POULTRYNSECT

Report on Task 4.3

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Content

Introduction

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The POULTRYNSECT Work Package 4 "**Integrated sustainability assessment**" aims to evaluate the potential changes in the sustainability of chicken meat achieved through Black Soldier Fly live larvae (BSFL) inclusion in the chicken diet.

Product sustainability lies on three pillars: environmental sustainability, economic sustainability, and social sustainability. Within task 4.1, Life Cycle Assessment (LCA) was used for an assessment of environmental impacts associated with all the stages of the production of organic broiler meat within the Poultrynsect system. The economic sustainability of broiler meat was tackled through Life Cycle Costing (LCC) within task 4.2.

Task 4.3 included the overall sustainability assessment, consisting of the environmental LCA, LCC analysis, and social LCA. Social LCA, conducted within the task, was used to analyse the social impacts of the Poultrynsect system, in both insect and chicken production. Furthermore, as a sensitivity analysis, the possible introduction of changes in the future was taken into account.

I Social Life Cycle Assessment (SLCA)

1. Material and Methods

Scope and Functional Unit of the assessment of the experimental results

The sustainability assessment of the experimental Poultrynsect system developed within the project was predominantly based on the information obtained from the project partners. These include the black soldier fly larvae production, and the in vivo chicken trial conducted within the project. Two different feeding trials were performed on a local Italian chicken breed Label Naked Neck. The first group was reared on 90% commercial feed and 10% of insect substitution, which consisted of the *Hermetia illucens* larvae, commonly known as black soldier fly larvae (BSFL). The second group was fully reared on commercial feed and was used as the control group. Within each of the groups, the differences between the sexes were closely followed. The data were partly extended by the data from the literature. The system boundaries used throughout the whole sustainability assessment took a cradle-to-slaughterhouse gate perspective with extensions of waste treatments and considered therefore the whole chain of poultry production. The main systems included are feed production, larvae production, hatchery, poultry production, and slaughterhouse. The functional unit across the sustainability assessment was 1 kg of packed ready-to-cook chicken carcass. The boundaries of the assessment are shown below schematically (Fig. 1, 2).

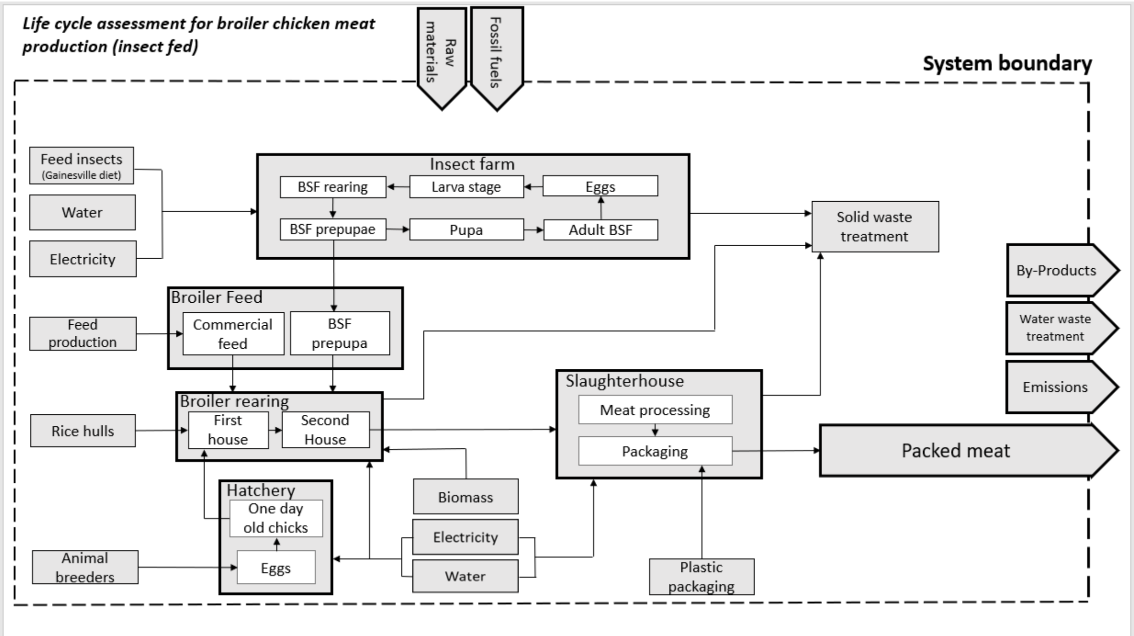

Figure 1: System boundaries of the sustainability analysis of the system with inclusion of insects in the diet of chicken

