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The Governance Approach of Certified Quality Wine Consortia With Regard to the Four Dimensions of Sustainability: SAFA and SSGI Methodologies

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ABSTRACT

The transition of the agri-food system toward sustainability necessitates robust assessment frameworks to both guide and evaluate stakeholder performance. This study applies the *Sustainability Strategy for Geographical Indications* (SSGI) to assess the governance role of Sicilian quality wine consortia in promoting sustainability among their affiliated members. Using a customised questionnaire encompassing 84 SSGI indicators, the research evaluates the performance of these Sicilian organisations across the four pillars of sustainability. The findings reveal a fragmented and uneven level of engagement: While several consortia exhibit moderate performance in economic and governance dimensions, significant weaknesses emerge in the social and environmental pillars. Limited strategic planning, insufficient internal accountability and the absence of shared sustainability objectives impede the systemic integration of sustainable practices. This study highlights the potential of the SSGI framework to serve as a practical guideline for geographical indication organisations and producers, facilitating the identification of sustainability priorities, the monitoring of progress and fostering continuous improvement. The Sicilian case study provides a valuable example of the broader challenges encountered within the Geographical Indication systems, underscoring the imperative for integrated and collaborative strategies that align the pursuit of quality production with core sustainability principles.

1 | Introduction

The agri-food system exerts a considerable impact on the environment, necessitating that all actors and stakeholders along the supply chain adopt increasingly sustainable practices [1, 2]. Assessing effective participation in this transition, i.e., the state of the art in terms of tangible improvement, requires robust scientific tracking of firm-level performance within the agri-food system [3]. In recent years, achieving sustainability has gained recognition as a pivotal instrument for facilitating this transition [4, 5]. Nevertheless, evaluating sustainability remains challenging, highlighting the need for a scientifically reliable method for its assessment [6].

Within this context, the wine sector represents a particularly relevant case for analysis, given its economic significance in both Italy and Europe and its representativeness of the broader agri-food system [7, 8]. Another rationale for focussing on this sector is the prevalence of high-quality productions along the wine value chain, which is regulated by legally established standards at the European level and by specifications at the local level [9]. According to Italian national statistical sources, the wine sector generated a total turnover of EUR 14 billion in 2024, representing

10% of the total agri-food sector turnover. The sector comprises 241,000 wine-growing enterprises, of which 30,000 are wine-makers. Total wine production amounted to 44.1 million hectolitres, 55% of which was produced under quality geographical indications (GIs), including 529 protected designation of origin (PDO) and protected geographical indication (PGI) recognitions, of which 77 are controlled and guaranteed designation of origin (DOCG), 333 controlled designation of origin (DOC) and 119 typical geographical indication (IGT), following the Italian classification of quality wines. Per capita wine consumption in Italy stands at 37.8 L [10].

Quality production provides a foundation for sustainable practices, as the standards required for specific quality labels align with sustainability principles [11, 12]. Sustainability encompasses multiple dimensions, environmental, social, economic and governance, while GI certifications partially address these aspects. For instance, GI processes positively influence local governance, a factor recognised by the *Food and Agriculture Organization* (FAO) *of the United Nations* as critical to sustainability [13, 14].

However, the global shift toward sustainability, driven by institutional agendas, necessitates broader adaptations across domestic economic sectors, including agri-food, beyond the scope of quality certification alone. In this context, quality labels also function as market differentiation tools, guiding conscious consumers seeking products aligned with sustainable consumption patterns [15]. Therefore, evaluating the sustainability performance of firms engaged in certified wine production is particularly relevant. The success of the GI quality productions depends on collaborative value creation among stakeholders [16], and adopting such collaborative approaches may enhance sustainability performance within the wine sector.

This study focuses on the consortia of quality wine producers, which serve as key institutional actors representing the context of quality wine production. Given their mandate to oversee and enforce compliance with GI production regulations, consortia are positioned to exert a more influential governance role than other stakeholders, such as cooperatives or private wineries. In Italy, quality wine consortia are central institutions responsible for managing PDO and PGI designations. Distinguishing between Voluntary Consortia, representing informal producer associations, and Protection Consortia, formally recognised by the Italian Ministry of Agriculture, clarifies the analytical framework. Protection Consortia are delegated public-interest functions for safeguarding and promoting quality production, as defined by the national Consolidated Text of Wine (Law No. 238/2016) and European Regulation (EU) No. 1308/2013, as amended by Regulation (EU) No. 2021/2117. These functions include countering counterfeiting, managing production specifications, providing technical support and regulating supply. Uniquely, Protection Consortia can exercise *erga omnes* powers if they meet representativeness requirements, allowing them to make binding decisions and impose financial contributions on all supply-chain operators, thus ensuring cohesive governance of GIs. Recent updates to the European Common Agricultural Policy further expand the consortia's responsibilities, integrating environmental, social and economic sustainability objectives into production specifications. Consequently, consortia now operate not only as guarantors of quality and origin but also as strategic promoters of sustainability.

The present study evaluates the role of Sicilian wine consortia in guiding their members toward sustainable practices, using the *Sustainability Strategy for Geographical Indications* (SSGI) framework. Due to practical constraints in conducting nationwide or international sustainability assessments, the analysis focuses on Sicily, a region notable for adopting certified, sustainability-oriented production models. In 2023, Sicily had a vineyard area of 95,760 ha (13.3% of Italy's total, according to *Unione Italiana Vini*), ranking second nationally and leading in organic viticulture. The *Nomisma Wine Regions Competitiveness Observatory* reports that Sicily hosts the largest organic vineyard in Italy, accounting for 25% of the national organic vineyard area (2024 data). Beyond organic practices, integrated production protocols, supported by *Regional Development Plans* aid schemes and the national *SQNPI–National Integrated Production Quality System* certification, have contributed to sustainability by reducing environmental impacts through optimised chemical inputs.

