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The analytic hierarchy process as an innovative way to enable stakeholder engagement for sustainability reporting in the food industry

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Abstract
The sustainable transition, which requires a combination of natural and human resources to foster the development and protection of ecosystems, is a challenge of civil society. New approaches may be proposed to support enterprises in identifying the appropriate strategic criteria for their sustainability initiatives, which are eventually documented in corporate sustainability reports. The present paper focuses on the food industry, particularly with regard to pasta production.
The analytic hierarchy process method was used to assign relevance to sustainability criteria, according to the judgment of 10 academic experts. The initial criteria were selected from the sustainability reports of a virtuous and Italian pasta producer, La Molisana S.p.A., and divided into four categories: (1) people and community, (2) innovation and new product development, (3) commitment to the environment and (4) local supply chain and traceability.
Promotion of social and economic development in the local community emerged as the most relevant criterion, followed by business development and promotion of talent. The people and community category was deemed most strategic for sustainability, while social and economic dimensions were given less relevance. Stakeholder engagement was proposed as an order winner for sustainable strategies.
The present work has relevant methodological implications, as it shows that the analytic hierarchy process, applied in conjunction with a sustainability materiality matrix, may provide new and useful information for strategy and communication. In terms of operational implications, an enterprise's historical connection to an area may attract global recognition and increase brand value through higher raw material quality, the harmonisation of human and natural resources, and synergy with the tourism industry.

Keywords AHP · Food · People and community · Stakeholder engagement · Sustainability reporting

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1 Introduction

Sustainability reporting shows the relationship between an enterprise and its stakeholders, by documenting corporate actions and outcomes in terms of corporate social responsibility (CSR). CSR is a multi-level concept that can also be used interchangeably with sustainability (Strand et al., 2015). Research has shown that companies that operate in environmentally sensitive sectors participate in less greenwashing and that lower greenwashing is associated with higher-quality sustainability reporting (Ruiz-Blanco et al., 2022). Accordingly, there is an assumed link between sustainability reporting and CSR practices.

Multi-criteria decision analysis (Aktaş & Demirel, 2021) may be used to improve sustainability initiatives and reporting. Ideally, the circular economy, waste management and management accounting practices work together to promote a sustainability-conscious ecosystem (Di Vaio et al., 2022a, 2022b). Indeed, sustainable change brings about change in multiple areas (Gautam & Hens, 2022; Jia et al., 2017) that, ideally, complement one another. Today, technological processes are fostering sustainable behaviours (Vacchi et al., 2021), which may find further support through changes in the public sector (Liu et al., 2021). More specifically, synergy between sustainable technology and public policies may bring about a market equilibrium in which all stakeholders benefit and there is a virtuous use of natural and human resources (D'Adamo et al., 2022a, 2022b, 2022c). For this reason, scholars have been called to propose new and viable solutions to support sustainable agriculture, food security and diet diversity (Lombardi et al., 2021).

Beyond these goals, decarbonisation of the food system cannot be postponed (Clark et al., 2020). According to a World Resources Institute report, the sustainable food industry is expected to reach a value of 2 trillion $, largely due to the greater demand for plant-based foods. The literature has analysed the relationship of CSR with the sustainable food industry, through an analysis of sustainability reports. Such reports document information related to environmental dimensions, such as greenhouse gas emissions, energy consumption, water withdrawal and waste management (Rajic et al., 2022). As a result of this analysis, scholars have highlighted that green investments are able to improve enterprise performance (Le & Ferasso, 2022). Additionally, there is a need to promote employee-based strategies (Usmani et al., 2022) and to issue sustainable documents in order to improve consumer trust (Mercadé-Melé et al., 2021). Furthermore, synthesis may be achieved through organisational collaboration (Ammirato et al., 2021) and the promotion of talent to support innovation (Kell, 2022). In particular, sustainability initiatives may counteract selfishness by fostering collaborative models geared toward the optimisation of resource use (D'Adamo & Sassanelli, 2022).

Business reporting aims at improving consumer trust. More specifically, sustainability reporting helps to counteract consumer expectations of greenwashing, which are unfortunately not rare in the food sector. Generally, consumers are seeking healthy foods that respect ethical principles and are obtained through eco-friendly production processes (Ciliberti et al., 2022; Nazzaro et al., 2019). These consumer demands are encouraging enterprises in the food sector to innovate. The literature points to three main determinants of eco-innovation (Rabadán et al., 2020): (1) the market pull that can occur when consumers are willing to pay more for green products (Li & Kallas, 2021); (2) regulatory actions, whereby policies (i.e. tax and regulatory incentives) encourage market change (Triguero et al., 2018); and (3) technological developments, which can occur either internally within a company or externally via collaboration (Rabadán et al., 2019).

