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Assessing the sustainability of hemp farms: a case study using the FAO SAFA tool

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Abstract. Recent changes in cannabis regulations and increased global attention to sustainability have contributed to a renewed interest in hemp farming. However, farm-level assessments of the sustainability of hemp farming remain limited, creating a research gap that constrains a comprehensive understanding of its environmental, economic, and social impacts. To address this, the present study employs the Food and Agriculture Organization (FAO) Sustainability Assessment of Food and Agriculture (SAFA) tool to evaluate a hemp farm across four dimensions: environmental integrity, economic resilience, social well-being, and good governance. Using an exploratory single-case study design, data were collected through internal documents, a semi-structured interview with the farm manager, and publicly available sources The results show strong performance in the social and governance dimensions, with the farm contributing to rural development through community engagement and tourism. In contrast, the environmental and economic dimensions reveal constraints, such as the absence of formal biodiversity monitoring, dependence on external energy supply, and limited revenue diversification. The findings indicate a need to adapt sustainability assessment frameworks to better reflect informal and small-scale farming contexts, where tacit knowledge and interrelated sustainability dimensions influence outcomes. Although exploratory and context-specific, the study contributes to a broader understanding of sustainability in niche or emerging crop systems and suggests directions for refining assessment methodologies.
Key words: Sustainability assessment, SAFA tool, industrial hemp, hemp farming, Latvia.

Introduction

Hemp, also known as Cannabis Sativa L., is one of the earliest known domesticated plants in human history (Ahmed *et al.*, 2022; Karus & Vogt, 2004; Kaur & Kander, 2023; Roulac, 1997; Yano & Fu, 2023). Due to its versatility, the plant has historically been cultivated across different regions and used by various cultures as a source of substance, clothing, paper, stockfeed, and medicine (Ahmed *et al.*, 2022; Karus & Vogt, 2004; Kaur & Kander, 2023; Martins, 2022; Roulac, 1997; Yano & Fu, 2023). Today, the applications of hemp have expanded significantly, finding a place in various industries such as construction, textiles, food, personal care, bioplastics, automotive, and biofuel production (Ahmed *et al.*, 2022; Amaducci *et al.*, 2015; Schumacher *et al.*, 2020; Enarevba & Haapala, 2024; Kaur & Kander, 2023; Manaia *et al.*, 2019; Martins, 2022; Tsaliki *et al.*, 2021).

Even with its long history of cultivation, hemp continues to face harsh restrictions in various parts of the world, largely due to its close resemblance to marijuana and the presence of THC (Kaur & Kander, 2023; Sebastian *et al.*, 2023; Yano & Fu, 2023). Remarkably, hemp farming has maintained resilience and expanded significantly in recent years, in spite of persistent legal and societal barriers (Ahmed *et al.*, 2022; Enarevba & Haapala, 2024; Kaur & Kander, 2023).

This resurgence can be attributed, in part, to the increasing recognition of hemp's multifaceted contributions to sustainability, as it not only enhances environmental stability through soil regeneration, carbon sequestration, and resource efficiency, all of which contribute to ecosystem health and mitigate climate change, but also advances social sustainability by fostering rural employment and strengthening community development, thereby helping to create more cohesive societies (Ahmed *et al.*, 2022; Enarevba

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& Haapala, 2024; Kaur & Kander, 2023; UNCTAD, 2023). Moreover, hemp can strengthen economic sustainability by driving market diversification and supporting emerging industries such as textiles, construction, and bioplastics, ultimately opening new economic opportunities (UNCTAD, 2023).

Although the contribution of industrial hemp to sustainability is fairly well documented, further evidence is needed to show that hemp farming, specifically hemp farms, can effectively incorporate sustainable practices across environmental, social, and economic dimensions (Aryal *et al.*, 2024; Ceyhan *et al.*, 2022; Giupponi *et al.*, 2020; Kaur & Kander, 2023; Muedi *et al.*, 2024). While existing literature emphasizes hemp's potential, fewer studies have utilized a structured framework to assess hemp farms practices in real-world settings. Thus, the objective of this research is to assess the sustainability of a hemp farm using the SAFA (Sustainability Assessment of Food and Agriculture) tool developed by FAO (Food and Agriculture Organization). The SAFA tool provides a structured approach to evaluating sustainability across four dimensions: environmental, economic, social, and governance (FAO, 2014).

Through this assessment, the research provides an analysis of a hemp farm, uncovering practical findings about its sustainability in action and going beyond theoretical discussions of hemp's benefits. Using a case study from a Latvian hemp farm, the research evaluates the farm's alignment with sustainability indicators, ultimately aiming to bridge the gap between hemp's potential for sustainability and its real-world applications.