Sicilian viticulture is further shaped by diverse sustainability standards to meet growing international market demands. The SOStain Sicilia Foundation has developed a region-specific sustainable production standard, while numerous wineries have adopted the globally recognised Equalitas standard, encompassing environmental, social and economic dimensions with measurable indicators. Additionally, many Sicilian producers participate in the VIVA program (Sustainability in the Italian Wine Sector), promoted by the Italian Ministry of the Environment, which assesses and improves sustainability performance across environmental, social, economic and cultural parameters. The integration of public and private sustainability initiatives creates a productive ecosystem where sustainability is a strategic driver for regional wine value.

Sicily also ranks highly in terms of GI products, with 36 agri-food products and 31 wines, placing it sixth among Italian regions by the number of GIs. In terms of the economic value of quality wines, Sicily ranks eighth nationally, with a production value of EUR 450 million [17]. Fifteen Sicilian quality wine consortia oversee the protection and promotion of 19 certified wines; four are Voluntary Consortia, and seven are officially recognised Protection Consortia. Table 1 provides a concise overview of each organisation's characteristics. Both Voluntary and Protection Consortia were included to ensure comprehensive representation of the Sicilian context.

The study addresses the following research questions:

> RQ1: "To what extent can the SSGI framework support the empirical assessment of Sicilian quality wine consortia in guiding their members toward sustainable production?"
>
> RQ2: "Considering the collective nature of GI quality productions, integrate environmental, social and economic objectives into their governance strategies to transform sustainability from a latent commitment into a competitive advantage?"

2 | Materials and Methods

2.1 | The SSGI

Since 2016, the FAO *of the United Nations* and the *Organization for an International Geographical Indications Network* (oriGIn) have collaborated to develop the SSGI.

TABLE 1 | Quality wine consortia overview.

IG denomination	Consortia	Main characteristics
Alcamo DOP	Strada del Vino Alcamo DOC	Includes the following types of wine: Bianco, Rosso, Rosato, Spumante Bianco, Spumante Rosé, Bianco Vendemmia Tardiva and Novello. The reference production area includes the territory of several municipalities in the provinces of Trapani and Palermo.
Cerasuolo di Vittoria DOP	Consorzio volontario di tutela Cerasuolo di Vittoria DOCG e Vittoria DOC	The appellation of origin under discussion is limited to red wine, and the designated production area encompasses the territory of several municipalities within the provinces of Ragusa, Caltanissetta and Catania.
Vittoria DOP		The wines Rosso and Novello Bianco (exclusively indicated by grape variety) are rooted in the territory of numerous municipalities in the provinces of Ragusa, Caltanissetta and Catania.
Contea di Sclafani DOP	Consorzio Tutela Contea di Sclafani DOC	Produces Bianco, Rosso, Bianco Riserva, Rosso Riserva, Vendemmia Tardiva Bianco and Vendemmia Tardiva Rosso wines in several municipalities in the provinces of Palermo, Caltanissetta and Agrigento.
Eloro DOP	Consorzio di Tutela del Vino DOC Eloro e Moscato di Noto	The wines are red and rosè. They are produced in the municipalities of Noto, Pachino, Portopalo di Capo Passero and Rosolini in the province of Syracuse and Ispica in the province of Ragusa.
Noto DOP		This wine is made from the types of grapes Rosso, Bianco, Spumante, Passito and Liquoroso (but only if the grape variety is indicated). It comes from the municipalities of Noto, Rosolini, Pachino and Avola in the province of Syracuse.
Erice DOP	Strada del Vino Erice DOC	Wines are numerous, i.e. Bianco, Rosso, Spumante and Passito. The production area includes the municipalities of Buseto Palizzolo and parts of Erice, Valderice, Custonaci, Castellammare del Golfo, Paceco and Trapani in the province of Trapani.
Etna DOP	Consorzio di Tutela Vini Etna DOC	Regards the production of Bianco, Bianco Superiore, Rosso, Rosato, Spumante Bianco and Spumante Rosato wines in the area of 20 municipalities in the province of Catania.
Faro DOP	Consorzio di Tutela Vini DOC Faro	It is a type of red wine that is only produced in the Messina area.
Malvasia delle Lipari DOP	Consorzio volontario per la tutela e la valorizzazione dei vini Malvasia delle Lipari DOC e IGP Salina	It includes Bianco, Passito and Liquoroso wines, and is produced in the area of the Aeolian Islands archipelago (or Lipari) in the province of Messina.
Salina IGP		The production of wine includes Bianco, Rosso, Rosato and Novello wines, which are all made on the Aeolian Islands in the province of Messina.

(Continues)

TABLE 1 | (Continued)

IG denomination	Consortia	Main characteristics
Marsala DOP	Consorzio Tutela Marsala DOC	Includes the following types of wine: Marsala Oro, Marsala Ambra and Marsala Rubino. The production area is all of Trapani province, except for the municipalities of Pantelleria, Favignana and Alcamo.
Monreale DOP	Consorzio Tutela DOC Monreale	This includes white, red, rosé, late harvest and Novello wines made in the areas of Monreale and Piana degli Albanesi, and in all of the municipalities of Camporeale, San Giuseppe Jato, San Cipirello, Santa Cristina Gela, Corleone and Roccamena in the province of Palermo.
Pantelleria DOP	Consorzio Volontario per la tutela e la valorizzazione dei vini a DOC dell'Isola di Pantelleria	The denomination includes the production of White, Moscato Spumante, Moscato Liquoroso, Moscato Dorato, Passito Liquoroso, Zibibbo Dolce, Moscato di Pantelleria and Passito di Pantelleria wines in the areas of the island of Pantelleria in the province of Trapani.
Riesi DOP	Strada del Vino e dei Sapori dei Castelli Nisseni	It produces different types of wine, including Bianco, Rosso, Rosato, Spumante, Vendemmia Tardiva and Novello. These wines are all made in the Butera, Riesi and Mazzarino areas of the Caltanissetta province.
Salaparuta DOP	Consorzio Volontario di Tutela Vini DOC Salaparuta	This includes Bianco, Rosso and Novello wines, which are all produced in the Salaparuta municipality in the Trapani province.
Sambuca di Sicilia DOP	Associazione Strada del Vino Terre Sicane	This includes white, red, rosé and sweet wines made in the Sambuca di Sicilia area of Agrigento.
Santa Margherita di Belice DOP		The denomination includes white and red wines. The production area is in the municipalities of Santa Margherita di Belice and Montevago in the province of Agrigento.
Sicilia DOP	Consorzio di Tutela Vini DOC Sicilia	The denominations refer to different types of wine: Bianco (including Riserva), Bianco Superiore, Rosso (including Riserva), Rosato, Spumante Bianco, Spumante Rosé, Vendemmia Tardiva Bianco, Vendemmia Tardiva Rosso, Passito Bianco and Passito Rosso. It is produced in the whole of Sicily.

