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SUSTAVIANFEED

ALTERNATIVE ANIMAL FEEDS IN MEDITERRANEAN POULTRY BREEDS TO OBTAIN SUSTAINABLE PRODUCTS

EXPLOITATION STRATEGY

DELIVERABLE 5.3

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Partners

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SUMMARY

The SUSTAvianFEED project addresses the challenges of sustainable poultry farming in the Mediterranean, particularly in Spain, Italy, Tunisia, and Turkey. These countries face environmental and economic constraints that hinder sustainable agricultural practices. The project's goal is to introduce alternative feed ingredients, promote slow-growing poultry breeds, and implement circular economy models to improve sustainability. A key focus is on smallholders, who often lack access to modern farming technologies. By providing sustainable feed solutions and fostering knowledge-sharing, SUSTAvianFEED seeks to ensure long-term improvements in the poultry industry. The exploitation strategy outlines activities and results targeted at stakeholders in the agri-food sector, particularly smallholders and private businesses.

Table of Contents

Table of Figures

Acronyms and abbreviations

Abbreviation	Description
BSF	Black Soldier Fly
KER	Key Exploitation Results
LCA	Life Cycle Assessment
PC	Project Coordinator

1 Introduction

The Mediterranean region, characterized by its unique blend of climates, cultures, and agricultural practices, faces significant challenges in ensuring sustainable food production. These challenges are exacerbated by climate change, resource scarcity, and socio-economic pressures. Within this context, SUSTAvianFEED exploitation activities are crucial for addressing these issues and maximizing the project's impact beyond its immediate scope.

Agriculture in the Mediterranean is predominantly carried out by smallholders who often lack access to innovative practices and technologies. These small-scale farmers are vital to the region's food security and economy, yet they face substantial barriers in adopting sustainable practices due to limited resources, knowledge, and support. Sustainable animal feeding practices can play a significant role in enhancing agricultural productivity, environmental sustainability, and economic viability in this region. By ensuring that the project's outcomes are effectively communicated and adopted by these stakeholders, the exploitation strategy aims to foster resilience and sustainability in Mediterranean agriculture. SUSTAvianFEED will contribute to a broader transformation towards sustainable agricultural practices in the Mediterranean, which is vital given the region's shared environmental and socio-economic challenges.

The implementation of SUSTAvianFEED spans several key Mediterranean countries: Spain, Italy, Tunisia, and Turkey. Each of these countries represents a unique context with its specific agricultural practices, climatic conditions, and socio-economic challenges. In Spain and Italy, agriculture is a significant part of the rural economy, but farmers face challenges such as water scarcity and the need for modernized agricultural practices. Tunisia and Turkey, while rich in agricultural heritage, also struggle with issues like limited access to advanced farming technologies and financial constraints for smallholders.

By focusing on these diverse yet interconnected regions, SUSTAvianFEED is well-positioned to develop and implement strategies that are both locally relevant and broadly applicable. The project's activities include on-the-ground training for farmers, the introduction of innovative feed solutions, and the creation of support networks to enhance knowledge sharing and collaboration among stakeholders. These efforts are designed to build capacity among smallholders, helping them to adopt sustainable practices that will improve productivity and resilience.

Overall, SUSTAvianFEED aims to create a ripple effect of positive change across the Mediterranean. By addressing the specific needs of smallholders in Spain, Italy, Tunisia, and Turkey, the project seeks to build a more sustainable, resilient agricultural sector that can withstand the pressures of climate change and socio-economic challenges. This holistic approach ensures that the benefits of the project extend beyond immediate outcomes, fostering long-term sustainability and food security in the region.

2 Methodology

2.1 Scope

SUSTAvianFEED exploitation strategy identifies the activities and results to be exploited among relevant actors of the agri-food sector. The strategy is especially focused on the promotion of project activities replication among smallholders and the private sector, to increase the socioeconomic growth of the regions through the sustainable diets proposed. However, academia and other relevant actors are key as well for an effective strategy development and further implementation.

The strategy has the main objective of ensuring that main project outcomes of the project reach the target groups. Some of the Key Exploitation Results (KER) are common for all project consortium, while others are relevant for specific partners or group of partners. This is why each partner will have an individual exploitation plan, containing activities and results to be exploited and main target groups to be addressed

2.2 Exploitation strategies and SUSTAvianFEED roadmap

SUSTAvianFEED has established a roadmap for the exploitation of results, during and after project implementation.

1. Identification of Key Exploitable Results (KER)
2. Analysis of barriers and mitigation measures
3. Evaluation and priority mapping
4. Individual exploitation plans
5. Guidelines for smallholder
6. Business model

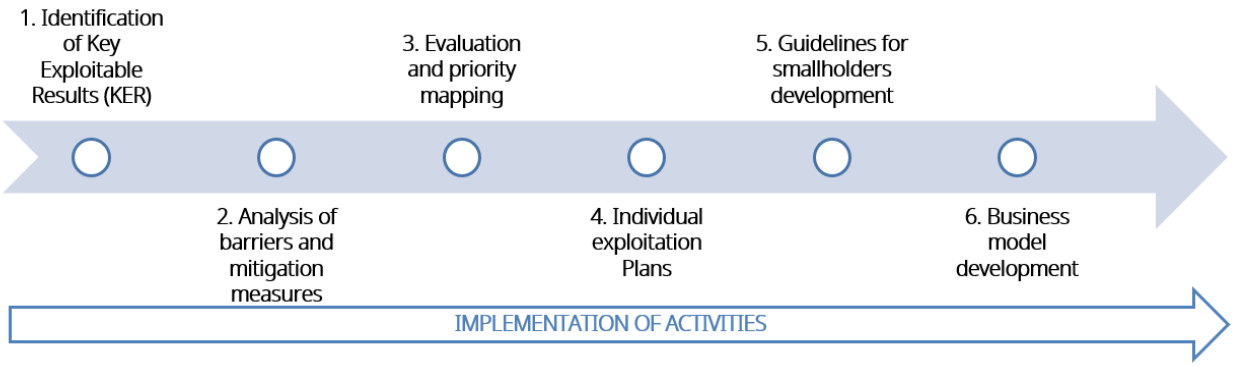


Figure 1. SUSTAvianFEED Exploitation Strategy roadmap

The adoption strategy for SUSTAvianFEED involves engaging target audiences to enhance their understanding of the project's benefits, encouraging users to embrace and integrate its outputs, and securing the necessary conditions for market delivery. This comprehensive plan includes a specific Intellectual Property Rights (IPR) management strategy to ensure both commercial and non-commercial applications of SUSTAvianFEED's innovations.

All project partners will actively participate in the exploitation and replication activities, which is led by ALIA, as project coordinator (PC).

3 Key exploitation results

3.1 SUSTAvianFEED KERs

SUSTAvianFEED project has developed a series of innovative Key Exploitable Results (KERs) aimed at enhancing the environmental, economic, and social sustainability of the poultry industry. With increasing pressures on agriculture to reduce environmental impacts while ensuring profitability and meeting consumer demands for ethical products, the project focuses on practical, scalable solutions that can be implemented by farmers and producers. By exploring new feed sources, improving animal welfare through slow-growing breeds, and integrating circular economy models, the project paves the way for a more sustainable future in poultry farming.

From an environmental standpoint, the project explores alternative feed ingredients like insect protein and agricultural byproducts to reduce the industry's reliance on resource-intensive traditional feeds. Additionally, low- and medium-tech insect production schemes offer sustainable, cost-effective alternatives for farmers at different levels of technology adoption. Economically, SUSTAvianFEED ensures that the use of these alternative ingredients not only promotes sustainability but also improves the profitability of poultry diets, offering financial benefits to producers. Socially, the focus on slow-growing breeds and the development of ethical production practices aligns with consumer preferences for animal welfare, high meat quality, and sustainable sourcing.

The following Key Exploitable Results (KERs) highlight the project's key innovations and their impact on the poultry industry, providing a holistic approach to fostering sustainability, economic resilience, and ethical production practices.

- **KER1: Alternative feed ingredients and byproducts to improve feed formulation and sustainability**: The project identifies novel feed ingredients, including agricultural byproducts, to create more sustainable and efficient feed formulations, reducing reliance on traditional feed sources. Pilot studies confirm that alternative diets reduce environmental impact, including at least 10% environmental impact reduction of CO_2 emissions, while maintaining animal health and performance. The final diets eliminate or reduce reliance on soybean meal by substituting locally sourced ingredients such as fava beans, rapeseed meal, and triticale.
- **KER2: Profitability of the alternative diets**: This KER focuses on evaluating the economic viability of using alternative feed ingredients, ensuring that sustainability does not compromise profitability for farmers and producers. The project results highlight that replacing traditional feed components with sustainable alternatives does not compromise profitability, with formulations designed to be isoenergetic and isoproteic.
- **KER3: Insects as an ingredient in the sustainable diet**: A breakthrough in feed sustainability, the project explores the potential of insects as a key protein source, contributing to more eco-friendly and nutrient-rich poultry diets. Specifically, Hermetia illucens larvae, were incorporated into experimental diets to evaluate their potential as a high-protein alternative. Nutritional analysis confirmed their benefits, with balanced amino acid profiles and favorable fatty acid compositions. Environmental assessments showed that diets incorporating insects significantly reduced CO_2 emissions, proving their role in sustainable poultry farming.
- **KER4: Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value**: Promoting the adoption of slow-growing poultry breeds, this KER highlights the ethical and quality-driven benefits that appeal to evolving consumer preferences for higher welfare standards and premium meat. Pilot studies confirmed that

these breeds could be successfully raised with alternative diets, achieving lower environmental footprints and appealing to consumer preferences for ethically produced, high-quality meat.

- **KER5: Insects' use in slow-growing breeds**: This result integrates insect-based diets specifically for slow-growing poultry, offering a sustainable and nutritious alternative for these breeds while aligning with the project's overall sustainability goals. Results showed that insect-based diets contributed to a reduction in global warming impact (up to 36% CO_2 reduction per kg of live weight). Growth performance, meat quality, and welfare indicators remained unaffected, supporting their adoption in sustainable poultry production.
- **KER6: Insects' use in broilers**: The potential of insect protein is further applied to broiler chickens, aiming to replace conventional protein sources with insect-based alternatives, thereby reducing the environmental impact of broiler production. Pilot studies demonstrated that the inclusion of larvae reduced environmental impact without compromising growth performance. The trials with Cobb and Anadolu-T broilers confirmed that insect diets led to significant CO_2 emission reductions while maintaining production efficiency.
- **KER7: Low and medium tech insects' production schemes**: To support the integration of insect-based feeds, this KER explores scalable and cost-effective insect production methods that can be adopted by farms with varying levels of technology access. The feasibility of rearing insects in varied settings, from low-tech farms to high-tech facilities, was analysed. The findings indicate that medium-tech production methods yield the highest sustainability benefits, with significant reductions in CO_2 emissions per kg of egg and meat produced.
- **KER8: Guidelines for farmers to promote project approach**: To facilitate the adoption of these innovations, the project provides practical guidelines for farmers, helping them implement sustainable practices and benefit from the project's research findings. ALIA and SLOWFOOD worked in producing the guidelines for smallholders, producing a leaflet in English and Spanish.
- **KER9: Circular Economy Business Model for the adoption of project approach**: This KER outlines a circular economy model designed to support the widespread adoption of sustainable poultry production practices, emphasising resource efficiency, waste reduction, and economic resilience. Environmental assessments demonstrated at least a 10% reduction in CO_2 emissions, validating the model's feasibility for commercial adoption.

Together, these KERs represent a holistic and transformative approach to poultry farming that balances environmental conservation, economic profitability, and social responsibility. The SUSTAvianFEED project's innovations promise to reshape the future of poultry farming by integrating cutting-edge research with practical solutions that meet industry needs for sustainability and ethical practices.

3.2 Target groups

SUSTAvianFEED project is designed to address a wide range of stakeholders within the poultry production value chain, focusing on environmental, economic, and social sustainability. By engaging with key target groups (TG), the project promotes the adoption of sustainable feed ingredients, alternative production methods, and circular economy principles. These innovations aim to reduce environmental impact, increase profitability for farmers and feed manufacturers, and align production practices with ethical and social considerations.

The project's approach is comprehensive, aiming to support environmental sustainability by reducing resource-intensive feed production through alternatives such as insect-based ingredients and

agricultural byproducts. It also addresses economic sustainability by ensuring these innovations are profitable and feasible for all stakeholders, from feed manufacturers to farmers. Socially, the project promotes ethical practices, improves the livelihoods of rural women, and responds to growing consumer demand for sustainable, high-quality products.

Below is an overview of the target groups (TG) that the project aims to reach, ensuring the widespread adoption of these sustainable innovations:

- **TG1: Feed Manufacturers**: A crucial group for scaling alternative feed ingredients and incorporating sustainable byproducts into commercial poultry diets, feed manufacturers will be key in transforming traditional feed systems.
- **TG2: Academia**: Researchers and universities will build upon the project's findings, developing new feed technologies and sustainable practices for broader industry application.
- **TG3: Farmers**: Poultry farmers, including those raising slow-growing breeds and broilers, will directly benefit from sustainable feed options and guidelines aimed at enhancing profitability and ethical practices.
- **TG4: Public Authorities**: Policymakers and regulatory bodies will use the project's results to create supportive frameworks for sustainable and ethical poultry production, encouraging adoption through regulation and incentives.
- **TG5: Consumers**: The project will ultimately benefit consumers by providing access to higher-quality, ethically produced poultry products that align with growing demand for sustainability.
- **TG6: Retailers**: Retailers, particularly those emphasizing eco-friendly and ethical products, will have new opportunities to market poultry products that are aligned with consumer values.
- **TG7: Rural Women**: Recognizing the role of rural women in poultry farming and insect production, the project offers opportunities for economic empowerment by promoting sustainable practices and livelihoods.
- **TG8: Insect Producers**: Insect farmers will play a pivotal role in providing a sustainable, nutrient-rich alternative to conventional feed ingredients, contributing to the project's environmental goals.
- **TG9: NGOs**: Non-governmental organizations focused on sustainability, animal welfare, and rural development will help disseminate the project's findings and promote the widespread adoption of ethical and sustainable practices.

Table 1. Key Exploitable Results and related Target Groups

Key Exploitable Result (KER)	Target Groups (TG)
KER1: Alternative feed ingredients and byproducts to improve feed formulation and sustainability	TG1: Feed Manufacturers, TG3: Farmers, TG2: Academia, TG8: Insect Producers
KER2: Profitability of the alternative diets	TG3: Farmers, TG1: Feed Manufacturers, TG6: Retailers
KER3: Insects as an ingredient in the sustainable diet	TG3: Farmers, TG1: Feed Manufacturers, TG2: Academia, TG8: Insect Producers
KER4: Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value	TG3: Farmers, TG5: Consumers, TG4: Public Authorities, TG6: Retailers
KER5: Insects' use in slow-growing breeds	TG3: Farmers, TG2: Academia, TG8: Insect Producers

Key Exploitable Result (KER)	Target Groups (TG)
KER6: Insects' use in broilers	TG3: Farmers, TG1: Feed Manufacturers, TG2: Academia, TG8: Insect Producers
KER7: Low and medium tech insects' production schemes	TG3: Farmers, TG8: Insect Producers, TG2: Academia, TG7: Rural Women
KER8: Guidelines for farmers to promote project approach	TG3: Farmers, TG4: Public Authorities, TG9: NGOs
KER9: Circular Economy Business Model for the adoption of project approach	TG3: Farmers, TG4: Public Authorities, TG1: Feed Manufacturers, TG2: Academia, TG8: Insect Producers, TG9: NGOs

By engaging these diverse target groups, the SUSTAvianFEED project aims to ensure the successful adoption of its sustainable innovations. These efforts will support the transformation of the poultry industry into one that is more resilient, ethical, and aligned with environmental, economic, and social sustainability goals.

