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- CIRC4Life-H2020-IND-CE-2016-2017/CIRC-2017/TwoStage

A circular economy approach for lifecycles of products and services

On site demonstration of CEBM for meat supply chain

Deliverable 6.4

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Summary

The implementation of the three Circular Economy Business Models (CEMBs) in the demonstration activities of the meat supply chain is described in this document. The present document has addressed in detail the co-creation of meat products (CEBM1), the sustainable consumption (CEBM2) of meat products and the collaborative biowaste recycling (CEBM3).

CEBM1 - Two new sustainable meat products have been elaborated. For this, a Product Design Specification (PDS), a list of sustainable practices to be implemented along the whole value chain, an Environmental and Social Life Cycle Assessment (LCA) were developed. In addition, several participatory activities and data analysis get consumer preferences were conducted.

CEBM2 - The main objective of this second CEBM has been to promote the sustainable consumption of the meat products. ALIA has established an eco-shopping system so people can check the sustainability of the products at the retailer, and communicated the eco-information of the products and developed tools, materials, and key messages to promote sustainable consumption and increase consumers' awareness.

CEBM3 - Its main objective was to enable and promoting the biowaste recycling among the citizenship by the establishment of an incentives scheme. Participatory activities, awareness campaigns and collaboration with other actors for the obtention of valuable resources from the biowaste were made.

For each of the CEBMs the main objectives and an extensive description of all the demo activities from the beginning of the project have been developed. In addition, the list of the involved stakeholders in the project has been explained, together with its role in the demo activities as well as the feedback provided.

In addition, for each of the CEBM the results, lessons learnt and further recommendations are presented and discussed. Furthermore, the showcase events developed for the presentation of project results are presented.

Finally, as described in Deliverable 6.5, the document highlights the continuous interaction and close cooperation between the demo activities of WP6 and the Living Lab activities of WP7, which have made it possible to define ALIA's demo activities in a co-creation approach.

The demo activities developed by ALIA have shown that there is room for improvement in the meat sector, and a circular economy approach can be implemented, making it more sustainable and balancing the affordable and quality product with the preservation of the environment.

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Acronyms and abbreviations

Abbreviation	Description
CEBM	Circular Economy Business Model
CSR	Corporate Social Responsibility
IPCC	Intergovernmental Panel on Climate Change
LCA	Life Cycle Assessment
PDS	Product Design Specification
SDGs	Sustainable Development Goals
S-LCA	Social Life Cycle Assessment

1 Introduction

The IPCC special report on Climate Change and Land[1] published in 2020 stresses that it will be impossible to keep global temperatures at safe levels unless there is a transformation in the way the world produces food and manages land. It estimates that 25-30% of global greenhouse gas emissions are a consequence of the food system, which greatly contributes to pollution of air, soil and water, and to biodiversity loss. Furthermore, the livestock sector represents about 14.5% of all human-induced emissions.

All these aspects have put the meat sector under the scrutiny for some groups of the society. However, meat is an important, quality and secure source of proteins for a vast amount of people all over the world and the sector will play an important role in this transition in which the introduction of sustainable practices based on circular economy principles will be a must.

CIRC4Life project has achieved to demonstrate three Circular Economy Business Models (CEBMs) in various activity sectors with substantial differences. ALIA has been the demonstrator of the CEBMs in the meat sector, being an example on how the meat sector can implement circular economy practices along the whole supply chain.

The *co-creation of sustainable meat products* (CEBM1) in which 1) soybean and others environmentally damaging imported sources of protein has been substituted by local ingredients and by-products, 2) more sustainable packaging solutions have been introduced, 3) the use of antibiotics has been reduced, 4) the animal welfare certification has been achieved and 5) many of the Best Techniques Available of the meat sector have been implemented. All of this have increased the sustainability of the whole process and have reduced the environmental impact of the final product. In addition, this has established the path towards a more sustainable sector.

The promotion of *sustainable consumption of meat products* (CEBM2) among the citizens is also an example on how things can be changed, developing actions in a difficult time (covid-19) which have given people another view about their daily habits and has given ALIA's sustainable products an added value.

The recycling practices along the whole supply chain and the promotion and the development of new techniques to promote the *collaborative biowaste recycling* (CEBM3) also given a second life to the wastes. Circular economy establish that recycling should be given an important role, and the possibility to move from a traditional waste management in which many valuable resources end-up in the landfill towards a valorisation of these kind of resources should be its focus.

The 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs), clearly establish the need of this transition in order to ensure a healthy diet for everyone and mitigate and adapt to climate change.[2] The actions implemented by ALIA in the demonstration activities in CIRC4Life project are steps to achieve the SDGs, under the assumption that it is time to act, we cannot wait for the future, and that all the steps, even the small ones are important. The humanity and the planet will be eternally grateful.

[1] https://www.ipcc.ch/srccl/
[2] https://www.un.org/sustainabledevelopment/

2 Co-creation of meat products

2.1 Objectives

The CEBM 1, co-creation of meat products, has been implemented by ALIA from the very beginning of the supply chain until the point of sale. The main objective of this CEBM has been the development of two new meat products by addressing end-user's requirements from the beginning of the product development in order to increase the meat products sustainability. Some of the key aspects implemented in the framework of the demonstration of this CEBM are:

- Development of a Product Design Specification (PDS) and a list of sustainable practices to be implemented along the whole value chain of the meat products in order to select the most interesting and suitable activities to increase products sustainability.
- Environmental and Social Life Cycle Assessment (LCA) to evaluate the environmental and social impacts through the product life cycle.
- Data analysis to get consumer preferences.
- Participatory activities in the framework of Living Lab activities such as workshops, surveys and testing activities, with the aim of incorporating the sustainability preferences of consumers in the product development.

2.2 Activities developed

- **Development of a Product Design Specification (PDS)**

Date: January 2019

Developed at the very beginning of the project and an important document for identifying opportunities and improvements areas along the whole supply chain regarding the co-creation of the sustainable products. It set the basis and the scope of the two meat products to be developed in a sustainable way and a reference document during the whole project. The first version and the improved version regarding sustainability aspects of the PDS are included in Annex I.

- **Sustainable practices possibilities for the meat supply chain**

Date: Sep 2018 – Sep 2019

An extensive list of sustainable practices and improvements to be implemented along the whole meat supply chain. Many of the Best Available Techniques of the meat sector, which are focused on the sustainability of the process along the different stages of the supply chain, were identified (and implemented in the final product development). This was a fundamental job for understanding the possibilities ALIA had for the elaboration of the sustainable products. This information was included in the Deliverable 1.5.

- **Questionnaire about consumer attitudes**

Date: June 2019

This questionnaire (Figure 1) was done in the framework of task 1.4 in order to get the first inputs about consumer preferences regarding their sustainability. The questions included were focused on the identification of consumers' preferences towards meat products and the meat sector in general. A total of 40 people answered the survey. The results showed the great importance people give some aspects to the animal welfare, the use of local resources, the reduction of antibiotics or the importance of communicating the information to

the users in an efficient way. All these aspects were explored with more details in the following participatory activities developed, in which the results showed a clear alignment with these previous results. This information was included in the Deliverable 1.4.

Figure 1. Questionnaire about consumer attitudes

- **Environmental and Social Life Cycle Assessment (LCA)**

Date: Feb 2019 - Sep 2019

This action was key in order to elaborate the sustainable products, as it showed the sources of negative environmental impact of the product along the whole value chain. The LCA focused on the two products in which ALIA would put its efforts for the co-creation of the sustainable products: the cured pork sausage and the cured pork loin.

Both the Social and the Environmental LCA showed a positive balanced of ALIA's traditional products in comparison to the average meat products at national (Spain) and European levels. Although a deeper analysis should be done to scale these values to exact figures, ALIA's traditional products were demonstrated to be about a 20-30% more sustainable from the environmental and social points of view than the average.

This showed two different aspects:

- ALIA's products where in a privileged situation from the starting point as it already implements many circular economy and sustainable practices.
- The room for improvement for ALIA's case was not easy and a challenging proposal had to be done.

So, in order to improve the good situation in where ALIA as regarding their product sustainability a deep analysis of the LCA was made and the recommendations listed in the report (Deliverable 1.2) were carefully checked. It was possible to check the feed production stage, which was the one with the biggest impact of the whole supply chain. Considering this and the fact that it is in this stage ALIA could modify the process in a more optimal way, a sustainable nutritional formula was developed.

Figure 2 shows the environmental impact of the main sub-processes of the whole production cycle. On the other hand, in order to get a clearer view of the feed production phase, Figure 3 shows the environmental impact of its sub-processes, in which can be appreciated the great environmental impact of the soybean use.

So, by analysing the LCA results, it was clear that the soybean, imported from Brazil in most of the occasions, was one of the biggest contributors to the environmental impact of ALIA's products. Thus, the main objective ALIA had after analysing the results, was to develop a soybean free nutritional formula, while satisfying the nutritional and safety of the animals.

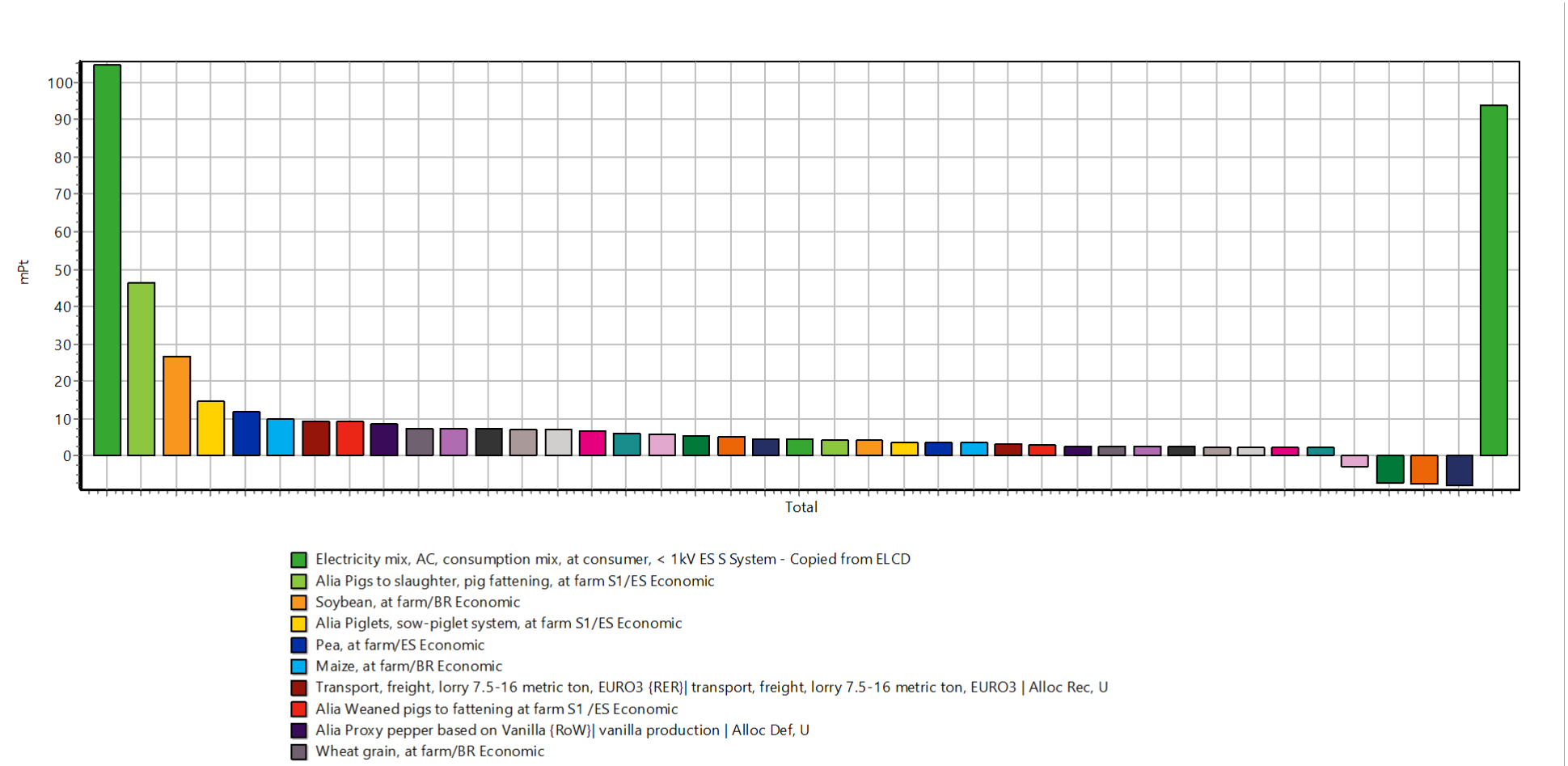


Figure 2: Environmental impact of the cured pork loin production per specific sub-processes