The primary aim of this initiative is to support GI producers and their associations in measuring, monitoring and achieving tangible progress in sustainability performance with relevant indicators. The SSGI framework enables GI producers to evaluate their operational context, identify critical issues and design strategies to enhance sustainability performance. The SSGI framework is grounded in several key principles: continuous improvement of sustainability performance; the role of the territory of origin in shaping the specificities of GIs; the voluntary nature of quality GI production; alignment with other recognised sustainability frameworks; recognition of sustainability as both an individual and collective, necessitating multiple types of indicators and cooperation as a fundamental element for sustainable development [11].

The SSGI framework adopts a hierarchical structure similar to that of the *Sustainability Assessment of Food and Agriculture systems* (SAFA) framework, a world-recognised scientifically robust method developed by the FAO in 2014 for the agri-food sector. SAFA employs a holistic approach, encompassing four fundamental dimensions (environmental integrity, economic resilience, social welfare and good governance) organised into 21 themes, 58 subthemes and 116 indicators. FAO guidelines, published in 2014, delineate this structure [18]. The framework is scalable, applicable to contexts ranging from individual producers to entire value chains and allows analyses to be tailored to specific operational environments [6]. Additional reference standards informing the development of the GI sustainability strategy were the *Sustainable Development Goals* (SDGs) of the 2030 sustainability Agenda, the *Global Reporting Initiative* standard, the *Ethos Social Responsibility* framework, the *Fairtrade* and the *Rainforest Alliance* certification indicators and the *United Nations Conference on Trade and Development* (UNCTAD) indicators. By integrating the scientific rigour of the SAFA framework with the specificities of GI systems and aligning with the SDGs, the SSGI methodology is particularly suited for this study. The SSGI framework facilitates the comprehensive mapping of sustainability characteristics for GIs through a comprehensive structured set of indicators aligned with the four fundamental pillars of sustainability: economic resilience, good governance, social well-being and environmental integrity. Within these pillars, 22 sustainability themes, comprising 62 sustainability topics, are assessed through a total of 442 indicators, enabling robust measurement of performance across each topic [17]. The SSGI guide and toolkit provide GI organisations with step-by-step guidance for designing and implementing their own sustainability roadmap. This process begins with identifying shared sustainability priorities, established through a structured stakeholder mapping and engagement phase. This is followed by the performance assessment using the relevant indicators and concludes with the development of an improvement plan [19].

2.2 | Application of the SSGI Framework to the Case Study

The present study adopted a questionnaire-based methodology grounded in the SSGI framework, with the aim of assessing the role of the Sicilian quality-wine consortia in promoting sustainability among their members. The development of an ad hoc questionnaire and the selection of indicators were guided by the SSGI framework, taking into account the characteristics of the production context, data availability and the specific objectives of the research. The selection of indicators was informed by the SSGI framework toolkit, with the aim of identifying those most appropriate to the analysed context. Within the scope of this study, all 442 indicators included in the SSGI framework were initially considered; of these, 84 were selected to evaluate the contribution of consortia to enhancing sustainability in quality wine production systems. The questionnaire comprised a list of 96 questions organised into five sections: (I.) structural and economic data; (II.) economic dimension; (III.) governance dimension; (IV.) social dimension; and (V.) environmental dimension. The indicators were operationalised within these sections, with the measurement requirements associated with each indicator guiding the formulation of the corresponding questionnaire items. This approach also enabled comparative analysis across the Sicilian context. The selected indicators covered the four dimensions of sustainability, comprising 4 themes for the economic dimension (9 subthemes, 22 indicators), 5 themes for the governance dimension (10 subthemes, 27 indicators), 6 themes for the social dimension (12 subthemes, 16 indicators) and 5 themes for the environmental dimension (10 subthemes, 19 indicators), as presented in Table 2. Each indicator was characterised and assigned with a score using a five-point rating scale. This scoring approach is consistent with the methodology adopted by the SAFA assessment framework.

The data collection process involved the administration of interviews based on the ad hoc questionnaire, which includes closed-ended questions (binary or multiple choice in the form of a 'check-all-that-apply' scale) as well as a *Likert*-scale items (ranging from 1 to 5, from '*irrelevant*' to '*highly relevant*'). A member of the research team contacted each of the 15 consortia involved in the protection and promotion of the GI wines in Sicily to request their participation in the survey. The questionnaire, previously translated into Italian to facilitate comprehension, was distributed via email to each organisation. Participants were informed of the voluntary nature of their involvement, their right to withdraw at any time and the data protection measures in place to ensure anonymity and confidentiality in accordance with the *European General Data Protection Regulation* (GDPR) No. 2016/679. Furthermore, it was specified that data would be reported only in aggregate form to preserve the anonymity of participating organisations. The survey was conducted between April and June 2025, with 10 out of 15 organisations participating. The collected data were systematically entered into an Excel spreadsheet for subsequent data management and analysis. Utilising a predefined five-point rating scale, the arithmetic mean was calculated to aggregate individual indicators and derive scores for each sustainability theme. For each organisation, results were visually summarised through spider diagrams, which effectively illustrate performance across the different themes. Finally, aggregated data were used to compute the overall average sustainability performance of all participating organisations within each sustainability dimension.

3 | Results

3.1 | Main Structural Characteristic of Sicilian Quality Wine Consortia

To analyse the role of the Sicilian quality-wine consortia in promoting sustainability, an ad hoc questionnaire based on the SSGI framework was administered. The data collected enabled

TABLE 2 | List of themes included in the SAFA assessment.

