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The Social Sustainability of Organic Cultivation with S-LCA Application in Research Project

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Abstract: *In this paper, the authors aim to present the methodology used to measure social sustainability, which is being implemented in a research project called "Innovations in organic agriculture to improve the sustainability of Apulian farms for cereal and industrial crops." The authors used the social life cycle assessment (S-LCA), based on the life cycle assessment, particularly the subcategory assessment method.*

The authors developed a questionnaire to collect information about workers and the time worked (weekly working hours, working weeks) in each plot of the experimentation plan. The authors administered the questionnaire to multiple recipients categorized as three identified types of stakeholders (workers, local community, consumers) to triangulate the answers. The use of the S-LCA in experiments in the agricultural sector, which presents critical issues in the social sustainability of production, could become a strategic tool for achieving sustainable development in agri-food sector.

1. INTRODUCTION

In this paper, we aim to present the methodology used to measure social sustainability, which is being implemented in a research project called "Innovations in organic agriculture to improve the sustainability of Apulian farms for cereal and industrial crops" (referred to hereafter as "the project") that a farm association lead. We carried out this project in the south of Italy to analyze not only technical and agronomical aspects but also the sustainable aspects of a new agro-ecological model based on the rotation of arable crops, legumes and vegetables.

We used the social life cycle assessment (S-LCA) to measure social sustainability, based on the life cycle assessment (LCA). This methodology has attracted the scientific community's attention in recent years (Traverso, Petti, & Zamagni, 2020, p. *v*). It has been increasingly used in an effort to adopt a rigorous methodology that is based on LCA, according to ISO standards 14040 updated in 2021.

The S-LCA is part of a life cycle sustainability assessment (LCSA) used to analyze the three pillars of sustainability: (environmental-LCA - E-LCA), economic (life cycle costing - LCC) and social (S-LCA). However, the combination of E-LCA, LCC and S-LCA is not easy to implement in practice due to overlapping issues in results and interpretation (UNEP 2020, p. 16).

It should be noted that in the assessment of social impacts, the implementation of the S-LCA method contributes to the achievement of the sustainable development goals (SDGs) of Agenda 2030, mainly regarding SDGs 12 (Responsible Consumption and Production), 1 (No Poverty), 2 (Zero Hunger), 3 (Good Health and Well-Being), 4 (Quality Education), 5 (Gender Equality), 6 (Clean Water and Sanitation), 8 (Decent Work and Economic Growth), 10 (Reduced Inequali-

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ties), 16 (Peace, Justice and Strong Institutions), and 17 (Partnerships for the Goal). In relation to SDG 8, the S-LCA, in the ILO Decent Work Agenda, contributes to the assessment of working conditions (UNEP, 2020, p. 24).

Despite these benefits, the S-LCA is still evolving from the first guidelines published in 2009. This methodology is also of interest to the EU, with Directive 2014/95/EU, which seeks to promote the responsibility of human rights within global value chains.

In 2013, the S-LCA Guidelines were supplemented with the publication of methodological sheets that are in updating. These methodological sheets are operational support in the selection of the categories and sub-categories of impact and the generic and specific indicators, with the related database sources. This supplementary material has allowed for an increase in experiments, with other documents that led to the updating of the Guidelines in 2020 (UNEP, 2020, p. 17).

However, the S-LCA approach still has few implementations in the agri-food sector (UNEP, 2020, p. 45). To measure the project's social impact, following the 2020 Guidelines, we have chosen to use the subcategory assessment method (SAM) (Sanchez Ramirez, Petti, Haberland, & Ugaya, 2014, p. 1518) and follow the ISO assessment path (UNI EN) 14040 (2021). This choice allows us to consolidate the implementation of the methodology in the project.

2. RESEARCH BACKGROUND

SAM has been used in the food sector for the production of tomatoes, which is a crop subject to experimentation (Petti et al., 2018, p. 569). Additionally, SAM is easy for supply chain stakeholders to understand for the purpose of widespread implementation among the organic farms in the area. SAM allows for analysis of organizations' behaviors during the product's lifecycle process. SAM is an objective method for evaluating each subcategory (SBC), as it transforms qualitative information into a quantitative evaluation with a scale score (Table 1).