3.3 Channels and ways for exploiting results

SUSTAvianFEED project aims to effectively disseminate its key exploitable results (KERs) across the poultry industry, ensuring that stakeholders such as farmers, feed manufacturers, researchers, policymakers, and consumers are fully engaged. To achieve this, a wide variety of channels and ways to exploit the results will be utilized, each catering to different target groups and ensuring broad uptake of the project's findings. These dissemination methods will be leveraged to ensure that the innovations of the project reach their intended audience, promote adoption, and contribute to the overall sustainability, economic viability, and ethical practices in poultry farming.

The project employs a multi-channel approach, combining in-person events, digital interactions, and scientific publications to engage stakeholders at every level. From congresses and trade fairs to online video calls and workshops, these channels will facilitate knowledge exchange, enable collaborative discussions, and encourage the implementation of sustainable practices. Additionally, local markets and focus groups provide opportunities for direct community engagement, while scientific articles contribute to the academic dissemination of results.

Below is an overview of the channels and ways of exploiting the results to maximize the impact of the SUSTAvianFEED project:

Table 2. Key Exploitable Results and related channels for exploiting results

Key Exploitable Result (KER)	Channels for Exploiting Results (C)
KER1: Alternative feed ingredients and byproducts to improve feed formulation and sustainability	C1: Congress, C2: Trade Fairs, C3: Online Video Call, C9: Scientific Articles
KER2: Profitability of the alternative diets	C1: Congress, C4: Physical Meeting, C5: Focus Group, C6: Online Meeting Workshop
KER3: Insects as an ingredient in the sustainable diet	C1: Congress, C2: Trade Fairs, C8: Satellite Seminar, C9: Scientific Articles
KER4: Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value	C2: Trade Fairs, C7: Rayhana Local Market, C4: Physical Meeting, C6: Online Meeting Workshop
KER5: Insects' use in slow-growing breeds	C3: Online Video Call, C7: Rayhana Local Market, C5: Focus Group

Key Exploitable Result (KER)	Channels for Exploiting Results (C)
KER6: Insects' use in broilers	C1: Congress, C2: Trade Fairs, C8: Satellite Seminar, C9: Scientific Articles
KER7: Low and medium tech insects' production schemes	C5: Focus Group, C7: Rayhana Local Market, C6: Online Meeting Workshop
KER8: Guidelines for farmers to promote project approach	C4: Physical Meeting, C3: Online Video Call, C6: Online Meeting Workshop, C5: Focus Group
KER9: Circular Economy Business Model for the adoption of project approach	C1: Congress, C2: Trade Fairs, C4: Physical Meeting, C9: Scientific Articles

3.4 Analysis of barriers and mitigation measures

SUSTAvianFEED project acknowledges several barriers that may affect the successful adoption of its innovations. These barriers range from economic factors such as the high prices of alternative raw materials and insects, lack of availability of alternative ingredients to awareness gaps among farmers and consumers, and regulatory challenges in various markets. Overcoming these barriers is critical to achieving the desired environmental, economic, and social sustainability outcomes.

The analysis below outlines each barrier's probability, consequence, and the resulting severity. The probability represents the likelihood of the barrier occurring, while the consequence reflects the potential impact if the barrier occurs. Both are rated on a scale of 1 to 3, where:

- **1** = Low
- **2** = Medium
- **3** = High

The **severity** score is calculated as the product of probability and consequence, allowing us to prioritize barriers based on their overall impact on the project.

Table 3. Identified barriers and their severity

Barriers	Severity = Probability x Impact	Key Exploitable Result (KER)
BR1: High prices of alternative raw materials	S = 3 × 3 = 9	KER1: Alternative feed ingredients, KER2: Profitability, KER3: Insects as an ingredient
BR2: Lack of awareness of farmers	S = 2 × 3 = 6	KER1: Alternative feed ingredients, KER8: Guidelines for farmers, KER4: Slow-growing breeds
BR3: High prices of insects	S = 3 × 2 = 6	KER3: Insects in sustainable diets, KER5: Insects in slow-growing breeds, KER6: Insects in broilers
BR4: Lack of awareness from the consumers	S = 2 × 3 = 6	KER4: Slow-growing breeds, KER9: Circular economy, KER1: Alternative feed ingredients

Barriers	Severity = Probability x Impact	Key Exploitable Result (KER)
BR5: International markets which force to high competitiveness and soft environmental regulations	S = 2 × 3 = 6	KER9: Circular economy business model, KER2: Profitability
BR6: Lack of regulatory basis, legislation in some countries.	S = 3 × 3 = 9	KER1: Alternative feed ingredients, KER8: Guidelines for farmers, KER9: Circular economy business model, KER5: Insects in slow-growing breeds
BR7: Although feed stuffs such as traditional soybeans are expensive, their quality is guaranteed to be accessible in the industry.	S = 2 × 2 = 4	KER1: Alternative feed ingredients, KER2: Profitability
BR8: lack of farmer's skills and know how to make local insect production	S = 3 × 2 = 6	KER7: Low/medium-tech insect production, KER5: Insects in slow-growing breeds, KER6: Insects in broilers

Analysis of the Barriers

BR1: High prices of alternative raw materials

- **Probability**: 3 (High probability, as the cost of sourcing alternative raw materials is often high due to competition and availability issues.)
- **Consequence**: 3 (High consequence, as the cost increase directly affects the feed formulation, making alternative feeds less viable economically.)
- **Severity**: 9 (This barrier is one of the most critical, affecting multiple KERs, particularly the use of alternative feed ingredients and the profitability of the diets.)

BR2: Lack of awareness of farmers

- **Probability: 2** (Medium probability, as farmer awareness can be improved over time through targeted dissemination.)
- **Consequence: 3** (High consequence, as lack of awareness could delay the adoption of sustainable practices and alternative feed sources.)
- **Severity: 6** (While it may not be as immediately impactful as BR1, it still affects the adoption of key innovations.)

BR3: High prices of insects

- **Probability**: 3 (High probability, as insect production still faces high costs due to technology and scale challenges.)
- **Consequence**: 2 (Medium consequence, as while high prices may limit initial adoption, the long-term potential remains strong.)
- **Severity**: 6 (This barrier is important for the widespread use of insects in sustainable poultry diets.)

BR4: Lack of awareness from the consumers

- **Probability**: 2 (Medium probability, as awareness efforts can take time to reach the broader consumer base.)
- **Consequence**: 3 (High consequence, as consumer demand for sustainable and ethical products is crucial for market success.)

- **Severity**: 6 (This barrier is critical for ensuring the market uptake of products from slow-growing breeds and sustainable diets.)

BR5: International markets which force high competitiveness and soft environmental regulations

- **Probability**: 2 (Medium probability, as market dynamics shift over time, but global competition remains fierce.)
- **Consequence**: 3 (High consequence, as it can undermine sustainability goals by promoting less-regulated, cheaper production methods.)
- **Severity**: 6 (This barrier can directly affect the adoption of circular economy models and profitability, limiting environmental impact reduction.)

BR6: Lack of regulatory basis, legislation in some countries

- **Probability**: 3 (High probability, especially in regions where animal feed regulations are underdeveloped or lag behind sustainable innovations.)
- **Consequence**: 3 (High consequence, as this barrier prevents legal implementation of new practices and feeds.)
- **Severity**: 9 (A critical barrier affecting both regulatory compliance and market access, particularly for insect-based feeds and sustainable practices.)

BR7: Traditional feedstuff like soybeans is expensive but quality is guaranteed

- **Probability**: 2 (Medium probability, as the market is competitive but traditional ingredients remain dominant.)
- **Consequence**: 2 (Medium consequence, as quality and reliability make traditional feedstuff difficult to replace quickly.)
- **Severity**: 4 (This barrier limits the shift toward alternative raw materials but is somewhat mitigated by the high quality and predictability of traditional feeds.)

BR8: Lack of farmers' skills and know-how to make local insect production

- **Probability**: 3 (High probability, especially in regions where insect farming is not yet established.)
- **Consequence**: 2 (Medium consequence, as while farmers may struggle initially, training and technical assistance can mitigate the impact.)
- **Severity**: 6 (This barrier affects the adoption of low- and medium-tech insect production systems but can be addressed with training and knowledge-sharing.)

By identifying and analyzing these barriers, the SUSTAvianFEED project can strategically plan solutions to mitigate their impact. The most severe barriers, such as **BR1** (high prices of alternative raw materials) and **BR6** (lack of regulatory basis), require immediate attention to ensure that the project's innovations can be successfully adopted across all relevant stakeholders. Targeted dissemination, training, and policy advocacy are crucial to overcoming these challenges and achieving the project's objectives of promoting sustainable, profitable, and ethical poultry production.

When considering the Mediterranean area and countries like **Spain**, **Italy**, **Tunisia**, and **Turkey**, each of these regions presents unique barriers tied to economic, regulatory, and social factors. These barriers can influence the adoption of sustainable feed ingredients, alternative diets, insect-based feeds, and slow-growing breeds in poultry production. Let's break down the barriers specific to each country or group of countries:

Spain and Italy (EU Countries)

Being members of the European Union, **Spain** and **Italy** are subject to the EU's stringent **regulatory frameworks** on animal feed, sustainability, and environmental protections. However, they still face some region-specific barriers:

- **Barrier: Regulatory Complexity (BR6)**
  - **Specific Issue**: While the EU has a well-developed regulatory framework, the process for introducing novel feed ingredients (e.g., insect-based feeds) remains complex, slow, and costly. The approval processes for alternative raw materials and insects can cause delays in their market adoption.
  - **Country Impact**: Spain and Italy are both subject to these regulations, which can be a barrier for innovations such as insect-based feeds.
- **Barrier: High Costs of Alternative Ingredients and Insects (BR1, BR3)**
  - **Specific Issue**: The cost of alternative raw materials and insects for feed is generally high due to production costs and competition with traditional feed sources like soybean meal. Insects are not yet produced at a large enough scale in these countries to reduce costs.
  - **Country Impact**: Spain and Italy, both being agricultural powerhouses, might find it challenging to incorporate alternative ingredients into traditional farming practices due to the economic implications.
- **Barrier: Consumer Awareness (BR4)**
  - **Specific Issue**: While there is growing interest in sustainable and ethical products in Western Europe, consumer awareness of the benefits of alternative poultry feed (insects, byproducts) remains low. Ethical concerns around slow-growing breeds are still evolving.
  - **Country Impact**: Particularly in Italy, where "quality" and "authenticity" are key factors in food purchasing, consumers may not fully understand or trust alternative feed products.
- **Barrier: Competitive Pressure from International Markets (BR5)**
  - **Specific Issue**: Although Spain and Italy are bound by EU environmental regulations, they face competitive pressure from non-EU countries with lower standards and costs, which may hinder the adoption of more expensive but sustainable practices.
  - **Country Impact**: Spain and Italy are both major food exporters. Competing with countries that have softer regulations could push them to prioritize cost over sustainability.

Tunisia and Turkey

Tunisia and **Turkey** face different barriers as they are not bound by EU regulations, though they are increasingly aligning with EU standards. Their agricultural sectors face challenges related to market structure, production technology, and consumer awareness:

- **Barrier: Lack of Regulatory Framework (BR6)**
  - **Specific Issue**: Both Tunisia and Turkey may lack comprehensive legislation on the use of alternative raw materials and insect-based feeds. Regulations for integrating insects into poultry diets or for circular economy practices in agriculture are either non-existent or underdeveloped.

- **Country Impact**: Without proper legislation, it becomes difficult for these countries to standardize insect production or approve novel feed ingredients, delaying the adoption of sustainable innovations.

- **Barrier: High Prices of Insects (BR3)**
  - **Specific Issue**: In Tunisia and Turkey, where agricultural sectors may operate with lower profit margins than in Europe, the cost of insects for feed is even more prohibitive. Additionally, insect farming technology is less advanced in these regions.
  - **Country Impact**: High production costs make it difficult for these countries to adopt insect-based feeds. In Tunisia, where rural agriculture plays a key role, cost-effective insect farming solutions are needed.

- **Barrier: Farmers' Skills and Know-how (BR8)**
  - **Specific Issue**: Farmers in these countries may lack the necessary knowledge and technical skills to implement insect production on a local scale, particularly in rural areas where agricultural methods may be more traditional.
  - **Country Impact**: In both Tunisia and Turkey, local farmers may need substantial training and support to adopt insect farming for poultry production, which creates a significant barrier to introducing insect-based feed innovations.

- **Barrier: Lack of Awareness Among Farmers (BR2)**
  - **Specific Issue**: In these regions, the adoption of alternative feed ingredients and the circular economy approach may face resistance due to a lack of awareness and understanding among farmers. Many farmers may not be familiar with the benefits of sustainable feed or the circular economy model.
  - **Country Impact**: This is particularly relevant in Tunisia, where small-scale farmers may prioritize cost-effective traditional farming methods over innovation. In Turkey, while there is growing interest in sustainable practices, the uptake may still be slow among rural farmers.

Cross-Cutting Barriers for the Mediterranean Region

There are also some overarching barriers that affect all four countries to varying degrees due to their shared geographic, economic, and agricultural characteristics:

- **Barrier: Climate and Water Scarcity**
  - **Specific Issue**: The Mediterranean region is prone to water scarcity and the impacts of climate change, which can affect agricultural productivity. This environmental factor influences the feasibility of alternative feed production and sustainability efforts.
  - **Country Impact**: All four countries face environmental pressures that could make alternative feed production, particularly insect farming, more challenging due to the need for resources like water and controlled environmental conditions.
- **Barrier: Traditional Feedstuff Dominance (BR7)**
  - **Specific Issue**: Soybeans and other traditional feedstuffs are still widely used because of their guaranteed quality and established supply chains. Farmers in all four countries are hesitant to switch to less proven alternatives.
  - **Country Impact**: In both EU and non-EU Mediterranean countries, the established dominance of traditional feed ingredients like soy makes the transition to insect-based or alternative feeds more difficult.

- **Barrier: Consumer Perception and Market Readiness (BR4)**
  - **Specific Issue**: In all countries, consumers may be slow to accept poultry products produced using alternative feed ingredients or ethical, slow-growing breeds. Market readiness for these innovations is still in its early stages across the Mediterranean.
  - **Country Impact**: While urban consumers in Spain and Italy may be more open to sustainable poultry products, rural and less affluent consumers in Turkey and Tunisia may prioritize cost over sustainability, making market penetration difficult.