Economic resilience (C)	Good governance (G)	Social well-being (S)	Environmental integrity (E)
C1 Investment	G1 Accountability	S1 Community safety and health	E1 Atmosphere
C2 Local economy	G2 Ethics	S3 Decent livelihood	E2 Biodiversity
C3 Product quality and information	G3 Holistic management	S4 Demography	E3 Land
C4 Vulnerability	G4 Participation	S5 Equity	E4 Materials and energy
	G5 Rule of law	S6 Labour rights	E5 Water
		S7 Rewarding commercial practices	

the identification of the main structural and economic characteristics of the sample, comprising ten organisations that participated in the survey. These characteristics are summarised in Table 3.

The consortia were asked whether they were aware of the SSGI strategy developed by the FAO. Only four out of the ten organisations interviewed reported being familiar with it. The radar charts in Figure 1 provide an overview of the sustainability by displaying the performance across the four dimensions of all analysed consortia, while more details of the scores are displayed in Table 4 (also, the detailed results of each Consortia performance are reported in Supporting Information Figure S1–S10). The resulting polygons fall within three performance ranges: scores of 4–5 indicate high performance; scores of 2–3 reflect moderate performance, highlighting areas requiring improvement; and scores of 0–1 denote low or unacceptable performance.

Table 5 presents the average scores derived from the survey results for each theme included in the sustainability assessment of the consortia.

Analysis of the economic dimension revealed that only a limited number of organisations achieved notable results and only across three themes: *investment* (C1), *local economy* (C2) and *vulnerability* (C4). Notably, only Organisation I demonstrated high performance across all three of these themes.

With regard to the governance dimension, Organisations A, D, E, F, G, H, I and J showed good performance in the *participation* theme (G4), while the Organisations A, D, F, G and J performed well in the *rule of law* theme (G5).

Within the social dimension, only Organisation I attained high performance in the themes *decent livelihood* (S3) and *labour rights* (S6).

None of the organisations achieved high scores across the environmental dimension. Indeed, this dimension exhibited the lowest performance overall, with the themes *atmosphere* (E1), *biodiversity* (E2), *materials and energy* (E4) and *water* (E5) exhibiting substandard results for the majority of consortia.

Finally, within the governance dimension, the *accountability* theme (G1), together with most themes within the social dimension, displayed performance levels significantly below the targets established by the SSGI framework.

The analysis presents a structure aligned with the four sustainability dimensions, with the aim of evaluating the overall performance of organisations in promoting sustainability among their members.

3.2 | Economic Resilience

For the economic dimension, the results indicate a limited and uneven level of overall commitment among the consortia (Figure 2). Except for one organisation, all demonstrated only modest engagement in sustainable investments (*investment* C1). Some consortia (B, F, I and J) reported involvement in innovative sustainability-oriented projects, while others (G and I) were engaged in the development of vineyard management plans. A large majority of organisations (7/10) actively promoted or participated in productive or agri-food districts, thereby contributing to the local economic development (*local economy* C2).

TABLE 3 | Characteristics of the analysed consortia (reference year: 2024).

Consortia	Year of acknowledgement	Production area	Vineyard area (ha)	Share of Sicily's GI vineyard area (67,832 ha) (%)	Bottled production (hL)	N. Members	Share of Sicily's GI wine producers (12,574) (%)
A	2017	Eastern Sicily	255	0.38	7339	40	0.32
B	2016	Western Sicily	700	1.03	226	2	0.02
C	2023	Eastern Sicily	400	0.59	1751	20	0.16
D	2018	Eastern Sicily	1350	1.99	30,773	250	1.99
E	2002	Eastern Sicily	16	0.02	179	14	0.11
F	2017	Eastern Sicily	160	0.24	1709	12	0.10
G	2021	Western Sicily	1540	2.27	46,793	17	0.14
H	2014	Western Sicily	359	0.53	8175	297	2.36
I	2006	Western Sicily	93	0.14	277	44	0.35
J	2014	Sicily	24,863	36.65	679,376	5597	44.51

Regarding the *product quality and information* theme (C3), performance varied across organisations. Most consortia (7/10) reported conducting systematic and regular checks to ensure that members' wine labels comply with product specification requirements. Organisation I, despite being the smallest in terms of cultivated area, demonstrated particularly strong performance in this theme, as reflected in several initiatives. These included the development of a programme to mitigate production losses (also undertaken by Organisation G); the implementation of training activities aimed at improving members' awareness and competencies in food safety regulations; the establishment of protocols for the maintenance and sanitation of machinery and processing/storage facilities and the definition of standardised procedures for product withdrawal and recall (also implemented by Organisation G). In addition, Organisations G and I carried out product research projects aimed at improving yields and productivity. Eight out of ten organisations implemented strategies to promote and disseminate certified products, while Organisations B, C and F maintained systematic records of certified products across their target markets.

Regarding the *vulnerability* theme (C4), most organisations (7/10) undertook actions to expand the presence of certified products in new markets, both domestic and international, through targeted incentives and support measures. Organisations E and I provided commercial assistance to member firms to facilitate market access and improve product positioning in Italy and abroad. Consortium I also retained the capacity to allocate member-contributed shares in the event of severe market crises. Organisation D, one of the largest in terms of membership, was the only consortium to have formalised an agreement with an insurance provider, offering potential benefits in terms of crop protection. Furthermore, Organisations F, H, I and J implemented measures to counteract product devaluation practices. Finally, to assess the sector's resilience, a question posed to participants pertained to the number of members who vacated the organisations or did not renew their membership in the previous year. In most cases, this figure was either zero or represents a negligible proportion of the total producer members.