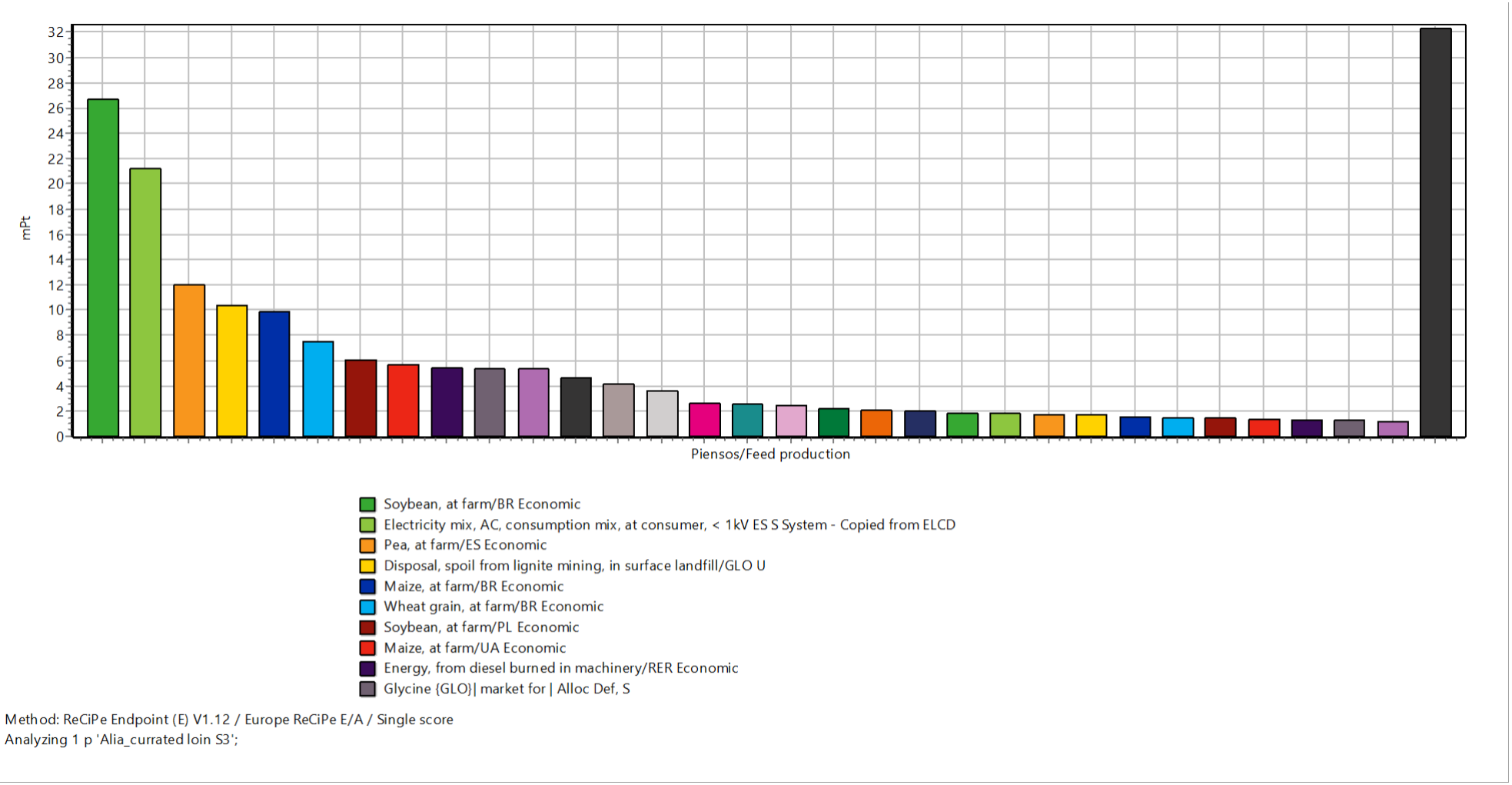


Figure 3: Environmental impact of the feed production phase within cured pork loin production per specific sub-processes

Furthermore, it was clear that the inclusion of by-products, use of local ingredients or the improvements in the energy efficiency and transportation along the whole supply chain, were key issues in order to improve the sustainability of the products.

A S-LCA was conducted on ALIA's products (using 1kg of pork salami and 1kg of pork loin) which showed that ALIA's products are about 30% more socially sustainable than the average Spanish meat product. A number of social indicators for each sector were assessed such as: Fair salary, Working time, Discrimination, Health and Safety, Workers´ rights, Fair competition, Supplier relationships, Contribution to economic development, Access to material resources, Safe and healthy living conditions, Local employment, Health and Safety and End of life responsibility.

It is worth mentioning that the gender wage gap in ALIA's plant is 33% smaller and the working time (weekly hours of work per employee) is 37% better compared to other meat products plants in Spain, which means that fewer extra hours are incurred at ALIA's. There are clear salary bands per category and no difference is made between men and women. The Corporate Social Responsibility (CSR) company plan has a whole section dedicated to gender equality and promotes the active recruitment of women.

Concerning the Safety measures, it is 32% better than in companies in the same sector, as there is an active enforcement of safety measures and regular training programmes for workers.

On worker's rights, the situation of Free Trade Unionism is 26% better than the average as there are three different trade unions which workers can affiliate to and usually there is only one Trade Union. Furthermore, the Fair Salary indicator shows that it is 24% better than in the other companies in the same sector as all salaries follow what is stipulated in the wage agreement, and 100% of the workers that remain in the company for over a year have obtained a permanent contract.

Finally, it should be remarked the importance of the conducted the LCA and that it has been identified in the exploitation phase as one of the key tools a green company should consider.

- **Data analysis**

The Big Data based system to collect consumers' review data was another of the planned activities in the co-creation business model for ALIA. However, there were several limitations regarding the implementation of the big-data software (technique developed in WP3 by NTU). The main limitation was the impossibility to extract the products' review from companies' websites, which made it difficult to have access to large volumes of data.

However, in order to solve this issue, ALIA contacted some research groups which had made extensive studies about the meat sector and consumer views in order to obtain raw data and implement the big data software on them. There were two positive answers which shared with us the data:

- IRTA (Institute of Agrifood Research and Technology), a research institute owned by the Government of Catalonia, provided a survey developed from project 'Creativity aimed at innovation to develop new products for agricultural producer groups' (IRTA, 2017). It contained a total 100 survey results. Each survey consists of 37 questions and there are about 10 questions related to the PDS of meat products.
- AECOC, which shared with us their study about shopping behavior around meat 'AECOC SHOPPERVIEW 2018'.

These two studies were treated with data analysis techniques, although the amount of available data made it difficult to directly apply the big-data tool developed in the framework of the project. In any case, a data analysis was performed in order to get extra insights from the ones reported in the two studies public information.

It is true that this data analysis was already well analysed in the two mentioned studies, so no major findings were obtained. However, it provided us with some relevant information, which was in line with the participatory activities developed in the framework of Living Labs (WP7). Some of the most interesting, identified aspects are:

Creativity aimed at innovation to develop new products for agricultural producer groups' (IRTA, 2017) (already reported in D1.4).

- Consumers more like meaty sausage products, required for a microwave safe packing, use natural ingredients, less chemical additives, and have more flavour choice with a good taste and texture.
- 316 reviews mentioned about the performance of the sausage, about 50% consumer mentioned the sausage was 'fatty', 'greasy' and 'oily' and with negative sentiment.
- 23% consumers thought the product was hard, and some consumer use the word of 'chewy' to describe the product, therefore, the product tastes hard and difficult to chew need to be improved in the further product development.
- Most consumers consider the safety of the meat as a concern for their kids' health. They would like the meat product with no preservatives or other chemical additives to reduce the health hazards.
- Some consumers cares whether the packaging materials are health and safe, whether it is environmentally friendly and recyclable.
- Most of consumers were satisfied with the price, they use 'cheap', 'worth the money', 'reasonable price' and 'price to quality' to describe the current pricing of the product.
- The analysis of survey results show that the consumers satisfy with the current products, but they more like meaty sausage products, required for a microwave safe packing, use natural ingredients, less chemical additives, and have more flavour choice with a good taste and texture.

Figure 4. Main customers' concerns when buying meat products

AECOC SHOPPERVIEW 2018

- More than 50% consumers would buy meat product with consideration of the quality of the product and service speed.
- There were near 50% consumers have made the decision about which type of meat/sausage product they would like to buy before and then went to the shop.
- More than 50% of consumers would like buy meat product at butcher shops and/or butcher counters in supermarkets, this means that consumers prefer to buy fresh cut meat products rather than pre-packed.

- The top five most important aspects could affect consumers make their decision to buy meat products are: 1. the appearance/colour of the meat; 2. the price; 3. the expiration of the product; 4. the amount of fat; 5. the origin of the animal. Thus, customers always first concern the freshness of the product, and then is the price, the fat and origin of animal.

One of the main conclusions obtained by the data analysis is that the sustainable products, in order to be appreciated by consumers, have to satisfy the quality, safety and healthy uses, while having a reasonable price.

- **Workshop with consumers to define product development and packaging**

Date: 29/05/2019.
Location: Lorca, Region of Murcia.

This workshop was one of the key aspects for the development of the sustainable products and was developed in the framework of Living Lab activities (Deliverable 7.2). The workshop was focused in three different themes:

1) Product development and packaging
2) Eco-information and visualizations
3) Marketing and products story

The first item was focused on the co-creation of the meat products, while the second and third items had a relation with the sustainable consumption CEBM. The results of these last two items are described in section 3 'Sustainable consumption of meat products'.

There were 21 participants and the workshop was mainly focused on the citizenship and end-users, however, members from companies also attended. The main objective of the first item was to understand which are the preferences about sustainable meat products and to get ideas on how to conduct the following actions in the project regarding the product and packaging development.

Figure 5. Workshop developed in the municipality of Lorca

During the event, lots of ideas were collected, which served as a basis for the development of the products. The participation of people was active and fruitful. The results about end-users' preferences about the sustainability of the meat products can be summarized in the following items:

- To avoid using harmful additives.
    - To achieve that, it was proposed to conduct a natural maturation process (without sugars or stabilizers).

- In addition, it was proposed that animal feed does not contain additives, stabilizers, or prejudicial oils. To this solution, it was said that, although it is a good idea, we should continue considering the sanitary and security issues.
- Finally, to avoid using transgenics was commented as an important improvement, although sometimes difficult to find non-transgenic cereals.

- To respect health and animal welfare.

  - To follow biosecurity regulations and to satisfy sanitary rules should be a must. Participants agreed that it is crucial.

- Local production, km 0.

  - Procurement of local raw materials (cereals and livestock in the area).
  - To use local intermediate industries.
  - To promote local business.

- Remove plastic from the packaging.

  - To promote local business, as this implies not to use plastic.
  - To promote sells in bulk and other kind of packages (paper-based ones).
  - To invest in R&D so it is possible to use alternative raw materials.

Most of votes in here were positives. It was pointed out that without packaging, the way of communicating the information must be rethought.

Figure 6. Inputs received during the workshop developed in the municipality of Lorca

It is important to remark that these conclusions were implemented in the elaboration of the sustainable products, as the products were developed avoiding the use of antibiotics, the farm was recognized with the animal welfare certification, local ingredients were prioritized during the whole process and plastic was

substituted by more sustainable packaging (biodegradable material was used). Thus, the citizenship input was considered from the very beginning of the pilot implementation.

- **Green procurement survey with competitors**

Date: September-November 2019.

The survey was developed and launched in order to get insights from other companies of our sector. Two national organization (INTERPORC, the Interprofessional Pig Food Organization, and FECOAM, Federation of Agricultural Cooperatives of Murcia) were contacted for its distribution, but this was not successful and just nine answers were collected. The relevance of these actions was low and the lack of answers may be due to the difficulty in engaging other companies' opinion via survey. Better ways of addressing them could be semi-structured interviews. This could lead to a similar number of involved companies but with much more information provided by each of them.

- **Traceability along the supply chain**

Date: November 2019 - May 2020.

ALIA started the elaboration of the products early in November 2019, when the sustainable nutritional formula was formulated and produced. After this moment, the traceability along the whole supply chain was ensured, in order to guarantee that the sustainable feeding produce would feed a selected group of animals which would be used for the development of the final products.

The ALIA's integral traceability system and the dedication of ALIA's staff, made this possible to guarantee this aspect. This suppose a transparent and scalable production technology that can be emulated at other places using available resources and skills.

Figure 7. Implementation of pilot activities guaranteeing the traceability along the value chain

2.3 Stakeholders involved.

Stakeholder	External / Internal	Involvement	Feedback
Animal feeding company	Internal	Feed production	ALIA's internal staff considers the development of sustainable diets a way to be more competitive in the market. Improvements in the environmental impact of the feeding production stage are a key aspect for the sector.
Farm	Internal	Pig rearing	ALIA's internal staff considers that animal welfare certifications as well as the improvements in the energy efficiency of its facilities and use of renewable energy are a priority for the sector.
Meat elaborates company (Los Quijales)	External	Development of sustainable meat products	Good welcome of the sustainable product. However, as meat elaborates company stopped being part of ALIA's group at the end of January, to continue developing the sustainable products will not be possible.

Slaughterhouse	Internal	To process the pigs while preserving the traceability	ALIA's internal considers that in order to gain competitiveness, the facilities' energy efficiency, use of renewable energy and water efficiency improvements are an opportunity for the sector.
Packaging supplier	External	Provider of the sustainable packaging for the sustainable products manufacturing	The sustainable packaging is not competitive at the moment for this kind of products, it increased the product price. It is the part of the product elaboration which has the biggest increase of the price in comparison to the regular one.
Local raw materials and by-products suppliers	External	Suppliers of raw materials for the sustainable products manufacturing	Some of them suppliers were similar than the ones of the traditional products (as ALIA already has these practices) but specific products, with a biggest sustainability, were selected. The price of the final products was increased especially for local spices. However, in a reasonable way.
Citizenship	External	End-users. They participated in the co-creation of the three CEBM via LL activities and 83 of them in validation activities. Many of this 83 from ASOFEM, civil protection team of the municipality of Lorca and sanitary workers of Rafael Méndez Lorca's public hospital	The citizenship has welcomed the idea of developing sustainable meat products. They have offered ideas in surveys and workshops and they have validated the sustainable products. Their preferences have been crucial for the sustainable products definition.
Localmente[3] (local shop)	External	Offering the sustainable products	Localmente is a local shop of the municipality of Lorca which has an extensive offer of local and traditional products. The idea of offering there the sustainable products was highly welcomed.
ASOFEM	External	End-users. Participation in testing activities for the co-creation	Good acceptance of the new products (aspect, flavour, etc.) and validation of their sustainability aspects.
Civil protection team of the municipality of Lorca	External	End-users. Participation in testing activities for the co-creation	Good acceptance of the new products (aspect, flavour, etc.) and validation of their sustainability aspects.
Sanitary workers of Rafael Méndez Lorca's public hospital	External	End-users. Participation in testing activities for the co-creation	Good acceptance of the new products (aspect, flavour, etc.) and validation of their sustainability aspects.