Methods

Considering the limited availability of previous sustainability assessments specifically targeting hemp farming operations (Aryal et al., 2024; Enarevba & Haapala, 2024; Kaur & Kander, 2023), and given the exploratory scope of this study, a single case approach was chosen to enable in-depth analysis. While multiple-case studies can enhance generalizability and enable cross-case comparison (Eisenhardt, 1989; Voss *et al.*, 2002; Yin, 2018), they often demand extensive time and resources and may limit the level of detail achievable in each case (Dyer & Wilkins, 1991; Piekkari *et al.*, 2009). As noted by Voss *et al.* (2002), focusing on a single case increases the opportunity for close observation, allowing for a deeper engagement with contextual specificities and internal dynamics. Such an approach is particularly valuable when access is granted to an unusual setting, or when the case holds theoretical or practical relevance (Barratt *et al.*, 2010). Single-case studies have proven effective for assessing sustainability in real-world contexts, for instance, Scuderi *et al.* (2025) applied the SAFA framework to evaluate the sustainability of Sicilian citrus farming in detail within a single-region study. Akbar *et al.* (2024) conducted a sustainability assessment of a single logistics company, demonstrating that individual case studies can provide valuable empirical contributions and inform practice in sector-specific contexts. Given the aim of this research to generate a rich, context-sensitive understanding of sustainability at the farm level, particularly in the underexplored context of hemp cultivation, a single-case design offers a suitable and focused approach for capturing the complexity of the topic. This approach was applied using Obelisk Farm as the selected case for study, with the FAO SAFA tool serving as the framework for analysis. The selection of Obelisk Farm as the case study followed a purposeful sampling strategy, based on its relevance to the research objectives and the opportunity for in-depth access. The farm was selected based on three main criteria: (1) its representativeness of small-scale, diversified hemp production in a European context; (2) its operational maturity and capacity to support a detailed sustainability assessment; and (3) its openness to external research and the possibility of accessing internal documentation and stakeholder perspectives. Obelisk Farm cultivates hemp for multiple purposes (seed, leaf, flower, and stalk) while also offering educational activities and promoting community involvement. These characteristics made it particularly well-suited for the application of the SAFA framework, which assesses sustainability in a multidimensional manner.

The SAFA (version 3.0) was chosen as the standardized framework for this assessment due to its ability to provide a comprehensive evaluation of sustainability across four dimensions: good governance, environmental integrity, economic resilience, and social well-being (FAO, 2014). Each of these dimensions is further divided into themes, sub-themes, and indicators that allow for a detailed assessment of different aspects of sustainability (FAO, 2014), as shown in Figure 1. The tool includes a set of performance indicators that guide the evaluation process, ensuring consistency and comparability across different agricultural contexts, for instance, good governance considers aspects such as transparency, ethical behavior, and stakeholder engagement, while environmental integrity evaluates biodiversity, water use, energy efficiency, and waste management. Economic resilience focuses on financial viability, risk management, and fair trade practices, whereas social well-being assesses labor rights, equity, food security, and cultural diversity (FAO, 2014).

The study did not aim to generate new theory but to offer a detailed account of the farm's sustainability

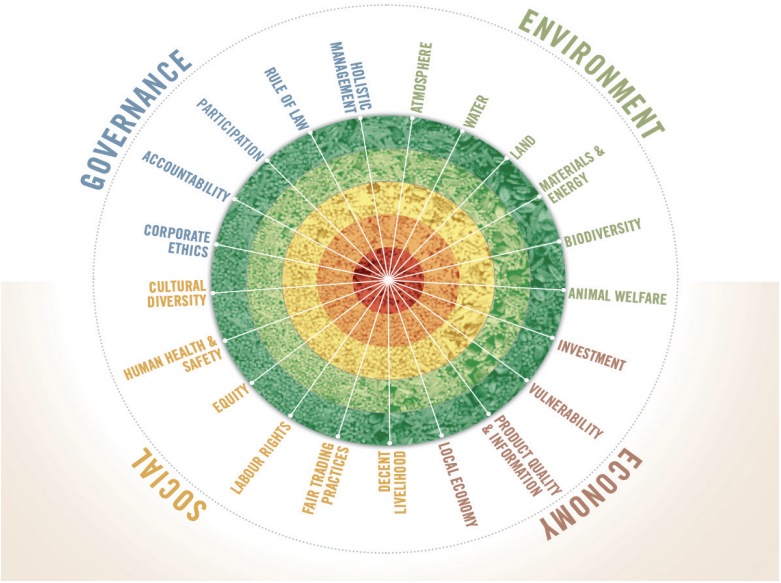

Figure 1. SAFA tool themes and sub-themes (FAO, 2014).

practices, providing relevant information for the development and management of similar agricultural initiatives. Although both qualitative and quantitative data were collected, the analysis was purely descriptive. The SAFA framework offers a structured scoring system, but no inferential statistical tests were conducted. This analytical approach is consistent with the exploratory nature of the study, which prioritizes contextualized understanding over statistically generalizable results.