The Mediterranean countries involved in SUSTAvianFEED project face a range of barriers, from regulatory hurdles in Spain and Italy to market readiness and technical know-how in Tunisia and Turkey. **Spain and Italy** must navigate **regulatory complexity** and **consumer awareness**, while **Tunisia and Turkey** face significant challenges related to **cost** and **lack of infrastructure and knowledge** for adopting insect-based feeds and alternative raw materials.
Addressing these region-specific barriers will require tailored solutions, including **regulatory advocacy**, **cost reduction strategies**, and **farmer training programs**, to successfully implement the project's innovations in each country.

Strategic Planning to mitigate key barriers in insect production

Insect production, particularly for black soldier fly (BSF), faces several key barriers that impact overall production costs, mainly related to feed, transportation, and energy consumption. Below are the strategic solutions for mitigating these barriers.

Transportation costs and decentralized model

One of the main cost drivers in insect production is the price of feed for the larvae, which can either be due to the intrinsic cost of the feed itself or the transportation involved. Large insect farms often need to transport significant amounts of waste from distant locations to maintain the farm. This transportation cost can be reduced by adopting a decentralized model.

In this model, low-cost mobile units would travel to where the waste is located, process it locally, and only transport the harvested larvae to the central breeding and processing facilities. This approach decentralizes the larval fattening process while centralizing breeding and processing, making the model more scalable and replicable.

Energy costs and climate control

Energy consumption is another significant cost factor, especially for maintaining the optimum climate conditions for BSF production. Mediterranean countries, in particular, face challenges with seasonal temperature extremes—winter temperatures are too low, and summer temperatures are often too high for optimal larvae growth.

A potential strategic solution is to schedule production seasonally, avoiding the cooler winter months. This approach would reduce the need for expensive insulation and air conditioning systems for the fattening phase of production. By limiting the need for climate control in certain months, production costs (excluding feedstock) could be reduced to €0.03-0.07/kg for fresh larvae.

Feed input costs

Addressing feed input costs is more challenging, as the price of waste is directly linked to its nutritional quality and stability. Moreover, as waste becomes more commonly used by other livestock farms, its price tends to rise. However, there is potential to reduce the cost of inputs to €0.00 or even negative if materials currently not eligible (such as animal waste and waste from supermarkets and restaurants) could be utilized for larval production. This would not only increase productivity (due to the higher nutritional value) but also significantly lower or eliminate feed costs.

While insect producer associations are working to change European regulations regarding the use of such waste, progress is slow. A strategic solution here is to investigate ways to eliminate the "waste" status of these materials, enabling their use in production.

Microalgae as a sustainable solution

At Entomo, one proposed solution is to produce high-concentration microalgae using waste as fertilizer. Preliminary tests have demonstrated the technical feasibility of this process, and further scaling up is required to evaluate its economic viability. The concentrated algae would then be fed to the larvae, offering a more sustainable and potentially cost-effective feed alternative.

Cost breakdown and impact of feedstock

Considering the drying process, which reduces larvae moisture content to 33%, the cost for producing 1 kg of dry larvae is approximately €0.36/kg (this includes the cost of fresh larvae €0.21/kg and €0.15/kg for drying). Other indirect costs, including marketing, distribution, and quality control, can raise the final price to around €0.40-0.45/kg, depending on the scale.

The price of feedstock can significantly impact the final cost. For example, beer bagasse is sold at €35/ton, and if 7 tons of it are required to produce 1 ton of fresh larvae, the cost of this feedstock would add €0.735/kg to the final price. This increases the production cost to €1,180-1,185/ton, highlighting how fluctuations in feedstock prices can dramatically affect the cost structure.

By addressing transportation inefficiencies, exploring alternative feed sources such as microalgae, and strategically scheduling production to minimize energy costs, insect farms can significantly reduce production costs. While feedstock prices remain a variable challenge, the ongoing development of new feed sources and regulatory changes could lead to a more sustainable and economically viable insect production model, promoting both scalability and replication across different regions.

3.5 Priority mapping

SUSTAvianFEED project involves multiple innovative approaches to improving poultry feed sustainability, encompassing alternative feed ingredients, insect-based diets, and promoting slow-

growing poultry breeds. To ensure successful adoption, the project partners have collectively assessed the feasibility and potential impact of each Key Exploitable Result (KER). This assessment was based on six critical criteria: High Expandability, Low Initial Investment, Low Fixed Costs, High Level of Automation and Standardization, and No Capacity Limits (Table 4).

Table 4. Criteria for prioritising KER

Criteria	Description
High Expandability	A solution is relatively easy to expand into new markets; its sale works practically without any problems in international markets, mostly through translation into other languages and minor regional adjustments.
Low initial investment	Solutions with relatively small fixed assests tend to be better able to increase their sales without major investments.
Low fixed costs	Fixed costs do not increase significantly even in the case of high expansion. These scalable models have a high proportion of variable costs.
High level of automation and standarization	Very automated process (optimized and standardized) enables fast expansion and more efficient execution.
No capacity limits	Offer can be used by many people at the same time, regardless of location.

Each partner rated the KERs based on these factors, with scores assigned from 1 to 3, where 1 indicates low feasibility or potential and 3 indicates high feasibility or potential. Table 5 shows the average scores for each KER, enabling us to prioritize the areas that will most likely lead to successful implementation and adoption of the project's results.

Table 5. KER evaluation in terms of potential for replication

	High Expandability	Low initial investment	Low fixed costs	High level of automation and standarization	No capacity limits	TOTAL
KER1: Alternative feed ingredients and byproducts to improve feed formulation	2,17	2,33	2,50	1,83	1,50	**10,33**
KER2: Profitability of the alternative diets	1,83	2,00	2,50	2,00	1,50	**9,83**
KER3: Insects as an ingredient in the sustainable diet	1,83	1,33	1,83	2,67	2,33	**10,00**
KER4: Improve and develop the slow growing breeds diffusion and market thanks to their meat quality and ethical value	1,83	2,00	2,00	2,50	2,33	**10,67**
KER5: Insects' use in slow growing breeds	2,50	2,00	2,33	2,50	2,50	**11,83**
KER6: Insect's use in broilers	1,50	2,00	2,33	1,67	1,67	**9,17**
KER7: Low and medium tech insects' production schemes	2,50	2,00	2,00	1,33	2,17	**10,00**
KER8: Guidelines for farmers to promote project approach	2,50	2,50	2,50	1,50	2,00	**11,00**
KER9: Circular Economy Business Model for the adoption of project approach	2,33	2,00	2,00	2,17	2,00	**10,50**

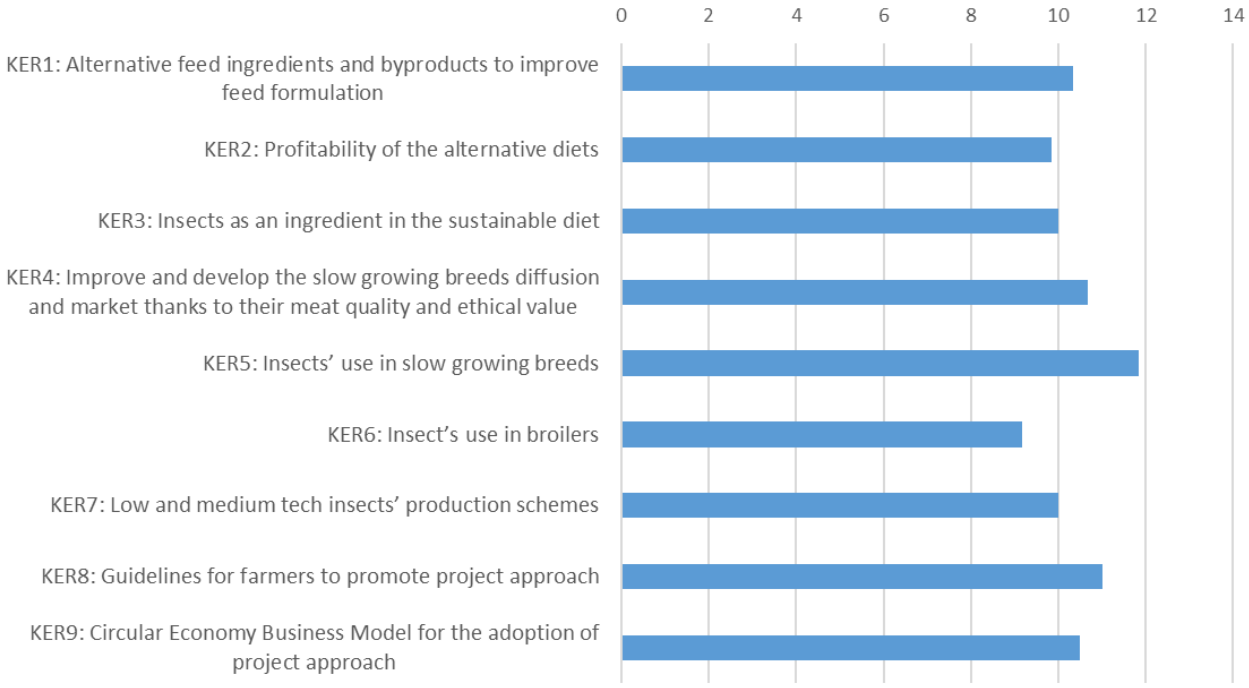


Figure 2. KER evaluation in terms of potential for replication

The Priority Mapping shows that KER5: Insects' use in slow-growing breeds received the highest overall score of 11.83, highlighting its strong potential for expandability and cost-effectiveness. This makes it a key priority for the project's exploitation and market adoption.

Closely following is KER8: Guidelines for farmers to promote the project approach with a score of 11.00, which underscores the importance of providing practical and accessible information to farmers. The expandability and low-cost nature of these guidelines make them an important tool for ensuring the project's impact at the grassroots level.

In contrast, KER6: Insects' use in broilers had the lowest score of 9.17, suggesting that this area might face more challenges in terms of scalability and cost management. However, given the increasing interest in sustainable feed practices, it remains a critical area of exploration but may require additional efforts to overcome these hurdles.

The table illustrates a balanced approach to prioritization, ensuring that high-potential areas receive focus while identifying specific KERs that may require additional resources or strategy adjustments to overcome existing barriers.

The priority mapping exercise highlights the critical areas where the SUSTAvianFEED project can achieve the greatest impact. By concentrating efforts on high-potential KERs, such as insects in slow-growing breeds and farmer guidelines, the project is well-positioned to promote sustainable practices in poultry production. The lower-ranked KERs, while still important, may need additional support or refinement to achieve broader market acceptance and feasibility.

4 Individuals Exploitation Plans

Within SUSTAvianFEED implementation, each partner has developed its own exploitation plan based on the

4.1 ALIA

ALIA is dedicated to advancing sustainable alternatives in feed production and farming practices. Their exploitation strategy focuses on key exploitable results (KERs) that enhance environmental, economic, and social outcomes for targeted stakeholders. ALIA's activities will primarily address the following target groups: **Feed manufacturers (TG1)** and **Farmers (TG3)**.

The key exploitable results that ALIA will focus on are:

1. **Alternative feed ingredients and byproducts to improve feed formulation** (KER1)

ALIA aims to engage **Feed manufacturers (TG1)** and **Farmers (TG3)** in adopting alternative feed ingredients, such as byproducts and regionally sourced alternatives, which offer a more sustainable and cost-efficient solution compared to traditional materials like soy. This approach reduces environmental impact while providing affordable feed solutions.

- **Target Groups**: Feed manufacturers (TG1), Farmers (TG3)
- **KER**: KER1 – Alternative feed ingredients and byproducts to improve feed formulation

2. **Profitability of the alternative diets** (KER2)

This aspect of ALIA's plan will help **Farmers (TG3)** and **Feed manufacturers (TG1)** understand the economic advantages of adopting alternative diets. ALIA will provide detailed insights into cost savings and profitability improvements that result from using these innovative feed formulations. The focus is on ensuring that the sustainability measures also enhance financial performance.

- **Target Groups**: Feed manufacturers (TG1), Farmers (TG3)
- **KER**: KER2 – Profitability of the alternative diets

3. **Insects as an ingredient in the sustainable diet** (KER3)

ALIA will introduce **Feed manufacturers (TG1)** and **Farmers (TG3)** to the use of insects as a sustainable and highly nutritious protein source for animal feed. This innovative approach is aimed at reducing the environmental footprint of feed production while maintaining or improving the nutritional value of the feed.

- **Target Groups**: Feed manufacturers (TG1), Farmers (TG3)
- **KER**: KER3 – Insects as an ingredient in the sustainable diet

ALIA's efforts focus on providing sustainable, profitable feed solutions for **farmers and feed manufacturers**. Their work strengthens the shift towards more **circular economy** practices in the poultry sector by developing insect-based feed that balances **cost-effectiveness and sustainability**.

4.2 UMU

As an academic institution, the **University of Murcia (UMU)** is leveraging its expertise to promote sustainable innovations in feed formulation and poultry farming practices. Their primary aim is to introduce new and alternative feed ingredients, support the adoption of insect-based feeds, and promote slow-growing poultry breeds in line with environmental, economic, and ethical standards.

The target groups addressed through UMU's exploitation strategy include **Feed manufacturers (TG1)**, **Farmers (TG3)**, and **Insect producers (TG8)**.

The key exploitable results (KERs) they will focus on are:

1. **Alternative feed ingredients and byproducts to improve feed formulation** (KER1)

UMU is committed to advancing the sustainability of animal feed by introducing alternative feed ingredients and byproducts to **Feed manufacturers (TG1)** and **Farmers (TG3)**. These alternative ingredients can help optimize feed formulation, reduce dependency on conventional feed components, and minimize environmental impact.

- **Target Groups**: Feed manufacturers (TG1), Farmers (TG3)
- **KER**: KER1 – Alternative feed ingredients and byproducts to improve feed formulation

2. **Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value** (KER4)

UMU will help drive the diffusion and market growth of slow-growing poultry breeds among **Farmers (TG3)** and **Retailers (TG6)**. These breeds are valued for their superior meat quality and ethical production methods, aligning with consumer demand for more sustainable and humane farming practices.

- **Target Groups**: Farmers (TG3), Retailers (TG6)
- **KER**: KER4 – Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value

3. **New and innovative ideas and possibilities to improve insect farming** (KER7)

UMU seeks to encourage innovation in insect farming by working with **Insect producers (TG8)**. They aim to introduce new technologies and farming methods to make insect farming more scalable and efficient, ensuring its viability as a key component of sustainable feed formulations.

- **Target Groups**: Insect producers (TG8)
- **KER**: KER7 – Low and medium-tech insects' production schemes

4. **Insects' use in slow-growing breeds** (KER5)

As part of its sustainability mission, UMU will focus on integrating insect-based feed into the diets of slow-growing poultry breeds. This initiative will be particularly beneficial for **Farmers (TG3)** and **Feed manufacturers (TG1)** who are looking to enhance the nutritional profile of their feed while reducing reliance on traditional ingredients.

- **Target Groups**: Farmers (TG3), Feed manufacturers (TG1)
- **KER**: KER5 – Insects' use in slow-growing breeds

5. **Insect's use in broilers** (KER6)

UMU also aims to promote the use of insect-based feed for broiler chickens. This effort targets **Farmers (TG3)** and **Feed manufacturers (TG1)** interested in adopting more sustainable feeding practices for high-demand broiler production.