[3] https://localmente.es/

2.4 Results, lessons learnt and further recommendations

2.4.1 Results

During CIRC4Life project, ALIA has studied the whole value chain for the product's co-creation. It is important to remark that ALIA is present in the Livestock Feeding, Farm, Slaughterhouse and Meat elaborates plant. During the project implementation the Slaughterhouse (Grupo Alimentario de Lorca) and Meat Elaborates Plant (Los Quijales) stopped being ALIA's responsibility and had moved to other companies' groups. However, this was not an obstacle and they maintained their commitment to cooperate in the demonstration.

Furthermore, the fact that the feed production is the stage of the meat supply chain with the biggest environmental impact has made it possible to reduce the environmental impact, as it is ALIA's mother company and where it is possible to focus the efforts with more possibilities.

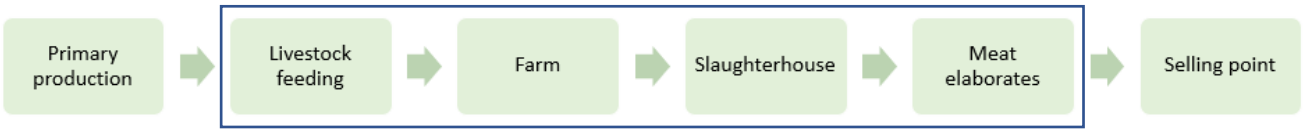


Figure 8. ALIA's main presence in the meat supply chain

After all the different activities developed, ALIA elaborated its two sustainable products implementing sustainable practices along the whole supply chain. The most relevant one in each stage are the following:

Feeding stage:

- Environmentally damaging proteins sources such as soybean have been substituted with by-products of the agri-food sector as well as cereals and raw materials from local industries in a km0 and circular economy approach. Biomass energy is used in the farm and animal feed production plan. The substitution of soybean has been achieved by the increase of wheat milling rests, sunflower cake, rapeseed flour or lard, among others.
- The outbounds of animal feed production are reused.
- Use of biomass for thermal energy production and solar panels for renewable electricity production.
- ALIA is certified with ISO 14001 in the animal feed production plant, and one of its objectives is to do green procurement in a continuous improvement process. In addition, during the demo, green considerations were taken for the acquisition of raw materials and packaging. ALIA includes energy efficiency practices in the overall process, as it is another important objective of ISO 14001.
- In addition, the feed has been produced in flour and not granulated, reducing the energy consumption of the process.

Farm:

- The slurry generated at the farm stage is treated in an innovative equipment which reduces the N (Nitrogen) and P (Phosphorus) content in a 55% and 90% respectively, and separate it in a liquid and solid fraction, which allows to obtain compost (solid fraction) and widespread in the field the liquid one and manage the farm waste in a more sustainable way. What is more, during the development of the pilot activity, ALIA has also participated in the Interreg MED project "Re-Live Waste: Improving innovation capacities of private and public actors for sustainable and profitable REcycling of LIVEstock WASTE" and the slurry produced.
- Biomass for energy production.
- Drastic reduction of antibiotics.
- Animal welfare certification obtained.

Slaughterhouse:

- Energy and water efficiency practices in a continuous implementation.
- By-products produced in the meat supply chain are used (existing practice) in the cosmetics sector and the pet food industry, so an added value is given to the meat which is discarded in this stage of the supply chain.

Meat elaborates:

- Energy and water efficiency practices in a continuous implementation.
- White label products: natural and local additives and spices were used in the elaboration of the product.
- In the case of the imperial sausage, the conventional package was changed in favour to the bioplastic. However, in the case of the pork loin this was not possible because of quality requirements of the product.
- By-products produced in the meat supply chain are used (existing practice) in the cosmetics sector and the pet food industry, so an added value is given to the meat which is discarded in this stage of the supply chain.

In summary, ALIA has developed two sustainable products with the focus on reducing their environmental impacts during the whole lifecycle. This was the key of the demonstration. In the social field, based on the good results that the report showed, ALIA has continued working in this line in a process of continuous improvement.

The sustainable products are more than a 30% more sustainable than average, and about a 15% more sustainable than the traditional version (which was already more sustainable than the average) according to the LCA and S-LCA results. The demonstration has shown the possibility of developing sustainable products without adding too much cost to the production: just about 10% of increase in the final product, while the reduction of soybean was total, local ingredients were used and a circular economy approach which has improved the sustainability in a relevant way.

Figure 9. Co-created meat products developed in the co-creation activities

This offers a new market for companies to offer sustainable products without having to change their production processes dramatically and far for the ecological certifications, but transforming their process in a more sustainable way.

As a further recommendation, it would be necessary to deeper study the market's opportunities in order to find the perfect combination between the sustainability of the process while not making a too expensive products, in order to make sustainable products affordable for everyone and not just for wealthy people.

The process of the products' elaboration has lasted from November 2019 to April 2020 (imperial sausage) and May 2020 (pork loin). This means that the release of the products was done during the pandemic situation and lockdown period in Spain, and that the planned activities had to be changed.
As originally planned, the products were expected to be offered in two different places: ALIA's shop, located inside ALIA's facilities, and Localmente. The release of the products in these shops was supposed to be useful for the real-life testing of the Sustainable Consumption CEBM activities (will be properly explained in the following section), and for the validation of the co-created products, this is, to study if people accepted, appreciated and supported all the concepts and actions included in the two products.

However, during April, May, and June it was not possible to develop any kind of activity in the shops or an open event with people because of the existing restrictions, which made it difficult to get this validation. Due to this fact, another kind of activities had to be planned.

In this context, ALIA developed several events focused on the donation of the products to several groups which, during the pandemic had an important role, including sanitary workers of the public hospital Rafael Méndez, members of the civil protection team of the municipality of Lorca, and the Mental Health Association Lorca and region (ASOFEM). During these events, it was possible to talk about the project, disseminate it, and also get the feedback of the participants.

Figure 10. Products' donation events

A total of 83 physical surveys after tasting the product were conducted with a clear result about the satisfaction of people with the co-created product. The survey was aligned with the validation framework document developed together with RISE, WP6 leader, which included KPIs for this CEBM and the rest. This validation framework is included in Deliverable 6.5. The results of the survey regarding the co-creation part follow as next:

- Regarding the degree satisfaction with the products, it was obtained a punctuation of 4.5 above 5.
- Regarding the acceptance of the products as one with an added value, it was obtained a punctuation of 4.38 above 5. In addition, 31% of participants answered with a 4 and 53% with a 5, so we can consider that the 84% accepted the products as a product with an added value.
- Regarding the acceptance of the products as more sustainable, it was obtained a punctuation of 4.43 above 5. In addition, 33.8% of participants answered with a 4 and 54.2% with a 5, so we can consider that the 88% accepted the products as more sustainable than the traditional one. During the showcase events, in which the products were explained and showed to the people, the 24 surveys collected showed the same punctuation about the products being more sustainable than the traditional ones (4.43/5).
- Regarding the question about whether or not they would continue buying the sustainable version of the product, 75% responded that would continue buying the sustainable version of the products. However, just the 2.4% (two respondents) said No, the rest said that they did not know.
- In addition, during the showcase events (section 5) it was asked about the appreciation of consumers about the statement 'The co-created product is more sustainable than the traditional one'.

2.4.2 Lessons learnt and further recommendations

During the development of all these activities in the framework of the co-creation CEBM, several lessons learned, and further recommendations have been detected:

- It is key to have technical knowledge on how to do the LCA and analyse it. It has been a key step for ALIA in order to actually make sustainability improvements in the most important stages of our process.
- As there is an existing difficulty in making some investments because of the low payback period it would be important to deeper analyse the market opportunities of the sustainable products, in order to scale the economic efforts made and the future revenues produced by this.
- It is important to know that apart from the ecological market certified as this and the existing standards, it is possible to reduce the environmental impact oh companies' processes by acting in the process with a continuous improvement view.
- Small steps are very beneficial and starting with them is so useful for the biggest objective.
- The Living Lab methodology is a must for the co-creation of products: to consider from the very beginning of the process the consumers preferences and taking into account the opinions and possibilities of the different actors has allowed us to elaborate a product with high acceptance for people.

Finally, it is also important to remark that this demo activity has been enormously useful for ALIA. It has shown that things can be done differently and that the commitment in the environment preservation is recognized. An example of this is that ALIA was awarded by the regional government in the 'Awards for Sustainable Development and Climate Change of the Region of Murcia 2020' for the application of circular economy principles in the animal feeding production, particularly for the development of a soybean free nutritional formula which satisfies animal nutritional requirements.

Figure 11. Awards for Sustainable Development and Climate Change of the Region of Murcia 2020 event

3 Sustainable consumption of meat products

3.1 Objectives

The second CEBM addressed in ALIA's demonstration activities is the Sustainable consumption of meat products. The main objective of this second pillar of ALIA's demonstration activities is to promote the sustainable consumption of the meat products. Some of the key aspects implemented in the framework of the demonstration of this CEBM are:

- To track and monitor the sustainability aspects of the products in order to provide the information along the value chain to consumers (related to Deliverable 5.3).
- To communicate the eco-information of the products based on the eco-point methodology developed in the project to people.
- To establish an eco-shopping system so people can check the sustainability of the products at the retailer. This work was developed in close cooperation with the ICT project platform and the traceability architecture (Deliverables 4.2, 4.3, 5.2 and 5.3).
- To develop tools, materials, and key messages to promote sustainable consumption and increase consumers' awareness.

3.2 Activities developed

- **Meetings with Carrefour**

Date: July - October 2018.
Location: Lorca/Madrid

One of the first tasks developed prior to demo activities was to look for a supermarket or other kind of shops in which the sustainable products could be offered, and the sustainable consumption activities promoted. Therefore, several meetings with Carrefour (French company which constitutes eighth-largest retailer in the world by revenue) were maintained, both via phone and in presential mode. The initiative, which consisted in offering the sustainable products in their supermarket located in the municipality of Lorca and collaborating in the awareness campaign and sustainable consumption activities (which at this moment was still to be developed) was accepted by Carrefour managers. However, after a change in the management, it was difficult to maintain contact with Carrefour and after a few months, it finished. This is why ALIA had look for other options.

- **Workshop with consumers to define eco-information, visualizations and marketing aspects**

Date: 29/05/2019.
Location: Lorca, Region of Murcia.

This workshop was developed together with the one addressing the co-creation of the sustainable products (explained in the previous section). The workshop was developed in the framework of Living Lab activities (Deliverable 7.2). In addition to this first topic, the definition of the best ways to communicate the information to the consumers was addressed. It is important to highlight that the creation of the eco-label was not a project objective itself, but a need which raised during the project implementation which concluded in a great way to communicate the eco-information and promote sustainable consumption.

The main objectives of this part of the workshop were:

1) the eco-information and visualizations: to define an idea on how the eco-information should be shown and what kind of sustainable information has value for the citizenship.
2) marketing and products story: to understand which kind of awareness and marketing campaign should be performed to promote the sustainable consumption habits.

Regarding the first topic, three main ideas were developed:

- The eco-information should be simple, clear, and intuitive. In order to improve the proposed eco-labels, several tips were proposed:

    - To use more intense and different colours.
    - To include emojis is also a great idea to attract the attention of the customers.

- The QR code is really important. To define which aspects, we should include there is also crucial, as we cannot include everything in the app/website, and it is not useful either. In order to achieve this, several actions were proposed:

    - To include the whole process of the product development, including traceability systems considered.
    - As it is not a good idea to include all the information in the QR code (we should include brief, useful and attractive information), it would be a good idea to include a link in which you can consult more information.
    - To include information of raw materials used and their origin.
    - To include actions carried out by the company which explains why the product is sustainable.
    - To include brief and simple slogans which can be useful for people who is not used to sustainability aspects and do not understand technical or complex information.
    - To include further information about the guarantee seal included (this solution raised by discussing the next main idea).

- To include a guarantee seal is vital.
    - It is needed to include something which proves that the information shown about ecological aspects is accurate. In order to make people understand what the logo means, we would conduct two different actions:
        - Awareness campaigns.
        - Simple and clear slogan next to the seal.
    - Regarding how the eco-label should look, one of the examples shown satisfied the ideas of the participants of this sub-group. Some modifications were proposed, as including the EU flag in the middle of the logo, removing the arm and including the seal of guarantee.
    - Regarding the location of the QR code, no preferences were shown.

Regarding the second topic, some interesting suggestions were also made:

- To include the word ‘sustainable’.
    - To include a quality seal and a certifying body.
    - To include an attractive and simple logo which can be easily identified.

- Awareness campaigns in schools and supermarket.
    - First of all, to explain what sustainability is in schools. To give clear and complete information about sustainability.

- Distribution of leaflets which also include the QR code and its explanation.
- To change the message considering the kind of public we are focusing on.

- To include a recycled plastic packaging.
  - To include a logo of it.
  - To develop a recycling chain just for food packages.

First inputs for the eco-label design were done. In addition, consumers preferences for an awareness campaign and message to be given to consumers was developed.

Figure 12. Workshop developed in the municipality of Lorca

- **Questionnaire about consumer attitudes**

Date: June 2019.