We selected these SBCs with the related indicators from the methodological sheets (UNEP - SETAC, 2013, p. 5) and the literature regarding the food sector (Petti, Sanchez Ramirez, Traverso, & Ugaya, 2018, p. 573) (Sanchez Ramirez, Petti, Haberland, & Ugaya, 2014, p. 1518).

Furthermore, we sought an S-LCA that the stakeholders in the supply chain could easily understand for the sake of widespread implementation among the organic farms in the territory because the SAM is an objective method for the evaluation of SBC that allows for analysis of organizations' behaviors during the process relating to the product's life cycle. The methodology is characterized by four steps:

(1) the use of the organization as a unit process, in which we decided to assess the social profile of the organization responsible for the processes involved in the product's life cycle,
(2) the definition of the basic requirement to assess each subcategory,
(3) the definition of levels based on the environmental context or organizational practice and the data's availability and
(4) assignment of a quantitative value (Table 1).

The system's boundaries are defined as the gate of the farm to the gate of the product collection center, and any by-products, according to the circular economy. We chose a functional unit of 1 kg of organic product from experimentation with the crop rotation model.

Table 1. Scale score and meaning

Scale score	1	2	3	4
Meaning	Denotes the inability to meet the basic requirements of social sustainability		Compliance with the basic requirements	Shows a proactive behavior higher than the basic requirements (best)

Source: own elaboration

We adopted questionnaires for the collection of social data to implement the SAM according to the UNEP (2020) (Life Cycle Inventory phase). We adapted the questionnaires adopted in the food sector to the project's needs.

The first phase is the preparatory phase, which is the same initial phase used in the E-LCA and LCC studies to conduct an integrated sustainability analysis according to the life cycle sustainability assessment (LCSA) study. The processing unit identified concerns soil management and product collection (and any by-product), with relative transport for each type of production. We made the identification according to a testing scheme implemented in two pilot organic farms (A and B) that practice crop rotation with legumes (chickpeas and peas), durum wheat (cultivar Senatore Cappelli and Nadif), industrial tomatoes, clover and field beans. Table 2 shows the testing scheme used to analyze innovation in crop rotation and innovative seeders.

Table 2. Testing scheme foresees with innovation in crop rotation and innovative seeder

ID test	Farmer	Previous crop	Crop	Variety	Innovation	Surfaces (ha)
1	A	Legumes	Durum wheat	Cappelli	Innovative seeder CREA	0.25
1a	A	Legumes	Durum wheat	Cappelli	Traditional seeder	0.25
2	A	Legumes	Durum wheat	Nadif	Innovative seeder CREA	0.25
2a	A	Legumes	Durum wheat	Nadif	Traditional seeder	0.25
3	A	Durum wheat	Durum wheat	Cappelli	Innovative seeder CREA	0.25
3a	A	Durum wheat	Durum wheat	Cappelli	Traditional seeder	0.25
4	A	Durum wheat	Durum wheat	Nadif	Innovative seeder CREA	0.25
4a	A	Durum wheat	Durum wheat	Nadif	Traditional seeder	0.25
5	A	Durum wheat	Tomato			0.50
6	A	Legumes	Tomato			0.50
7	B	Tomato	Durum wheat	Cappelli	Innovative seeder CREA	0.25
7a	B	Tomato	Durum wheat	Cappelli	Traditional seeder	0.25
8	B	Tomato	Durum wheat	Nadif	Innovative seeder CREA	0.25
8a	B	Tomato	Durum wheat	Nadif	Traditional seeder	0.25
9	B	Durum wheat	Tomato			0.50
10	B	Legumes	Tomato			0.50
11	A	Durum wheat	Legumes 1	Chickpea		0.50
12	A	Durum wheat	Legumes 2	Pea		0.50
13	A	Durum wheat	Legumes 3	Field bean		0.50

Source: own elaboration

The *testing scheme* highlighted the need to prepare 14 questionnaires based on crop precessions. The cutoff criteria are related to the number of hours worked in each unitary process of the life cycle (Petti, Sanchez Ramirez, Traverso, & Ugaya, 2018, p. 571), as follows:

$$W_h = W \times h \times n / p \quad (1)$$

where:

- W_h is the number of labor hours,
- W is the number of workers involved in the processing unit,
- h is the number of working hours per week,

- n is the number of working weeks per year and,
- p is the total production (kg) per year.