3.3 | Good Governance

In terms of average performance, the governance dimension showed relatively positive results for the themes participation (G4) and rule of law (G5), as illustrated in Figure 3. Within the *participation* theme (G4), no organisation reported having established formal complaint procedures enabling members to express concerns regarding unfair treatment or other issues. However, consortia showed considerable efforts to comply with internal regulations. This emerges in the scheduling of meetings to elect representatives and assemblies with members (9/10 consortia) as well as the convening of boards of directors in accordance with the procedures and frequency defined in their statutes or regulations (8/10 consortia). Furthermore, six out of ten consortia (A, D, F, H, I and J) actively participate in the formulation and implementation of public policies potentially affecting the system of GIs and quality schemes. In addition, 80% of consortia have developed strategies to engage with relevant public actors at the local level in order to promote their institutional objectives.

Regarding the *rule of law* theme (G5), all the organisations showed high performance. Eight out of ten organisations

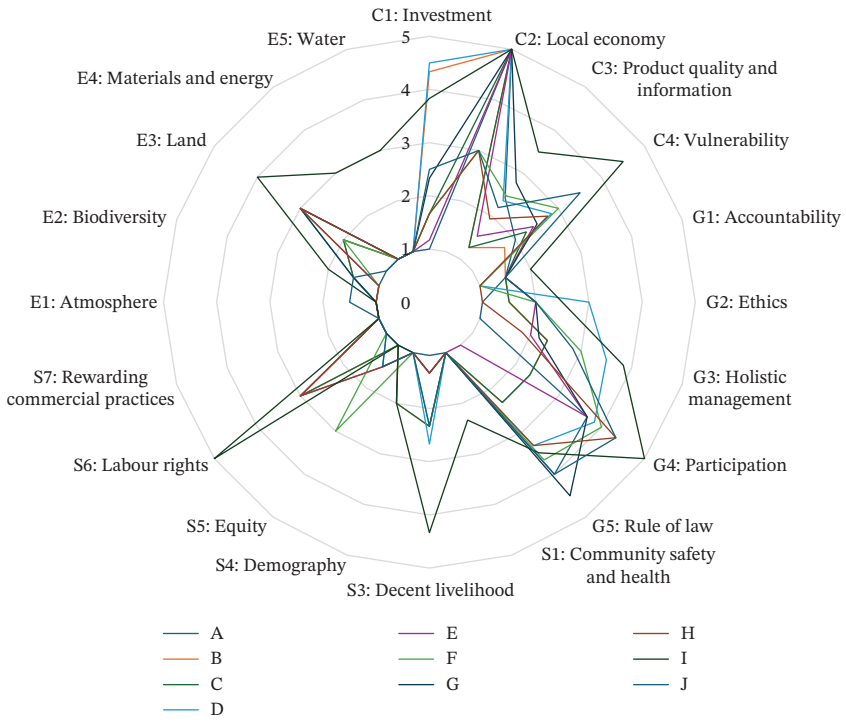

FIGURE 1 | Consortia (a–j) results of the sustainability assessment according to the SSGI framework per theme (as listed in Table 2).

implemented policies and initiatives to promote compliance. Seven out of ten were responsible for documenting and disseminating all relevant regulations related to the GI system to their members. Six out of ten consortia (A, D, G, H, I and J) had systems in place to monitor and communicate regulatory updates. Finally, Consortia F, G and I established formal complaint management procedures.

In contrast, the *accountability* theme (G1) revealed significant shortcomings, indicating the need for greater organisational commitment. None of the consortia reported conducting internal sustainability audits, nor had they established formal procedures or designated personnel responsible for such audit activities. Training and information initiatives related to anticorruption policies were largely absent. Furthermore, none of the

TABLE 4 | Analytical results for consortia (a–j) of the sustainability assessment according to the SSGI framework per theme (as listed in Table 2).

Dimensions	Themes	Consortia									
		A	B	C	D	E	F	G	H	I	J
Economic resilience	C1: Investment	1.0	4.3	1.7	4.5	1.2	1.7	2.3	1.7	3.8	2.5
	C2: Local economy	5.0	5.0	5.0	5.0	5.0	3.0	5.0	3.0	5.0	3.0
	C3: Product quality and information	2.4	1.3	1.3	2.4	1.5	2.5	2.8	1.9	3.5	2.2
	C4: Vulnerability	2.0	1.8	2.3	2.8	2.4	3.0	2.5	2.8	4.5	3.5
Good governance	G1: Accountability	1.5	1.5	1.5	1.0	1.5	1.0	1.5	1.0	2.0	1.5
	G2: Ethics	1.0	1.5	1.5	3.0	2.0	2.0	2.0	1.0	2.5	2.0
	G3: Holistic management	1.0	2.3	2.3	3.5	2.0	3.0	2.2	1.8	3.8	2.8
	G4: Participation	3.7	2.3	2.3	3.8	3.7	4.0	3.7	4.3	5.0	4.3
	G5: Rule of law	4.0	2.3	2.3	3.3	1.0	3.7	4.5	3.3	3.5	4.0
Social well-being	S1: Community safety and health	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.3	1.0
	S3: Decent livelihood	1.0	2.3	2.3	2.7	1.3	2.3	1.3	1.3	4.3	2.3
	S4: Demography	1.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0
	S5: Equity	1.0	1.0	1.0	1.5	1.5	3.0	1.0	1.5	1.0	1.5
	S6: Labour rights	1.0	3.0	3.0	1.0	3.0	1.0	1.0	3.0	5.0	1.0
	S7: Rewarding commercial practices	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Environmental integrity	E1: Atmosphere	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5
	E2: Biodiversity	1.0	1.5	1.5	1.5	1.0	1.0	1.5	1.0	2.0	1.5
	E3: Land	1.0	2.0	2.0	3.0	3.0	2.0	3.0	3.0	4.0	1.0
	E4: Materials and energy	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0	1.0
	E5: Water	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0	1.0

TABLE 5 | Average results of the sustainability assessment according to the SSGI framework per theme.