Data collection

In single-case study research, drawing on multiple sources of data is considered essential for capturing the complexity of the phenomenon and ensuring analytical depth (Yin, 2018; Kohlbacher, 2006; Stake, 1995). Triangulation involves the integration of diverse types of material and evidence, enhancing the depth and reliability of the analysis (Kohlbacher, 2006). This study applied triangulation through four qualitative data collection methods conducted between October 2024 and January 2025: (1) a review of relevant literature and acquisition of formal consent and access, (2) internal documents, including financial records, operational protocols, and environmental practices, (3) publicly available materials, such as certification reports, website content, and external recognition, and (4) a semi-structured interview with the farm manager. This approach aligns with the SAFA guidelines, which recommend integrating both qualitative and quantitative inputs to contextualize and validate sustainability indicators (FAO, 2014).

All data collection procedures adhered to ethical standards in line with the European Code of Conduct for Research Integrity (ALLEA, 2023). As the case study is not anonymous, verbal informed consent was obtained from the farm's owner, who authorized the use of internal documentation, participation in the interview, and public identification of the case. Transparency was maintained throughout the research process, and all information was collected and used exclusively for research purposes.

Literature review and consent

The process began with a literature review to inform the analytical framework and deepen the contextual understanding of sustainability practices in small-scale hemp agribusinesses. While this review started at the outset, it continued throughout the project, supporting the interpretation and triangulation of data. In parallel, formal consent and access agreements were established with the case study participant, ensuring ethical compliance and mutual understanding regarding data use.

Internal documents

The first substantive data source consisted of internal documentation provided by Obelisk Farm. These materials included operational protocols, financial data, records related to energy use and environmental practices, and documentation on certifications. This information was essential for assessing indicators related to economic resilience, environmental integrity, and organizational governance.

Publicly available materials

The second source consisted of publicly accessible materials such as certification reports, content from the farm's website, media coverage, and external

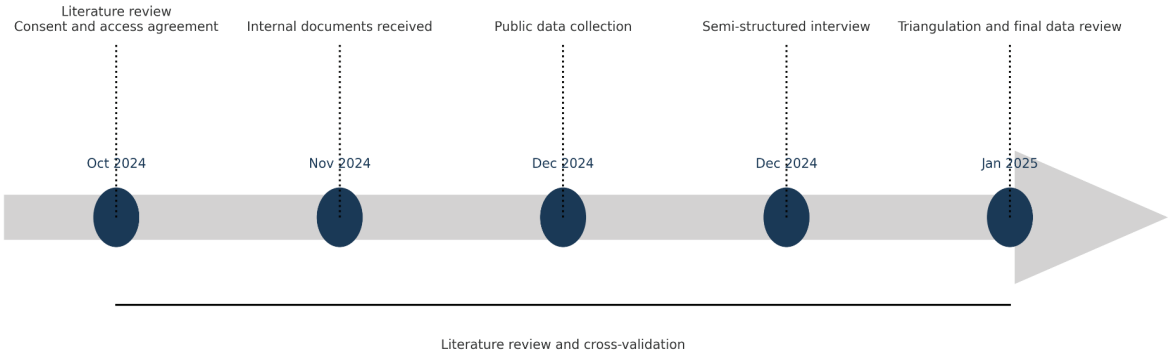

Figure 2. Timeline of data collection and validation.

Source: Own illustration.

recognition (e.g., awards, directories, or listings). These materials supported the validation of internal data and offered an external perspective on the farm's sustainability performance. They were particularly relevant for cross-checking claims and understanding how the farm was positioned in the broader agribusiness and sustainability landscape.

Semi-structured interview

The third source involved a semi-structured interview with the farm manager, conducted to gather qualitative insights into the farm's governance, economic strategies, and social engagement. Open-ended questions were designed in alignment with the four dimensions of the SAFA framework (FAO, 2014). Given the small-scale and owner-operated nature of the case, the farm manager holds comprehensive knowledge of the farm's operations, making him a key informant with direct involvement across all sustainability domains. Importantly, the interview did not serve as a self-assessment by the manager, but as a means of data collection that provided relevant data for the assessment process. Rather than relying solely on self-reported opinions, the interview functioned to enhance the accuracy and consistency of the data, particularly where documentary evidence was limited or required interpretation. In order to mitigate potential bias, the information provided through the interview was triangulated with internal documents and publicly available materials (Yin, 2018; Kohlbacher, 2006).