The number of working hours refers to the FU (WFU) for each unit process and is given as

$$W_{FU} = W_h \times c \tag{2}$$

where c is the amount of all materials necessary to produce 1 FU.

In this way, we could add work hours to the traditional quantitative information (material and energy flows) to identify the labour-intensive processes.

Furthermore, we used the questionnaire to collect information about workers (numbers, gender, employment contract) and the time worked (weekly working hours, working weeks) in a year and the entire annual production of the product in each plot to calculate the working hours in each unitary process (minutes or hours).

Table 3 shows an example standardized by questionnaire for each culture object of cultural rotation. By considering tomato production as an example the survey addressed to the top management referring to the stakeholder category "workers", subcategory "working hours" is related to the following questions:
- indicate the number of overtime hours on average per week per worker;
- indicate the number of hours worked on average per week per worker.

Table 3. Example standardized from the questionnaire for each crop

Phases	Working process	Which company carries out each type of processing		How many work hours per hectare?	How many workers were employed?		Which type of contract? Duration?			
		own	third parties		males	females	farmer	other	hours/ week	number of weeks
Soil management	ploughing									
	fertilising									
	…									
Harvesting	harvesting									
	transport									
By-product	by-product harvest									
	transport									
End-of-life plants	end-of-life plants									
	a) grinding and buring									
	transport									
End-of-life mulching sheet	harvesting mulching sheet									
	transport									

Source: own elaboration

An example from the stakeholder category "workers", subcategory "fair wage" fellows:
- what is the basic salary of the production manager?
- what is the basic salary for the agricultural worker?

- what are the types of employment contracts of the company each month? (fixed-term contract, permanent contract, part-time contract etc).

In this sense, particular attention should be paid to these labour-intensive processes' social aspects because a problem could occur (presence of forced labor, no fair wage, etc.).

We administered (in progress) the questionnaire to multiple recipients categorized as three types of stakeholders (workers, local community and consumers) to triangulate the answers (Table 4). For each of these categories, we have selected subcategories, according to the literature, that follow the 2013 guidelines. Table 5 shows the categories of stakeholders with their related subcategories.

Table 4. -Questionnaire recipients, contents, stakeholders

Questionnaires recipients	**Questionnaires Contents and/or Stakeholder**
Legal Representative	Information about the farm, production, type of processing, manufacturing companies and workers; Stakeholder: Workers, Local Community; Consumer
Marketing /sales manager	Stakeholder: Consumer
Worker	Stakeholder: Workers
Trade union delegate	Stakeholder: Workers
Representative of the local community	Stakeholder: Local Community

Source: own elaboration

Table 5. Categories of stakeholders with the related subcategories (SBC)

	STAKEHOLDER		
SUBCATEGORY	**WORKERS**	**LOCAL COMMUNITY**	**CONSUMERS**
	Benefits / Social security	Relocation and migration	Health & Safety
	Working hours	Community involvement	Feedback mechanism
	Forced labor	Cultural heritage	Consumer privacy
	Fair wage	Respect for the rights of "indigenous"	Transparency
	Freedom of association and collective bargaining	Local employment	End-of-life responsability
	Health and safety in the workplace	Access to intangible resources	
	Equal opportunities / discrimination	Access to material resources	
	Child labor	Safe and healthy living conditions	

Source: own elaboration

3. FUTURE RESEARCH DIRECTIONS

We will use the questionnaires' results to conduct an S-LCA study related to the experimentation in progress in the project. We used this process to define a model to measure social sustainability with the S-LCA methodology in the pilot companies' activities.

Future research will concern the recognition of third parties to improve corporate reputation as determined by the target audience of customers/consumers.

4. CONCLUSION

The use of the S-LCA in experiments in the agricultural sector treated some critical issues in the social sustainability of production. Facing these issues could become a strategic tool to achieve sustainable development in the agri-food sector.

The S-LCA in this project represents a complement of LCA and LCC to obtain an LCSA once we evaluate the answers we collect with the survey. The S-LCA's results will allow us to analyze an ex-post situation. We will transfer this methodology to the members of the farm association.

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CONTRIBUTION OF THE AUTHORS

A. Di Noia carried out the bibliography, the collection and processing of the data, G.M Cappelletti and A. Di Noia carried out the application of the methodology, C. Russo reviewed the paper.

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