This questionnaire was done in the framework of task 1.4 and is the same which was used for the co-creation part of the demo in order, this time, to get preliminary results about the best ways to promote sustainable among the citizenship. One interesting result was the difference between the acceptation of the use of an eco-label (low punctuation) and knowing the sustainable information of the products (higher) which reveals that people respondents preferred a way of checking the information of the products more than a traditional label which, in many times, do not clearly shows the environmental impact of a product, but the accomplishment of some parameters which, in sometimes are not well-known for consumers so there is a lack of transparency on them. This information was included in the Deliverable 1.4.

- **Design Challenge**

Date: July 2019.

The Design Challenge was an activity developed in CIRC4Life project and promoted by LAUREA in the framework of Living Lab activities, in order to expand the creation of the label to design students and international participants. After the process, a more solid eco-label was created in the Design Challenge, which was tested in following activities developed by ALIA.

- **Eco-label test in food fair**

Date: September 2019
Location: Murcia

The eco-label development has been one of the most iterative process developed in the framework of Living Lab activities. After the Design Challenge, concepts were tested in food fair in order to refine the results and test them in a more real context. The first physical event where the concepts were tested was the food fair Gastrovin, developed in city of Murcia and where ALIA has a stand in which their products were offered. A total of 17 people participated in this activity with the general aim of selecting the best versions of the eco-label according to people and to get insights for its further development. In general, the results showed the acceptance of the eco-label and the addition of those kind of aspects of the products. The EU-flag, the QR code and the colour scale, were appreciated as important aspects as well.

Figure 13. Eco-label testing in 'Gastrovin' food fair (Murcia)

- **Eco-label test in SEPOR (international livestock fair trade)**

Date: November 2019.
Location: Lorca

The testing activities in SEPOR had a similar purpose of the previous one, to get insights from people and to continue refining the eco-label. Similar conclusions were obtained as in the previous one. A total of 19 respondents participated on this activity.

Figure 14. Eco-label testing in SEPOR trade fair (Lorca)

After these two testing activities, the selected eco-label was the following:

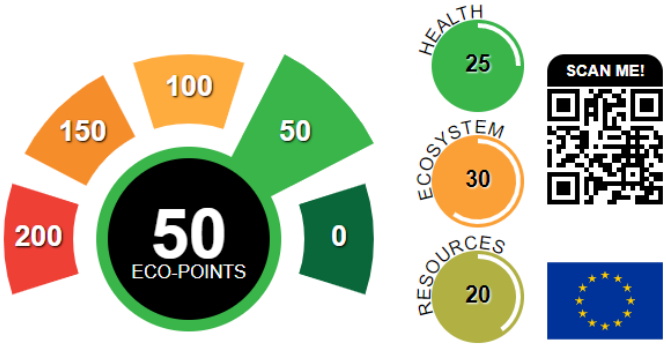


Figure 15. Eco-label co-created version after the two fair events

- **Products available in ALIA's shop and Localmente**

Date: April 2020-ongoing
Location: Lorca

Once the collaboration with Carrefour was not feasible, ALIA started to look for alternatives of external shops in which it was suitable and effective to offer the co-created products in addition to ALIA's local store. After conversations with some supermarkets, Localmente, a shop which mainly offers traditional and local products, showed a positive answer and the collaboration was effective.

First ALIA's sustainable products were ready by April 2020. By this time, the outbreak of the covid-19 pandemic made it impossible to develop promotion activities of the products. Localmente, as it is a food shop and it is considered and essential activity, did not close during the lockdown period, so the products were located in the shop and offered to people. However, because of covid situation, no events were held and less feedback was collected from consumers.

Figure 16. Products' promotion at Localmente shop (Lorca)

- **Promotion of the sustainable products and Final version of the eco-label and eco-point test**

Date: May - June 2020
Location: Lorca

During the lockdown period, but once the situation was considered a bit more stable, several events were to be developed. These events were similar to the ones mentioned in the last section regarding the co-creation of products, but they had also the purpose to continue developing the eco-label.

A total of 83 responses were collected and two main outputs were obtained in order to improve the ecolabel:

- Eco-point concept was not useful and not well understood in the label.
- The sub categories were not well understood.

Therefore, in the following testing activities, the 'eco-points' were changed to 'eco-costs', what was thought to be associated as the more eco-costs of the products regarding sustainability issues, and the subcategories were avoided.

- **Eco-shopping internal testing**

Date: October 2020
Location: Lorca

During October 2020, before the real-life testing activities regarding the eco-shopping, an internal test of the process was performed. The test was successful and no major needs for change were detected. This activity was developed in the framework of Living Lab activities.

- **Sustainable shopping real life testing**

Date: December 2020 – January 2021
Location: Lorca

This activity was developed in the framework of WP7 Living Lab activities. The testing included two phases:

1) Interpreting eco-label and communication materials at local market. Conducted in both, Localmente and ALIA's shop.
2) Purchasing Alia's products while using CIRC4Life application. Conducted at Alia's factory shop

The first phase of the testing was focused on the following key issues:

- Interpretation of the eco-label.
- Attractiveness of sustainable products.
- Interpretation of communication materials.
- Perceived interest towards QR and CIRC4Life application.

The first phase of the testing was conducted in Localmente and a total of 20 participants took part on them.

Figure 17. Real life testing activities at Localmente shop (Lorca)

A total of 8 participants took place in the second phase, which had similar key issues to be tested and additional ones:

- Interpretation of the eco-label
- Attractiveness of sustainable products
- Interpretation of communication materials
- User experience of eco-account enhanced shopping
- Willingness to use CIRC4Life application in the future

Figure 18. Real life testing activities at ALIA's shop (Lorca)

Based on these results, it can be suggested that the green colour and EU flag communicate the most information to the users instead of a numerical value in the eco-cost, and that having the label itself on the product is more effective indicator for a sustainability, than any specific piece of information that the label displays.

The modifications made to the label for the testing phase 2, including the '30% better' statement and removal of the visual sub-categories, resulted in participants being more capable of understanding and describing the main message in their own words. As revealed during the previous Living Lab testing events, one of the issues of comprehending the eco-cost value and the label has been the lack of a presentable base line. It can be suggested, that the '30% better' statement offered users this rateable base line, and similar approach should be applied when utilizing the label in the future.

Moreover, while 17 out of 19 participants stated that they would scan the product QR code to access the sustainability information during shopping routine, only seven people actually scanned the QR code when they were requested about the products sustainability. This can, perhaps, be interpreted as an indicator between

the perceived and expressed willingness to act - and the real-life actions. This should be kept in mind when making conclusions based on the perceived and expressed willingness to use other CIRC4Life elements, recorded during the facilitated Living Lab tests. In other words, the real willingness to use something can be only verified in investigating the user behaviour during unfacilitated, longitudinal, real-life periods.

Regarding the communication materials, all participants considered that the presented communication materials helped them to better understand the information presented in the label, whereas no further explanation on how this understanding was formulated, were given by the participants.

While the testing reports did not display critical technical issues related to the CIRC4Life app, and there seemed to be a general interest towards using it during shopping, the usability and interpretability of the app seem to continue to be an issue. Three participants out of eight, asked and received help from the shop employee in finding the right section in the application during the process, and all participants mentioned the employee as the main contact for solving any issues which might occur during the process. In other words, none of them noticed the contact or help features in the app. Additionally, all participants saw the app as the main object for improving their experience. After testing, the app was improved in order to solve these issues.

Moreover, according to these results, there seems to be high approval and customer demand for the new, sustainable meat products. The sustainability aspects and products impact have risen to the interest of conscious consumers, alongside of the animal welfare.

3.3 Stakeholders involved

Stakeholder	External / Internal	Involvement	Feedback
Carrefour	External	Sustainable products sale	The possibility of showing the products was not a big problem. In addition, the inclusion of eco-debits, eco-credits, etc. in their system was welcomed as a good idea (although as the concept was not defined yet, no specific discussions were made).
Municipality of Lorca	External	Sustainable products promotion activities. Participation on events and publication of project information in project website.	Awareness campaigns in schools and to the general public were started to be planned with them. Before the local elections of May 2019, the collaboration with the local authorities was not achieved, however, after them, the new local authorities said the collaboration as something very positive.
Localmente shop	External	Sustainable products sale. They offered ALIA's sustainable products during real life testing activities and during demo phase.	Good acceptance of selling the sustainable products in a shop in where traditional, handmade, and local products are offered. In addition, an event was planned for the promotion of this action. However, this had to be stopped.
Citizenship	External	End-users. They participated in the co-creation of the three CEBM via LL activities.	Good acceptance of the eco-label, dissemination materials and the app, and suggestions for improvement.

ASOFEM	External	End-users. Participation in testing activities for the sustainable consumption	Good acceptance of the eco-label, dissemination materials and the app, and suggestions for improvement.
Civil protection team of the municipality of Lorca	External	End-users. Participation in testing activities for the sustainable consumption	Good acceptance of the eco-label, dissemination materials and the app, and suggestions for improvement.
Sanitary workers of Rafael Méndez Lorca's public hospital	External	End-users. Participation in testing activities for the sustainable consumption	Good acceptance of the eco-label, dissemination materials and the app, and suggestions for improvement.

3.4 Results, lessons learnt and further recommendations

3.4.1 Results

In the Sustainable Consumption business model demonstration, ALIA has resulted in several key achievements:

- Development of an eco-label to show the sustainable information of the products. The eco-label shows clear and relevant information about the sustainability of the products to consumers. The eco-label contains a QR code which drives consumers to an ALIA's webpage section in which is possible to get more information about the reasons which made the products sustainable. The eco-label is an extraordinary example of an iterative development process following Living Lab methodology.

Figure 19. Final version of the eco-label

The inclusion of the QR code, the omission of the sub-categories, the EU label or the statement are some of the aspects which have been included in the label because of the inputs obtained during the process.

Furthermore, CIRC4Life partner EECC developed an eco-label generator which allows different companies to create their own eco-label. The eco-label generator includes an explanation of the eco-label, instructions for the eco-label creation, and possibilities for editing its different fields.

The CIRC4Life Eco Label displays the ecological impact of the product as a cumulative value. The eco-cost value of the products is indicated in the central ring. The coloured main gauge indicates how the total impact relates to the impact of similar products. The central value is the average, smaller values indicate that the product has

a smaller impact than average impact and is hence more sustainable than the average product. The highlighted circular sector indicates which is the position in which the product is situated in comparison with similar kind of products. In addition, the colour scale refers than the greener, the more sustainable the product is.

The 30% better than the average included in the statement was obtained from the LCA calculations. Even though the project did not create a common scale for the whole food system, in the LCA developed for ALIA's products, this figure was obtained in comparison with similar meat products. Thus, considering the eco-points of the products, 0.47, we calculated the benchmark: 0.64 (0.47/0.64=0.73, which is the 30% better than the average it we consider more decimals).

The eco-cost indicator was a modification of the eco-point concept to be included in the label so it was clearer for consumers. This was also a result of the Living Lab activities. This indicator makes it possible to compare products, and it is based on the LCA results, so it reflects the sustainability of the products along the whole supply chain.

- Establishment of an eco-shopping system at ALIA's shop: ALIA has included the eco-shopping module developed in the project at ALIA's shop, so it is possible to directly get the sustainability information at the point of sale. The app developed in the project has been used already, so it is possible check the information of the products' acquired once they have been bought and the impact of consumers' consumption habits.
- Development of communication materials in order to develop awareness campaigns for sustainable consumption promotion.

During the whole project implementation, it has been remarkable that the awareness campaigns are key for the development of the demo. Therefore, materials have been developed in order to promote the eco-shopping and to explain in a brief the sustainable practices implemented by ALIA during the project which made the products more sustainable than the average.

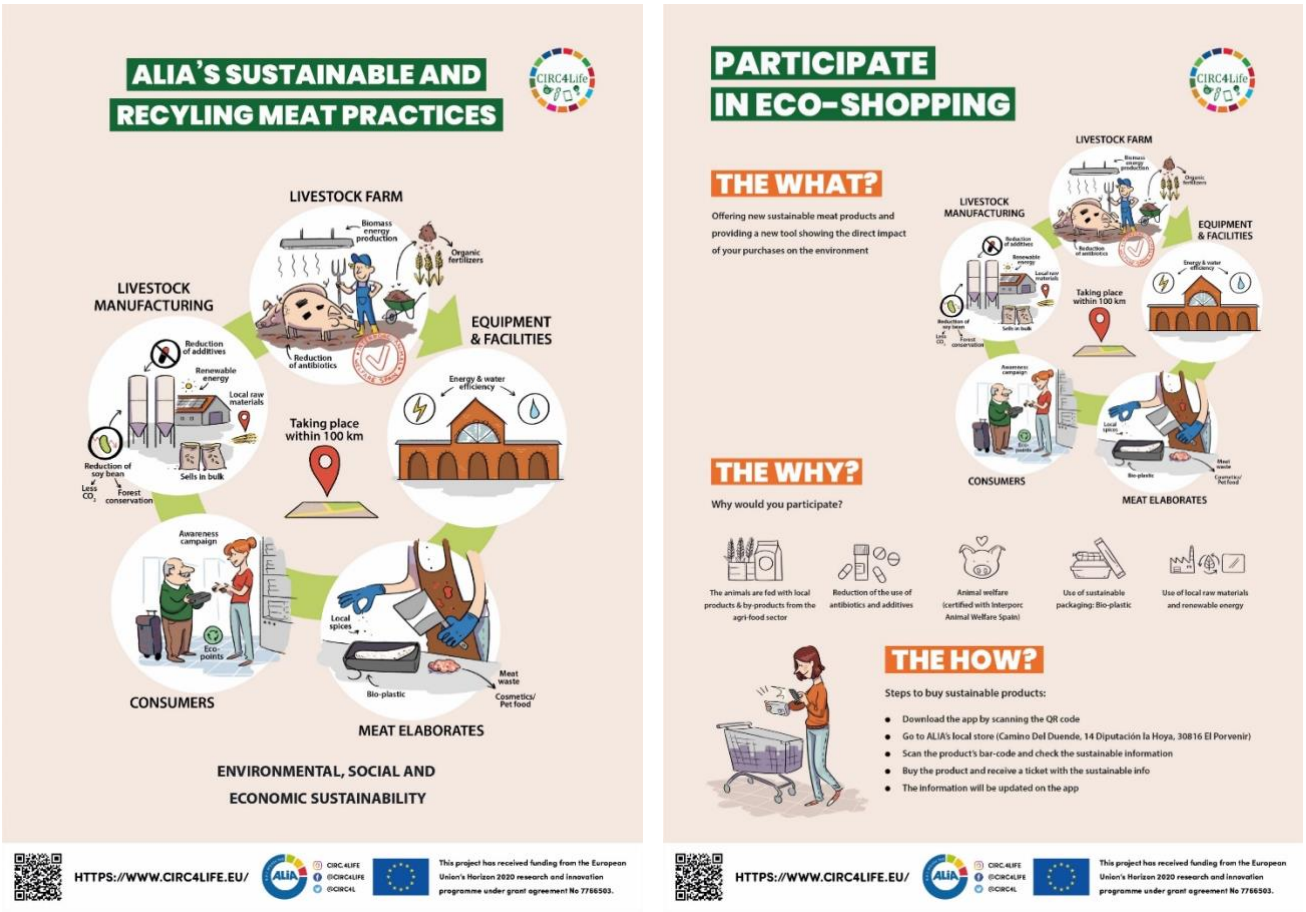


Figure 20. Communication materials developed for the sustainable consumption promotion

These materials have been used during the project implementation in the showcases, Living Lab activities and promotion events.