Data analysis

The sustainability evaluation was structured using the SAFA framework, focusing specifically on hemp cultivation activities at Obelisk Farm, with the scope limited to operations and data up to 2023. This scope was defined during the mapping and contextualization phases to ensure clarity and analytical depth. The application followed the FAO's four-step SAFA process: (1) mapping, which included a description of the assessed entity and boundaries; (2) contextualization, involving the review and refinement of relevant sub-themes and exclusion of irrelevant ones; (3) indicator selection, guided by sustainability objectives and accuracy scores; and (4) reporting, which documented results and identified areas for improvement (FAO, 2014). This process is summarized in figure 3.

The initial stage of data analysis involved a detailed mapping of the farm's characteristics, including its size, production model, market scope, and environmental setting. This descriptive baseline informed the contextualization process, during which the sustainability objectives of the farm were reviewed and used to determine the relevance of each SAFA sub-theme. Certain sub-themes and indicators were excluded to ensure alignment with the scope of hemp cultivation. Based on the farm's operational focus and available data, 45 sub-themes and 90 indicators were selected for the assessment. Each indicator was analyzed using the SAFA framework's official scoring methodology, which includes five qualitative ratings ranging from "best" to "unacceptable". Ratings were color-coded for visual clarity (dark green, green, yellow, orange, red) and later represented through a polygon diagram. Indicator scores were not assigned arbitrarily but derived through the structured triangulation process. An indicator was scored only when at least two of the three sources corroborated the evaluation. In this way, the analysis aimed to reduce subjectivity and ensure a robust basis for scoring. A manual coding process was employed to match collected data with the relevant indicators. Where data were ambiguous or incomplete, the lowest justifiable score was applied, following SAFA's precautionary approach. All evaluations were aligned with the scoring criteria and accuracy guidance provided by the FAO. In the final reporting phase, results were compiled into a visual format. A polygon diagram illustrated the performance of each sustainability dimension, while a score distribution table (table 1) displayed the number of indicators across the five scoring levels.

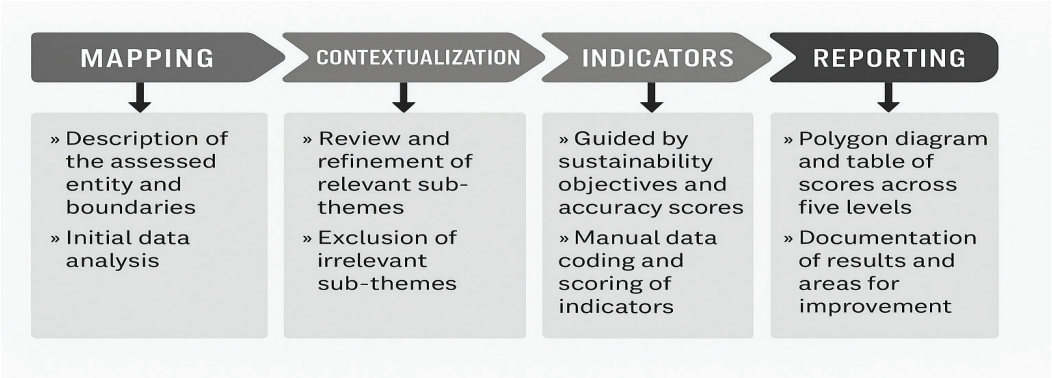

Figure 3. Structured process of sustainability evaluation according to SAFA.

Source: Own illustration.

Table 1

Distribution of SAFA indicator scores by dimension. Source: SAFA tool

GOOD GOVERNANCE		ENVIRONMENTAL INTEGRITY		ECONOMIC RESILIENCE		SOCIAL WELL-BEING	
Indicator	Accuracy Score	Indicator	Accuracy Score	Indicator	Accuracy Score	Indicator	Accuracy Score
1.1.1	4	3.1.1	5	1.1.1	2	1.1.1	2
1.1.2	4	3.1.2	0	1.2.1	5	1.2.1	5
1.2.1	4	3.1.3	0	1.3.1	5	1.3.1	5
2.1.1	2	3.1.4	0	1.3.2	5	1.3.2	5
2.2.1	3	3.1.5	0	1.4.1	5	1.4.1	5
2.3.1	4	3.2.1	4	1.4.2	4	1.4.2	4
3.1.1	3	3.2.2	4	1.4.3	5	1.4.3	5
3.1.2	4	3.2.3	0	2.1.1	3	2.1.1	3
3.1.3	4	4.1.1	2	2.1.2	2	2.1.2	2
3.1.4	2	4.1.2	0	2.2.1	4	2.2.1	4
3.3.1	2	4.1.3	0	2.2.2	4	2.2.2	4
4.1.1	2	4.1.4	0	2.2.3	3	2.2.3	3
4.3.1	5	4.1.5	0	2.3.1	1	2.3.1	1
4.4.1	5	4.2.1	1	2.4.1	5	2.4.1	5
4.4.2	5	4.2.2	2	2.4.2	4	2.4.2	4
5.1.1	2	4.2.3	0	2.5.1	3	2.5.1	3
5.2.1	4	4.2.4	5	3.1.1	5	3.1.1	5
		4.3.1	1	3.1.2	5	3.1.2	5
		4.3.2	0	3.1.3	5	3.1.3	5
		4.3.3	0	4.1.1	5	4.1.1	5
		4.3.4	0	4.1.2	5	4.1.2	5
		4.3.5	0	4.2.1	5	4.2.1	5
		5.1.1	5				
		5.1.2	0				
		5.1.3	4				
		5.1.4	0				
		5.2.1	1				
		5.2.2	4				
		5.2.3	0				
		5.2.4	2				
		5.3.1	3				
		5.3.2	4				
		5.3.3	5				
		5.3.4	5				