Pasta is a staple food of the Mediterranean diet (Di Marco et al., 2021), with rich nutritional value. Pasta manufacturers, seeking to achieve sustainability and productivity while maintaining high product quality, are being called upon to rethink their supply chain and their use of raw materials (Cappelli & Cini, 2021). Technological innovation, institutional action and consumer behavioural change are required to support sustainability in this sector (Faggini et al., 2021). Additionally, a wide choice of ingredients are available to modify and improve the nutritional profile of pasta (Romano et al., 2021). Among the pasta producing countries, Italy produces the greatest volume (Palmieri et al., 2021). Therefore, Italy was the focus of the present study.

Enterprises operating in the food sector—and particularly pasta producers—are significantly challenged in their efforts to deliver sustainability reporting that provides useful information to both internal and external stakeholders. In this vein, the materiality matrix may be helpful for demonstrating an enterprise's commitment to sustainability (Beske et al., 2020). For the tool to be helpful, the quality of the analysis and the engagement of stakeholders must be high (Sardianou et al., 2021; Torelli et al., 2020). Consequently, the present work aimed at achieving two research objectives. The first research objective concerned the methodological sphere, with the goal to integrate the materiality matrix with the analytic hierarchy process (AHP). In order to demonstrate the application and benefits of the materiality matrix to sustainability reporting, the sustainability reports of an Italian enterprise in the pasta sector characterised by green initiatives and strong market performance were considered. From these reports, criteria were identified and evaluated using pairwise comparison, with the input of academic experts. The second research objective concerned the practical sphere. The AHP methodology was applied to identify the most relevant criteria for sustainability in the pasta sector. The findings provide insight into sustainable strategies to increase market competitiveness in local and global markets and to improve consumer understanding and trust in an enterprise's sustainable activities.

2 Methods

Decision-making methodologies aim at transforming judgments and opinions into quantitative terms, in order to identify the best performing alternatives and/or most relevant criteria (Goyal et al., 2021; Kaymaz et al., 2022). In the present study, AHP was used to compare different criteria for sustainability in the food sector, and specifically pasta production. AHP is based on pairwise comparison, and the output is a priority level assigned to all criteria, based on a nine-point rating scale (Saaty, 2008). The highest weight is assigned to the most relevant criteria, and all weights are normalised for comparison. The present study applied the methodology in four steps: (1) criteria selection, (2) local–global prioritisation, (3) expert identification and (4) the aggregation of weights.

The methodology integrated the materiality matrix (based on a Likert scale) with AHP (D'Adamo et al., 2022a, 2022b, 2022c). The main differences between these methodologies are that the materiality matrix with a Likert scale provides individual assessments of values, with no final control parameter of judgment reliability. In contrast, AHP draws on pairwise comparison and generates a final parameter (consistency ratio (CR)) of judgment reliability. Additionally, the Likert scale method is generally quicker to administer.

2.1 Criteria selection

To identify relevant sustainability criteria, several sustainability reports of companies operating in the sector were consulted. According to Allianz trade data from 2021, Italy accounts for 67% of European pasty production and approximately one-quarter of global dry pasta production. A 2022 quality price report (ITQF, 2022) showed that the best pasta production enterprise is La Molisana S.p.A., located in southern Italy. La Molisana's turnover grew from 16 million € in 2011 to more than 185 million € in 2021, resulting in an export share of approximately 40% of turnover, demonstrating 50% growth over the 10-year period. La Molisana is the fifth largest pasta producer in Italy, and it exports to more than 80 countries. Its distinguishing factors are that its pasta is produced with 100% Italian wheat and it implements various sustainability initiatives.

On this basis, the present study reviewed the sustainability reports of this enterprise, identifying a strategy based on four pillars (La Molisana, 2021): (1) local supply chain and traceability, (2) commitment to the environment, (3) innovation and new product development and (4) people and the community. With the exception of the third pillar, all of the other pillars were defined by four actions. For the purpose of the analysis, the pillars were identified as categories and the associated goals and actions as criteria.

