al. 2021). While some contributions already highlight the potential of AI-based tools for supporting data-driven marketing decisions (Tian 2024; Mu et al. 2022), their application remains relatively underdeveloped compared to technical and production-oriented uses.

In addition, prior literature highlights that the effectiveness of AI in marketing contexts is strongly dependent on the availability and quality of consumer-level data, which may represent a constraint, particularly for SMEs (Wamba-Taguimdje et al. 2020); it was confirmed by existing study (Rialti and Zollo 2023), suggesting the need for further research on scalable and accessible solutions that enable the integration of AI into marketing analytics processes.

From a technological perspective, the literature shows that current applications are mainly based on machine learning models and recommender systems for consumer preference analysis and personalized suggestions (Tian 2024; Mu et al. 2022), as well as natural language processing techniques for the analysis and generation of user-generated content (Carlson et al. 2023). At the same time, emerging approaches based on generative AI are increasingly being explored for marketing communication and content creation (Sigurdsson et al. 2025; Melas et al. 2024).

These developments reinforce the central role of data-driven approaches, where the availability of structured and unstructured consumer data enables the application of AI algorithms to support wine marketing analytics functions. In this sense, future research could further investigate how different AI techniques can be effectively combined with wine consumer data to enhance segmentation, personalization, and predictive modeling capabilities in the wine sector. Indeed, the use of predictive algorithms and advanced language models can facilitate the development of highly personalized wine marketing contents, reducing time and costs (Haefner et al. 2021).

Finally, the increasing use of AI in consumer-facing applications raises important challenges related to transparency, data protection, and algorithmic bias (Wang et al. 2025); Du Plessis 2025). As highlighted by several studies included in this review, these aspects are particularly relevant in marketing contexts, where AI-driven decisions directly influence wine consumer perceptions and behaviors (Wang et al. 2024; Sigurdsson et al. 2025). Future research could therefore investigate how to balance the effectiveness of AI-based marketing analytics with ethical and regulatory requirements (Omotayo et al. 2025; Ashok et al. 2022).

Conclusion

This study aimed to provide a structured overview of the application of artificial intelligence in the wine sector, with a specific focus on its implications for marketing analytics. The results reveal a clear imbalance in the current literature: while AI is widely applied in technical and operational domains (such as production, quality control, and traceability), its integration into marketing analytics processes remains limited. Despite the growing availability of AI technologies, only a small subset of studies applies these tools to core marketing analytics functions, such as segmentation, personalization, and consumer behavior prediction. As a consequence, the potential of AI to support data-driven marketing decision-making in the wine sector is still largely underexplored. The findings also suggest that the current stage of AI adoption can be interpreted as transitional. While a variety of AI techniques are increasingly available, such as machine learning, recommender systems, natural language processing, and generative AI, their application remains predominantly disconnected from consumer-level data and marketing analytics practices. From this perspective, the wine sector can be considered a data-rich agri-food system, where a more effective integration of AI into marketing analytics could support not only firm-level decision-making but also broader processes of value creation and differentiation within the supply chain.

While data-driven approaches are increasingly shaping decision-making processes across industries, the findings suggest that the wine sector has not yet fully leveraged the potential of available data for marketing analytics purposes. Although substantial amounts of data are generated across the wine system (particularly in production and operational processes), their integration into consumer-oriented analytics remains limited. This reinforces the need for future research focused on bridging the gap between data availability and its effective use in AI-driven marketing decision-making.

Appendix

See Table 2.

Table 2 Scientific documents extracted using PRISMA protocol

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
1	2025	Article(CrossRef)	*European Journal of Innovation Management*	Festa, G.; D'Amato, A.; Palladino, R.; Papa, A.; Cuomo, M.T	Digital transformation in wine business – from Marketing 5.0 to Industry 5.0 in the world of wine adopting artificial intelligence	Impact of artificial intelligence on digital transformation in the wine industry and transition within Marketing 5.0	The interviewees (wine business operators) recognized that AI has the potential to reduce environmental impact, increase business efficiency and productivity, optimize marketing strategies, and improve economic and financial performance
2	2025	Review(CrossRef)	*Foods*	Ma, Y.; Li, Y.; Shao, F.; Lu, Y.; Meng, W.; Rogers, K.M.; Sun, D.; Wu, H.; Peng, X	Advancing Stable Isotope Analysis for Alcoholic Beverages' Authenticity: Novel Approaches in Fraud Detection and Traceability	Use of stable isotope analysis as a powerful tool for verifying the authenticity and traceability of alcoholic beverages	Stable isotope improves the authenticity and traceability of alcoholic beverages and wine. Results provide key elements for branding quality wines, objective differentiation and identification of fraud, gaining the trust of consumers
3	2025	Review(CrossRef)	*NUTRITION RESEARCH*	Hans, S; Zabetakis, I; Lordan, R	The potential cardioprotective bioactive compounds in fermented alcoholic beverages: Mechanisms, challenges, and opportunities in beer and wine	Explore the cardioprotective potential of bioactive compounds found in fermented alcoholic beverages—particularly wine and beer	There is a growing trend towards innovation in health-oriented products, positioning dealcolized or functional wines as credible alternatives for health-conscious consumers. This opens up strategic opportunities for branding, premium positioning and the development of derivative nutraceutical products