Themes	Subthemes	Mean score
Economic resilience		
C1 Investment	Long-term investment–profitability	2.5
C2 Local economy	Local value creation	4.4
C3 Product quality and information	Product quality–food safety–product information	2.2
C4 Vulnerability	Diversification–risk management–stability of markets and production	2.8
Good governance		
G1 Accountability	Holistic audits–transparency	1.4
G2 Ethics	Due diligence–mission statement and purpose	1.9
G3 Holistic management	Sustainability management plan	2.5
G4 Participation	Conflict resolution–legitimacy–stakeholder dialogue	3.7
G5 Rule of law	Civic responsibility–GI product compliance and infringement prevention	3.2
Social well-being		
S1 Community safety and health	Workplace safety and health provisions	1.1
S3 Decent livelihood	Capacity development for increased GI system productivity–fair access to means of production–poverty and quality of life	2.5
S4 Demography	Producer and employee retirement–producer and worker demographics	1.3
S5 Equity	Gender equality–nondiscrimination	1.4
S6 Labour rights	Forced labour–terms of employment and contracting–freedom of association and rights to bargaining	2.2
S7 Rewarding commercial practices	Buyer practices of GI products	1.0
Environmental integrity		
E1 Atmosphere	Air quality–emissions	1.0
E2 Biodiversity	Ecosystem diversity–species diversity	1.4
E3 Land	Landscape, land management and use–soil quality	2.4
E4 Materials and energy	Efficient energy use–waste reduction and disposal	1.2
E5 Water	Interaction with water systems–water use	1.2

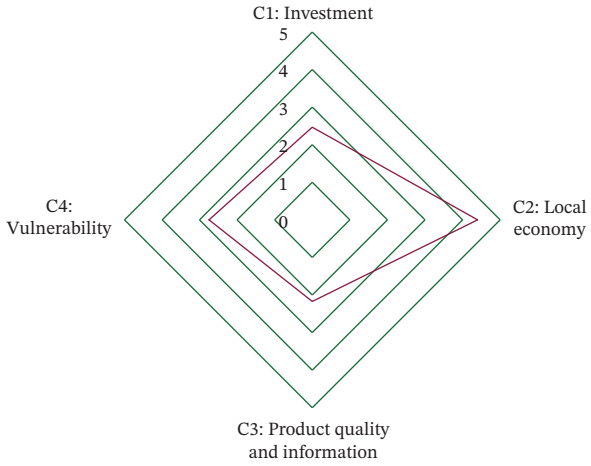

FIGURE 2 | Overall sustainability average performance for the economic dimension.

organisations reported integrating sustainability information into their annual reports. Nevertheless, the majority of consortia (6/10) have adopted transparency-oriented policies, including objectives and tools aimed at preventing corruption.

The approach to the *ethics* theme (G2) was generally limited. Consortia B, C and I implemented due diligence policies, including risk assessment and verification procedures. Consortia E, G and J have established formal codes, while Consortia D and F developed internal communication channels encouraging stakeholders to report unethical behaviour anonymously.

Finally, results for the *holistic management* theme (G3), which reflects alignment with sustainability objectives, were heterogeneous. Although nearly all organisations (9 out of 10) recognise sustainability as a relevant strategic priority; only Consortium I had developed a comprehensive sustainability management plan encompassing all four dimensions (economic, social, environmental and governance). However, most organisations (8/10) expressed their intention to adopt sustainability objectives within the next 5 years. These objectives include the reduction of CO2 emissions, adopting more sustainable production processes, increasing organic production, providing training to enhance production efficiency and expanding the use of renewable sources.

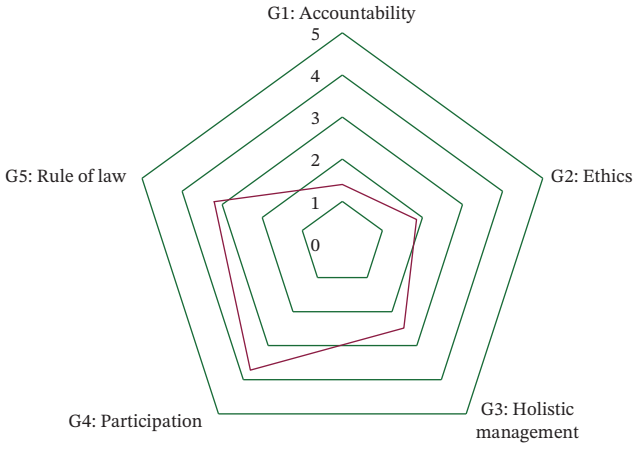

FIGURE 3 | Overall sustainability average performance for the governance dimension.

3.4 | Social Well-Being

With regard to the social dimension (Figure 4), the commitment of consortia to promoting social sustainability among their members appears insufficient and warrants further strengthening. Concerning the theme *decent livelihood* (S3), several organisations provide technical assistance to their members (D, E, F, G and H), disseminate market information and best practices in cultivation (D, F, I and J), implement training activities aimed at fostering sustainable development (D, F, I and J), undertake initiatives involving local communities (B, C and I) or deliver technical updates to their members (J and D). Organisation I also promotes training activities and the improvement of working conditions among its members (*community safety and health* S1).

The theme *demography* (S4) received only limited attention. No consortium established agreements with supplementary pension fund providers for the benefit of its members, as recommended by the good practices outlined in the SSGI strategy. Only Organisations B and C monitor the total number of individuals dependent on the quality system at the local level, including producers/processors/their families/employees within the GIs value chain. Organisation I is the only entity implementing and managing programmes and initiatives specifically targeted for young producers.

Finally, five out ten organisations are actively engaged in combatting irregular and undeclared work (labour rights S6). However, none of the members undertook initiatives related to gender equality and inclusion among their members (*equity* S5), nor did they promote policies to improve producers' and suppliers' freedom of association and their right to collective bargaining (*rewarding commercial practices* S7).

3.5 | Environmental Integrity

Within the environmental dimension, the mean score reflecting the performance of the ten organisations surveyed remains low across all five themes, revealing their limited commitment to promoting environmental sustainability among member wineries (Figure 5).

To date, no organisation has implemented measures with its members specifically designed to reduce greenhouse gas emissions and air pollutants (*atmosphere* E1). Only the consortium with the largest membership, identified here by the letter J, has formally committed to promoting best practices aimed at reducing greenhouse gas emissions and carbon footprints among its members. Organisation J showed this commitment also through its collaboration with the *SOStain Foundation*, which promotes sustainability within the Sicilian vitivinicultural supply chain [20].