- **Target Groups**: Farmers (TG3), Feed manufacturers (TG1)
- **KER**: KER6 – Insect's use in broilers

This exploitation plan demonstrates UMU's role in facilitating sustainable innovations in animal feed and poultry farming. By focusing on alternative feed ingredients and insect-based solutions, UMU addresses key challenges faced by **Feed manufacturers (TG1)**, **Farmers (TG3)**, and **Insect producers (TG8)** while promoting ethical and sustainable practices across the value chain.

4.3 UNITO

The **University of Torino (UNITO)** is dedicated to advancing the sustainability of poultry farming in Italy by promoting alternative feed ingredients, insect-based feeds, and improving the diffusion of slow-growing poultry breeds. With its focus on research, development, and dissemination of sustainable practices, UNITO targets several key stakeholders: **Feed manufacturers (TG1)**, **Farmers (TG3)**, and **Insect producers (TG8)**.
The key exploitable results (KERs) that UNITO will prioritize are:

1. **Alternative feed ingredients and byproducts to improve feed formulation** (KER1)

UNITO is engaged in research and development aimed at introducing alternative feed ingredients that can help improve the sustainability of poultry farming. These new formulations will be communicated to **Feed manufacturers (TG1)** and **Farmers (TG3)**, offering them options to optimize feed use, reduce environmental impacts, and lower dependency on conventional ingredients such as soy.

- **Target Groups**: Feed manufacturers (TG1), Farmers (TG3)
- **KER**: KER1 – Alternative feed ingredients and byproducts to improve feed formulation

2. **Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value** (KER4)

UNITO aims to promote the benefits of slow-growing poultry breeds among **Farmers (TG3)** and **Retailers (TG6)**. The focus will be on their superior meat quality and the ethical value of slower, more humane production methods. This will allow farmers to tap into growing consumer demand for ethically produced meat in Italy.

- **Target Groups**: Farmers (TG3), Retailers (TG6)
- **KER**: KER4 – Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value

3. **New and innovative ideas and possibilities to improve insect farming** (KER7)

To support sustainable feed practices, UNITO will also focus on the advancement of insect farming. By working with **Insect producers (TG8)**, UNITO will promote innovative ideas and new farming practices that can make insect production more efficient and sustainable.

- **Target Groups**: Insect producers (TG8)
- **KER**: KER7 – Low and medium-tech insects' production schemes

4. **Insects' use in slow-growing breeds** (KER5)

UNITO will collaborate with **Farmers (TG3)** and **Feed manufacturers (TG1)** to integrate insect-based feeds into the diets of slow-growing poultry breeds. This practice supports sustainability by offering high-quality nutrition without relying on traditional feed ingredients, which are often less sustainable.

- **Target Groups**: Farmers (TG3), Feed manufacturers (TG1)
- **KER**: KER5 – Insects' use in slow-growing breeds

5. **Insect's use in broilers** (KER6)

Additionally, UNITO will emphasize the use of insect-based feeds in broiler production, targeting **Farmers (TG3)** and **Feed manufacturers (TG1)**. This initiative offers a more sustainable feeding strategy for high-demand broilers, while also ensuring nutritional quality and reducing environmental pressures.

- **Target Groups**: Farmers (TG3), Feed manufacturers (TG1)
- **KER**: KER6 – Insect's use in broilers

UNITO's exploitation plan demonstrates a strong commitment to improving the sustainability of feed formulations and poultry farming in Italy. By focusing on key innovations, particularly in alternative feed ingredients and insect-based feed, the university is helping **Feed manufacturers (TG1)**, **Farmers (TG3)**, and **Insect producers (TG8)** adopt more sustainable, ethical, and profitable practices in the industry.

4.4 ISA-CM

ISA CM is committed to enhancing the sustainability of poultry farming in Tunisia by focusing on innovative feed ingredients, the inclusion of insects in poultry diets, and promoting the diffusion of slow-growing breeds. In Tunisia, the focus on circular economy practices, resource optimization, and ethical breeding is crucial due to the local environmental and economic context. The key target groups for ISA CM include **Farmers (TG3)**, **Insect producers (TG8)**, and **Feed manufacturers (TG1)**. ISA CM's exploitation plan emphasizes the following key exploitable results (KERs):

1. **Alternative feed ingredients and byproducts to improve feed formulation** (KER1)
   ISA CM will focus on identifying and promoting alternative feed ingredients that can replace expensive and less sustainable traditional feeds. This approach is particularly relevant in Tunisia, where economic and environmental constraints necessitate the development of more sustainable, locally sourced feed options. These solutions will benefit **Farmers (TG3)** and **Feed manufacturers (TG1)**, helping them improve productivity while reducing costs.
   - **Target Groups**: Farmers (TG3), Feed manufacturers (TG1)
   - **KER**: KER1 – Alternative feed ingredients and byproducts to improve feed formulation

2. **Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value** (KER4)
   ISA CM will promote the adoption of slow-growing poultry breeds, which are known for their high meat quality and ethical production. This is essential in addressing local consumer preferences for higher-quality meat products. **Farmers (TG3)** and **Retailers (TG6)** will be the primary focus, benefiting from the added value of producing meat with greater ethical and sustainable credentials.
   - **Target Groups**: Farmers (TG3), Retailers (TG6)
   - **KER**: KER4 – Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value

3. **New and innovative ideas and possibilities to improve insect farming** (KER7)
   ISA CM will focus on developing and promoting insect farming techniques as a sustainable source of protein for animal feed. This is especially relevant in Tunisia, where there is a growing need to reduce reliance on imported feed ingredients. **Insect producers (TG8)** will be key beneficiaries of this initiative, as ISA CM aims to introduce low- and medium-tech farming solutions that are cost-effective and feasible for small-scale producers.
   - **Target Groups**: Insect producers (TG8)
   - **KER**: KER7 – Low and medium-tech insects' production schemes

4. **Insects' use in slow-growing breeds** (KER5)
   ISA CM will also explore the integration of insect-based feeds into the diets of slow-growing poultry breeds. This strategy will support **Farmers (TG3)** and **Feed manufacturers (TG1)** by offering a more sustainable and locally-sourced alternative to traditional protein sources.
   - **Target Groups**: Farmers (TG3), Feed manufacturers (TG1)
   - **KER**: KER5 – Insects' use in slow-growing breeds

5. **Insect's use in broilers** (KER6)
   ISA CM will extend its research to promote the use of insect-based feeds in broiler production for the obtention of chicken meat (instead of the obtention of eggs). This initiative will benefit **Farmers (TG3)** by reducing feed costs and improving the sustainability of poultry production, while also maintaining the nutritional quality of the birds' diets.
   - **Target Groups**: Farmers (TG3), Feed manufacturers (TG1), Public Authorities (TG4)
   - **KER**: KER6 – Insect's use in broilers

Through its exploitation plan, **ISA CM** focuses on promoting sustainable, ethical, and innovative farming practices in Tunisia. By targeting **Farmers (TG3)**, **Insect producers (TG8)**, and **Feed manufacturers (TG1)**, the institution aims to support the adoption of alternative feed ingredients and insect-based feed solutions, while enhancing the diffusion of slow-growing poultry breeds. These efforts will ultimately help strengthen the poultry sector's sustainability and competitiveness in Tunisia.

4.5 RAYHANA

RAYHANA, a Tunisian NGO in Jendouba, is deeply committed to empowering rural women and promoting social engagement through sustainable agriculture and ethical food production practices. As part of the SUSTAvianFEED project, RAYHANA's exploitation plan centers on creating local solutions to enhance community resilience and improve the livelihoods of women in rural areas. By focusing on insect-based poultry feed, they aim to address the critical need for sustainable and affordable agricultural inputs while also empowering women with the knowledge and skills necessary to lead these initiatives.

The key exploitable results (KERs) that RAYHANA will focus on are:

1. **Climate challenges of Black Soldier Fly (BSF) larvae's low-tech production with farmers** (KER7)
   RAYHANA aims to address the **climate-related challenges** faced by local farmers, especially women, in producing larvae as an alternative feed source using low-tech methods. This work will involve training farmers on the benefits of insect farming, providing them with practical skills, and ensuring that women in rural communities are actively involved in these processes. By engaging rural women in overcoming these environmental challenges, RAYHANA not only contributes to food security but also strengthens the social and economic position of women in agriculture.
   - **Target Groups**: Farmers (TG3), Rural women (TG7)
   - **KER**: KER7 – Low and medium-tech insects' production schemes

2. **To analyze and collect recommendations related to circular economy solutions for smallholder farmers** (KER9)
   In line with the principles of the circular economy, RAYHANA focuses on empowering smallholder farmers, particularly women, by promoting sustainable and ethical production systems. This includes utilizing local byproducts and agricultural waste for insect farming, which reduces dependency on imported feed sources and promotes self-sufficiency. The knowledge and skills gained through these initiatives will enable rural women to improve their farms' sustainability while also contributing to the broader economic resilience of their communities.
   - **Target Groups**: Public authorities (TG4), Rural women (TG7), Farmers (TG3)
   - **KER**: KER9 – Circular Economy Business Model for the adoption of project approach

3. **Awareness day on the importance of local products, especially poultry products** (KER4) RAYHANA is dedicated to raising awareness about the value of local, sustainable poultry products, particularly those produced by rural women using insect-based feed. Through community events, training sessions, and awareness campaigns, RAYHANA helps rural women gain recognition for their contributions to ethical food production. These efforts not only enhance the visibility of women's work in agriculture but also create stronger connections between rural producers and local consumers, fostering social solidarity and community engagement.
    - **Target Groups**: Consumers (TG5), Local market visitors (TG8), Rural women (TG7)
    - **KER**: KER4 – Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value

RAYHANA's exploitation plan places a strong emphasis on **social engagement**, focusing on empowering rural women by integrating them into sustainable agricultural practices. By addressing climate challenges in larvae production, promoting circular economy solutions for smallholders, and enhancing community awareness around local products, RAYHANA is building pathways for socioeconomic growth. Through these initiatives, women in rural Tunisia can become key contributors to agricultural innovation, ensuring their economic empowerment and strengthening community resilience. This socially-oriented approach ensures that the benefits of the SUSTAvianFEED project extend far beyond farming, touching the lives of women and their communities in profound ways.

4.6 ENTOMO

ENTOMO, a specialized company in insect farming technologies, plays a critical role in supporting the development of insect-based poultry feed within the SUSTAvianFEED project. Their main contribution is providing advanced containers and infrastructure for insect production, facilitating the transition towards sustainable, circular economy practices across different regions. By working closely with both farmers and insect producers, ENTOMO aims to streamline production methods and integrate insect meals into poultry feed, creating a scalable model for the industry.

The key exploitable results (KERs) that ENTOMO will focus on are:

1. **Product testing: Insect meals as ingredient for poultry feed** (KER5) ENTOMO is at the forefront of testing insect-based meals as a viable ingredient in poultry feed. By developing efficient production schemes and validating the nutritional benefits of insect meals, they enable farmers to adopt insect-based feed confidently. The company provides essential infrastructure, such as insect-rearing containers, which simplifies the production process and enhances scalability. Through this, ENTOMO helps farmers and insect producers establish sustainable and economically viable feed production systems.

    - **Target Groups**: Insect producers (TG1), Farmers (TG3)
    - **KER**: KER5 – Product testing of insect-based feed formulations for poultry

2. **Low and medium-tech insects' production schemes** (KER7) ENTOMO offers tailored solutions for both low and medium-tech insect farming, catering to the specific needs of small and large-scale producers. Their technology solutions are designed to be flexible and accessible, providing farmers and insect producers with scalable options depending on their resource availability and production capacity. ENTOMO's

production schemes aim to make insect farming more accessible, reducing entry barriers and helping stakeholders integrate insect farming into their existing agricultural practices.

- **Target Groups**: Insect producers (TG1), Farmers (TG3)
- **KER**: KER7 – Low and medium-tech insects' production schemes

ENTOMO's individual exploitation plan centers on supporting the **insect production infrastructure** for both smallholder and large-scale producers through the provision of **low and medium-tech solutions**. By facilitating **product testing** and offering scalable insect production models, ENTOMO plays a pivotal role in helping farmers and insect producers successfully adopt insect-based poultry feed. Their work is essential in driving the commercialization of sustainable feed options, reinforcing the SUSTAvianFEED project's overall mission to foster a **circular economy** and improve food sustainability.

4.7 EGE

As a leading academic institution in Turkey, **Ege University (EGE)** is committed to enhancing the sustainability and profitability of poultry farming by focusing on alternative feed ingredients, insect-based diets, and promoting slow-growing poultry breeds. In addition to these technical aspects, EGE is also responsible for the **economic evaluation of the diets**, ensuring that the proposed feed innovations are not only environmentally sustainable but also economically viable for farmers and feed producers. Their exploitation plan targets **Feed manufacturers (TG1)**, **Farmers (TG3)**, and **Public authorities (TG4)**, as well as **Retailers (TG6)** who are interested in promoting sustainable products.

The key exploitable results (KERs) EGE will focus on are:

1. **Alternative feed ingredients and byproducts to improve feed formulation** (KER1)
   EGE will work to introduce alternative feed ingredients and byproducts to **Feed manufacturers (TG1)** and **Farmers (TG3)**. These ingredients can help improve the sustainability of animal feed production while also offering cost-effective solutions. EGE will ensure that these alternatives are economically viable by conducting thorough economic evaluations, making them accessible and attractive to key stakeholders.
   - **Target Groups**: Feed manufacturers (TG1), Farmers (TG3)
   - **KER**: KER1 – Alternative feed ingredients and byproducts to improve feed formulation

2. **Profitability of the alternative diets** (KER2)
   A key responsibility for EGE is to evaluate the profitability of the alternative diets being promoted. By providing detailed economic assessments, EGE will give **Farmers (TG3)**, **Feed manufacturers (TG1)**, and **Public authorities (TG4)** the data they need to make informed decisions about adopting these new diets. This will be critical in ensuring that the environmental benefits of these diets are matched by their financial feasibility.
   - **Target Groups**: Farmers (TG3), Feed manufacturers (TG1), Public authorities (TG4)
   - **KER**: KER2 – Profitability of the alternative diets

3. **Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value** (KER4)
   EGE aims to support the diffusion of slow-growing poultry breeds by highlighting their superior meat quality and ethical production methods. By conducting economic analyses, EGE will ensure that these breeds offer a competitive advantage for **Farmers (TG3)** and **Retailers (TG6)**, making it easier for them to access the growing market for ethically-produced meat.
   - **Target Groups**: Farmers (TG3), Retailers (TG6)

- **KER**: KER4 – Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value

4. **New and innovative ideas and possibilities to improve insect farming** (KER7) EGE will collaborate with **Insect producers (TG8)** to promote innovations in insect farming, helping to make this emerging industry more sustainable and economically feasible. By providing economic evaluations of different farming techniques, EGE will ensure that insect farming can be scaled and adopted by a wider range of producers, benefiting the poultry feed sector.
   - **Target Groups**: Insect producers (TG8), Farmers (TG3)
   - **KER**: KER7 – Low and medium-tech insects' production schemes

5. **Insects' use in slow-growing breeds** (KER5) EGE will promote the use of insect-based diets for slow-growing poultry breeds. In addition to the nutritional and environmental benefits, EGE will provide economic evaluations that demonstrate the profitability of using insects as feed, making it an attractive option for **Farmers (TG3)** and **Feed manufacturers (TG1)**.
   - **Target Groups**: Farmers (TG3), Feed manufacturers (TG1)
   - **KER**: KER5 – Insects' use in slow-growing breeds

6. **Insect's use in broilers** (KER6) EGE will extend their work on insect-based diets to broiler production, again ensuring that the financial benefits are clear for **Farmers (TG3)** and **Feed manufacturers (TG1)**. By showing the economic viability of these diets, EGE will help support their wider adoption in Turkey's poultry industry.
   - **Target Groups**: Farmers (TG3), Feed manufacturers (TG1)
   - **KER**: KER6 – Insect's use in broilers

Ege University's exploitation plan demonstrates a comprehensive approach to promoting sustainable and profitable feed solutions in Turkey. By focusing on the **economic evaluation of alternative diets** and ensuring their financial feasibility, EGE is well-positioned to support the adoption of these innovations by **Farmers (TG3)**, **Feed manufacturers (TG1)**, and **Public authorities (TG4)**. This combination of sustainability and profitability will help ensure the long-term success of these practices in Turkey's poultry sector.