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
4	2025	Article(CrossRef)	*Food Control*	Zanchin, A.; Vincenzi, S.; Guerrini, L	Effervescence description of No-Low alcohol wines at different temperatures and ethanol concentrations through image analysis	Provide a detailed assessment of the foamability of sparkling dealcolized or low alcohol wines across various levels of dealcoholisation and temperatures using AI-driven image analysis	AI can optimize the perception of the visual appeal of sparkling wines, improving the consumer experience and supporting the marketing of emerging wine categories such as dealcolized or low alcohol wines with potential health benefits to consumers
5	2025	Article(CrossRef)	*Psychology and Marketing*	Sigurdsson, V.; Larsen, N.M.; Folwarczny, M.; Dubois, M.; Fagerstrøm, A	Putting an artificial intelligence-generated label on it comes naturally	Fictitious artificial intelligence-generated labels and backgrounds impact on wine consumers' perceptions, susceptibility to sustainability signaling, willingness to buy, and purchasing decisions	Wines with sustainability labels, both authentic and AI-generated, lead to a higher willingness to buy and pay, highlighting consumers' susceptibility to such signs and suggesting that AI-generated labels can be equally persuasive in shaping consumer perceptions
6	2024	Article(CrossRef)	*ADMINISTRATIVE SCIENCES*	Aman, EE; Papp-Váry, AF; Kangai, D; Odunga, SO	Building a Sustainable Future: Challenges, Opportunities, and Innovative Strategies for Destination Branding in Tourism	Explore the impact of sustainable branding strategies and territorial marketing on consumer perception, with a particular focus on wine tourism, analyzing trends, challenges and emerging strategies	Artificial intelligence and sustainability are reshaping branding strategies and territorial marketing, predicting consumer preferences and improving brand appeal
7	2024	Conference paper(CrossRef)	*2024 IEEE 3rd International Conference on Electrical Engineering, Big Data and Algorithms, EEBDA 2024*	Tian, S	Design and Implementation of Marketing Classification System Based on Artificial Intelligence	Investigate the application of machine learning and artificial intelligence for classification and analysis of marketing data in the high-end wine industry	AI has a high potential in the strategic and operational management of wineries, with a particular focus on the interaction between AI and environmental sustainability

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
8	2024	Article(CrossRef)	*Journal of Agriculture and Food Research*	Aiello, G.; Tosi, D	An Artificial Intelligence-based tool to predict "unhealthy" wine and olive oil	Design and evaluate a machine learning tool capable of predicting the quality (or "unhealthiness") and geographical origin of wine, with the aim of proposing a customizable framework for use by operators in the sector	Classification based on artificial intelligence can improve product authenticity, increase consumer confidence and optimize quality control processes, enhancing the role of artificial intelligence in fraud detection and marketing transparency in the wine industry. AI is highly effective in identifying fraudulent or mislabeled products
9	2024	Review(CrossRef)	*HELIYON*	Frigerio, J; Campone, L; Giustra, MD; Buzzelli, M; Piccoli, F; Galimberti, A; Cannavacciuolo, C; Larbi, MO; Colombo, M; Ciocca, G; Labra, M	Convergent technologies to tackle challenges of modern food authentication	Explore how artificial intelligence, nanotechnology, and DNA barcoding are revolutionizing food authentication, including in the wine industry	Machine vision, spectroscopy and molecular markers can improve traceability, fraud prevention and quality control. Combining artificial intelligence with blockchain-based traceability systems increases transparency and consumer confidence