When the number of criteria is large, evaluation cannot rely on a single AHP. Thus, the present research applied the local–global priority method (Brudermann et al., 2015), as described below. As this method is most effective when each category has the same number of criteria, a 16th criterion was added to the 15 proposed by La Molisana in their sustainability reports: the green loyalty programme. According to the green loyalty programme, consumers could (e.g. through point collection or access to special packaging) visit the enterprise, buy products at a reduced price and enjoy special access to nearby tourist and cultural sites. Similar initiatives have already been conducted by the enterprise.

Table 1 presents the complete list of criteria, broken down into the four categories. Of note, while the criteria selection was based on the sustainability reports of La Molisana, the analyses concerned the wider food industry (and specifically pasta production). The origin of the criteria was not disclosed to the experts, in order to prevent any influence on their judgments.

2.2 Local–global priority

AHP results in a priority ranking of criteria. To assess the reliability of this ranking, the CR can be calculated, which has a maximum of 0.10. The CR is the ratio of the consistency index (CI) to random inconsistency (RI). CI is calculated as a function of λmax, which is the inner product of the row vector containing column sums and the eigenvector matrix; RI is equal to 0.90, in accordance with the number of factors (Saaty, 2008).

RI goes up to a maximum of 10 factors, whereas the sustainable framework model that was reviewed in the present study included 16 criteria. In the literature, the local–global priority approach has been used (D'Adamo et al., 2022a, 2022b, 2022c) to categorise criteria, and it was therefore applied in the present study. The initial step involved comparing the four categories and determining category priority. Second, criteria within each category were given local priority, as a measure of local relevance. Third, for each category, respective analyses were conducted for the four distinct rankings. Finally, the criteria were made comparable through the calculation of global priority (i.e. the product of local priority and

Table 1 List of criteria

Acronym	Criterion
Local supply chain and traceability (ST)	
ST1	Promotion of sustainable agricultural practices
ST2	Traceability of the integrated supply chain, from grain field to table
ST3	Selection of suppliers based on social and environmental criteria
ST4	Collaboration with farmers for high-quality, high-protein wheat, at a fair price
Commitment to the environment (CE)	
CE1	Reduced consumption of raw materials for products and packaging additives
CE2	Energy-efficient initiatives and installation of renewable systems
CE3	Management and reduction of greenhouse gas emissions
CE4	Recovery of waste materials and water used in production, following the circular economy
Innovation and new product development (IP)	
IP1	Research for innovative products to meet new food needs
IP2	Highest quality products and food safety
IP3	Business development
IP4	Green loyalty programme (e.g. trips to production sites and surroundings)
People and community (PC)	
PC1	Care for employees and their health and safety
PC2	Promotion of talent
PC3	Promotion of social and economic development in the local community
PC4	Promotion of food education in schools to combat food waste

category priority). Of note, in a four-criterion matrix, six judgments must be provided. Considering five matrices (one to compare categories and four to compare criteria in each category), a single evaluator would provide 30 data points (judgements).

2.3 Expert identification

The quality of AHP depends on the selection of experts, who, by virtue of their experience, should reduce the subjectivity of the analysis (Tsyganok et al., 2012). The present study considered the contribution of 10 academics (D'Adamo & Sassanelli, 2022). Screening was performed via an email that introduced the research objectives and methodology and explained that the first 10 positive responses would be accepted. This email was sent scholars who had published on the topics of sustainability and food, and had a minimum academic experience of 10 years. Table 2 presents the 10 experts who contributed to this work through their feedback. Where requested, online meetings were scheduled with individual experts to provide further guidance on the task and to answer questions about the interpretation of the criteria. The task was administered in May 2022, with run times ranging from

Table 2 List of experts

Number	Role	Country	Years of experience
1	Full professor	Turkey	19
2	Full professor	United Kingdom	20
3	Full professor	Germany	16
4	Associate professor	Australia	12
5	Associate professor	Sweden	10
6	Associate professor	China	10
7	Associate professor	Bangladesh	10
8	Full professor	Italy	15
9	Full professor	Spain	18
10	Full professor	United States	20

30–60 min. Experts were aware that CR would automatically be calculated at the end of each matrix to assess the 'goodness' of their analysis.