In order to validate the business model, 83 physical surveys were conducted about the sustainable consumption CEBM. Its analysis was done together with MMM and the results follow as next:

- No of participants of total no of participants that find the eco-information/eco-points useable during the shopping process (before the concept was improved): average score 3.98/5. 71.8% saying 4 or 5. Real testing activities, once the concept was improved: almost 100% answered positively (28 participants).
- No of participants of total no of participants that find the eco-information/eco-points important at point of purchase (before the concept was improved): 3.96/5. 83 respondents. 71,8% saying 4 or 5. Real testing activities: almost 100% answered positively (28 participants).
- No of participants of total no of participants that will continue buying the sustainable version of the product (already included in CEBM1): 83 respondents: 75% saying yes. 2% no. 23% I do not know.

Then, in the real-life testing activities, which were developed jointly between demo and Living Lab activities, it was possible to obtain additional results about the proposed concepts:

Statement (1= strongly disagree, 5 = strongly agree):	Average score
I would like to use this application frequently when shopping	4
I think that the process of buying and registering the products was easy	4
I felt confident using the application	4

I understand the eco-cost value well	4.13
I think the eco-account was useful	4.38
I think the eco-label is useful	4.38

In addition, during the showcase, several statements were asked to people in order to get more feedback about the implemented solutions. A total of 24 respondents were collected:

Statement (1= strongly disagree, 5 = strongly agree):	**Average score**
The ecolabel is useful to promote sustainable consumption.	4.67
The eco-shopping process is useful and could be applied on a large scale.	4.42
The concept of eco-cost is relevant when making your purchase.	4.17

3.4.2 Lessons learnt and further recommendations

The results show a great acceptance on the concept, especially the about the eco-label potential, while remarking that there is still room for improvement. During the development of all these activities in the framework of the sustainable consumption CEBM, several lessons learned, and further recommendations have been detected:

- The eco-label concept makes it easy to understand the sustainability of products. The EU eco-label and these kinds of labels do not show the actual environmental impact of the product, but they show if the accomplish the accomplishment of some parameters (something tricky many times).
- Eco-cost value is not an official figure to measure the sustainability of products, so it is difficult to understand for people. A standardization of the value and regulations to make it applicable at large scale of them should be needed. In CIRC4Life we have not developed a scalation of eco-cost, we (ALIA) just implemented a scale with the comparison of other meat products. If implemented at large scale, it would allow consumers to compare the sustainability of the products of a product among those of their sector and in a general view. A market in where the sustainable products are not standardized, consumers who may not care about sustainability aspects.
- The awareness campaigns, in addition to the promotion of the products, increase the awareness of the citizenship, so it supposes a good way to implement the (CSR).
- The communication materials seemed too extensive for some users to read them through. However, they have great acceptance about their visual aspect and usefulness for most of the people.
- Eco-shopping module is difficult to be implemented in supermarkets daily work. The eco-accounting system needs to be well integrated to existing shops' infrastructure to reach exploitation potential. The current approach of recording products to two different systems is not feasible.
- Lack of IOS versions and the incapability to get the app in non-android mobile phones is a critical point for the further exploitation of the app.

4 Collaborative biowaste recycling

4.1 Objectives

CEBM 3, collaborative recycling and reuse, has been demonstrated by ALIA in a collaborative biowaste recycling pilot activity. This last part of the demo has the main objective of enabling and promoting the biowaste recycling among the citizenship by the establishment of an incentives scheme to properly collect the biowaste and obtain added value from it. Some of the key aspects implemented in the framework of the demonstration of this CEBM are:

- To establish an incentive scheme based on the eco-credits' methodology developed in the project.
- To develop awareness campaigns and training actions with the citizenship to promote the biowaste recycling.
- To find further use of the biowaste collection so the citizenship can get benefit to it.

Two different pilot actions have been implemented in this part of the demo with two different municipalities: Lorca and Abarán, both located on the Region of Murcia. The two pilots have several differences; however, they share the main principles of the development of the CEBM. The main similarities and differences about the two experiences are listed below:

	Abarán	Lorca
Type of bin	Intelligent bin. Users interact with the container trough the CIRC4Life application or through a card obtained by CIRC4Life app interface. Similar to the one used by Indumental in DEMO 2	Users interact with the container trough chipped ID cards provided by the waste management company
Eco-account	Personal eco-account	Shared eco-account per family
Traceability	Traceability is achieved by attaching a sticker to each bag (the sticker is printed by the intelligent bin)	Traceability is achieved by providing each family with ID equipped recycling bags
Users involved	6-7 users recruited for active participating, (more will carry on the recycling activities), distance to the container varies between 1-10 minutes. 16 users were actively involved.	29 families recruited, distance to the container varies between 1-2 minutes

4.2 Activities developed

- **Meat waste management along the whole supply chain**

As stated in CIRC4Life proposal, ALIA's original plans at the demonstration stage regarding the CEBM "Collaborative Recycling and Reuse" was to extend the usual recycling practices of the meat sector to include the final consumer in the process. This would be achieved by means of using the incentives scheme developed in the project.

Therefore, it is important to remark that wastes along the different stages of the supply chain of the meat sector are used in several activity sectors such as cosmetics or pet food. In the whole supply chain, meat and other wastes (as feed) are managed according to Spanish regulations, so the different stages of the supply chain were covered for the demo activities and the demo should focus on the consumers.

- **Meeting with COPRESA: meat waste manager**

Date: July 2018
Location: Lorca

Early in the implementation of the business model, the first idea was to recycle the meat waste produced by the citizens. As it has been explained in past deliverables (mainly Deliverable 2.2), because of sanitary and legislation issues, this was changed into the biowaste recycling. Some concerns were risen during the meeting ALIA had with COPRESA, a waste management company which is specialized in the meat sector, converting meat waste into pet food, products for the cosmetics industries and others and giving value to them.

The meeting was focused on the study of collaboration for the future pilot activities, as COPRESA could be the actor in charge of obtaining valuable resources from the meat. Although the answer was positive and they had a good response about the collaboration, the traceability and sanitary problems were highlighted as issues which could be a hazard for the pilot activity.

- **Questionnaire for D1.4 about consumer attitudes**

Date: April 2019

First inputs for the consumer preferences regarding recycling were obtained. These attitudes were explored more in detail in the following workshops. There was already a difference between people willing to recycle biowaste and people willing to recycle meat waste. Biowaste appeared as the best option (Figure 21). This information was included in the Deliverable 1.4.

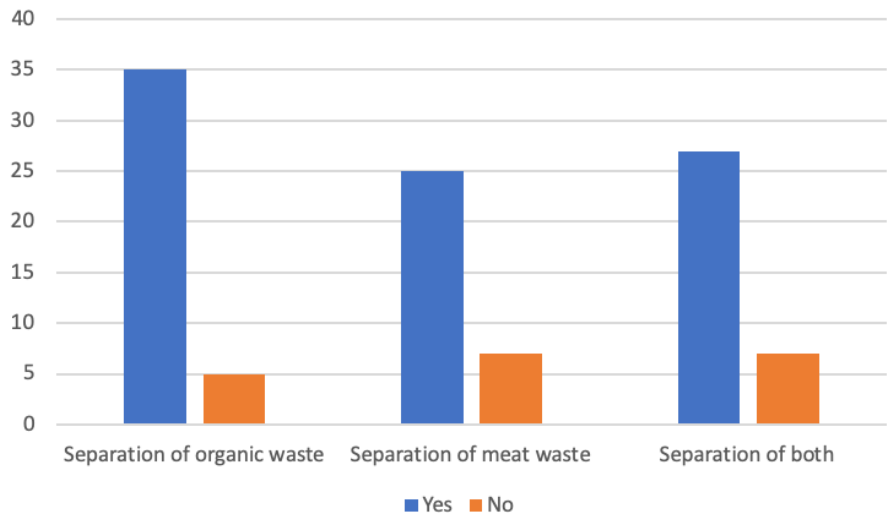


Figure 21. Attitudes to the recycle of biowaste and meat waste

- **Meetings with Carrefour**

Date: July – October 2018
Location: Lorca / Madrid

From the beginning, the idea of establishing the intelligent bin in the supermarket for the collection of meat waste was thought as something which had to deal with several problems: hygienic and sanitary issues, odours, visual impact, etc. However, conversations with Carrefour supermarket were established and the first inputs

were positive and progress was made. Nevertheless, it was not agreed to establish the intelligent bin and after the changes in Lorca's Carrefour management team, as it has explained in section 3.

- **Meetings with ADRI: LIVERUR project partner in the Region of Murcia**

Date: February – March 2019
Location: Abarán (Murcia)

As there is no meat nor biowaste waste manager in CIRC4Life consortium, from of the beginning of the project, there was a need about the engagement of an external actor who would manage the meat waste, later changed to the biowaste. In order to fulfil the objectives of the demonstration, a collaboration with another H2020 project LIVERUR[4] was set up. The collaboration agreed was that CIRC4Life would be in charge of the biowaste collection and LIVERUR would be in charge of obtaining a valuable resource from it. The biowaste collected in the demonstration was provided to LIVERUR project to perform the pilot activities planned in the same territory, so a decision about the further use of the biowaste was made in the framework of the engaged project.

Both projects included in their pilot tasks several workshops with stakeholders, as part of Living Lab methodology, which also established a good scenario for their collaboration.

Thus, in order to study and to establish the collaboration with LIVERUR project, which was finally reflected in the approved Amendment of the project about the meat to biowaste collection, several meetings were hold with the LIVERUR partner 'ADRI' (Association for the Integrated Rural Development of the Municipalities of La Vega del Segura) members.

- **Workshop for the definition of recycling activities in Abarán. Citizenship**

Date: 04/04/2019
Location: Abarán (Murcia)

The main objective of the workshop was to evaluate the interaction with the intelligent bin of the end-users, to study which are the most appropriated incentives for the citizenship of Abarán and to define possible locations of the intelligent bin. As well, it was important to evaluate the interest of the inhabitants of Abarán towards the pilot recycling project. This workshop was developed in the framework of Living Lab activities.

Regarding the interaction with the bin mockup developed, there was no important difficulties, maybe the position of the door was too high for some of the participants.

Three main aspects raised as things to be solved: visual impact of the bin, when to receive the incentives or how the waste management of this waste will be performed.

For the visual impact, to integrate the intelligent bin in the environment and culture of the municipality, the idea of involving local artist or students in order to decorate was suggested. This would have not only the benefit of doing the bin more appealing for the users, but also it would make the society participate in the development of the solution for the recycling system of the bio-waste. The covid-19 situation and the difficulties in organizing events during the demo activity made this impossible.

[4] https://liverur.eu/

Regarding the incentives, there was no consensus about the convenience of giving them instantaneously or in a cumulative way. And regarding the waste management, to include the collection of the bio-waste in the general collection system of the rest of the wastes.

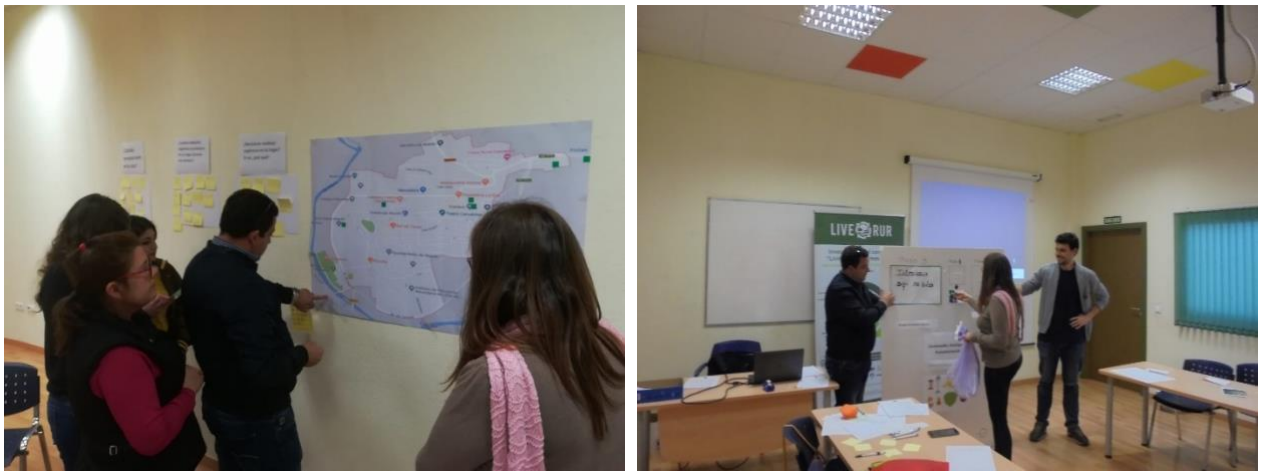


Figure 22. Workshop with the citizenship for the definition of recycling activities in Abarán

After a brainstorming, each participant voted for the optimal location of the bin regarding their preferences and four main optimal locations were selected.