4.8 SLOWFOOD

Slow Food, an international organization that advocates for sustainable food systems and social equality, plays a critical role in the SUSTAvianFEED project by promoting ethical, sustainable food practices and supporting smallholders across the globe. Slow Food's exploitation plan focuses on fostering community-driven solutions, enhancing food sovereignty, and ensuring that smallholders, particularly those in marginalized communities, benefit from the project's innovations. By focusing on sustainable poultry feed systems, Slow Food aims to bridge the gap between environmental sustainability and social justice in the food sector. The key exploitable results (KERs) that Slow Food will focus on are:

1. **Global promotion of sustainable poultry feed systems (KER9)** Slow Food uses its global network to disseminate knowledge about sustainable poultry feed systems based on the principles of the circular economy. This involves sharing best practices, promoting the use of locally sourced insect-based feed, and encouraging

smallholders to adopt these sustainable solutions. By advocating for these methods in rural communities, Slow Food ensures that smallholders can reduce their dependency on costly, imported feed, thereby improving their economic resilience while contributing to environmental sustainability.
    - **Target Groups**: Farmers (TG3), Smallholders (TG7), Rural communities (TG7)
    - **KER**: KER9 – Circular Economy Business Model for the adoption of project approach

2. **Empowering smallholders through ethical food production (KER4)**
A key pillar of Slow Food's mission is to promote ethical food production that values quality, tradition, and environmental responsibility. Within the framework of the SUSTAvianFEED project, Slow Food will focus on promoting **slow-growing poultry breeds** raised on sustainable feed, including insect-based alternatives. This approach enhances the meat's quality and aligns with Slow Food's commitment to high standards of animal welfare and ethical production. By involving smallholders in this sustainable model, Slow Food strengthens their market position and encourages consumers to value local, ethical products.
    - **Target Groups**: Farmers (TG3), Consumers (TG5), Local market visitors (TG8)
    - **KER**: KER4 – Improve and develop the slow-growing breeds diffusion and market thanks to their meat quality and ethical value

3. **Community-driven awareness and social engagement (KER10)**
Slow Food is deeply committed to raising awareness about the importance of local, sustainable food systems. Through its extensive network of events, campaigns, and educational initiatives, Slow Food will organize **awareness days** and engage communities on the benefits of sustainable poultry products and insect-based feed. These events will not only inform the public but will also build stronger connections between smallholders and local consumers, reinforcing social cohesion and supporting the economic empowerment of rural communities.
    - **Target Groups**: Consumers (TG5), Local market visitors (TG8), Rural communities (TG7)
    - **KER**: KER10 – Awareness campaigns promoting sustainable food production systems

SLOWFOOD's approach to SUSTAvianFEED project emphasizes the intersection of sustainability, social justice, and community empowerment. By promoting circular economy principles, ethical food production, and deep community engagement, Slow Food ensures that smallholders are equipped to thrive in a sustainable food system. Through its global outreach, Slow Food will continue to advocate for food sovereignty and fair trade, ensuring that the project's innovations benefit both producers and consumers while fostering social equality in the food sector.

5 Business Plan for Black Soldier Fly as poultry meal

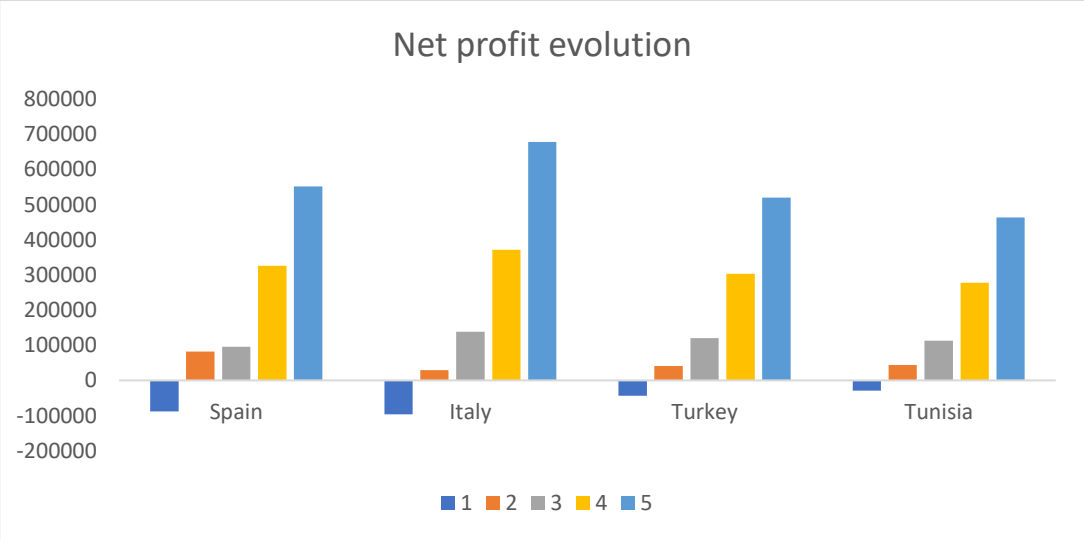
Supplementary information to reinforce the analysis of the business plan can be found under Annex 9.1

5.1 Executive Summary

The purpose of this business plan is to create a company dedicated to the production of dried black soldier fly larvae (Hermetia illucens), using agricultural waste as raw material. The main product will be used to feed laying and broiler hens, as a partial substitute for fishmeal and imported soy.
The project is part of the circular economy and contributes to solving two fundamental problems: the management of agricultural waste and the poultry sector's dependence on conventional protein sources. Through a bioconversion process, plant waste will be transformed into high-quality protein, with immediate applications in poultry farming.
The company will focus on the local market, to make it as sustainable as possible and with the capacity for progressive growth towards the regional or national level. Based on estimates, within a five-year horizon, it is expected to achieve sustained profitability, with attractive margins and the possibility of industrial expansion.
The business model includes:
- Collection of agricultural waste as a free or low-cost input.
- Production of sustainable and traceable protein for poultry feed.
- Marketing of by-products (organic fertilizer).
- Progressive expansion through modular scalability.

The living labs provided information for the preparation of the business plan. The types of waste common in each region, costs associated with these resources, and other costs (personnel, construction, machinery, or energy). Social acceptance of the product, and which format would be best for marketing, as well as the simplicity or complexity of its distribution.

The main projected financial figures are presented below:



These projections reflect a start with controlled losses in the first year, a return to profitability in the second year and accelerated growth from the third year onwards. By the fifth year, the project will

have a net profit of around 551,250 €(Spain), 678,000€ (Italy), 519,375€, (Turkey) and 463,125€(Tunisia), ensuring viability, reinvestment capacity and attractiveness to potential investors.

Italy is where the business plan is more interested to be implemented in terms of absolute profit. However, the net profit in Tunisia provably if more interesting in terms of relative profit because the intrinsic value of money in Tunisia, where each euro has more relative value than in European countries.
This executive summary outlines the business opportunity, value proposition and expected results, providing a solid basis for the detailed development of the business plan.

5.2 Description of the Project

The project's mission will be to recover value from agricultural waste by transforming it into alternative proteins of entomological origin for animal feed. The aim is to create an innovative, sustainable production model in line with the principles of the circular economy as proposed in the SUSTAVIANFEED project.
The company's vision is to establish itself as a benchmark in the production of sustainable protein for poultry feed, providing solutions that reduce dependence on imported raw materials such as soya and fishmeal. In the medium term, the aim is to achieve a strategic position that will enable the export of products and know-how to other countries in the Mediterranean basin.

The values that will guide the company's activity are as follows:

a. Sustainability: reducing environmental impact by recovering waste and saving natural resources.
b. Innovation: applying biotechnology to the breeding and processing of insects on an industrial scale.
c. Quality and safety: complying with European and national regulations to guarantee a safe, high-quality product.
d. Traceability: control systems at each stage of the process to offer guarantees to the end customer.
e. Social responsibility: support for local agriculture and contribution to the creation of green jobs.

The project is based on a biological bioconversion process: agricultural waste (fruit, vegetables and vegetable by-products) that is very abundant in the Mediterranean basin, such as olive pomace, vegetables, vinasse and dairy by-products, which are used as a feed substrate for Hermetia illucens larvae. After several growth phases, the larvae reach an optimal size and are collected, dried and transformed into a protein feed for laying and fattening hens.

In addition, the by-product derived from the process (frass) will be marketed as a nutrient-rich organic fertilizer, reinforcing the circularity of the production model and generating a second line of income.

The business project is designed to be set up as a commercial company, although in some locations it could be created with a more social purpose, with a small but scalable initial organizational structure. In the first phase, there will be a manager, a plant manager, production technicians and an administrative-commercial manager. As the business grows, it is expected that additional profiles specializing in biotechnology, quality and business development will be incorporated.

This project therefore integrates waste recovery, sustainable protein production and the generation of natural fertilizers, providing real solutions for agriculture and poultry farming under the same circular economy model.

5.3 Market Analysis

Market analysis allows us to identify the context in which the company will operate, as well as the opportunities and threats that influence the alternative protein and animal feed sector.

3.1 Global and Mediterranean Basin Trends

Global demand for animal feed protein is on the rise due to population growth and increased consumption of animal products. The FAO estimates that by 2050, global animal protein production will need to increase by more than 50% to meet demand. This puts strong pressure on traditional resources (soya, fishmeal).

In this context, insect proteins have emerged as a sustainable alternative, with a lower environmental impact and greater feed conversion efficiency. The European Union has regulated its use through Regulation (EU) 2017/893, which allowed the use of insect proteins in aquaculture, subsequently extending to poultry and pig feed (Regulation (EU) 2021/1372).

3.2 Spanish market

Spain is one of Europe's leading poultry producers, with an annual volume exceeding 1.6 million tonnes of poultry meat and more than 1 billion dozen eggs. The poultry sector accounts for more than 13% of final national livestock production.

The increase in demand for sustainable and differentiated products, such as free-range and organic eggs, creates a clear opportunity for the inclusion of alternative proteins in feed formulation. These producers seek to reduce the use of imported raw materials and value local and circular solutions.

3.3 European basin market

If we take in account the feed consumption for poultry in the mediterranean basin, the potential for insect meal could be to substitute a portion of the soy for dry insect meal, and in the following table it shows the potential need for different level of insect meal inclusion. In all cases demand is far larger than possible production.

Contry	***Poultry feed (Mt/year, estimated)***	***Soy meal in poultry (Mt/year)***	***Potential insect demand 1% (kt/year)***	***Potential insect demand 3% (kt/year)***	***Potential insect demand 5% (kt/year)***
Spain	9	1,8	18	54	90
France	6,5	1,3	13	39	65
Italy	5	1	10	30	50
Greece	1,5	0,3	3	9	15
Croatia	0,6	0,12	1,2	3,6	6
Eslovenia	0,2	0,04	0,4	1,2	2
Malta	0,05	0,01	0,1	0,3	0,5
Chipre	0,35	0,07	0,7	2,1	3,5
Turkey	11	2,2	22	66	110
Egipt	14	2,8	28	84	140
Marrocco	3	0,6	6	18	30
Algeria	4	0,8	8	24	40
Tunez	1,2	0,24	2,4	7,2	12
Israel	1,6	0,32	3,2	9,6	16
Lebanon	0,6	0,12	1,2	3,6	6
TOTAL	58,6	11,72	117,2	351,6	586

5.3.1 Customer Segmentation

The main customer segments identified are:

1. Medium and large poultry farms: seeking stability in feed costs and differentiated products.
2. Compound feed manufacturers: interested in incorporating new protein sources into their formulas.
3. Organic and free-range producers: with a high interest in sustainable and traceable ingredients.
4. Agricultural and livestock cooperatives: which can function as strategic distribution partners.
5. All types of farms that could use frass as fertilizer.

5.3.2 Competition

In Spain, direct competition is still limited, with few companies having scaled up their operations to an industrial level. However, in countries such as France, the Netherlands and Germany, there are already established companies exporting insect protein. This represents both a competitive challenge and an opportunity to position oneself in the domestic market before foreign competition increases. In other Mediterranean countries, some projects have also been set up, but in any case, the need for imported protein is such that the market can be considered large.

5.3.3 Market Opportunity

The business model based on the production of dried BSF larvae from agricultural waste is at the intersection of three growing markets:

1. Waste management and the circular economy.
2. Alternative protein production.
3. Sustainable animal feed.

The convergence of these trends, combined with a favorable regulatory framework and growing demand from the poultry sector, creates a highly attractive environment for the implementation of the project.

5.4 Product and Services

The business model is based on the production of inputs derived from black soldier fly (BSF) larvae, mainly for use in poultry feed. Diversification of products and by-products is key to maximising profitability and reducing risks.

5.4.1 Product Portfolio

1. Whole dried larvae: mainly intended for small poultry producers and the differentiated animal feed market. It is an attractive product for small farms and organic farms. In addition, based on the results obtained throughout the project, whole larvae provide health benefits by enriching the environment.
2. Insect meal: obtained by drying and grinding the larvae. Its protein content (40–60%) makes it a strategic ingredient for feed manufacturers. It is the company's main product in terms of volume and turnover. Degreased meal is necessary to increase the relative protein concentration.
3. Larvae oil: a by-product of lipid extraction, with potential use in high-energy formulations. It represents a future line of diversification with high added value.
4. Frass (solid waste from breeding): organic fertiliser, rich in nitrogen, phosphorus and potassium, in high demand in organic farming.