Before the criteria were sent to all experts, a pre-screening was conducted with two experts, to determine whether any relevant criteria had been overlooked. The analysis was negative, and thus, the criteria were not modified. Instead, the mixed methodology of local–global priority was explained to all experts, who recognised the strengths of this approach (e.g. its ability to aggregate a substantial number of criteria). While the methodology may present flawed results if the set of criteria in a category is misaligned with the weight given to the same category, this limitation is alleviated by the use of the Likert scale.

2.4 Aggregation of weights

The final stage of the analysis was the aggregation of all judgments, which is presented in full in Appendix A. In this step (as in all others), the anonymity of experts was guaranteed. There is no association between the numbers associated with the experts in the aggregated data and the numbers shown in Table 2. For example, as displayed in the aggregated data, expert 1 considered the PC category 'moderately to strongly important' with respect to the EC category, and reported a value of 4. Subsequently, this expert considered ST2 'equally to moderately important' with respect to ST1. Therefore, the expert considered the PC category most relevant (0.51), followed by IP (0.22). Within the individual categories, the following criteria were identified as most relevant: ST2 (0.39), CE2 (0.39), IP4 (0.39) and PC (0.45). Aggregation allowed the different expert perspectives to be combined, with each assigned the same relevance. Prior to the aggregation, CR values were calculated for all experts.

Of note, online meetings with individual experts were focused on further explanation of the methodology and research objectives and critical analysis of the criteria. The AHP was administered separately from these meetings, with the results sent via email. A deadline was provided to each expert, and no reminder was needed. Most likely, experts' independent analysis allowed them to reflect in greater depth on the values to be assigned. However, experts may have also felt pressured or potentially judged in their decisions, due to the automatic calculation of CR. This automatic calculation was designed to prevent the

duplication of experts' time and work, in the event that their first analysis was not deemed suitable.

3 Results

The initial phase of testing with two experts confirmed that all criteria were relevant for sustainability strategies. However, one of the limitations of the analysis is that the AHP was unable to capture the relationships among criteria. To resolve this limitation, future analyses should consider other methodologies, such as novel fuzzy multi-attribute decision-making (MADM), which has also been applied in the literature (Xu et al., 2020; Zolghadr-Asli et al., 2021). Another relevant aspect of materiality matrixes is the presence of different criteria that do not overlap. This section presents the values that experts assigned to the categories and criteria, and the resulting global priority values.

3.1 Assessment of category priority

The experts did not achieve a consensus in their choice of the most relevant category. As shown in Table 3, three experts assigned the highest value to local supply chain and traceability (ST) and commitment to the environment (CE), while two experts assigned the greatest weight to innovation and new product development (IP) and people and community (PC). This finding is consistent with the initial impressions of the two experts during the pre-screening phase. The experts expressed that they found it difficult to assign priority values at the category level, as they were well acquainted with the AHP and local–global priority mix methodologies, and aware that the weight they assigned at this stage would amplify or reduce the weight they gave to individual criteria.

According to the literature, there is a need to strengthen the social dimension of sustainability (Hristov & Appolloni, 2022; Sarker et al., 2021; Walker et al., 2021). The expert judgments expressed support for this goal, particularly in the prioritisation of stakeholder

Table 3 Category priority

Expert	Local supply chain and traceability (ST)	Commitment to the environment (CE)	Innovation and new product development (IP)	People and community (PC)
1	0.116	0.153	0.223	0.508
2	0.387	0.275	0.140	0.198
3	0.171	0.120	0.450	0.260
4	0.164	0.441	0.139	0.256
5	0.115	0.165	0.506	0.214
6	0.218	0.148	0.531	0.104
7	0.142	0.106	0.241	0.511
8	0.104	0.148	0.218	0.531
9	0.275	0.387	0.198	0.140
10	0.464	0.330	0.085	0.121
Average	0.215	0.227	0.273	0.284

engagement. In fact, the PE category places special emphasis on all stakeholders involved in the transformation process. Pasta is a product that is typically consumed daily, during mealtimes shared with others. Perhaps on this basis, experts assigned an average weight of 0.284 to the PE category (just above the 0.273 assigned to the IP category). Their value attribution may have also been associated with a more markedly economic characteristic of the sector, which is characterised by a great multiplicity of products of a variety of tastes and formats.