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
10	2024	Article(CrossRef)	*Foods*	Wang, H.; Jeffery, D.W	Machine Learning Model Stability for Sub-Regional Classification of Barossa Valley Shiraz Wine Using A-TEEM Spectroscopy	Evaluate the stability and accuracy of machine learning models for classifying Shiraz wines from five sub-regions of the Barossa Valley using A-TEEM spectroscopy	The method has an exceptionally high classification accuracy, even for aged or blended wines. The robustness of the method offers strong support for branding based on terroir and sub-regional differentiation, helping to achieve a premium position on the market and to combat wine fraud
11	2024	Article(CrossRef)	*REVESCO-REVISTA DE ESTUDIOS COOPERATIVOS*	Ibáñez-Jiménez, JW; Palomo-Zurdo, R	Wine tokenization: the opportunity of DLT technology for the economic and social challenges of the wine sector	Explore how Distributed Ledger Technology (DLT) and blockchain-based tokenization can transform the wine industry's digitalization	Tokenization of wine enables better traceability, authentication and market transparency, reducing fraud and improving consumer confidence. Tokenization, blockchain, AI and IoT all play a role in creating secure, transparent and efficient wine markets. The legal, economic and technological barriers to digital wine markets are also examined

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
12	2024	Article(CrossRef)	*International Journal of Hospitality Management*	Lu, L.; Hua, M.; Sun, X.; Zou, R.; Lin, B	AI robots over sommeliers? Exploring the service provider effect on diners' wine ordering decisions at restaurants	Investigate how the type of service provider—human sommelier versus AI-powered service robot—affects consumer behavioral intentions when ordering wine in restaurants	Consumers feel more confident when ordering wine from AI robots, helping to reduce the stress of choosing wine in situations with high social pressure. In more confidential situations, human sommeliers generate greater trust and a stronger preference for their recommendations, particularly among consumers with a low knowledge of wine
13	2024	Article(CrossRef)	*Food Technology and Biotechnology*	Kurtanjek, Ž	Causal Artificial Intelligence Models of Food Quality Data	Apply artificial intelligence causal modeling to analyze and predict wine quality; discover the causal relationships between measurable physicochemical variables and subjective quality assessments provided by consumers and experts	Causal AI models can more accurately identify direct and indirect influences on quality perception, showing the limitations of traditional regression models. AI can be exploited for sensory analysis, predictive modeling and optimization of wine production to meet consumer preferences

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
14	2024	Conference paper(CrossRef)	*Proceedings of 9th International Conference on Science, Technology, Engineering and Mathematics: The Role of Emerging Technologies in Digital Transformation, ICONSTEM 2024*	Geetha, C.; Arunsundar, B.; Vasumathi, G.; Thamizhazhakan, K.; Sudhakar, C.V	Decoding AI: Experimental Analysis of Artificial Intelligence based Wine Quality Prediction Logic using Convoluted Deep Classification Strategy	Develop and evaluate a novel deep learning framework (Convoluted Deep Classification) for accurately predicting wine quality by extracting hierarchical features from chemical and sensory wine data	Classification models based on artificial intelligence can be used to optimize product quality, predict consumer preferences and support marketing strategies in the wine industry. Deep learning techniques significantly improve predictive accuracy, making them valuable tools for quality assessment, production optimization and consumer preference analysis
15	2024	Article(CrossRef)	*Acta Horticulturae*	Fuentes, S.; Tongson, E.; Hernandez-Brenes, C.; Valiente-Banuet, J.; Villarreal-Lara, R.; De Anda-Lobo, I.; Harris, N.; Dutton, J.; Mattioli, F.; Viejo, C.G	Perception and acceptability of artificial intelligence applications in viticulture and wine by consumers from Mexico and Australia	Examine consumer attitudes toward AI-driven technologies in the wine production chain	Consumers are more willing to accept AI technologies used in the vineyard than those that influence the final product. This study highlights the importance of consumer confidence in AI-driven wine innovations, cultural differences in technology acceptance, and potential barriers to the adoption of AI in wine branding and production