Rating	Accuracy score
No data	0
Unacceptable	1
Limited	2
Moderate	3
Good	4
Best	5

Results

A visual summary in the form of a polygon was generated by the software to present the sustainability assessment results, with each segment corresponding to one of the four SAFA sustainability dimensions (Figure 2). The results show stronger performance in Social Well-being (average score: 5.00) and Economic Resilience (average score: 4.09), with more moderate outcomes in Good Governance (average score: 3.47) and Environmental Integrity (average score: 3.35, excluding indicators with no available data).

Case study's findings: Obelisk Farm

Obelisk Farm is located in the Latgale region of eastern Latvia, covers 3.5 hectares and was established in 2017 with the aim of revitalizing the European hemp industry. The farm specializes in the cultivation and processing of hemp, producing a variety of food and non-food products, serving both local and international markets. Its mission is to educate the public about hemp's diverse applications and benefits through initiatives such as the hemp school, hemp museum, and events. Recently, the hemp school was distinguished by the European Training Foundation as the winner of the 2024 Green Skills Award, recognizing its contributions to sustainable education. In addition to its agricultural activities, the farm has expanded into tourism, offering workshops, courses and guided tours that focus on the sustainability potential of hemp. The farm is the only hemp business in Europe to offer such a comprehensive selection of hemp-related services, further positioning it as an important player in the hemp industry.

Good governance

The farm's mission and values are clearly articulated on its website, providing a transparent overview of its guiding principles. However, there is a lack of a formal, detailed plan that outlines a structured decision-making process or the specific procedures being implemented. This gap is particularly evident in the area of sustainability assessments, as no reports or metrics are available to quantify the impact of daily operations. Nevertheless, the farm's practices align with sustainable principles, as inferred from its operational focus and guiding philosophy. Relationships with customers and government entities are positively growing though there is an opportunity to further strengthen these connections through systematic evaluation and the development of action plans, which could help formalize the governance model. While customers can gain insight into the farm's philosophy through its mission and values, the internal decision-making process remains unclear, as it is not communicated externally. The farm complies with legal requirements for hemp cultivation and integrates customer initiatives within its autonomous framework, guided by its mission and values. Nonetheless, formal planning and documentation of processes such as analysis, justification, counseling, and decision-making are still under development.

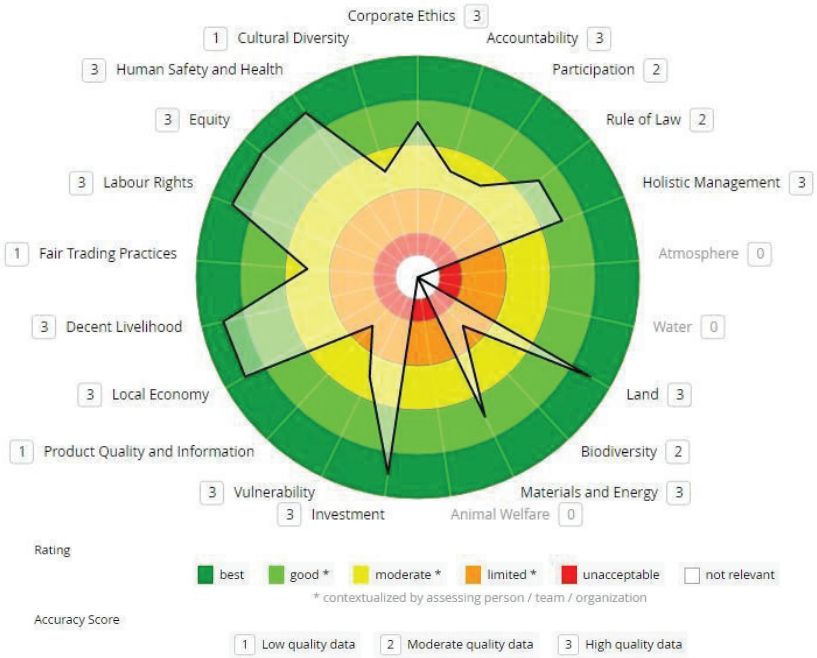

Figure 4. Sustainability assessment results for Obelisk Farm using the SAFA tool.