The experts ranked the CE category third (0.227), understanding commitment to the environment as the protection of ecosystems. Finally, the experts ranked the ST category fourth (0.215). The ST category concerns the sustainable sphere, which overlaps the other dimensions and, in this context, focuses particularly on raw material inputs. Two observations flow from these results. The first, which is purely numerical in nature, is that the difference in weights between the two extremes is approximately 24%. The second concerns a managerial implication: pasta is a 'Made in Italy' product that is highly valued in both the domestic and the global markets. The product is also a staple of the Mediterranean diet (Caruso & Fortuna, 2020) and linked to the tradition of many regional territories. In fact, pasta production is not concentrated in Italy. However, it is affectively attached to territory, and this quality can be leveraged to attract consumers. In this context, innovation in ecosystems could aim at creating new market spaces or expanding market share by combining traditional and sustainable product characteristics.

3.2 Assessment of local priority

3.2.1 People and community

Within the most relevant category (PC), promotion of social and economic development in the local community (PC3) achieved the highest average value (0.293). This criterion envisions an enterprise that is a reservoir of local employment and local promotion. Globalisation has shifted production to sites that are inexpensive and convenient, even when these are located far from the company headquarters. However, the sustainability discourse has drawn attention to the need for territories to be self-sufficient (Barcaccia et al., 2020), encouraging local production with export upon demand. Italian wheat is a high-protein (i.e. nutritious) ingredient in pasta, and its production should be promoted more widely (Finco et al., 2021). This would allow Italian pasta enterprises to offer a genuine product that, combined with other actions, would support sustainability.

Other actions to support sustainability would include the promotion of talent (PC2) and care for employees and their health and safety (PC1) (valued at 0.256 and 0.245, respectively). The promotion of talent refers to the ability to retain and attract promising professionals from the local area and beyond. In this practice, different cultures can be brought together, generating interdisciplinary problem-solving to generate value. The school of human relations has defined that good business practices are realised when the needs of the organisation coincide with the needs of the individual, and thus, every team member must be a protagonist.

Finally, the promotion of food education in schools to combat food waste (PC4) was ranked fourth (0.206). This criterion represents actions that, relative to the previous criteria, are relatively less influential to the enterprise. Table 4 presents the values experts attributed to these four criteria, demonstrating a difference of 0.087 between the

Table 4 Local priority—People and community

Expert	Care for employees and their health and safety (PC1)	Promotion of talent (PC2)	Promotion of social and economic development in the local community (PC3)	Promotion of food education in schools to combat food waste (PC4)
1	0.120	0.171	0.260	0.450
2	0.440	0.232	0.193	0.135
3	0.140	0.177	0.419	0.264
4	0.139	0.441	0.164	0.256
5	0.101	0.145	0.554	0.200
6	0.173	0.237	0.452	0.138
7	0.198	0.275	0.387	0.140
8	0.554	0.200	0.101	0.145
9	0.384	0.126	0.300	0.191
10	0.200	0.554	0.101	0.145
Average	0.245	0.256	0.293	0.206

maximum and minimum values. Four experts assigned the greatest importance to PC3, 3–PC1, 2–PC2 and 1–PC4.

3.2.2 Innovation and new product development

In the transition from the 'invisible hand' to the 'sustainable hand', economic welfare should be distributed to more people (D'Adamo & Sassanelli, 2022). However, while practising the sustainable hand, businesses must still have a viable market and consumer demand. For this reason, within the IP category, business development (IP3) received the highest ranking (0.272). Of note, the green loyalty programme (IP4) ranked second (0.265), very close behind. This is an interesting result, as this criterion was not present in the original reference list and was only included on the basis of the product-service system concept (Taddei et al., 2022) and a review of La Molisana's sustainability actions. In the case of La Molisana, the green loyalty programme combines tourism and industry, representing a local development initiative with potential benefits for both the enterprise and the local community (consistent with PC3).

The experts gave the third rank to highest quality products and food safety (IP2) (0.249), which they expressed as strongly interconnected with the ST category. However, compared to IP3 and IP4, IP2 emerged as less relevant, with the experts expressing that enterprises should not seek to generate competitive advantage through their product quality, but aim at maintaining high product quality at all times. Finally, the experts ranked research for innovative products to meet new food needs (IP1) fourth (0.214). These results do not suggest that the market is static (e.g. the market for whole wheat pasta is showing interesting growth), but simply identify that the most impactful innovation may relate to additional services for consumers. This category demonstrated the smallest difference between categories (0.057). Three experts ranked IP3 and IP4 highest, while two ranked IP1 and IP2 first (Table 5).