With regard to biodiversity protection (*biodiversity* E2), only a partial level of commitment emerges among certain organisations. Consortia D, I and J organised training activities for their members with the aim of promoting biodiversity within production processes. Consortia B, C, I and J encourage the reduction in the use of pesticides and chemical fertilisers among their members. Conversely, no action has been undertaken regarding conservation measures for wild species.

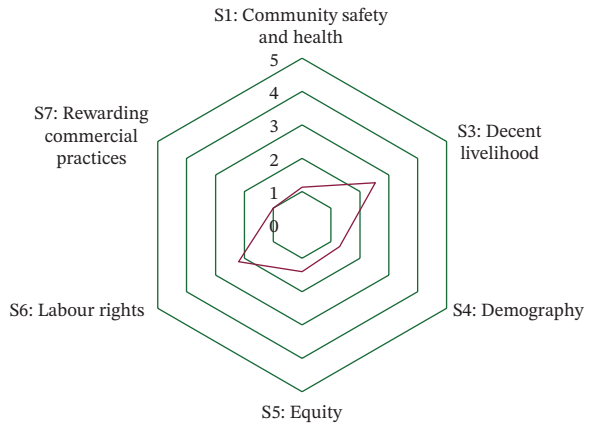

FIGURE 4 | Overall sustainability average performance for the social dimension.

The most frequently addressed theme is soil protection and preservation (*land* E3). Six out of ten organisations actively promote practices aimed at maintaining and enhancing the natural and cultural components of the typical landscape associated with the traditional GI production systems. However, no organisation has established a shared objective among its members for soil protection and rehabilitation, although Organisations E and I are committed to promoting best practices in soil conservation and restoration.

With respect to the *materials and energy* theme (E4), the level of commitment among organisations remains negligible. Only Organisation I defined a common goal and disseminated best practices aimed at increasing the use of renewable energy sources. Conversely, no organisation addressed issues related to waste reduction and management.

A similar pattern occurs for water management (water E5), where only Consortium I has established a shared objective aimed at minimising water consumption.

4 | Discussion

The adoption of the SSGI has proven to be an effective tool for evaluating the capacity of the consortia to promote sustainable practices among associated members (therefore, the RQ1 receives a positive feedback). The questionnaire results revealed that Sicilian wine consortia engage in the protection and valorisation of Sicilian quality wines and exhibit a partial and uneven commitment to sustainability. This finding is consistent with the statements of Broccardo and Zicari [21], who demonstrate that, within the Italian wine sector, sustainability is often not yet fully integrated into the organisations' core business models. Accordingly, the present analysis highlights substantial scope for improvement across all four dimensions of sustainability: economic, governance, social and environmental.

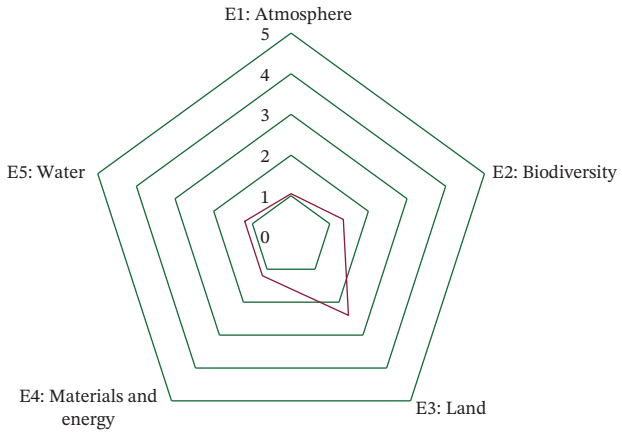

FIGURE 5 | Overall sustainability average performance for the environmental dimension.

The analysis of the economic dimension reveals a marked sensitivity to issues such as local economy and trade expansion. This aligns with the well-established role of GIs as drivers of territorial value. Consortia's participation in productive or agri-food districts, together with initiatives aimed at promoting exports, exemplifies a strategic commitment to enhancing territorial competitiveness through quality wines [22]. However, investment in structured sustainability initiatives, as well as in research and development activities, remains limited, with only a few organisations, among which most notably Consortium I, demonstrating a more proactive approach. Cooperative practices play a central role in fostering innovation within the agri-food sector by facilitating knowledge exchange, supporting the adoption of advanced technologies and enhancing sustainability performance [23]. In line with the findings of Ceccacci et al. [24], the limited resources available to individual small- and medium-sized enterprises often constrain the transition toward sustainable viticulture, thereby highlighting the critical role of collective entities, such as consortia. These organisations act as *'cluster constituents'*, enabling access to knowledge and technical innovations that would otherwise remain beyond the reach of individual producers. In this context, a more collaborative approach, particularly through partnerships with public and private research institutions, is essential to develop strategies that effectively enhance sustainability among members.

The governance dimension shows comparatively positive results with respect to the ability of the consortia to play an active role in defining public policies influencing the GI system and quality schemes. By contrast, the approach adopted with regard to *Accountability*, as defined within the SSGI framework, remains inadequate and requires further development. This finding is consistent with the observations of Ceccacci et al. [24], who highlight that, despite possessing significant regulatory authority, Italian certified quality wine Consortia often lack structured systems for the transparent reporting of their socio-economic and territorial impacts. This limitation is particularly relevant, as such systems constitute a fundamental prerequisite for enabling transformative processes in GI systems. Strengthening internal capacities for strategic planning and sustainability reporting, in alignment with European policy frameworks, therefore represents a key priority [25, 26].