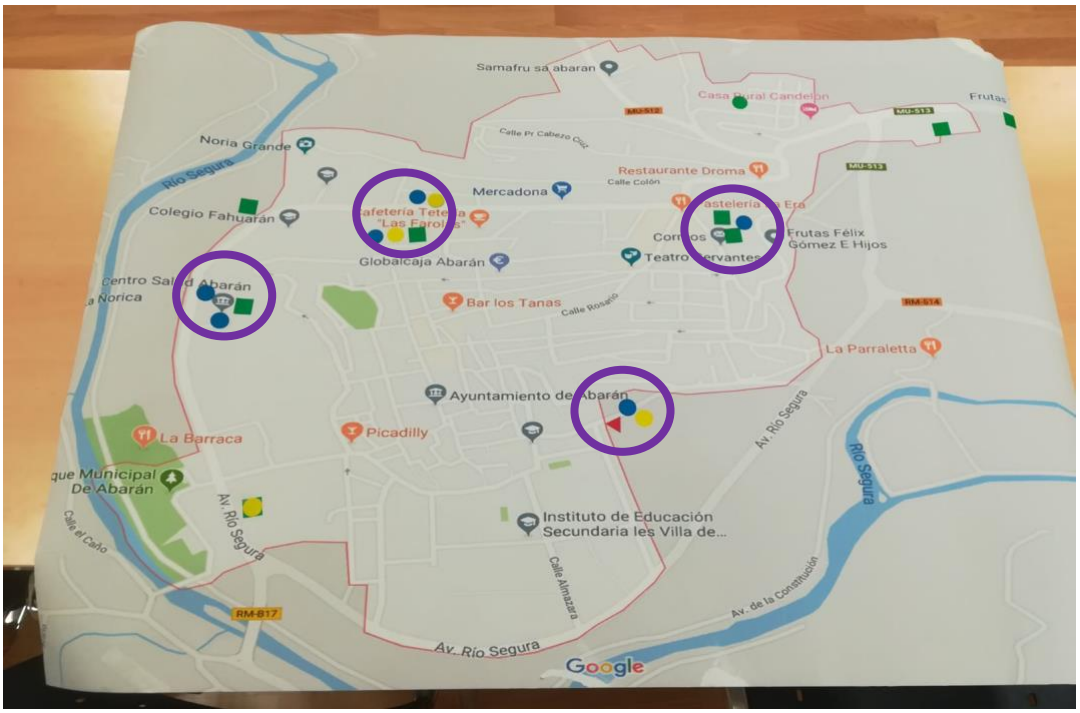


Figure 23. Workshop's results with the citizenship for the definition of recycling activities in Abarán

- **Workshop for the definition of recycling activities in Abarán. Local Authorities**

Date: 09/04/2019
Location: Abarán (Murcia)

After the workshop with the citizenship, it was decided for the final location of the intelligent bin, and that the incentives could be explored in a survey to be distributed to the whole citizenship and in general, good acceptance of the initiative was obtained. The main objective of the workshop was to evaluate the results obtained from the workshop with end-users to the local authorities and to obtain their feedback about it.

Figure 24. Workshop with the local authorities for the definition of recycling activities in Abarán

There was a big consensus within local authorities on which one was the most appropriate. So, this place will be the one where the intelligent bin will be located if no other issues raised.

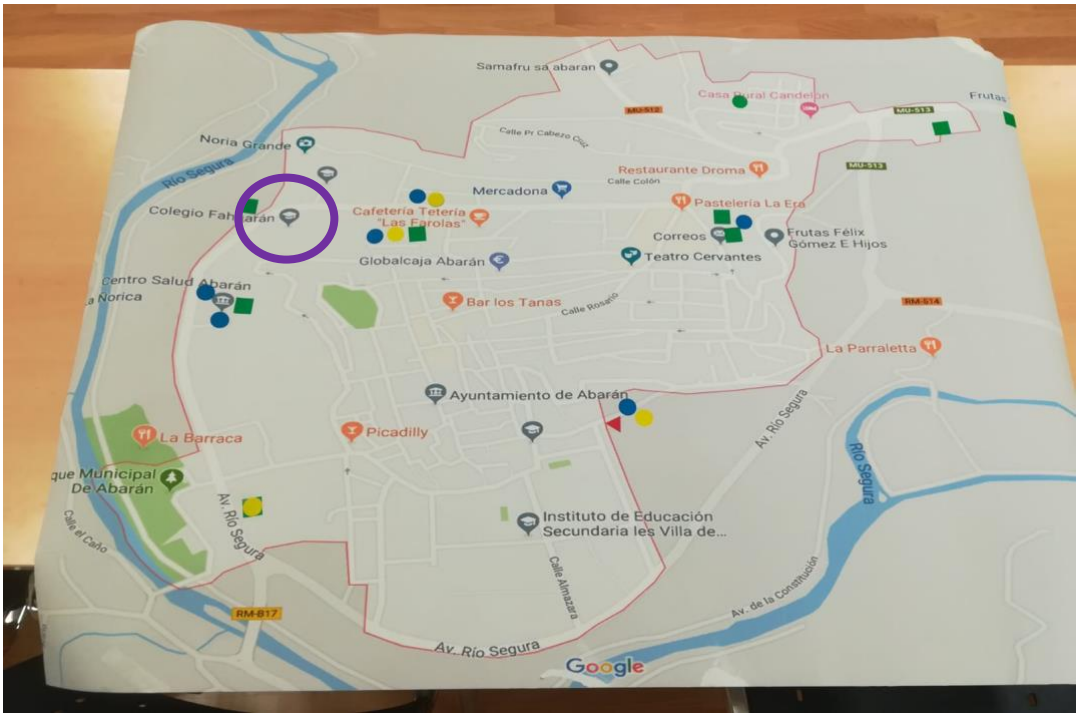


Figure 25. Workshop's results with the local authorities for the definition of recycling activities in Abarán

New possible incentives came out and the definition of the previous ones were complemented according to the public administration point of view.

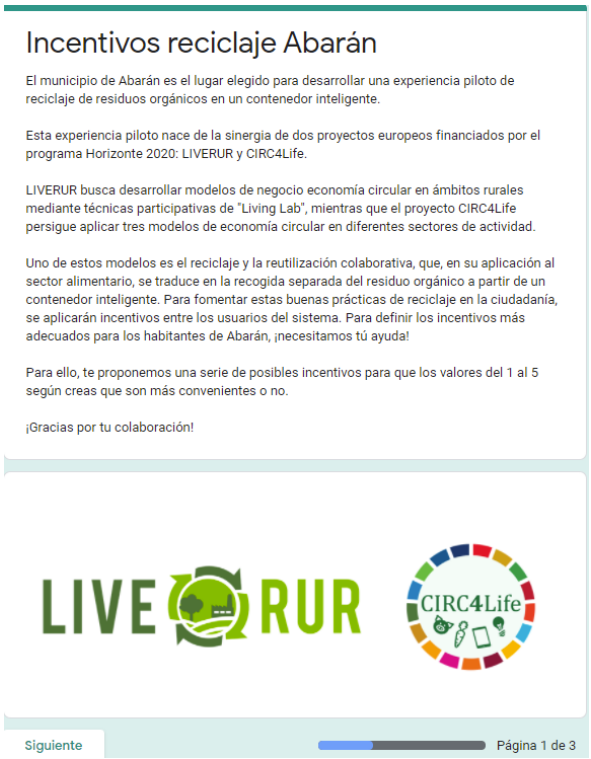
After that, a survey has been prepared in order to spread it among the entire municipality of Abarán, so it is possible to obtain the feedback from as much people as possible. The list of possible incentives which contained the survey follows as next:

1. To receive discount vouchers and/or gifts in Abarán cultural activities (theatre, concerts, dinners in restaurants, etc.).
2. To receive direct financial compensation.
3. To donate the corresponding economic incentives for social actions in the municipality.
4. To donate the corresponding economic incentives for rehabilitation actions on the river bank: tasks for the elimination of reeds and planting of native species.
5. To donate the corresponding economic incentives for cleaning actions in the municipality.
6. To donate the corresponding financial incentives for investments in playgrounds.
7. Discounts on municipal taxes.
8. To appear in a municipal list on a monthly basis in which their good practices are recognized.
9.To receive the incentives immediately (although the amount is lower).
10. To receive the incentives cumulatively using a points card.

- **Survey for incentives definition**

Date: April-May 2019
Location: Abarán (Murcia)

In order to continue with the definition of the incentives to be given in the demonstration activities, a survey was conducted addressing citizens from Abarán. A total of 47 answers were collected. According to the results, seven options were considered as good option (Figure 26). Theatre and other cultural event tickets were decided to be the ones to be given in pilot activities. They will be donated by the municipality.



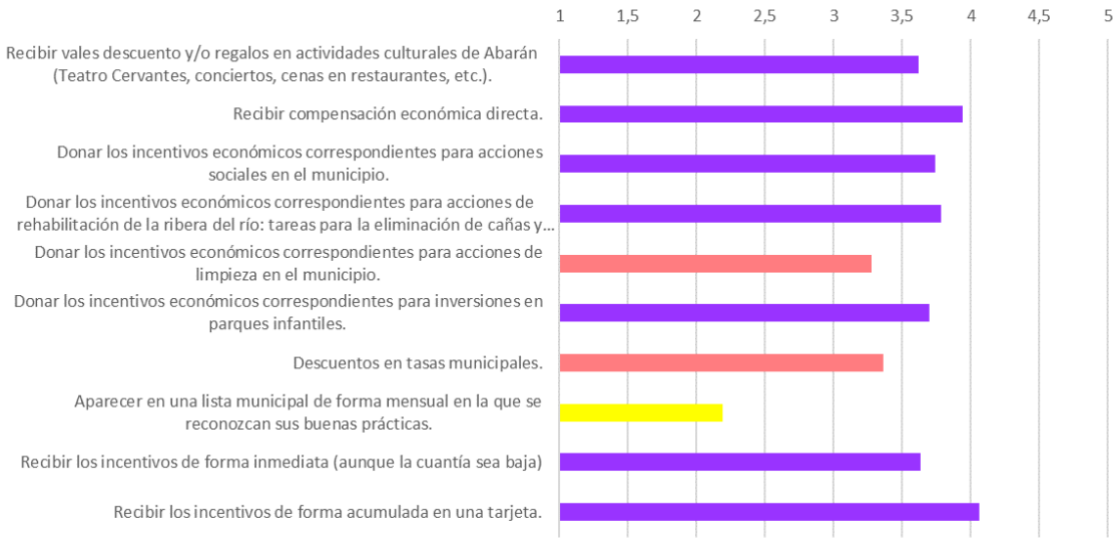


Figure 26. Survey for incentives definition in Abarán recycling initiative

- **Meeting with local authorities of Lorca**

Date: February 2020
Location: Lorca (Murcia)

From the beginning of the project, contacts with the local government of the municipality of Lorca were taken in order to explore possible collaboration in the framework of the project activities. However, it was not until the change in the government were this collaboration started to take form. In February 2020, after previous contacts, a meeting with the local authorities was done about the recycling part of the demo and the biowaste collection initiative. The meeting was focused on the possible location of the bin, definition of incentives and dates for the demonstration activities.

It is important to mention that another kind of bin was proposed to be established. The system would consist in a close container and pre-identified bags, so traceability was achieved without the need of using the intelligent bin, used in Abarán initiative as the main part of the demonstration activities. This would allow us to compare the two initiatives. The incentives scheme and the main principles of the CEBM were followed as well in Lorca case.

Furthermore, the initiative would be focused on a specific neighbourhood involving about 30 families as a pilot experience.

- **Workshop in Lorca with citizens involved in the initiative**

Date: March 2020
Location: Lorca (Murcia)

In order to start with the biowaste recycling experience, several workshops with the citizenship were done for the explanation of the initiative, acceptance of the incentives and other general aspects about it. The workshops were developed in the framework of Living Lab activities.


Figure 27. Workshop with the participants in Lorca's recycling activities

The workshops have limited participation, as when the experience was about to start, the pandemic took off. However, as the Lorca would be focused on a specific set of people, it was possible to continue with the activities regarding the training of people.

On the other hand, once this training and workshops were done, it was not possible to start the demo activities soon, as during lock-down period, the priorities of the local authorities were others.

- **Meeting with Abarán local authorities and waste management company to re-launch the demo**

Date: September 2020
Location: Abarán (Murcia)

After a standby period caused by the project amendment and the covid-19 situation, during September 2020 a meeting with Abarán local authorities was held in order to re-launch the demo activities. In this meeting, a new calendar of activities to be developed was established.

- **Online meetings for recycling activities in Lorca with local authorities and waste management company**

Date: November - December 2020
Location: Lorca (Murcia)

During November and December, once the situation in Lorca (one of the most affected municipalities of the Region of Murcia on the pandemic by this time) several meetings were held with local authorities and the waste management company with the aim of defining the final location of the bin, the collection frequency, further use and biowaste treatment, the connection of the CIRC4Life project app and the traceability infrastructure followed by the waste management company and other general issues.