Source: SAFA tool

Figure 5. Good governance.

Source: SAFA tool

Environmental integrity

From an environmental standpoint, the hemp cultivation on the farm contributes positively to soil quality. Minimal tillage practices are used to control weeds, reducing the need for herbicides, and all natural waste is repurposed to enhance soil fertility. However, there is no formal documentation verifying whether soil properties are being preserved or improved, as soil analysis is conducted only once every four years in accordance with the farm's participation in a subsidy program. In terms of its agricultural practices' relationship with ecosystems, the operator acknowledges that these practices, such as crop rotation, offer indirect benefits to biodiversity. These benefits, however, are not officially documented; for instance, even if crop rotation may boost biodiversity, the farm is unsure which species are helpful for natural pest control or whether any protected species are part of national or local conservation programs. Regarding raw materials and energy, the farm uses unprocessed materials only when no alternatives are available, such as in the case of packaging hemp bales, where plastic is the only option. This use of plastic is one of the few exceptions to the farm's overall practice of reusing biodegradable materials. In terms of energy use, the farm relies on agricultural service providers and utility-supplied energy, with no immediate plans to invest in renewable energy self-sufficiency. Nonetheless, the farm's commitment to environmental sustainability is also demonstrated through its certification of energy-efficient building, which is the first and only of its kind awarded to a hemp-based structure in Latvia. This was achieved through the construction of the farmhouse using hempcrete, a material made from hemp hurds, lime, and water, prized for its insulating, breathable, and durable qualities. As a carbon-negative material, hempcrete supports the farm's sustainability efforts and showcases hemp's versatility as a renewable resource (Teirumnieka *et al.*, 2023). The national certification is important because it acknowledges hempcrete's energy efficient properties and affirms the farm's leadership in pioneering sustainable construction practices, setting an example for others to follow.

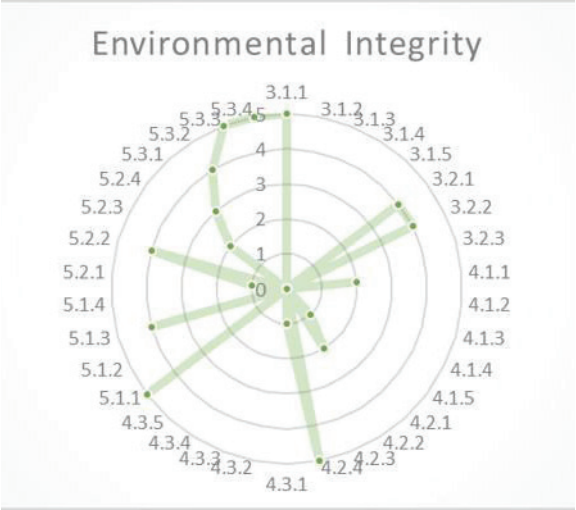

Figure 6. Environmental integrity.

Source: SAFA tool

Economic resilience

The farm has significantly impacted its region, not only by establishing a successful operation but also by fostering a ripple effect that has led to the development of numerous businesses in the area. Since the farm began operating, its presence has encouraged local entrepreneurship and contributed to the growth of related sectors, such as agribusinesses and tourism. This has created a more vibrant, interconnected community, with new opportunities arising for local suppliers, service providers, and other businesses that support the farm's operations. However, the lack of formal records makes it difficult to quantify or measure certain effects. Alongside its external impact, the business remains focused on its mission and values, which has allowed it to remain profitable over the years. Its strong economic performance attracts investments aimed at addressing the evolving needs within the business's relationships. These investments include advancements in expansion of processing facilities, and research into new hemp-based products. Hemp's versatility, ranging from food products like hemp seeds, oil, and protein to non-food applications such as hemp paper, provides the farm with varied revenue streams. The farm's relationship with suppliers is built on trust and respect for its guiding philosophy, with no external conditions or pressures influencing the

commercial relationships. However, one of the key challenges the farm faces is the absence of a formal risk analysis process. This limitation restricts the ability to conduct comprehensive evaluations, which could better inform decision-making processes and strategic planning. Another vulnerability is that the farm consumes all of its production. This reliance on internal consumption for its output creates challenges in terms of economic efficiency, as the absence of alternative markets for distribution prevents the farm from optimizing profits. Without external outlets for its products, the farm is exposed to fluctuations in demand or pricing, making it more susceptible to risks that could impact its financial stability.

Figure 7. Economic resilience.