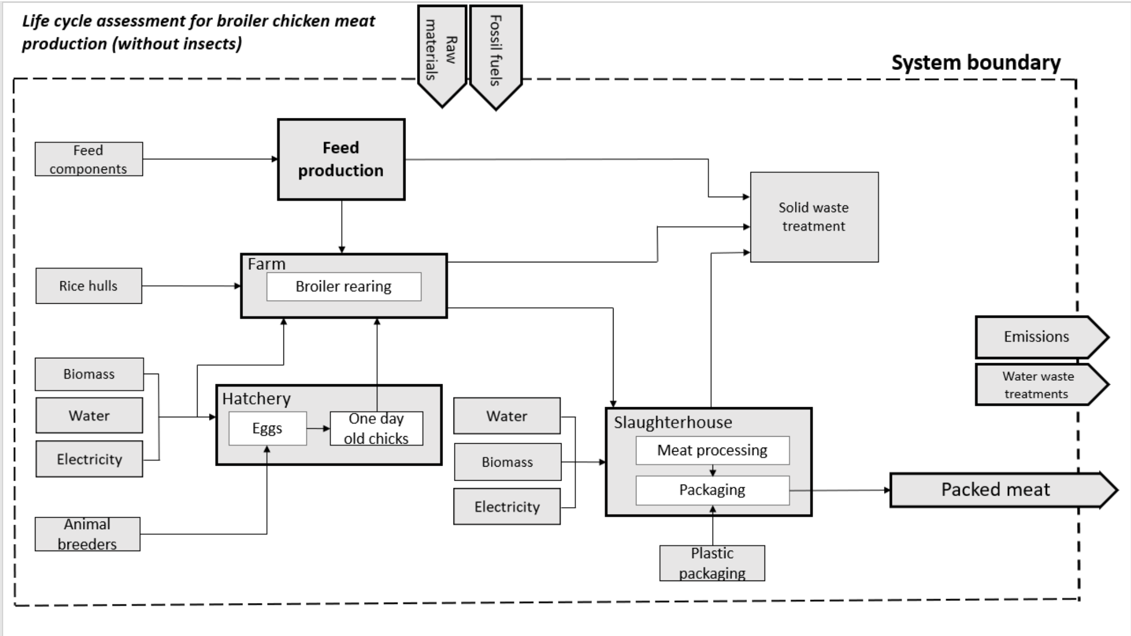

Figure 2: System boundaries of the sustainability analysis of the system without inclusion of insects in the diet of chicken

Goal, scope, system boundaries and functional unit

The main goal of the research was to compare the social sustainability of organic chicken meat produced with the inclusion of 10% of Black Soldier Fly larvae (BSFL) in the diet with the organic meats produced conventionally.

This Social Life Cycle Assessment (SLCA) study followed the system boundaries previously established and explained. Within the defined boundaries, special attention was paid to the social impacts of insect rearing. Additionally, as automation was identified as a likely innovation that is to take place in both chicken and insect rearing, and that is expected to impact the social sustainability of the system, it was also taken into account. The same functional unit as explained was used.

The assessment was based on the information collected from the project partners, combined with the information from the market, and from the literature. The scope of the study included the assessment of the broiler farm identical to the experimental chicken farm, and the insect farm identical to the experimental farm. The main focus was on the changes that would be introduced by the introduction of live BSFL into the chicken diet. As the chicken production took place in Italy, the parameters were adapted to Italy, and when possible, specifically to the region of Piedmont.

The methodology was mostly based on the research of Pelletier, N. (2018). Keeping in mind the size of both the chicken and the insect farm, their relevance for the wider society was estimated as insignificant, and workers were identified as the crucial stakeholders for the social sustainability assessment. Based on the classification of the social risks presented in the paper, a grading system of the socially risky behavior of employers was developed, as follows:

5 – Not assessed (questionable sources)

4 – Risky

3 – Compliant

2 – Proactive

1 – Committed

As can be seen from the above, the lower the grade, the lower the social risk (and the higher the social sustainability). The fair wage potential was calculated per Neugebauer, S. et al. (2016).

Social Life Cycle Assessment Inventory

The specificities of the current production system flow, efforts, risks, and social security were collected from the partners. Some of the economic factors were collected from the literature. As the importance of automation was identified, the data on automation was collected from the market and especially the machinery producers. Automation was assumed to decrease the negative health impacts (especially allergic reactions) in both chicken and insect growers. This is especially true for insect production, which is still in the early stages of the development of production. Many operations are still being done manually, which increases the health risks, but also the potential for automatization in the near future.