The waste management company of the municipality of Lorca, LIMUSA[5], proposed to use another kind of intelligent bin, different from the one used in Abarán, but which is opened with a e-card and registers the user id when opening it in a data set, which makes it possible to get statistics and analyse the results.

[5] https://limusa.es/

- **Internal test of the intelligent bin in Abarán**

Date: January 2021
Location: Abarán (Murcia)

Once the intelligent bin was received in the municipality of Abarán, an internal test of the bin was performed together with the technicians of the municipality and the LIVERUR partners.

Figure 28. Reception of the intelligent bien in Abarán

This internal test was key in order to check that everything was working effectively and was a prior step to the workshops with the citizenship along the street.

- **Workshops with local authorities and citizenship for recycling activities in Abarán**

Date: March 2021
Location: Abarán (Murcia)

The intelligent bin was located in the street by March 2021. Once it was established, two workshops with the citizenship were done in order to explain the operation of the container, the use of the app, which kind of wastes shall be disposed in the bin, the incentives to be given by the people and, in general, how the whole initiative worked.

Figure 29. Workshop with the participants in Abarán's recycling activities

In addition, by March 2021 a launch event was done together with the local authorities of Abarán, in where the Mayor of the municipality and its team, technicians and also the citizenship took part on it. This was a great opportunity to disseminate the use of the bin and the experience as well as the importance of promoting circular economy initiatives in rural areas and obtaining value from the biowaste.

Figure 30. Promotion event for Abarán's recycling activities

- **Launch event of the initiative in Lorca**

Date: March 2021
Location: Lorca (Murcia)

Following the beginning of the demo activities in Abarán, Lorca started a few weeks later its action. Prior to this, an event with the local authorities, waste management company, the provider of the bin (Contenur[6]), ALIA staff and some of the citizens involved in the initiative for the promotion of the initiative to the general public.

Figure 31. Launch event of the initiative in Lorca

The bin is opened by a e-card which was distributed among the participants. When it is opened the user, id is registered in a database, so it is possible to track the use of the bin by the people.

[6] https://www.contenur.com/

Figure 32. Smart bin and e-card to be used in Lorca's recycling activities

Following the launch event, compostable bags, information leaflets about what should be disposed in the bin and the final instructions were given to the participants in order to star the activity.

Figure 33. Delivery of compostable bags and final instructions to Lorca's participants

4.3 Stakeholders involved

Stakeholder	External / Internal	Involvement	Feedback
COPRESA	External	Recycling of the meat waste to be collected	Difficulties in the kind of meat waste to be collected for further use: traceability, hygienic and sanitary issues, etc. Thus, although they saw potential on this, several considerations had to be made in order to ensure an appropriate implementation of the activity.
Carrefour	External	Establishment of the intelligent bin	Regarding the intelligent bin, the feedback, although not negative, showed up that there were many difficulties (too many) in the establishment of the bin inside the supermarket, because of hygienic issues,

			visual impact, supermarket space organization, etc.
Municipality of Abarán	External	Development of the pilot in Abarán municipality	Acceptance of the initiative. Willingness to collaborate and conduct the activities. At the end of the initiative, they were really satisfied with the experience and the results, as they were one of the first municipalities which implemented the biowaste recycling at regional level.
Municipality of Lorca	External	After the local elections in May 2019, the local authorities showed their willingness to conduct a pilot activity, so a second biowaste pilot demo was established.	Acceptance of the initiative. Willingness to collaborate and conduct the activities. As no intelligent bin will be established and considering the municipality particularities (one of the biggest of the Region), it was decided to focus it on a set of households. They were really satisfied with the experience and the results, as they were one of the first municipalities which implemented the biowaste recycling at regional level. The municipality will continue with the initiative and expand it to other areas of the city.
LIVERUR project member: ADRI	External	Collaboration in pilot activities. The collected biowaste will be used in their project.	LIVERUR partner accepted to collaborate in the pilot activities and common activities were conducted successfully in the framework of LL. The overall result of the collaboration was very satisfactory.
Intelligent bin provider	External	Providing the	No problem in providing it and adapting it to our particularities.
Citizenship of Lorca and Abarán	External	End-users. They participated in the co-creation of the three CEBM via LL activities.	Good acceptance of the initiative. They contributed to the definition of the bin location and the incentives and suggested different improvements for the pilot development.
Orgánicos Pedrín	External	Organic fertilizer company which made compost from the biowaste	Good acceptance of the initiative. Identification of a new business model possibility based on circular economy principles. Good quality of the biowaste collected.
LIMUSA	External	Waste management company of the municipality of Lorca	The company had previous experience in biowaste collection, however, not successful ones. This is why they were totally satisfied with the result of the initiative, as they were able to actually obtain biowaste which could go directly to the compost and no separation had to be made in the treatment plant. They will expand this initiative to other areas of the municipality.
Recicla y Gana	External	Intelligent bin provider in Abarán	N/A
Contenur	External	Bin provider in Lorca	It was an opportunity to develop and test the biowaste container in a real life and they

			were very satisfied with the success of the initiative.
Alfonso X El Sabio primary school of Lorca	External	Participation in biowaste recycling activities and in the use of compost for their school gardens	Willingness to collaborated in the initiative.
Nature association 'La Carrasca'	External	Participation in reforestation activities using the obtained compost	Willingness to collaborated in the initiative.

4.4 Results, lessons learnt and further recommendations

4.4.1 Results

In the recycling part of the demo, ALIA has resulted in several key achievements:

- Establishment of a method for rewarding consistent and repeated recycling of recyclable materials by the incentives scheme developed. The incentives are given with the aim of promoting the proper separation of biowaste so composting or the obtention of organic fertilizers is possible.
- Obtention of added value products (compost) from biowaste which would otherwise end-up in landfill.
- Developing of two pilot experiences in which every key actor (local authorities, waste management companies and citizenship have been involved). As the effective implementation of the biowaste collection is still a pending activity for most of the municipalities, this pilot experience would be important to the further activities of other municipalities of the Region of Murcia and other regions across Europe.
- Elaboration of communication materials for the promotion of the initiative. During the whole initiative the importance of the awareness of the citizenship was present. This is why several workshops and activities were done. All of them were supported by the communication materials.

Figure 34. Communication materials developed for the recycling activities promotion

The results from the two initiatives, both the Lorca and Abarán ones, shows that the initiative has been of great usefulness to study the best ways for biowaste collections.

In **Lorca** case, it has been possible to collect a total of 1.140 kg of biowaste from the 24th of March 2021 till the 23rd of August 2021. This means per day and household, 250g have been collected, which shows a good recycling rate of the users.

In addition, we have shown that, during the months, the use of the container has not decreased during the demo implementation, most users have continued using the bin regularly. Checking the statistics, we can consider that, after the first two months, 20 out of 29 were active recyclers. The average of the bin openings has been 40 per week, so an average of two disposals peer week has been made. Thus, each user has opened the bin twice a week, which seems to be a reasonable frequency for biowaste collection.

The quality of the biowaste obtained has been high, so it has not been necessary to process them in the waste treatment plant, as it happened in the regular biowaste initiative of Lorca in which CIRC4Life approach was not implemented. The biowaste has gone directly to the composting plant. A total of 30 kg of compost have already been obtained. In addition, the obtained compost will be used in two different activities: reforestation activities in the municipality and schools' gardens, closing the loop and making circular economy real. During the 9th of September 2021, a reforestation activity was done in which the waste management company of the municipality, local authorities and the nature association 'La Carrasca' participated together with ALIA. In the next months, additional activities will take place.

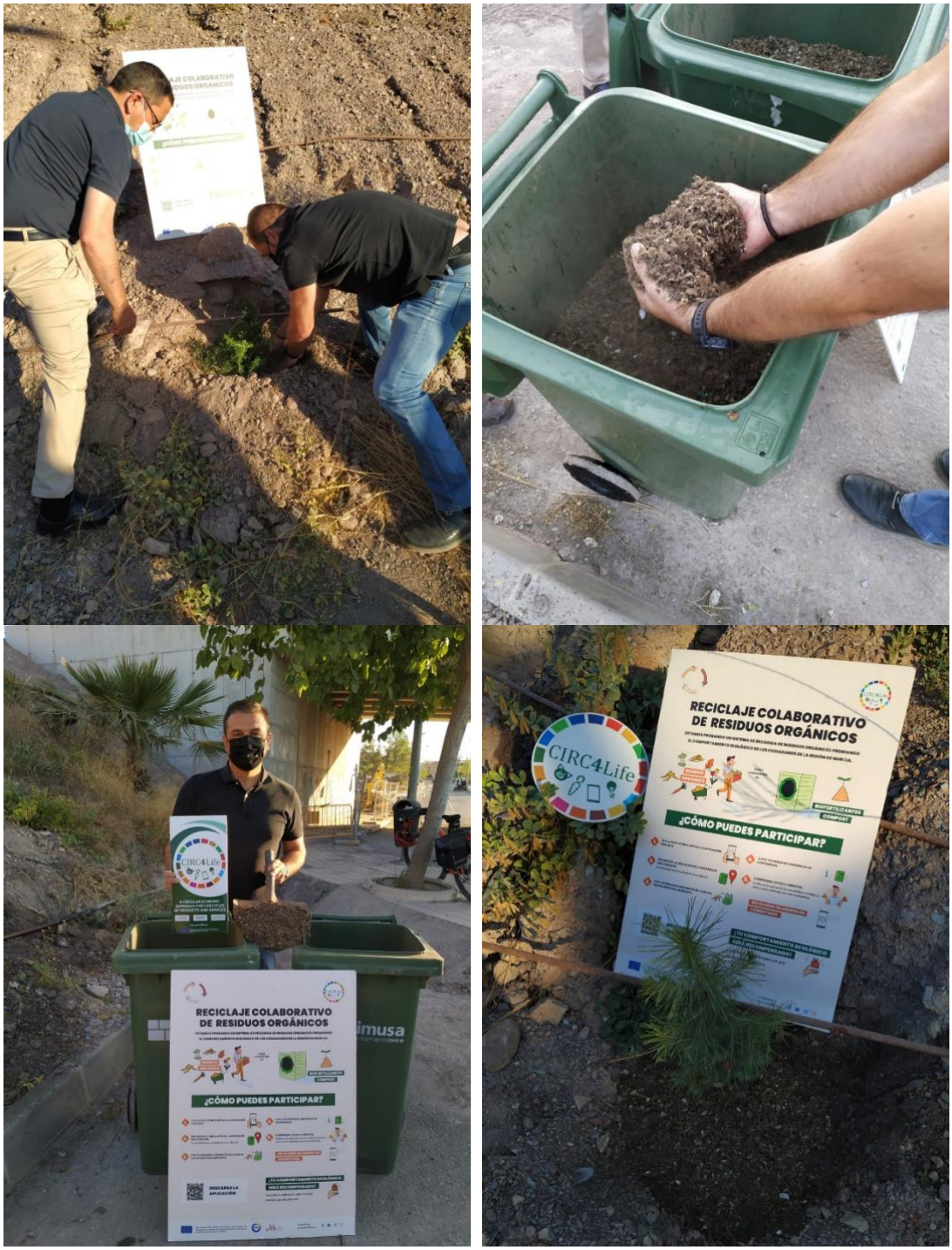


Figure 35. Reforestation activity in Lorca.

During June, incentives were given to users in an event developed together with local authorities, participants, companies which provided the incentives and the waste management company.

Figure 36. Incentives' event developed in Lorca.

The satisfaction of the participants involved in the demo has been high. The feedback survey conducted offered the following results:

(1= most negative, 5 = best one):	**Average score**
Was the information provided clear to understand the recycling process?	4.8
What did you think of the information about the incentive you receive for recycling your organic waste?	4.5
Are you satisfied with the smart container or did you run into any problems?	5
How easy has the application been to use?	4.1
Would you go back to the bin to bring your biowaste and use the app again?	4.75
Will you recommend your friends and family to come bring your biowaste to the bin?	4.75

In addition, regarding the question 'What was your motivation for bringing the biowaste to the container?', all of them answered that because of environmental issues. During the workshops, the idea that incentives would be helpful was highlighted.

In **Abarán** case, from the beginning of June to the 21th of September, 197 uses of the bin have been made. If we consider that 16 users can be considered as active ones, this supposes an average of one disposal per partner and week of 0.8. This seems low; however, the number of containers uses and the amount different of users is growing at this time. In addition, as some of the users are elderly people who lives alone, the quantity of biowaste generated and the frequency of bin use seems logical.

It is also important to remark that, that even though the summer period was coincident with the development of the demo activities, the use of the intelligent bin is in continue growth. September is expected to be the one with the number uses of the bin by checking the number of the three weeks analysed (Figure 38).

The municipality of Abarán has the aim of developing an event for the incentive's donation. However, because of the cancellation of several cultural events, the event is thought to be made in the next few weeks.