3.2.3 Commitment to the environment

Within this category (CE), experts accorded the greatest weight to the management and reduction of greenhouse gas emissions (CE3) (0.317), largely because they considered this a summary indicator of circular and green economy actions. Importantly, any reduction in greenhouse gas emissions should not result from a decrease in production or an economic crisis, but from the aforementioned actions in support of sustainability (Calisto Friant et al., 2021; Settembre-Blundo et al., 2021). The experts ranked energy-efficient initiatives and installation of renewable systems (CE2) as a close second (0.302). At present, energy is very much in focus—particularly in Europe, following the outbreak of the conflict in Ukraine. Thus, a reduction in energy costs could have significant benefits for competitiveness.

In this category, there was a significant difference between the top- and bottom-ranked criteria (0.147). The experts ranked reduced consumption of raw materials for products and packaging additives (CE1) and recovery of waste materials and water used in production, following the circular economy (CE4) 3rd (0.210) and 4th (0.171), respectively. This suggests that the experts gave less weight to the environment, in return for greater weight to the economic and social spheres. Later, when they analysed the criteria in this category, they rewarded the more general criteria (i.e. the green economy, represented by CE2, and the circular economy, represented by CE1 and CE4). Thus, in essence, although material reduction and waste recovery differ, the experts did not perceive much difference in their value. One expert assigned the highest relevance to both CE1 and CE4, while four experts chose both CE2 and CE3 (Table 6).

3.2.4 Local supply chain and traceability

Regarding the category deemed least relevant by the experts (ST), a similar result to the CE category emerged, with the two top-ranked criteria significantly outperforming the others. This category demonstrated the greatest difference between criteria (0.164). The experts

Table 5 Local priority—innovation and new product development

Expert	Research for innovative products to meet new food needs (IP1)	Highest quality products and food safety (IP2)	Business development (IP3)	Green loyalty programme (IP4)
1	0.140	0.198	0.275	0.387
2	0.301	0.224	0.199	0.276
3	0.126	0.384	0.300	0.191
4	0.275	0.198	0.387	0.140
5	0.092	0.548	0.220	0.140
6	0.387	0.198	0.140	0.275
7	0.140	0.198	0.387	0.275
8	0.275	0.140	0.387	0.198
9	0.269	0.128	0.222	0.381
10	0.140	0.275	0.198	0.387
Average	0.214	0.249	0.272	0.265

gave highest weight to collaboration with farmers for high-quality, high-protein wheat, at a fair price (ST4) (0.331). This result is consistent with IP2, as well as the concept of the sustainable hand, as the final product is strongly dependent on the choice of raw materials, and the 'Made in Italy' brand may make a difference in the market. Similarly, the experts deemed it necessary to build farmer loyalty by recognising the true price of their goods. The experts ranked traceability of the integrated supply chain, from grain field to table (ST2) second (0.324), in alignment with efforts to increase digitisation in the food industry to promote sustainability (Remondino & Zanin, 2022) and increase consumer confidence through transparency in the supply chain. As described above, the remaining two criteria were ranked much lower: promotion of sustainable agricultural practices (ST1) (0.177) and selection of suppliers based on social and environmental criteria (ST3) (0.167). Most likely, ST1 was understood to have points of contact with ST4, albeit more general and not related only to wheat. Thus, the experts seem to have prioritised wheat, while viewing the contribution of suppliers as less relevant. Within a sustainable system, supply chain boundaries are based on an integrated relationship with various upstream and downstream activities (Morone & Imbert, 2020). Relative to the previous categories, in this category, there was more agreement among the experts, as six favoured ST2 and four favoured ST4 (Table 7).

3.3 Assessment of global priority

In the final stage of the analysis, the priorities assigned to individual criteria were aggregated with the relative weight associated with each category (Table 8). Of note, global priority was obtained as a product of category priority (Sect. 3.1) and local priority (Sect. 3.2).

The local–global priority method depends on two aspects: (1) the relevance of one category to the others and (2) within a category, the extent to which one criterion is valued more than others. The results of the present analysis show that the weight of category priority was very significant, because the first four places were assigned to the two most relevant categories and, on the other hand, the last four places were associated with the 2 categories deemed least impactful. PC3 ranked first (0.0833), followed by IP3 (0.0741), PC2 (0.0726) and IP4 (0.0723). The most relevant criteria in the other 2 categories followed in priority ranking: CE3 (0.0722) and ST4 (0.0714).