5.4.2 Production process

The production process as presented at CEBM comprises the following phases:

1. Collection of agricultural waste: obtaining low-cost vegetable by-products in fruit and vegetable production areas. This part is essential, as any increase in the cost of inputs has a considerable impact on the final price of the products and, in many cases, agricultural waste is rich in water, meaning that transporting it over long distances involves transporting large quantities of water.
2. Preparation of the substrate: grinding and homogenisation to serve as food for the larvae and achieve a formulation that allows for the most homogeneous production possible.
3. Larvae rearing: under controlled temperature, humidity and ventilation conditions, ensuring rapid and efficient growth. However, at various stages, it is possible to opt for rearing with less climate control in order to reduce implementation costs and energy costs.
4. Harvesting of mature larvae: optimal biomass moment before their transformation into pupae. This is the moment when they have accumulated the greatest amount of nutrients that can be assimilated into animal feed.
5. Drying and grinding: obtaining whole dried larvae or protein meal, depending on the commercial destination. Whole dried larvae for simpler business models with lower implementation costs.
6. Storage and packaging: under hygienic and traceable conditions that prevent the rancidity of fats and meal, which, although defatted, usually contains substantial amounts of fat (11-13%).
7. Marketing: direct distribution to farms, cooperatives and feed manufacturers. However, the most sustainable model consists of distribution to farms closest to the larval production sites.

5.4.3 Innovation and Added Value

The model offers clear differential value, such as the use of agricultural waste, reducing raw material costs; modular scalability of the production process; compliance with European food safety and sustainability standards; generation of additional by-products with their own market (fertilisers).

5.4.4 Impact on the Poultry Sector

Hens fed with insect protein show, as demonstrated by the results of SustavianFeed, improved digestibility and intestinal health in the animals, increased nutritional quality of eggs and meat, and above all, improved animal welfare and consequently improved health. All this gives the final product a distinctive character in premium markets (free-range and organic eggs), although it can also be applied to poultry whose production pursues high quality standards.
In conclusion, the BSF-based product portfolio allows for diversification of income sources, increased competitiveness with conventional proteins, and reinforcement of the sustainability of the agri-food chain.

5.5 Marketing Strategy

The marketing strategy aims to position products derived from Black Soldier Fly (BSF) larvae as an innovative, sustainable and competitive solution for poultry feed. The aim is to attract customers in the domestic market and subsequently consolidate our presence in the European market.

5.5.1 Positioning

The product will be presented under the concept of 'Natural and sustainable protein for poultry', highlighting the benefits of:

1. Local and circular origin (agricultural waste transformed into protein).
2. Nutritional benefits for hens and the final product (eggs and meat).
3. Contribution to environmental sustainability and reduction of carbon footprint.

5.5.2 Product Strategy

Several product lines will be marketed (dried larvae, insect meal, oil and frass). Differentiation from other similar products will be based on:

- Quality and traceability certifications.
- Possible organic certification in advanced stages. However, this can only be carried out in places where organic production is abundant enough to provide sufficient inputs.
- Adaptation to specific customer needs (format, packaging, composition).

5.5.3 Pricing Strategy

The pricing policy will be competitive with conventional proteins, using fishmeal as a benchmark. Although fishmeal is not a common input in poultry feed formulation:

- Insect meal: €1,000–1,200/t, compared to fishmeal (€1,200–1,800/t).
- Frass: €200/t, aimed at agricultural and organic producers in a palletized format that is easier for farmers to use.

The pricing strategy will attract early customers and consolidate demand, with margins increasing as the scale of production increases.

5.5.4 Distribution Strategy

The first sales and distribution channel is direct to poultry farms through stable supply agreements, always seeking to reduce distribution margins. In this phase, more limited volumes are expected to be produced, so extensive distribution networks are not as necessary.

In a second phase, or when direct sales cannot absorb production, alliances will be formed with agricultural and livestock cooperatives to expand the territorial reach and place a greater quantity of product. This will be at the expense of lower profit margins that will have to go to distribution.
Finally, when none of the above customer profiles can absorb more products, it will be marketed through distributors to feed manufacturers as a base ingredient for commercial formulas. In this case, profit margins will have to be reduced considerably if there is to be market appetite for this product, which will be difficult to market at a value higher than €0.75/kg.

5.5.5 Promotion Strategy

Communication will focus on conveying the added value of the product and its positive impact. Planned actions:
- Participation in agri-food and sustainability trade fairs.
- Digital marketing through social media, with an emphasis on circularity and innovation, and referring to the quality of the final product (eggs or meat) when birds are fed a diet that includes MSN.
- Publications in magazines and media specializing in poultry farming show the use of MSN as a reality that can be implemented on farms.
- Co-branding strategies with farms seeking to differentiate their free-range and organic egg production with high added value for eggs or meat. Examples from the Spanish market would be (https://www.cobardesygallinas.com/).

5.5.6 Expansion Strategy

Initial entry will focus on the local market, prioritizing regions with high poultry production density. From the third year onwards, expansion into regional and national markets will be considered, focusing on regions with strong demand for alternative protein.

Overall, the marketing strategy seeks to consolidate the company's reputation as a reliable supplier of insect protein, creating value for both the poultry sector and society through a sustainable model.

5.6 Operational and technology plan

The operational and technological plan defines the material, human, and technical resources necessary for the efficient operation of the Black Soldier Fly (BSF) larva production plant.

5.6.1 Facilities and Equipment

The plant will be organised into functional areas:
Agricultural waste reception area: space for unloading, sorting, and preparing the substrate.
Larvae breeding room: controlled environment with ventilation and air conditioning systems and modular tray racks to maximise production density.
Processing area: for drying, grinding and packaging the final product.
Finished product warehouse: with adequate hygiene conditions and pest control.
Administrative and quality control area: offices and analysis laboratory.
The equipment will include temperature and humidity control systems, high-efficiency drying equipment, grinding mills, industrial scales and automated packaging systems.

5.6.2 Operational Process

1. Collection of agricultural waste: through agreements with farmers and agri-food companies. In the proposed CEBM, the main supply of inputs in the Mediterranean basin could be olive pomace, vegetables, dairy products and beer bagasse. The pomace will be collected and stored once a year, while the rest of the inputs will be used according to their seasonal availability.
2. Substrate preparation: crushing and homogeneous mixing.
3. Inoculation of eggs and rearing of larvae: in trays arranged in modular racks.
4. Collection of larvae: when they reach the optimum size (14–18 day cycle).
5. Processing: heat drying or mechanical dehydration and subsequent grinding.
6. Packaging and storage: ensuring batch traceability.
7. Distribution and logistics: transport to end customers or distribution centers.

5.6.3 Staff and Organization

In the initial phase, the staff employed to carry out the activities will be just those necessary to keep the plant operational. The workforce will consist of:
- 1 plant and production manager.
- 3 breeding and processing technicians.
- 1 logistics and maintenance manager.
- 1 administrative and commercial manager.

In later phases, specialists in biotechnology, quality control and R&D will be incorporated, and the number of employees will be increased to allow for increased production.

5.6.4 Scalability and Technology

The proposed production model is modular, allowing for a start-up with limited facilities and progressive expansion as demand grows. Each production module can handle between 50 and 100 tons of agricultural waste per year.
The technology used will ensure energy efficiency, biosafety and compliance with European food hygiene and safety regulations. Digital batch tracking systems will also be implemented to ensure complete traceability.
In summary, the operational plan combines modular infrastructure, specialized equipment and efficient organization, which will enable production targets to be met and the quality of the final product to be guaranteed.

5.7 Investment and Financing Structure

The economic viability of the project depends on adequate planning of initial investments, as well as a financing structure that guarantees liquidity during the start-up and expansion phases.

5.7.1 Estimated Initial Investment

The investment required to start up the pilot plant is estimated at approximately €230,000, distributed as follows:

CONCEPT	COST(€)
WAREHOUSE AND FACILITY ADAPTATION	50000
BREEDING SYSTEMS (TRAYS, RACKS, BIOCELLS)	40000
DRYING AND GRINDING EQUIPMENT	60000

AIR CONDITIONING AND ENVIRONMENTAL CONTROL SYSTEMS	30000
LOGISTICS AND WASTE TRANSPORT	10000
PERMITS, LICENCES AND CERTIFICATIONS	10000
INITIAL WORKING CAPITAL (6 MONTHS)	30000
TOTAL	230000

During the first year it would be needed to

5.7.2 Financing

A balanced structure is proposed between own contribution, bank financing and public subsidies:
Partners' own capital: 25% (€57,500)
Bank loans / ENISA / ICO: 40% (€92,000)
European/national subsidies and grants: 35% (€80,500)
This scheme guarantees the commitment of the partners, reduces the level of debt and takes advantage of existing support lines for bioeconomy and circular economy projects.

5.7.3 Possible lines of public funding

CDTI (Centre for Industrial Technological Development): support programmes for R&D projects in the bioeconomy.
Horizon Europe: European funds for sustainability and circular economy projects.
Regional and national programs: aid in innovation and investment in clean energy and sustainability.

5.7.4 Reinvestment Requirements

From the third year onwards, an expansion in production capacity is anticipated, which will require additional investment in new facilities and equipment. This reinvestment may be financed mainly through retained earnings and, to a lesser extent, through new lines of credit.
In conclusion, the investment and financing structure is designed to sustain progressive growth, with an appropriate balance between equity, external financing and public subsidies, ensuring the economic viability and scalability of the project.

5.8 5- Years Financial Projections

Year	1	2	3	4	5
Income (€)	91000	273000	455000	910000	1365000
Expenses (€)	150000	225000	300000	450000	605000
EBITDA (€)	-59000	48000	155000	460000	760000
Net profit(€)	-88000	15000	96000	325500	551250
Cash Flow (€)	-65000	38000	119000	348500	574250

5.8.1 Analysis of Results

Year 1: start-up losses (€–61,000), typical of the technical and commercial validation phase.
Year 2: entry into profit (€38,000), with improved cash flow.

Year 3: consolidation of the model (€96,000 net profit).
Year 4: significant growth, exceeding €325,500 net profit.
Year 5: maturity and full scaling, with €551,250 net profit and €574,2500 cash flow.

5.8.2 Break-even point

The break-even point is expected to be reached at the end of the second year, when revenues cover operating and financial costs.

5.8.3 Expected profitability

The project may offer attractive potential for investors as it has economic indicators for the agricultural system.
- EBITDA margin growing over the five years.
- Estimated IRR above 20%.
- Positive NPV at a discount rate of 10%.

The figures show that financial projections demonstrate that the project is profitable, scalable and sustainable over time, offering guaranteed returns for partners and investors.

5.9 Milestones and Growth Plan

The company's growth plan is structured in phases that allow for the validation of the business model, the progressive scaling of production, and the consolidation of market presence.

5.9.1 Milestones by Stage

Year 1 – Pilot Phase
- Start-up of the pilot plant with a capacity of 100 t/year of dry larvae.
- Technical validation of the larval breeding and drying process.
- First supply agreements with local poultry farms.
- Obtaining initial certifications and regulatory compliance.

Year 2 – Initial Scaling Up
- Expansion of capacity to 300 tonnes/year of dried larvae.
- Establishment of stable contracts with feed manufacturers.
- Start of procedures for organic certification of products.
- Break-even point reached.

Year 3 – Commercial Consolidation
- Expansion to 500 tonnes/year of dry larvae.
- Diversification of customers: medium-sized farms, cooperatives and organic producers.
- Strengthening of the organisational structure with profiles specialising in quality and R&D.
- Consolidated net profit above €96,000.

Year 4 – Industrial Expansion
- Growth in production capacity to 1,000 tonnes/year.
- Technological optimization and partial automation of processes.
- Active marketing of by-products (larvae oils and frass) as new revenue streams.
- Start of exploration of regional markets.

Year 5 – Maturity and National Expansion
- Achievement of 1,500 t/year of dry larva production.
- Establishment of export agreements in Europe.

- Positioning as a national benchmark in insect protein production.
- Net profit above €550,000 and positive cash flow for reinvestment.

5.9.2 Growth Strategy

The growth strategy is based on:
Modular scalability: progressive expansion of production capacity in line with demand.
Product diversification: incorporation of new lines (larva oil and fertilizers).
Strategic alliances: agreements with cooperatives, feed manufacturers and international partners.
Continuous innovation: investment in R&D to optimise bioconversion and improve efficiency.

5.9.3 5-Year Objective

The objective is to become a leading supplier of insect protein in the domestic market, with recognition in the Mediterranean basin for possible expansion, a solid and sustainable structure, and an attractive business model for investors and strategic partners.

5.10 Risk analysis

Risk identification and management is a fundamental aspect of ensuring the viability and sustainability of the project. Risks have been classified as technical, market, regulatory, and financial.

5.10.1 Technical Risks

Larvae mortality: variations in environmental conditions can affect survival rates.
Substrate quality: variability in agricultural waste can influence production yield.
Biosecurity: risk of cross-contamination by pathogens or pests.
Mitigation measures: implementation of environmental control protocols, substrate quality testing, strict biosecurity and ongoing staff training.

5.10.2 Market Risks

Fluctuations in the price of conventional proteins: a drop in the price of soy or fishmeal may reduce the competitiveness of the product.
Market acceptance: initial resistance from traditional farms to incorporating insect protein.
International competition: entry of foreign companies with greater production capacity.
Mitigation measures: differentiation strategy based on sustainability and proximity, long-term supply agreements and customer diversification.

5.10.3 Regulatory Risks

Changes in European regulations: modification of limits or authorizations for the use of insects in animal feed.
Additional traceability and food safety requirements: increased compliance costs.
Mitigation measures: active monitoring of legislation, collaboration with industry associations and rapid adaptation to new regulatory requirements.

5.10.4 Financial Risks

Limited access to financing: difficulties in obtaining loans or grants.
Dependence on public aid: risk if bioeconomy support programmes are reduced.
Energy costs: increase in electricity and fuel prices.
Mitigation measures: diversification of funding sources, capital reserve planning, investments in energy efficiency and reinvestment of profits.

5.10.5 Overall Assessment

The project presents risks inherent in any innovative initiative, especially in the early stages. However, the proposed mitigation measures, together with the robustness of the business model and the favourable regulatory framework, significantly reduce the likelihood of critical impacts. The overall risk of the project is considered moderate and manageable.

6 Guidelines for smallholders

ALIA and SLOWFOOD developed guidelines for small holders to support them in adopting sustainable livestock farming practices that enhance economic independence and environmental resilience. These guidelines are included in Annex 9.2.

Developing Alternative Diets and Reducing Dependency on Imported Feed
The SUSTAvianFEED project has formulated alternative diets that utilize locally available agricultural byproducts and insect-based protein sources, significantly reducing farmers' reliance on imported feed. By integrating these alternatives, smallholders can achieve greater self-sufficiency while minimising their environmental impact. The methodology behind this approach involves an exhaustive analysis of available byproducts to assess their nutritional suitability, ensuring that they meet poultry dietary needs. Additionally, the project employs Life Cycle Assessment (LCA) tools to evaluate the environmental impact of each potential feed ingredient. This scientific, evidence-based approach guarantees that all feed options contribute to more sustainable and efficient poultry production.

As a result, smallholders now have access to affordable, high-quality feed alternatives that lower production costs while enhancing ecological sustainability. By incorporating locally sourced byproducts and insect-based feeds into their operations, farmers not only reduce their carbon footprint but also strengthen their economic independence. These solutions demonstrate that sustainable, locally sourced feed production can successfully replace traditional imported feed, fostering resilience within rural economies.