The relatively low performance observed in the social and environmental dimensions constitutes perhaps the most critical finding. Indeed, GI wine organisations exhibit the weakest results within the SSGI framework in this area and appear insufficiently engaged in promoting related practices among their member wineries. In particular, limited attention is devoted to issues such as gender equity, social protection and inclusion. Only a small number of organisations actively promote training

initiatives or measures to combat irregular labour. This evidence is consistent with the literature, which frequently identifies the social dimension as the least developed pillar of wine sustainability. Indeed, programmes are often found to prioritise environmental actions over social ones [27]. This imbalance appears at odds with the recognised potential of GIs as instruments for social cohesion and the enhancement of local human capital and suggests an opportunity to strengthen the social dimension. The FAO has emphasised that GIs can act as a catalyst for rural development, by fostering inclusivity, supporting female entrepreneurship and encouraging the involvement of younger generations [28]. However, addressing RQ2, such outcomes depend on a willingness to engage in collective action, which currently appears insufficiently structured. Similarly, consortia have yet to establish explicit and collectively recognised environmental objectives for their members. Only a limited number of organisations promote measures aimed at reducing emissions, ensuring the sustainable management of natural resources or protecting biodiversity. The absence of shared objectives among members suggests the lack of shared environmental governance. This gap reflects a historical tendency among consortia to prioritise legal protection and regulatory compliance over the proactive management of territorial environmental resources [29], although a shift toward sustainability-oriented policies is anticipated in response to the new CAP. In the context of the territorial identity inherent to GIs, sustainability represents a fundamental component, as the conservation of local resources is essential for ensuring the continuity of quality production [30]. A stronger integration of environmentally sustainable practices into production specifications, in line with ongoing reforms of European GI policy, could therefore represent an initial step toward enhancing the environmental accountability of the wine sector.

Quality wine consortia in Sicily demonstrate a latent capacity to promote sustainability. However, the collective dimension, traditionally considered as a key strength of GIs, has yet to be translated into a structured and integrated sustainability strategy. As noted by Ceccacci et al. [24], consortia have the potential to overcome these limitations by functioning as *'cluster constituents'*, thereby fostering collaboration and providing the technical and administrative support that individual wineries are unable to sustain independently. The adoption of the SSGI, combined with capacity-building initiatives and strengthened regulatory specifications, could serve as a strategic catalyst for a concrete and measurable transition toward sustainability within GI supply chains. Achieving this objective, however, requires the consolidation of synergies among local actors, institutions and organisations, with a view to promoting shared, long-term oriented spatial planning [31].

Consequently, the observed weaknesses highlight strategic pathways through which quality wine consortia can enhance the integration of environmental, social and economic sustainability, supporting their members in converting sustainability commitments into tangible territorial competitive advantages (RQ2).

5 | Conclusion

The application of the SSGI framework to the Sicilian wine sector reveals a fragmented and still nascent adoption of sustainability practices among quality wine consortia. While some initiatives have been undertaken in the economic and governance dimensions, engagement with the social and environmental pillars remains comparatively limited. The results of the study highlight a discrepancy between the theoretical potential of GIs as instruments for sustainable territorial development and their actual implementation by consortia. Despite the well-recognised role of GIs in promoting sustainability principles, the Sicilian wine GI sector currently lacks effective collective governance practices to translate these principles into shared objectives and concrete operational strategies. This lack of structured collaboration and a common definition of objectives limits the capacity of consortia in facilitating the transition toward production models that integrate the environmental, social and economic dimensions of sustainability. It also undermines the long-term stability of the GI system, whose value results are closely tied to the preservation of local resources and territorial identity.

These findings carry important implications for the sector: Although sustainability is frequently acknowledged at a rhetorical level, it has yet to be embedded as a strategic priority within the governance frameworks of these organisations. In this context, consortia have the potential to play a pivotal role in driving more effective outcomes. To address these critical issues, the SSGI framework represents a valuable operational tool, supporting quality wine consortia in identifying sustainability priorities, monitoring progress and fostering continuous improvement. However, this transition requires the support of targeted capacity-building initiatives, appropriate regulatory adjustments, particularly with regard to production disciplinary reforms, and the proactive engagement of all territorial and institutional stakeholders. Realising the full potential of GIs as instruments for environmental protection, social inclusion and economic resilience in rural territories necessitates a coordinated and systemic approach. In this regard, the Sicilian case exemplifies the broader challenges faced by the GI system, highlighting the need for integrated and collaborative strategies capable of effectively linking quality production with sustainability performance. A further limitation is the often-limited capacity of these entities to influence land management or to promote the adoption of sustainable practices, particularly in cases where consortia are small or under-resourced.

Despite the central role of consortia, focussing the empirical survey exclusively on these entities may be considered a limitation of this research. However, this study is conceived as pilot research in which quality wine consortia represent the primary stakeholders of reference for the reasons discussed above. Future empirical research could broaden the scope of analysis to include additional actors, such as prominent social cooperatives and leading private firms, which may exert substantial influence on production systems and the effective adoption of sustainable innovations, thereby contributing to a more comprehensive analytical framework. To address these limitations, future research efforts should prioritise two key areas in order to advance the practical implementation of sustainability within GIs in the agri-food sector. First, there is a clear need for longitudinal studies that systematically monitor and evaluate the impacts of sustainability roadmaps over extended periods. Such analyses would provide valuable insights into the dynamics of sustainability adoption, the persistence of implemented measures and their tangible outcomes in terms of economic viability, environmental protection, social equity and governance effectiveness

within producer organisations. Second, future studies should extend the application of the SSGI methodology to large private and cooperative actors, in order to achieve a more comprehensive mapping of the sector. The complexity of sustainability challenges in agri-food value chains necessitates coordinated action among diverse stakeholders, including producers, consortia, policymakers and local communities. In this context, examining the role and effectiveness of structured collective governance models becomes essential to strengthen the capacity of GIs to enhance sustainability performance and contribute more effectively to sustainable rural development. These research directions will not only enrich the scientific knowledge base but also inform evidence-based policy and practice, ultimately facilitating the transition toward more sustainable and equitable agri-food systems at regional, national and international levels.

Author Contributions

No indication is disclosed here to preserve anonymity, as the work is under review process.

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Disclosure

This work has not been published previously, is not under consideration for publication elsewhere, and its publication is approved by all authors.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study will be sent from the corresponding author upon specific request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Supporting Information.** The detailed results of each consortia's performance of sustainability are reported in radar charts (Figure S1–S10).