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
16	2024	Conference paper(CrossRef)	*2024 15th International Conference on Computing Communication and Networking Technologies, ICCCNT 2024*	John, A.; Damodar, N.; Mohith, N.; Vijayan, B	Understanding Red Wine Quality with Feature Importance in Machine Learning and Explainable AI	Explore the application of machine learning models to classify and predict red wine quality	The study proposes AI as an objective and data-driven alternative for wine evaluation. AI-guided classification and feature analysis can optimize wine quality control, improve product differentiation, and refine marketing strategies based on predictive consumer preferences
17	2024	Article(CrossRef)	*New Media and Society*	Wang, Y.; Liu, W.; Yao, M	Which recommendation system do you trust the most? Exploring the impact of perceived anthropomorphism on recommendation system trust, choice confidence, and information disclosure	Investigate how the characterization of recommendation systems (such as AI assistants) affects the anthropomorphism perceived by users and, consequently, their trust and privacy protection	A greater perception of anthropomorphism increases trust in recommendations and confidence in choices, but decreases the willingness to share personal information
18	2024	Conference paper(CrossRef)	*Smart Innovation, Systems and Technologies*	Melas, D.; Kalabisová, J.; Kubátová, A.; Gavurová, B.; Zelený, J	Wine Consumers' Attitudes Toward AI-Generated Images of Wine Regions: Exploring Relationship Between Preferences and Imaginative Conceptions	Explore the relationship between wine consumers' preferences and their imaginative conceptions elicited by AI-generated images of wine regions	Images of wine regions generated by artificial intelligence can influence consumer preferences towards buying wine or visiting wine tastings, brand perception and engagement strategies. These results demonstrate the psychological and behavioral effects of artificial intelligence-generated visual marketing materials

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
19	2023	Book(CrossRef)	*Digital Transformation of SME Marketing Strategies: Innovating for the 4.0 Era*	Rialti, R.; Zollo, L	Digital Transformation of SME Marketing Strategies: Innovating for the 4.0 Era	Review the existing literature on innovation and new technologies in SME marketing, on what they could do and what they should avoid	The practical strategic framework developed could be used by SMEs that wish to effectively innovate their marketing strategies in the contemporary digital era. In addition, it is studied how AI, big data, blockchain, IoT and digital payments are redesigning the marketing approaches of small and medium-sized enterprises (SMEs)
20	2023	Conference papaer(CrossRef)	*BIO Web of Conferences*	Kucherenko, V	Complex automation of processes at the enterprise	Introduce an AI and blockchain-based digital identification system designed to provide electronic traceability of wine and alcoholic beverages (SCANDARD system)	The proposed methodology for the system improves logistic efficiency, brand protection and tax compliance, helping to combat the illegal production and sale of wine. In addition, it facilitates personalized marketing strategies through direct interaction with consumers, offering features such as loyalty programs and targeted promotions based on consumer behavior

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
21	2023	Article(CrossRef)	*ANALYTICAL METHODS*	Abi-Rizk, H; Bouveresse, DJR; Chamberland, J; Cordella, CBY	Recent developments of e-sensing devices coupled to data processing techniques in food quality evaluation: a critical review	Analyze the use of electronic sensory systems, in particular electronic nose, electronic tongue and electronic eye, combined with chemometric techniques for the evaluation of the quality of food and wine	The adoption of e-sensing technologies improves the ability to objectively evaluate and guarantee the quality attributes of food, enhancing the positioning of products based on sensory excellence, building consumer confidence and supporting premium branding strategies, especially in competitive and quality-sensitive sectors such as wine and gourmet foods
22	2023	Article(CrossRef)	*International Journal of Research in Marketing*	Carlson, K.; Kopalle, P.K.; Riddell, A.; Rockmore, D.; Vana, P	Complementing human effort in online reviews: A deep learning approach to automatic content generation and review synthesis	Explore the use of transformer-based deep learning models in marketing to generate and synthesize content, such as online reviews, and offer relevant insights for wine marketing	AI helps to reduce the workload of experts, streamline the management of reviews for companies and improve consumer decision-making in online markets
23	2023	Opinion(CrossRef)	*Sustainability (Switzerland)*	Monaco, S.; Sacchi, G	Travelling the Metaverse: Potential Benefits and Main Challenges for Tourism Sectors and Research Applications	Exploring the opportunities and challenges posed by the Metaverse in the context of food and wine tourism to transform consumer experiences	To expand the consumer experience, food and wine in the Metaverse can open up new and unconventional possibilities, such as the opportunity to visit production sites, wineries or farms in different states or countries and to interact with influencers and chefs

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
24	2022	Book's chapter(CrossRef)	*Social Impact of Wine Marketing*	Ramšak, M	Wearable Technology and Wine	Investigate the social and cultural consequences of digital wine marketing, focusing on how the sector exploits new technologies to influence consumption patterns and avoid legal regulations	Digital media increase user engagement and normalize wine consumption. The book invites marketers to think critically about responsible innovation, urging a balance between commercial success and public health responsibility
25	2022	Article(CrossRef)	*Italian Journal of Food Science*	Mu, W.; Feng, Y.; Shu, H.; Wang, B.; Tian, D	Wine recommendation algorithm based on partitioning and stacking integration strategy for Chinese wine consumers	Develop a framework based on a personalized wine recommendation system for Chinese consumers, predicted by using various AI algorithms	The proposed method significantly improves the accuracy of recommendations for most wine attributes, surpassing traditional single-model approaches. The study identifies key consumer characteristics that influence preferences, improving the model's ability to provide relevant and personalized recommendations. This approach allows for hyper-personalization in wine promotion