Insect-Based Feed: Production, Benefits, and Animal Welfare
Recognizing the potential of insect farming as a sustainable protein source, the project has developed low- and medium-tech insect production systems specifically designed for smallholders. By utilizing low-cost containers and locally available organic waste, farmers can raise insects sustainably with minimal infrastructure investment. These production models, which have been successfully piloted on partner farms, prove that small-scale insect farming is a viable and practical solution, particularly in rural settings.

The benefits of insect-based feed extend beyond its economic advantages. It provides an ethical and sustainable protein source that is both affordable and efficient. Compared to conventional feed, insects offer a higher protein-to-resource ratio while requiring fewer environmental resources. Additionally, insect-based feeds align with the natural diet of poultry, improving animal health and welfare. By incorporating these feeds, smallholders can not only reduce costs but also contribute to a more sustainable agricultural system that prioritizes both ethical considerations and environmental responsibility.

Benefits of Using Native Poultry Breeds and Extensive Livestock Farming
The SUSTAvianFEED project highlights the importance of native poultry breeds, which are naturally well-adapted to local climates and environmental conditions. These breeds exhibit greater resilience to diseases and environmental stressors, making them an ideal choice for sustainable poultry farming. Unlike commercial breeds that often require intensive management, native poultry thrive in free-range settings with minimal intervention, reducing the need for expensive inputs.

Extensive livestock farming further enhances sustainability by promoting biodiversity, improving soil regeneration, and fostering healthier ecosystems. By allowing native breeds

to graze freely, farmers contribute to natural nutrient cycling, which is essential for maintaining long-term soil health. This method of poultry farming also offers financial advantages, as it reduces costs associated with intensive farming systems. Additionally, it strengthens the rural economy by fostering a close relationship between farmers and their environment, ensuring that agricultural practices remain sustainable and ecologically balanced.

Native breeds play a crucial role in climate resilience, as they are better adapted to withstand local climatic changes. This adaptability makes them an invaluable asset, particularly in regions vulnerable to shifting weather patterns. By prioritizing resilient breeds, SUSTAvianFEED empowers rural communities to adapt to environmental challenges and secure the future of sustainable poultry farming. The economic benefits of extensive livestock farming are significant, as they contribute to the overall stability of rural economies and provide long-term financial security for smallholders. Moreover, the role of extensive farming extends beyond North Africa, demonstrating its value as a global solution for rural agricultural sustainability.

Economic and Social Impact on Rural Communities

SUSTAvianFEED's approach goes beyond individual farming practices by fostering a symbiotic relationship within rural communities. By promoting collaboration through farmer associations, smallholders can share resources, exchange knowledge, and collectively market their products. This cooperative model strengthens community ties and ensures that farmers have the necessary support to adopt sustainable practices.

The economic benefits of these initiatives are further amplified by economies of scale. By creating scalable, sustainable poultry farming models, the project provides smallholders with opportunities to expand their operations without compromising ecological balance. Increased production efficiency leads to greater local food supplies, enhanced food security, and a more resilient rural economy. Sustainable livestock farming not only ensures economic stability for individual farmers but also strengthens the social fabric of rural areas by reinforcing traditional agricultural practices that align with environmental conservation.

Certification and Market Differentiation for Local, Sustainable Products

To further support rural farmers, SUSTAvianFEED aims to certify poultry products derived from native breeds, emphasizing their ecological and ethical value. This certification process enhances market differentiation by creating a niche for high-quality, sustainable poultry products that align with consumer demand for ethical and environmentally responsible food choices. Certified products provide an opportunity for farmers to access higher-value markets, allowing them to command premium prices while reinforcing the importance of sustainable agriculture.

Market differentiation plays a vital role in promoting these certified products within both local and international markets. By highlighting the unique attributes of native breeds, farmers can distinguish their poultry products and attract conscious consumers willing to invest in sustainable and ethically produced food. The integration of alternative diets into larger-scale poultry production also holds promise, as these feed solutions can be adapted for more intensive farming operations. This scalability ensures that the benefits of sustainable livestock farming extend beyond smallholders, contributing to a broader transformation within the industry.

Scalability of Alternative Feed Solutions for Industrial Applications

Although the primary focus of SUSTAvianFEED is to support smallholders, the project's findings have the potential to be applied on a larger scale. The development of alternative feed models, particularly insect-based protein and byproduct utilization, presents an opportunity for industrial poultry production to transition towards more sustainable practices. By integrating these solutions, large-scale producers can reduce their dependence on imported feed, lower their environmental footprint, and contribute to the advancement of a more resilient global food system.

The ability to scale these feed solutions highlights the adaptability of sustainable practices across different farming models. By bridging the gap between small-scale and industrial production, SUSTAvianFEED fosters a holistic approach to poultry farming that prioritizes environmental stewardship while ensuring economic viability at every level. The symbiosis between rural and industrial farming strengthens the sustainability of the poultry sector and supports long-term food security.

7 Activities developed during project implementation

The following exploitation activities were undertaken during the project implementation and will continue beyond its duration, serving as a bridge for the ongoing utilisation and impact of the project results.

7.1 ALIA

Result for exploitation #1:	*Adopting alternative feed ingredients considering manufacturers and farmers*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Agustín Fernandez - President of CACHAMUR	Phone call and participation at ALIA's national conference	05/2024
Antonio J. Vidal Gomez - Deputy Director General for Sustainable Livestock Production Region of Murcia	Phone call and participation at ALIA's national conference	05/2024
Eva Armero Ibáñez- Technical Director of the Programme for the Conservation and Improvement of the Gallina Murciana breed and Spokesperson for the AGAMUR Association	Phone call and participation at ALIA's national conference	05/2024
ALIA'S farmers cooperative	Participation at ALIA's General Assembly	06/2024
Javier Prieto – Product manager and poultry nutritionist at MIAVIT	Interview	08/2021
José Ángel Ayala – Veterinary Technical Manager at LORCA NUTRICION ANIMAL (Guadalen)	Interview	08/2021
Salvador Escobar- Technical Director at Pollos Pujante	Interview	08/2021

Result for exploitation #1:	*Adopting a sustainable label for different products*

Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Salvador Escobar- Technical Director at Pollos Pujante *María Paz Carrasco Benso- Pollos Pujante*	Phone call, emails using preexisting networks and at the participation at ALIA & UMU workshop of ECOLABEL	13.06.2023 (in person)
José Mª Egea Fernández *Mamen Martínez Graciá* *Gaspar Ros*	Phone call, emails using preexisting networks and at the participation at ALIA & UMU workshop of ECOLABEL	13.06.2023 (in person)
Experts from sustainability label: *Suso Méndez- Technical Advisory Group (TAG) on Integrating Circular Bioeconomy in Livestock Supply Chains* *Ana Hurtado – Technical Director at Feed & Food Associations CESFAC*	Online meeting	*25.10.2022 (online)*

7.2 UMU

Result for exploitation #1:	*Implementing feeds with more sustainable alternative plant-based ingredients than current or common ones involves a multi-level approach, considering producers, marketers, distributors, and more.*

Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Avícola San Isidro (distributor and marketer)	Online meeting	January/February
Huevos Inmaculada (distributor and marketer)	Online meeting	January/February
Huevos Fulgencio (distributor and marketer)	Online meeting	January/February
Granja avícola Tomás Pérez (Producers)	Online meeting	January/February

Result for exploitation #2:	*Implementing feeds with insects (approach at the producer, marketer, distributor levels, etc...)*

Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Avícola San Isidro (distributor and marketer)	Online meeting	January/February
Huevos Inmaculada (distributor and marketer)	Online meeting	January/February
Huevos Fulgencio (distributor and marketer)	Online meeting	January/February
Granja avícola Tomás Pérez (Producers)	Online meeting	January/February

Result for exploitation #3:	*Enhancing biodiversity by utilizing local breeds, if considered as added value (approach at the producer, marketer, distributor levels, etc...).*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Avícola San Isidro (distributor and marketer)	Online meeting	January/February
Huevos Inmaculada (distributor and marketer)	Online meeting	January/February
Huevos Fulgencio (distributor and marketer)	Online meeting	January/February
Granja avícola Tomás Pérez (Producers)	Online meeting	January/February

7.3 UNITO

Result for exploitation #1:	*Individuate alternative feed ingredients and possible byproducts to improve feed formulation*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Piero Gaidano, Borello Mangimi (feed industry)	Online video call	06/24
Paolo Monge, Monge Mangimi (feed industry)	Online video call	06/24
Mellano Emanuele (poultry farmer)	Online video call	06/24

Result for exploitation #2:	*New and innovative ideas and possibilities to improve insects farming*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Piero Gaidano, Borello Mangimi (feed industry)	Cellphone	07/24
Paolo Monge, Monge Mangimi(feed industry)	Cellphone	07/24
Mellano Emanuele (poultry farmer)	Cellphone	07/24

Result for exploitation #3:	*Improve and develop the slow growing breeds diffusion and market thanks to their meat quality and ethical value*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Piero Gaidano, Borello Mangimi (feed industry)	Online video call	08/24
Paolo Monge, Monge Mangimi(feed industry)	Online video call	08/24
Mellano Emanuele (poultry farmer)	Online video call	08/24

7.4 ISA-CM

Result for exploitation #1:	*Use of local raw materials and byproducts to develop sustainable feed formulas and presentation of their environmental impact*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
DGPA (Ministry of Agriculture)	Physical meeting	02/ 2025
CTAB (Centre Technique de l'Agriculture Biologique)	Physical meeting	02/ 2025

Office de l'élevage et des pâturages (Sousse)	Physical meeting	02/ 2025
GIPAC Groupement Interprofessionnel des Produits avicoles et Cunicoles	Online meeting	02/ 2025

Result for exploitation #2:	*Presentation of the Results of meat chicken performance and products quality traits and animal welfare*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
The farmers of the GDA (Agricultural Development group) Sidi El Héni /Kroussia (Sousse)	Focus group	02/ 2025
DGPA (Ministry of Agriculture)	Physical meeting	02/ 2025
TECHNA (feed manufacturing)	Physical meeting	02/ 2025
CTAB (Centre Technique de l'Agriculture Biologique)	Physical	02/ 2025
Office de l'élevage et des pâturages (Sousse)	Physical meeting	02/ 2025

Result for exploitation #3:	*Dissemination of project results of poultry performance*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
CTAB (Centre Technique de l'Agriculture Biologique)	Physical meeting	02/ 2025
The farmers of the GDA (Agricultural Development group) Sidi El Héni /Kroussia (Sousse)	Online meeting	02/ 2025
African countries -Kenya, Uganda, ...	Online meeting workshop	January 2025

7.5 RAYHANA

Result for exploitation #1:	***Climate challenges of larvae's low-tech production with farmers***	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Farmers	Workshop with the different stakeholders	April-May
Representative of the regional agricultural commission	Workshop with the different stakeholders	April-May
Representative of environmental local association	Workshop with the different stakeholders	April-May
…		

Result for exploitation #2:	***To analyze et to collect recommendation related to marketing linked to the circular economy (product fed with larvae)***	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
representative of the regional agricultural commission	Meeting with the different stakeholders	*Mai-Juin*

representative of private sector (poultry enterprises, poultry structure…etc)	*Meeting with the different stakeholders*	*Mai-Juin*
Association working on local product marketing and environment	*Meeting with the different stakeholders*	*Mai-Juin*

Result for exploitation #3:	***Awareness day to the importance of the local products especially poultry product***	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Local consumer	Rayhana Local market	December-January
Local market visitors	Rayhana Local market	December-January
Local restaurants	Rayhana Local market	December-January

7.6 ENTOMO

Result for exploitation #1:	*Product testing, Insect meals as ingredient for poultry feed*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Aritan	Direct contact and samples supply	37
Grupo huevos guillen	Direct contact and samples supply	37
Grupo Dagu	Direct contact and samples supply	37
Camar Agroalimentaria	Direct contact and samples supply	37
Granja San Miguel S.A.T.	Direct contact and samples supply	37

Granja Balón	Direct contact and samples supply	37
Granja Virgen del Rosario S.A.T.	Direct contact and samples supply	37
Interovo	Direct contact and samples supply	37
Coorporacion alimentaria Guissona S.A.	Direct contact and samples supply	37
Avicola Llombay S.A.	Direct contact and samples supply	37
Grupo Sada	Direct contact and samples supply	37
Vall Companys	Direct contact and samples supply	37
Uvesa	Direct contact and samples supply	37
Avinatur	Direct contact and samples supply	37
Coren	Direct contact and samples supply	37
AN Melída	Direct contact and samples supply	37
Grupo MLR	Direct contact and samples supply	37
Padesa	Direct contact and samples supply	37
Avimosa	Direct contact and samples supply	37

Result for exploitation #2:	*Product testing, insect fats for animal feeding*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Cefusa	Direct contact and samples supply	36
Vall companys	Direct contact and samples supply	36
Stakeholder 3		
…		

7.7 EGE

Result for exploitation #1:	*The project results of the alternative diets on performance of broiler chickens*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
Türkiye Feed Industrialist Association members (Feed manufacturer directors of Lezita, Özlem yem, Beypiliç)	Satellite seminar in conjunction with 4. International Animal Nutrition Congress (Antalya, TÜRKİYE)	Jan 29, 2024
Themembersof Animal NutritionScıenceAssociation	Satellite seminar in conjunction with 4. International Animal Nutrition Congress (Antalya, TÜRKİYE)	Jan 29, 2024

Academicians and Experts (animal nutrition and feed technology)	Satellite seminar in conjunction with 4. International Animal Nutrition Congress (Antalya, TÜRKİYE)	Jan 29, 2024

Result for exploitation #2:	*Possible alternative agri-industrial byproducts and BSF larvae meal for chicken diets*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
SakineYalçın, AnimalNutritionist, Academia	Online zoom meeting	May, 2024
MetinÇabuk, PoultryNutritionist	Online zoom meeting	May, 2024
FahrisKılıç, İlkerAğın, EgeZootekniAssociationBoardMember	Online zoom meeting	May, 2024
RukenYıldırım, MinistryofAgriculture General DiroctorateofAgriculturalResearch and Policies *EdipSühaoğlu, Izmir MinistryofAgricultureProvincial DirectorateofAgriculture and Forestry*	Online zoom meeting	May, 2024
MerveKarabıyık, representative oftheinsectproducingunitoftheMunicipalityof İzmir	Online zoom meeting	May, 2024
İsmail Kor, DamlaÇetinkolKonca, Poultryproducers	Online zoom meeting	May, 2024
MustafaTufan, Feed raw material supplier	Online zoom meeting	May, 2024

Result for exploitation #3:	*Possibility of insect use in broiler production*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
MerveKarabıyık, representative oftheinsectproducingunitoftheMunicipalityof İzmir	Online zoom meeting	May, 2024
Dr. TamerÇalıkoğlu, Eren Carkçı, Insectproducer	Online zoom meeting	May, 2024
LeventTopçu, İsmail Kor MuharremDoğan, Organicchickenproducers	Online zoom meeting	May, 2024
EdipSühaoğlu, Izmir MinistryofAgricultureProvincial DirectorateofAgriculture and Forestry	Online zoom meeting	May, 2024

EGE will focus its exploitation activities on small-scale broiler farmers. The focus will be on broiler nutrition.	Presences on workshops, trade fairs, conferences and other events will be key to exploit results among broiler producers.	Small-scale farmers; Insect producers; Ministry; Municipal authorities; Academy; Experts, poultry nutritionists; Feed manufacturers; Non-Governmental Organizations operating in the fields of animal nutrition and poultry breeding

7.8 SLOWFOOD

Result for exploitation #1:	*Announcement of project objectives goals and activities to develop*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
• Organic and traditional farmer associations (AIAB, BioForum, SlowFood Network) • Breeders (SYSAAF) • Nutrition firms • Animal housing designers (Vanggaard Staldmontage) • Research and technical institutes (EV ILVO, Luke, CNRS, CRAW, Thuenen, ACTA) • Universities (UU, AU, WU, HAU, UNIPG, JUNIA, USAMV) • The European Federation of Animal Science (EAAP) • Consumers	PPIllow Project conference, Terra Madre 2022	September 2022
"Unconventional Egg" brand, Frutteto di Famiglia producers	Interview	Dec 2024
Worldwide network of farmers, cooks, food producers, activists, and people interested in sustainability in the food industry	Newsletter, article on SlowFood.it	July 2024

Result for exploitation #2:	*Dissemination of project final results*	
Stakeholders to be addressed, not only type of stakeholder, but specific actors (include as many rows as necessary)	Ways of reaching the stakeholders identified	Expected month to this aim
General public, media	Press release	September 2024
World wide network of farmers, cooks, food producers, activists, and people interested in sustainability in the food industry	Newsletter	March 2025

8 Conclusion

The SUSTAvianFEED project has successfully demonstrated that sustainable poultry farming is viable bringing a positive change across the Mediterranean and addressing the specific needs of smallholders in Spain, Italy, Tunisia, and Turkey.