Source: SAFA tool

Social well-being

The farm consistently demonstrates strong performance through the cultivation of an inclusive and equitable work environment, the promotion of community development, and the enhancement of local services and tourism. The social aspect of its operations is so crucial that the managing partner himself has observed changes in the community due to the farm's presence and development. Its activities have led to significant improvements in the region, including enhanced access to essential services and the creation of new business opportunities. In terms of community development, the farm actively engages with local residents and stakeholders to support initiatives that enhance the quality of life in the area. This includes creating traineeship opportunities, collaborating with local businesses, and participating in community projects that address social and economic challenges. Additionally, neighboring farmers have established cooperative networks to ensure the sustainability of their economic activities. The presence of hemp production and related initiatives has played a key role in revitalizing the local economy, particularly by attracting visitors interested in rural tourism. This growing interest has contributed to boosting tourism in the area and strengthening the economic resilience of the region, providing long-term benefits to businesses and residents alike.

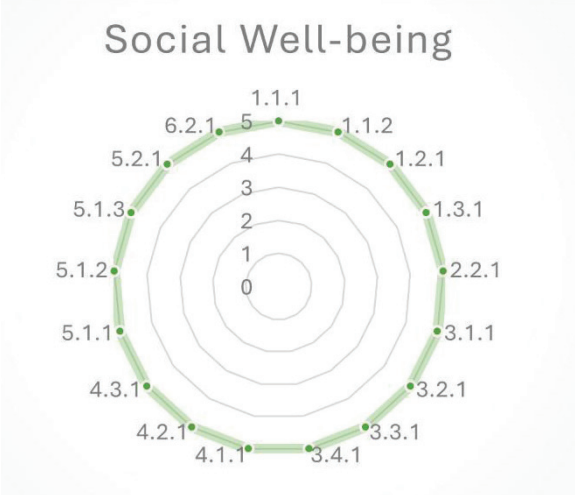

Figure 8. Social well-being.

Source: SAFA tool

Discussion

The assessment identifies social well-being as the farm's strongest dimension, a finding consistent with broader studies that highlight the importance of small-scale agricultural enterprises in promoting rural development (Cammarata *et al.*, 2021; Curran *et al.*, 2020; Muedi *et al.*, 2024; Oliveira *et al.*, 2023; Timpanaro & Foti, 2024). The farm supports community engagement, encourages tourism, and contributes to the socio-economic vitality of the region. Observations from the farm manager underline the broader community benefits generated through its activities, reinforcing the idea that agricultural enterprises play a central role in regional development by influencing both public and private dynamics. The continuity of these contributions will depend on sustained collaboration with local stakeholders and responsiveness to evolving social needs.

The governance dimension is supported by a strong ethical orientation and transparent decision-making. Many of the farm's activities are guided by informal practices, rooted in trust, shared values, and tacit knowledge. These informal structures, while effective and locally appropriate, are not always documented in ways that align with conventional evaluation tools. Similar patterns have been observed across other small-scale agricultural contexts, where traditional knowledge-sharing and relational governance are

preferred over written policies (Curran *et al.*, 2020; Oliveira *et al.*, 2023; Timpanaro & Foti, 2024). This highlights the importance of sustainability assessment tools that are flexible enough to accommodate informal management systems. Approaches that include narrative-based evidence or context-sensitive indicators could improve the ability to recognize and validate sustainability practices in small, community-embedded agricultural models. Formalizing certain elements of governance, such as through sustainability reports or operational guidelines, can also support accountability and provide useful benchmarks for continuous improvement (Escribano *et al.*, 2014; Testa *et al.*, 2022).

Environmental performance aligns with hemp's ecological potential, particularly its low-input requirements and contributions to soil health. However, the absence of formal monitoring mechanisms limits the ability to demonstrate and quantify these benefits. This reflects a broader issue in the sector, where hemp's sustainability is widely assumed but not systematically evaluated (Aryal *et al.*, 2024; Enarevba & Haapala, 2024; Kaur & Kander, 2023; Muedi *et al.*, 2024). Establishing standardized monitoring protocols for biodiversity, energy use, and soil impact, possibly in collaboration with research institutions and conservation organizations, would help fill this gap and strengthen the evidence base for hemp's environmental contributions (Escribano Sánchez, 2014; Farooq *et al.*, 2024; Omer *et al.*, 2024). This step would also enhance comparability across farms and inform the development of best practices. Existing sustainability frameworks should consider promoting such protocols as part of broader methodological improvements.

Infrastructure upgrades, such as the integration of hempcrete in buildings, indicate a commitment to energy efficiency. The farm's receipt of national certification for energy-efficient construction provides external validation of these efforts. At the same time, its reliance on the local electricity grid, without current plans to transition to renewable energy sources, accentuate an area of untapped potential. Incorporating decentralized solar or wind energy systems could increase self-sufficiency and further reinforce environmental sustainability, especially given recent innovations in renewable energy technologies (Harkányi & Ujj, 2024; Kander & Kaur, 2023; Mazur-Włodarczyk & Gruszecka-Kosowska, 2024).