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
26	2021	Conference paper(CrossRef)	*IFIP Advances in Information and Communication Technology*	Gayialis, S.P.; Kechagias, E.P.; Konstantakopoulos, G.D.; Papadopoulos, G.A.; Tatsiopoulos, I.P	An Approach for Creating a Blockchain Platform for Labeling and Tracing Wines and Spirits	Propose a platform based on blockchain technology with the aim of developing a unique system for the wine industry, aimed at guaranteeing traceability along the entire supply chain, preventing fraud, improving product control and protecting both consumers and producers	Implementing the platform as Blockchain-as-a-Service (BaaS) can significantly reduce counterfeiting, improve production efficiency and build consumer trust by enabling end users to verify the origin and quality of products in real time through smart labeling
27	2021	Article(CrossRef)	*Journal of Retailing and Consumer Services*	Taghikhah, F.; Voinov, A.; Shukla, N.; Filatova, T	Shifts in consumer behavior towards organic products: Theory-driven data analytics	Examine the gap between wine consumer intention and behavior through the use of advanced machine learning techniques, investigating the willingness to pay for organic wine, integrating five behavioral theories	By applying supervised and unsupervised machine learning models, the research goes beyond simple correlations to identify causal relationships, highlighting that trust in organic wine, environmental concerns, price sensitivity and habitual purchasing patterns are determining factors for the adoption of organic wine
28	2020	Conference paper(CrossRef)	*2020 3rd International Conference on Artificial Intelligence and Big Data, ICAIBD 2020*	Zhang, S.; Shao, C.; Xiao, W	Research on Red Wine Quality Based on Data Visualization	Determine which attributes have the greatest impact on wine quality by applying data mining and visualization techniques	Artificial intelligence-driven data visualization and machine learning techniques can improve quality control, support the formulation of marketing strategies and refine consumer targeting in the wine industry

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
29	2019	Review(CrossRef)	*Foods*	Viejo, C.G.; Torrico, D.D.; Dunshea, F.R.; Fuentes, S	Bubbles, foam formation, stability and consumer perception of carbonated drinks: A review of current, new and emerging technologies for rapid assessment and control	Explore the role of bubbles and foam in sparkling wine, through evaluation and quality control methods based on emerging technologies, discussing how artificial intelligence can be used to evaluate sensory descriptors and consumer perception/acceptance	Artificial intelligence-guided sensory analysis can improve product consistency, the prediction of consumer preferences and the automation of beverage production, demonstrating the potential of this methodology in optimizing sparkling wine quality and branding strategies
30	2014	Article(CrossRef)	*International Journal of Production Economics*	Ting, S.L.; Tse, Y.K.; Ho, G.T.S.; Chung, S.H.; Pang, G	Mining logistics data to assure the quality in a sustainable food supply chaIn A case in the red wine industry	Present a quality sustainability decision support system (QSDSS) applied to the wine sector, for the improvement of quality management and food safety for consumers	AI and data mining techniques can improve the quality assurance and sustainability of wine supply chains, highlighting the role of AI in optimizing logistics, maintaining quality and improving consumer perception through greater supply chain transparency

Table 2 (continued)

Refs. no.	Year	Type of document	Name of journal/ book	Authors	Title	Summary of objective	Summary of findings
31	2013	Article(CrossRef)	*INTERNATIONAL JOURNAL OF FOOD ENGINEERING*	Latorre-Biel, JI; Jiménez-Macías, E; Blanco-Fernández, J; Sáenz-Díez, JC	Decision Support in the Rioja Wine Production Sector	Develop a decision support methodology suitable for SMEs in the Rioja wine sector, with the aim of optimizing wine production management through artificial intelligence tools, especially under the pressure of globalization, competition and increasingly complex supply chains	The implementation of AI-driven decision tools enhances agility, quality control, and strategic planning, which are vital for maintaining competitive positioning in high-quality wine markets. It empowers producers to react quickly to market demands, optimize product consistency, and support value-based storytelling around tradition, efficiency, and innovation—key factors in branding and consumer trust

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Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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