2. Results and discussion

It was assumed that all the labor-related laws and regulations were followed, which led to “compliant” being the lowest grade assigned to any of the assessed SLCA categories. Considering the social security stipulated by the EU and Italian regulation (relative to the rest of the world), the grade “compliant” should already indicate relatively low social risks workers are being exposed to. The results of the assessment are in the table 1.

Table 1: Social Life Cycle Assessment Result Matrix

	Insect farm		Chicken farm			
	Predominantly manual	Automated	Predominantly manual		Automated	
			Insects included	Control	Insects included	Control
Health and safety	3	2	3	2.5	2.5	2
Fair wage potential	2.42	2	2.42	2.42	2	2
Freedom of association and collective bargaining	Small, likely family farm, and therefore not relevant					
Child Labour						
Working Hours	3	1	3	3	2	2
Equal opportunities/Discrimination	3	2	3	3	2	2
Forced Labour	3	1	No difference introduced by insects expected			
Social benefits/Social security	3	3				
Overall	2.90	1.83	2.85	2.73	2.13	2

The grades for most of the categories were based on the information received from the project partners. The fair wage potential was calculated per Neugebauer, S. et al. (2016) and was based on the average salary (stated above).

What stands out is that automation can significantly improve the social sustainability scores of both insect and chicken farming. It is expected to have a mildly positive impact on fair wage potential, but a more pronounced impact on the decrease of the health and safety risks (due to lower risk of injuries and allergic reactions), respect of the working hours (due to the expected development of and strict adherence to the production procedures and schedules) and equal opportunities (as the decrease in physical labor will allow people with limited physical abilities to access the jobs). Specific to insect production, forced labor risks are also expected to decrease (due to the decreased need for manual and physical labor and the increased need for skilled machine operators). Secondly, the inclusion of insects into chicken feed represents an allergenicity risk, which was reflected by the higher health and safety risks grades.

3. Conclusions

From the perspective of social sustainability, automated production limits social risks and has proven to be a crucial factor in both insect and chicken production. It led to differences of up to 1 point in comparison with their manual counterparts. As a result, automated chicken production based on conventional organic feed proved to be the most socially sustainable, closely followed by automated chicken production with the inclusion of BSFL. As far as insect production is concerned, automated production proved to be significantly more socially sustainable than its manual counterpart.

II Integrated sustainability assessment

The integrated sustainability assessment combines single-score LCA results, LCC production price results, and Social LCA results in an attempt to give a simplified overview of the sustainability of the Poultrynsect organic chicken meat production system. As the functional unit for the sustainability assessments was 1 kg of packed ready-to-cook chicken carcass, the integrated assessment refers to the sustainability of produced organic chicken meat.

In order to make the results of the different sustainability assessments comparable, the grading scale used for social LCA was applied to environmental LCA and LCC. The standardization of the results to the scale from 1 to 5 was carried out, so that 1 remains the most sustainable option, and 5 the least sustainable.

The standardized results of all three experimental sustainability assessments, as well as the aggregated results of the integrated sustainability assessment, are presented in Table 2.

Table 2: Integrated Sustainability Assessment Matrix

	Chicken meat production							
	Predominantly manual				Automated			
	Insects included		Control		Insects included		Control	
	Males	Females	Males	Females	Males	Females	Males	Females
LCA	4.23	4.65	4.27	5.00	4.23	4.65	4.27	5.00
LCC	3.85	5.00	3.63	4.58	3.85	5.00	3.63	4.58
SLCA	2.85	2.85	2.73	2.73	2.13	2.13	2.00	2.00
Sum	10.94	12.51	10.63	12.30	10.21	11.78	9.90	11.58
Overall grade	3.65	4.17	3.54	4.10	3.40	3.93	3.30	3.86
	3.91		3.82		3.66		3.58	

The results indicate a major difference between the sexes of the chicken, standing at about half a point, indicating that male broilers are more sustainable. A smaller difference in sustainability, amounting to about 0.25, was associated with the presence of automatization. Finally, a difference of less than 0.1 was associated with the inclusion of insects into the chicken diet.

While the biggest difference in integrated sustainability was observed between the two sexes, it is questionable if these findings can be utilized – both from an organizational and ethical point of view. The introduction of automatization led to a significant improvement in integrated sustainability. The introduction of insects to the chicken diet did not lead to a significant change in the sustainability of the system.

References

Pelletier, N. (2018). Social sustainability assessment of Canadian egg production facilities: Methods, analysis, and recommendations. Sustainability, 10(5), 1601. https://doi.org/10.3390/su10051601

Neugebauer, S., Forin, S., & Finkbeiner, M. (2016). From life cycle costing to economic life cycle assessment—introducing an economic impact pathway. Sustainability, 8(5), 428. https://doi.org/10.3390/su8050428

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