The economic dimension reveals a working model based on internal production and consumption. While this model supports operational self-reliance, it also limits diversification, which can expose the farm to income instability. Studies have emphasized the value of diversified revenue streams, including product development, agritourism, and ecosystem services, as strategies for building resilience in small-scale enterprises (Curran *et al.*, 2020; Hansson *et al.*, 2008; Koloszko-Chomentowska *et al.*, 2025; Vik & McElwee, 2011). Introducing new crops, engaging in carbon credit markets, or expanding distribution channels could contribute to long-term viability (Harkányi & Ujj, 2024; Kaur & Kander, 2023; Kumar *et al.*, 2024; Parré *et al.*, 2024). Moreover, the absence of a structured risk assessment framework limits the farm's capacity to anticipate disruptions or evaluate strategic options. A formal approach to risk, such as scenario planning, financial stress testing, or vulnerability mapping, would strengthen adaptive capacity and support forward-looking decision-making (Castoldi & Bechini, 2010; Giupponi *et al.*, 2020; Jafri *et al.*, 2024; Quaicoe *et al.*, 2024; Herrero *et al.*, 2014; Pavlova *et al.*, 2024; Vigani & Kathage, 2019).

Overall, the assessment suggests that sustainability dimensions influence and reinforce one another. For instance, the farm's strong community ties shape governance practices, while financial limitations affect environmental strategies. These interdependencies are central to how sustainability unfolds in practice, particularly in small-scale contexts where resource constraints and informal systems prevail (de Olde *et al.*, 2016). While the SAFA tool is conceptually based on four interconnected dimensions, its application often relies on assessing each area independently, guided by predefined benchmarks. This approach may miss how context-specific trade-offs, synergies, or overlaps influence sustainability outcomes (Binder *et al.*, 2010; de Olde *et al.*, 2016). This case study shows that a more integrated assessment approach, one that explicitly accounts for interdimensional interactions and informal practices, is essential for evaluating farms with hybrid or localized models of sustainability. Enhancing tools like SAFA to include narrative-based evidence, structured reflection prompts, or indicators for cross-dimensional linkages would increase their relevance in small-scale or niche farming systems (de Olde *et al.*, 2016; Jia, 2023). Such adaptations might also improve accuracy and support a more grounded understanding of how sustainability is experienced and managed on the ground.

Conclusions

This study assessed the sustainability performance of a small-scale hemp farm using a structured evaluation approach. The findings point to strong results in the social and governance dimensions, particularly in terms of community engagement, ethical practices, and transparent operations. The farm's contribution

to local development through tourism, cooperative relationships, and informal support networks demonstrates the wider socioeconomic value of small-scale agricultural enterprises. These elements underline the importance of social capital as a core driver of sustainability in rural contexts.

Environmental and economic dimensions, while functional, present key areas for improvement. The absence of formal biodiversity monitoring, despite environmentally responsible practices, limits the ability to quantify ecological benefits or establish clear conservation goals. Continued reliance on external energy sources also constrains progress toward energy autonomy. Collaborating with conservation entities and gradually investing in renewable energy systems, such as solar or wind, would reinforce both environmental integrity and long-term resilience. In the economic dimension, the farm's self-sufficiency model provides short-term stability but limits adaptability to market fluctuations. Diversifying revenue through hemp-based products, rotational crops, or engagement with carbon credit markets presents opportunities to strengthen financial sustainability. Given hemp's potential for carbon sequestration, leveraging environmental finance mechanisms offers a strategy that aligns ecological goals with income diversification.

In addition to evaluating farm-level sustainability, the analysis underlines important considerations for the application of assessment tools in underrepresented agricultural sectors. The results show that when standardized frameworks are applied to small-scale or informal farming systems, they must be capable of recognizing tacit knowledge, undocumented governance practices, and localized expressions of sustainability. Tools that assess each dimension independently risk overlooking the dynamic interactions between social, environmental, governance, and economic factors. A more integrated approach, one that acknowledges cross-dimensional interdependencies and contextual variation, would increase the relevance and accuracy of sustainability assessments in diverse farming contexts.

Although grounded in a single case, this study offers methodological and practical observations that capture the nuances of informal and hybrid farming systems, with potential relevance for both research and applied sustainability practice. The findings reinforce the importance of flexible, evidence-based frameworks that reflect the complexity of real-world agricultural systems. Future research involving multiple hemp farms in varied contexts would allow for testing the transferability of these results and support a more comprehensive understanding of sustainability strategies in niche or emerging crop sectors.

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