There is an evident link of our strategic exploitation strategy with D5.1 Dissemination and communication strategy. In fact, previous communication deliverables have pathed the way to raise awareness about sustainable farming practices, disseminate project milestones and results and support the exploitation of project results to various target audiences. Our strategic exploitation strategy is complementary to C&D actions, further ensuring the project extend beyond immediate outcomes. KERs of partners were exploited to specific target audiences and the guidelines for smallholders was produced fostering collaboration contribute to long-term sustainability in the sector and food security in the region. Future efforts should focus on policy advocacy, increasing farmer training, and scaling up sustainable practices.

9 Annex

9.1 Supplementary information to the Business Plan

The annexes provide supplementary information to reinforce the analysis of the business plan, providing greater detail on technical, financial and regulatory aspects.

9.1.1 Circular Flow Diagram

Stages of the Circular Flow
1. Generation and Collection of Agricultural Waste
Horticultural waste (fruit, vegetables, leaves, agricultural by-products unfit for human consumption) represents a management problem for farmers and distributors. These materials, which have little or no commercial value, constitute the main input for the process.

- Origin: farms, cooperatives, distribution centers.
- Impact: reduction in waste management and recovery costs.

2. Biological Conversion by BSF Larvae
Hermetia illucens larvae feed on agricultural waste, transforming it into protein and lipid biomass in a short cycle of 14–18 days.

- Efficient conversion: up to 60% of organic matter is transformed into usable biomass.

Biological advantages: high growth rate and adaptation to various substrates.
3. Obtaining Main Products
At the end of the larval cycle, the larvae are collected and processed to generate different products:

- Whole dried larvae: suitable for feeding direct birds on small farms.
- Insect meal: standardized product with high protein content (40–60%), intended for feed manufacturers.
- Larvae oil (by-product): lipid fraction with potential use in high-energy feeds.

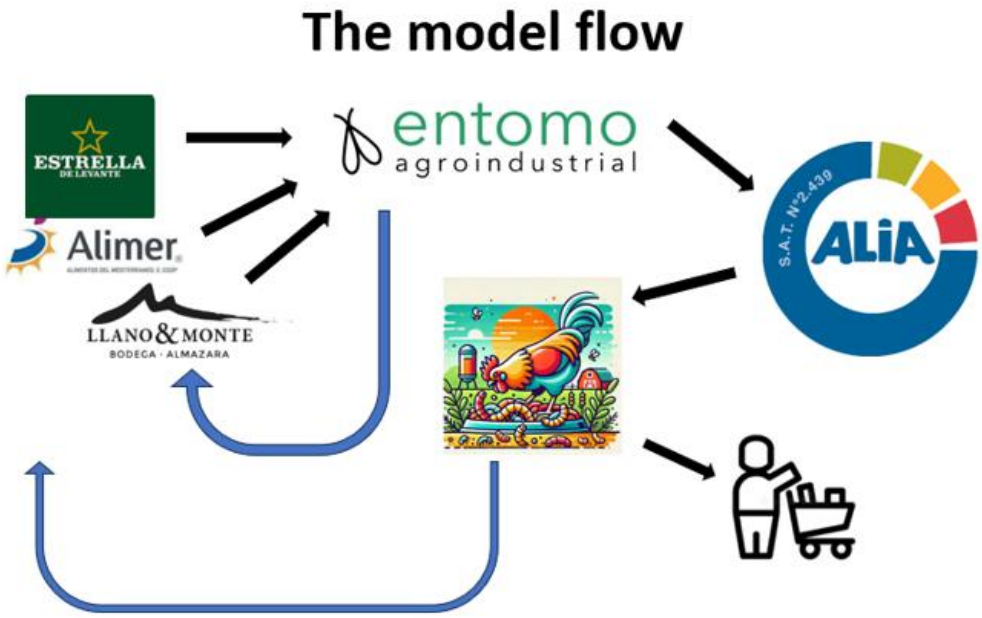
4. Obtaining by-products (frass)
Frass, composed of undigested substrate remains and larval excrement, is an organic fertilizer rich in nitrogen, phosphorus and potassium.

- Direct agricultural use improves soil fertility.
- Additional market: growing demand in organic and sustainable agriculture.

5. Chicken Feed
Protein products derived from larvae are incorporated into feed for laying and broiler chickens.

- Benefits: better digestibility, improved egg and meat quality, reduced dependence on soya and fishmeal.
- Impact: differentiation of producers who can label their products as more sustainable.

6. Return to the agricultural cycle
Chicken manure, together with frass, can be returned to agricultural soil as a natural fertiliser, closing the production cycle.



9.1.2 Detailed Financial Tables

Financial projections are a key tool for assessing the viability of the project. They have been prepared based on assumptions of progressive growth in production capacity, costs and sales prices.

Main assumptions:

1. Dry larva production: from 100 tons/year in the first year to 1,500 tons/year in the fifth year.
2. Proportional frass production: from 80 tons/year to 1,200 tons/year.
3. Average price of dry larvae: €750/tons.
4. Average price of frass: €200/tons.
5. Progressive scaling of personnel, energy and maintenance costs.
6. Straight-line depreciation of equipment: 23,000€/year.
7. Initial financing: loan with an average interest rate of 7% per annum.

Projected results (summary in €):

Table 4. Financial table Spain

year	*1*	*2*	*3*	*4*	*5*
Larvae income (€)	75000	225000	375000	750000	1125000
Frass income (€)	16000	48000	80000	160000	240000
Total income (€)	91000	273000	455000	910000	1365000
Personnel cost (€)	100000	150000	200000	300000	400000
Energy/water (€)	20000	30000	40000	60000	80000
Transport (€)	15000	20000	25000	40000	60000
Maintenance (€)	10000	15000	20000	30000	40000
Other (€)	5000	10000	15000	20000	25000
Total expenses (€)	150000	225000	300000	450000	605000

EBITDA (€)	-59000	48000	155000	460000	760000
Amortization (€)	23000	23000	23000	23000	23000
Interests (€)	6000	5000	4000	3000	2000
BAI (€)	-88000	20000	128000	434000	735000
TAX (€)	0	5000	32000	108500	183750
Net profit (€)	-88000	15000	96000	325500	551250
Cash Flow (€)	-65000	38000	119000	348500	574250

Table 5. Financial table Italy

year	*1*	*2*	*3*	*4*	*5*
Larvae income (€)	75000	225000	375000	750000	1125000
Frass income (€)	16000	48000	80000	160000	240000
Total income (€)	91000	273000	455000	910000	1365000
Personnel cost (€)	115000	126500	138000	230000	230000
Energy/water (€)	21000	31500	42000	63000	84000
Transport (€)	16500	22000	27500	44000	55000
Maintenance (€)	1050	15750	21000	31500	42000
Other (€)	5000	10000	15000	20000	25000
Total expenses (€)	158550	205750	243500	388500	436000
EBITDA (€)	-67550	67250	211500	521500	929000
Amortization (€)	23000	23000	23000	23000	23000
Interests (€)	6000	5000	4000	3000	2000
BAI (€)	-96550	39250	184500	495500	904000
TAX (€)	0	9812	46125	123875	226000
Net profit (€)	-96550	29438	138375	371625	678000
Cash Flow (€)	-73550	52438	161375	394625	701000

Table 6. Financial table Turkey

year	*1*	*2*	*3*	*4*	*5*
Larvae income (€)	52500	157500	262500	525000	787500
Frass income (€)	11200	33600	56000	112000	168000
Total income (€)	63700	191100	318500	637000	955500
Personnel cost (€)	50000	55000	60000	100000	100000
Energy/water (€)	12000	18000	24000	36000	48000
Transport (€)	12000	16000	20000	32000	40000
Maintenance (€)	750	11250	15000	22500	30000
Other (€)	4000	8000	12000	16000	20000
Total expenses (€)	78750	108250	131000	206500	238000
EBITDA (€)	-15050	82850	187500	430500	717500
Amortization (€)	23000	23000	23000	23000	23000
Interests (€)	6000	5000	4000	3000	2000
BAI (€)	-44050	54850	160500	404500	692500
TAX (€)	0	13712	40125	101125	173125

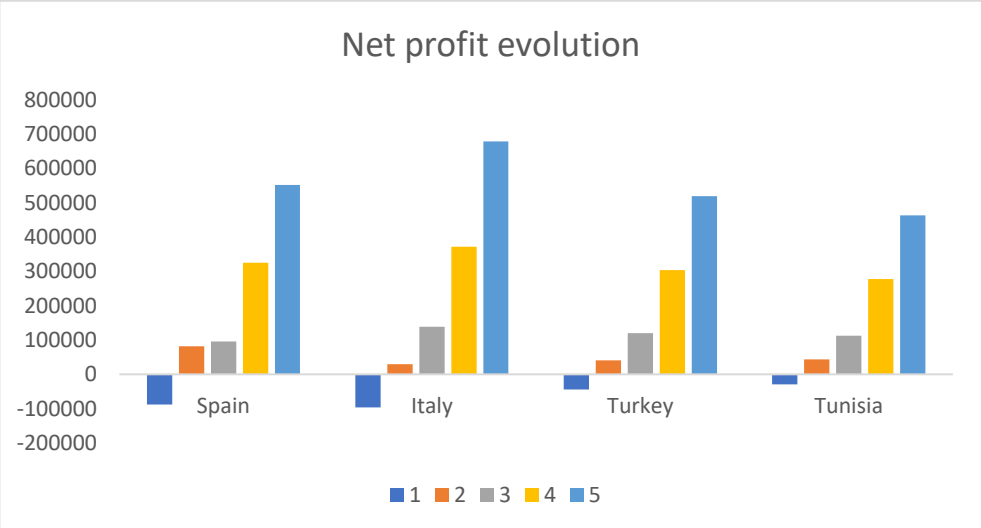
Net profit (€)	-44050	41138	120375	303375	519375
Cash Flow (€)	-21050	64138	143375	326375	542375

Table 7. Financial Table Tunisia

year	*1*	*2*	*3*	*4*	*5*
Larvae income (€)	45000	135000	225000	450000	675000
Frass income (€)	9600	28800	48000	96000	144000
Total income (€)	54600	163800	273000	546000	819000
Personnel cost (€)	30000	33000	36000	60000	60000
Energy/water (€)	10000	15000	20000	30000	40000
Transport (€)	10500	14000	17500	28000	35000
Maintenance (€)	600	9000	12000	18000	24000
Other (€)	3500	7000	10500	14000	17500
Total expenses (€)	54600	78000	96000	150000	176500
EBITDA (€)	0	85800	177000	396000	642500
Amortization (€)	23000	23000	23000	23000	23000
Interests (€)	6000	5000	4000	3000	2000
BAI (€)	-29000	57800	150000	370000	617500
TAX (€)	0	14450	37500	92500	154375
Net profit (€)	-29000	43350	112500	277500	463125
Cash Flow (€)	-6000	66350	135500	300500	486125

The break-even point with your new prices (larvae: €750/t, frass: €200/t), estimating fixed and variable costs based on the historical operating expenses (linear regression of costs vs. tonnes of larvae).

Evolution of the net profit is shown in Graf 1. And it could be appreciated how Italy is where the business plan is more interested to be implemented in terms of absolute profit. However, the net profit in Tunisia provably if more interesting in terms of relative profit because the intrinsic value of money in Tunisia, where each euro has more relative value than in European countries.



Graf 1. Net profit evolution

Key results:
- Unit income per ton of larvae (including 0.8 t/t frass): €910/t
- Estimated variable cost: €321.12/t
- Unit contribution margin: €588.88/t
- Estimated annual fixed cost: €127,639.75
- Break-even point: ≈ 216.7 tons of larvae/year
- Break-even revenue: ≈ €197,242/year

If you produce/sell more than ~217 tons/year, you will cover the estimated operating costs (with this product mix and cost structure).

9.1.3 Regulatory Framework

The regulatory framework governing the production and use of insects in animal feed in the European Union and Spain is a key factor in the viability of the project. Knowledge and compliance with this framework guarantee legal certainty, market confidence and consumer acceptance.

European legislation

1. Regulation (EU) 2017/893: Authorizes the use of processed animal proteins (PAT) derived from seven insect species, including Hermetia illucens (black soldier fly), in aquaculture feed.
2. Regulation (EU) 2021/1372: Extends the use of insect proteins to poultry and pig feed and establishes strict traceability, biosecurity and hygiene control requirements.
3. Directive 2008/98/EC on waste: Prioritises the recovery of agricultural by-products as a resource rather than their disposal and encourages the reuse of plant waste in processes such as insect breeding.
4. Food and feed safety regulations (Regulation (EC) 183/2005): Establishes hygiene conditions for the production and marketing of feed and requires operators to ensure full traceability and good manufacturing practices.

National legislation (Spain)
- Adaptation of European regulations to the Spanish framework through Royal Decree 465/2003 and subsequent amendments.
- Control by the Spanish Food Safety and Nutrition Agency (AESAN).
- Mandatory registration of production plants in the General Register of Animal Feed Establishments (RGSEAA).

The regulations implications for the Project are:

1. The plant must comply with hygiene, biosafety and traceability requirements at all stages of production.
2. It is mandatory to keep detailed records of waste intake, production batches, microbiological analyses and product distribution.
3. European regulations favour the proposed model, as it promotes the circular economy and the reduction of protein imports.

4.

9.2 Guidelines for smallholders