4 Discussion

The present results contribute several insights. First, the experts provided different judgments in all categories (with the ST category representing the least variance). Sustainability metrics, including the Sustainable Development Goals (Di Vaio et al., 2022a, 2022b; Dwivedi et al., 2021), have several components, and the optimal point of balance between social, economic and environmental dimensions can only be achieved via a complex system. Clearly, this optimal point requires that all criteria are met, in full or in part. In this vein, the variety of expert opinions may be understood to affirm the 'goodness' and relevance of the proposed criteria. This suggests that La Molisana's actions were suitable as a starting point for the materiality matrix at the sustainability level.

Second, the difference between experts' maximum (PC3) and minimum (ST3) values was 0.0472. The use of the Likert scale provided important information within the materiality matrix, integrating the judgments of different stakeholders. This paper does not

Table 6 Local priority—Commitment to the environment

Expert	Reduced consumption of raw materials for products and packaging additives (CE1)	Energy-efficient initiatives and installation of renewable systems (CE2)	Management and reduction of greenhouse gas emissions (CE3)	Recovery of waste materials and water used in production, following the circular economy (CE4)
1	0.275	0.387	0.198	0.140
2	0.175	0.440	0.310	0.075
3	0.173	0.237	0.452	0.138
4	0.102	0.160	0.530	0.208
5	0.387	0.275	0.198	0.140
6	0.140	0.198	0.275	0.387
7	0.269	0.121	0.417	0.193
8	0.177	0.264	0.419	0.140
9	0.200	0.554	0.101	0.145
10	0.198	0.387	0.275	0.140
Average	0.210	0.302	0.317	0.171

criticise the Likert scale approach in conjunction with a materiality matrix, but advocates for the addition of complementary methodologies, such as AHP. AHP is a robust methodology that, through the application of a consistency ratio, is able to reduce variability between experts. In some cases, it is possible to apply a hybrid approach that integrates both methodologies, as in the present research (D'Adamo et al., 2022a, 2022b, 2022c). Future research should seek to replicate the data obtained in this work, using the same methodology, with other categories of stakeholders (e.g. customers, non-profit organizations, local communities, enterprise workers, academics). Values could be used within a materiality matrix that defines a weight for individual stakeholder categories (i.e. the number of respondents for each) and compares this with the enterprise (again, identifying a proper mix between different professional figures). From a methodological perspective, the weights obtained from these analyses could be used to compare enterprises operating in the same sector, via multi-criteria analysis. The enterprises would represent alternatives, and judgments would be provided by all stakeholders. In this context, since the results would be either rewarding or detrimental to enterprises (depending on their rankings), the most objective performance indicators should be used. Such analyses could influence investors and consumers, as sustainability is bound to serve as an order qualifier. The present work suggests that stakeholder engagement may be interpreted as order winning, thus determining competitive advantage.

Moving to the operational level, the fourth reflection concerns the social component, which appears fundamental. In a dynamic vision in which sustainability has become the benchmark, consumers might favour not only sustainable companies, but also companies with strong roots in the local community. This aspect does not counter globalisation and the quest to sell products beyond national borders. On the contrary, it reinforces the idea that an enterprise should not only be concerned with generating profit, creating employment opportunities and following green and circular practices to reduce its impact on the environment, but it should also seek to promote the local community and region. We might summarise this strategy as one in which competitive advantage is materialised by the

Table 7 Local priority—supply chain and traceability

Expert	Promotion of sustainable agricultural practices (ST1)	Traceability of the integrated supply chain, from grain field to table (ST2)	Selection of suppliers based on social and environmental criteria (ST3)	Collaboration with farmers for high-quality, high-protein wheat, at a fair price (ST4)
1	0.275	0.387	0.198	0.140
2	0.198	0.275	0.140	0.387
3	0.100	0.430	0.209	0.262
4	0.248	0.419	0.137	0.195
5	0.145	0.200	0.101	0.554
6	0.231	0.117	0.168	0.484
7	0.120	0.260	0.171	0.450
8	0.140	0.387	0.198	0.275
9	0.198	0.387	0.140	0.275
10	0.115	0.380	0.213	0.292
Average	0.177	0.324	0.167	0.331

establishment of strong local roots, combined with the capacity to market and sell products globally. After all, the pandemic and the conflict in Ukraine have shown that the most crisis-resilient economies are those that hold raw materials.

Thus, a fifth consideration emerges that Italy must restore Italian wheat production and support small entrepreneurs, through incentives. Similarly, there must be strong synergy between business and academia, through collaboration that promotes human resources and attracts employees to the relevant territories. Academic work should aim at solving problems that exist in the 'real' world, transferring knowledge to future generations and creating knowledge interchange with the world of industry. This collaboration should also extend to local politicians, so they might be encouraged to develop initiatives to build the necessary infrastructure for industrial competitiveness. Here, the focus should be on public services, intermodality and infrastructure.

Finally, the sixth reflection concerns the relevance of food sustainability, which applies not only to business, but also to health. Optimal nutrition results from better health in the population and affordable healthcare expenses (i.e. costs borne by the community). In fact, as pasta is a staple of the Mediterranean diet, we should encourage its spread to as many areas as possible, to support global sustainability.

5 Conclusions

The present work considered a product that is consumed by many Italian citizens on a daily basis. In fact, the consumption of pasta is common in many countries—and in some contexts, a tourist attraction. This is especially true for Italy, where pasta has always been strongly valued. In recent years, the European Commission has actively promoted the green transition. However, in the sustainability pursuit, initiatives should not create inequality among citizens and make some countries dependent on others due to the raw materials required. Above all, sustainability must not create social unrest. Circular practices, the use of renewable sources and waste reduction are required for the sustainable transition and

should be documented in sustainability reports. However, in the materiality matrix, performance against certain criteria is typically reported from the perspectives of the enterprise and its stakeholders.

The present work applied an integrative method, AHP, to better describe the sustainability results of food enterprises. One limitation of the work is that the team of experts was comprised of only academics. Future research should extend the analysis to other stakeholders, while also assessing additional criteria. There are multiple perspectives on sustainability, and thus, it is unsurprising that the experts disagreed on their precise prioritisation of the criteria. However, a consensus emerged that the social dimension of sustainability requires more attention. 'Made in Italy' products, including pasta, have a competitive advantage in the global market. This benefit could be extended to other products. In addition, as the experts identified stakeholder engagement as an order winner, consumers should be brought into enterprises (e.g. through tours of production and operation sites). Some enterprises (including La Molisana) have already implemented initiatives combining tourism and industry, and these initiatives have the potential to generate customer loyalty and increase revenues in the local area. In particular, enterprises that follow sustainable practices and operate in attractive natural settings may take particular advantage of this opportunity for development and growth.

The green transition is a significant challenge, and policies are needed to support enterprises and citizens in their pursuit of this goal. Contributions are needed to support green and circular investments, foster industrial symbiosis and network models for knowledge exchange, provide the necessary infrastructure and re-establish the significance of primary activities (e.g. agriculture, grain cultivation) in economic development models. In addition, enterprises should seek to reduce costs, promote the use of innovative products and

Table 8 Global priority

	Local priority	Ranking	Global priority	Ranking
Local supply chain and traceability [priority: 0.215]				
ST1	0.177	3	0.0381	15
ST2	0.324	2	0.0699	7
ST3	0.167	4	0.0361	16
ST4	0.331	1	0.0714	6
Commitment to the environment [priority: 0.227]				
CE1	0.210	3	0.0477	13
CE2	0.302	2	0.0688	9
CE3	0.317	1	0.0722	5
CE4	0.171	4	0.0388	14
Innovation and new product development [priority: 0.273]				
IP1	0.214	4	0.0585	12
IP2	0.249	3	0.0680	10
IP3	0.272	1	0.0741	2
IP4	0.265	2	0.0723	4
People and community [priority: 0.284]				
PC1	0.245	3	0.0696	8
PC2	0.256	2	0.0726	3
PC3	0.293	1	0.0833	1
PC4	0.206	4	0.0586	11

maintain high food safety and raw material quality. Furthermore, they must ensure that their efforts are recognised by consumers.

Future research should investigate consumers' propensity to buy green products, recognition of a circular premium and attribution of greater brand value to companies focused on sustainability. The present work suggests that the provision of economic support to small grain producers could be useful, as such policies could reward both 'Made in Italy' products and consumers. In particular, the VAT (now at 4% for elementary products such as bread and pasta) could be eliminated. However, future research should assess the impact of such initiatives on public accounts. A country can be sustainable when it supports innovation, promotes talent (across all roles and industries) and exports its excellence.

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