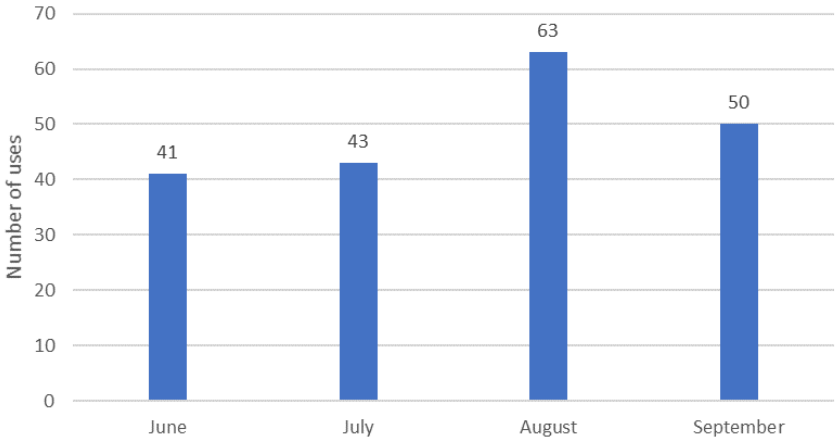


Figure 37. Number of users per month of the intelligent bin in Abarán until 21/09/2021

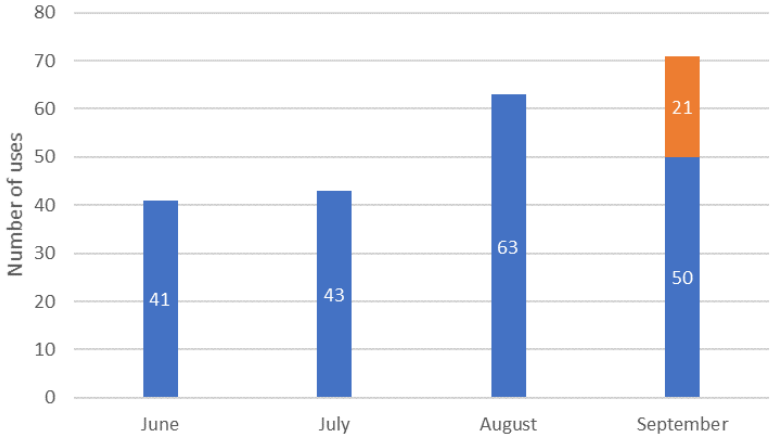


Figure 38. Number of users per month of the intelligent bin in Abarán with expected results for September

Furthermore, 120 kg of compostable biowaste selectively collected in the municipality of Abarán has been collected. Once the biowaste was received at the Orgánico Pedrín facilities, the different biowaste samples were analysed to detect the presence of improper or non-compostable elements. The results have shown the high degree of effectiveness of the methodology proposed by the consortium, since the presence of such materials was hardly detected.

In the composter made available to the project needs, the biowaste plus an accelerator have been treated. In this case, the accelerator has been sheep manure from extensive livestock farms, which has acted as a precursor to the aerobic fermentation processes. Over time, the evolution of the aerobic process has been verified by frequently measuring the temperature and detecting the evolution of all the elements that make up the substrate. Temperatures of up to 65ºC have been reached.

In September 2021 the compost obtained was evaluated. The following analyzes have been carried out:

i) Physical and chemical
ii) Heavy metals
iii) Microbiological. Salmonella spp. = Absence / 25g, E. coli with limit <10 MPN / g.

From the results obtained, it is clear that the composting process has been adequate, obtaining a compost of excellent quality, without risks for the soil or for the applicators.

The compost will be used in urban and school gardens. Because of the delay of the pilot activity of Abarán, these activities will be done in the next few months.

4.4.2 Lessons learnt and further recommendations

During the development of all these activities, several lessons learned, and further recommendations have been detected:

- There is a difficulty in the use of the system when apps and other devices are necessary, especially for the elderly. This is why a combination of the use of an app and e-cards and two alternatives would be an optimal solution.
- There is always a difficulty in teaching people, especially at the beginning of the process. This is why the awareness campaigns has to be addressed by many actors and with different perspectives and channels.
- Regulations may make it difficult to use by-products, this was one of the reasons why ALIA discarded the meat waste collection.
- It is necessary a good separation by people in order to obtain valuable products with feasibility. For this, awareness campaigns are key.

5 Showcases

The demonstration activities of ALIA's pilot started in November 2019 and some of them are still ongoing. However, by May 2021, ALIA has already completed the most important aspects of their demo and has obtained valuable conclusions and results, as it has been mentioned in the present document.

Thus, during May 2021, ALIA has organized two showcase events to communicate project results and obtained relevant feedback from different actors, including academia, policy makers, citizens and the private sector.

It is important to remark that, during the project implementation ALIA has already organized different showcases events, as the donations of products to different associations or the presentation of the recycling activities in Lorca and Abarán. However, these showcases contemplated the whole demonstration of ALIA in a single event. In the two showcases, videos developed during the whole demo activities were presented, so it was possible to properly understand the specific actions carried out during the pilot implementation.

- **Showcase in the University of Murcia**

Date: 05/05/2021
Location: Veterinary Faculty of the University of Murcia, Murcia.

This showcase had the general aim of disseminating the project results to the academy field. Professors and students participated in it. The event took place in presential mode with limited audience due to the pandemic situation. In addition, it was broadcasted via zoom. In total, 19 people participated on it.

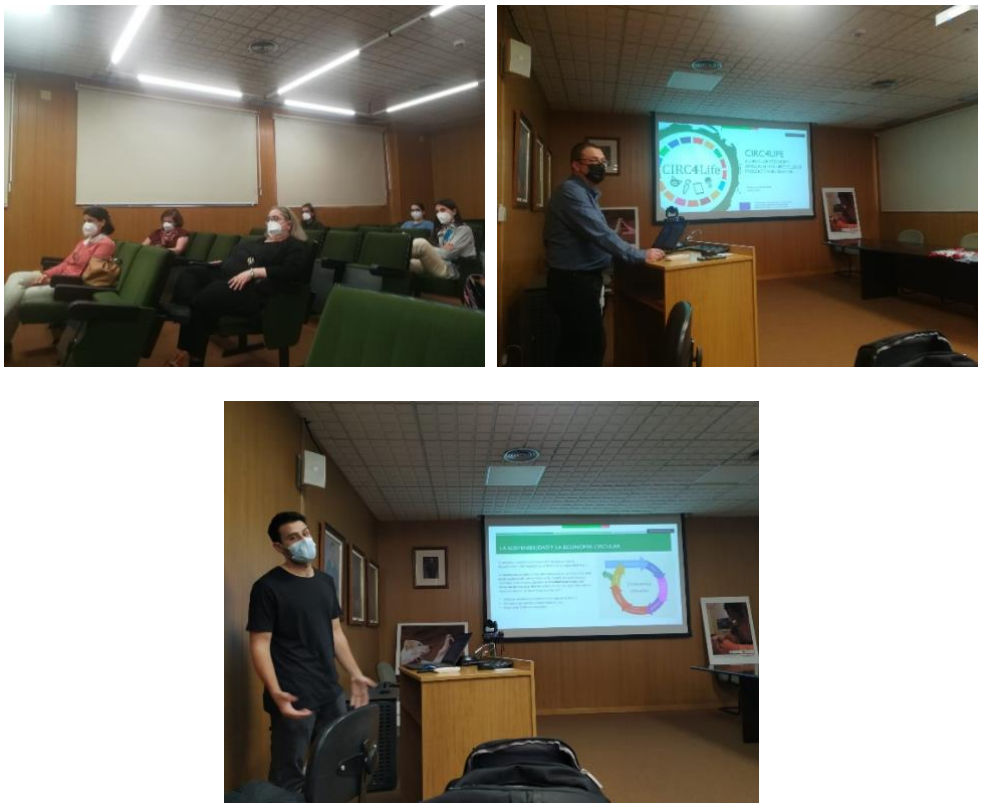


Figure 39. Showcase event at the University of Murcia

Participants showed interest in the project results and the whole approach. Two main aspects were subject to discussion after event:

Firstly, it was highlighted the need of moving from linear and non-sustainable approaches, to proposals as the one we CIRC4Life puts in place. However, a general discussion about what should be made in order to

implement these kinds of techniques at large scale and not just because of the conviction of several aspects was held. The role of the administration and the power of consumers were the two main mechanisms highlighted.

Secondly, the eco-label was another aspect subject to discussion and the same aspects which had raised in the Living Lab activities were raised again: the need of establishing a general scale for the eco-cost should be necessary in order to use the eco-label at large scale.

- **Showcase in Lorca**

Date: 20/05/2021
Location: 'La Viña' Neighborhood Association meeting place, Lorca, Murcia.

The second showcase was developed with the aim of communicating the results to the citizenship and industry workers. There was a big consensus about the need of acting step by step, realizing that it would not be possible to change our world development patterns in a short period of time, but highlighting that it is time to act, being even small and individual steps useful for this. A total of 15 participants attended to the event.

Figure 40. Showcase event in Lorca

After each showcase, a survey was conducted in order to get the insights of the participants containing some open questions. The most relevant results follow as next:

- Please indicate how you would improve the ecolabel and what elements you think could reinforce it:

Comments showed great acceptance about the concept. However, the scale was the critical point mentioned by the people, similarly as the opinions showed in the Living Lab activities.

- Please indicate what elements you would have included in the co-creation of sustainable products:

In general, no major aspects were mentioned. The inclusion of health issues in the co-creation or the need of promoting the activities were some of the comments.

- Please indicate any considerations you have about the event or about the pilot carried out by ALIA:

All the comments collected were totally positive. The main aspect mention was the important of the disseminating activities and communicating this kind of activities to the whole citizenship. The awareness of the consumers was considered as the key aspect for the sustainability of our society.

6 Conclusions

CIRC4Life project has allowed ALIA to have a deeper knowledge of all their processes in the field of sustainability, identifying strengths and weaknesses and has provided the appropriate tools to be able to act in certain phases in a process of continuous improvement. This is a key aspect for the implementation of the CEBMs in any organization.

It has made ALIA see that doing things differently, while being respectful of the natural, social, and economic environment is possible, as well as necessary, with an affordable economic effort.

It has allowed ALIA to involve administrations, legislators, people from the academic world, companies, and society in general, creating a social fabric much more committed to Sustainability. To address all the involved actors in the implementation of the CEBMs from the very beginning should be a must for every company.

What we, from ALIA, would say to other companies is that it is time to take steps, even small, in meeting the sustainable development goals, humanity and the planet will be immensely and eternally grateful.

Annex I

The meat products' Product Design Specification (PDS) was divided in the four main stages of the meat supply chain. The first version established the pre-conditions for product development, while the second one contains modifications regarding the improvements done during the project implementation.

First Version.

ANIMAL FEEDING

1. **Performance**

The animal feed has to conserve its nutritional properties depending on the stage of the feeding.

2. **Environment**

The product has to be kept in a fresh and dry environment and to conserve its properties during 3 months in there.

3. **Life in Service (Performance)**

It has already been included in last section.

4. **Maintenance**

N/A

5. **Target Product Cost**

The cost of the product has to be of 250 €/Tn.

6. **Shipping**

The sale of feed must have two different modalities: in bulk and in sacks of an ergonomic size.

7. **Packing**

The sacks have to be made with eco-friendly materials whenever possible. It will be studied the use of returnable options as bags or sacks made of raffia.

8. **Quantity**

It is going to be produced a total amount of 6.000 kg.

9. **Manufacturing Facility**

The machinery which has been used for the manufacturing of products can be used again for the repetition of the process. Other tools and auxiliary machinery will also be reused for new processes.

10. **Size**

The granulate of the feed must have a dimension of 3,5 mm.

11. **Weight**

The density of the feed has to be about 700 kg/m^3.

12. **Aesthetics, Appearance and Finish**

The feed has to be compacted in a percentage between 95-97%.

13. **Materials**

The sources of proteins and fats should be chosen with sustainability criteria. The use of probiotics instead of antibiotics will be favored.
Use of fat sources from other industries whenever possible (by-products of other industries).
Use of hydrate and protein sources from other industries whenever possible (10-15% of by-products from other industries).
Reduction of N and P through animal feed. Selection of appropriated raw materials to reduce it in slurry.
Materials not related to the main activity (office material) must be acquired with sustainability criteria.

14. Product life span

The label of the product should contain the information of the best-before date.

15. Customer

The elaboration of the products will be based on the preferences of the end consumers.

16. Timescales

The formulation time must be around a month.
The quality test must be done once a month.
The LCA and the Living Labs (carried on to know the opinions of the end consumers) will be done in one month.

17. Testing

For the product testing, LCAs will be done. In the Living Labs, it will be checked if the product design is related to the preferences of the consumers. Quality tests will also be carried out.

18. Safety

These tests will be carried out for all production batches. If the results are positive, it will be carried out in the same proportion as for the rest of the batches. In addition, the quality test is compared with similar products.

19. Processes

It will be used machinery of high energy efficiency and renewable energy sources whenever possible.

20. Ergonomics

The sacks must have an appropriated size for its handling.
The weight of the sacks has to comply with the cargo handling legislation.

LIVESTOCK FARMING

1. Performance

The different stages of growth and fattening of the animals must be defined by the following periods of time:

- Birth to end of weaning of piglets – 21 days.
- End of weaning to fattening transition – 42 days.
- Fattening – 118 days

The weight of the pig at the end of the three must be between 110-115 kg.

2. Animal welfare

An occupation of animals in each cage allowing the free movement of animals must be allowed.
The temperature must be regulated so that it complies with the comfort conditions of the animals.

It should be chosen the specific breeding species in the farm according to the climatic conditions of different periods of the year and animal needs.

3. Prevention of pests and diseases

Preventive treatments by the use of natural products should be prioritized instead the use of antibiotics.

4. Life in service (performance)

The animals must go to the slaughterhouse in a period of time between 5 and 6 months, and a weight of 110-115 kg.

5. Target Product Cost

The farm must not spend more than a certain amount of money 1,05 €/kg of pig

6. Shipping

The transport must be carried out in an adapted truck for animal transport and must be as sustainable as possible in terms of CO_2 emissions.

7. Quantity

A total of 25 batches will be produced (equivalent to 25 pigs).

8. Manufacturing Facility

The energy sources should be as clean as possible.
The tools used in the process must be reusable (silos, cages, water troughs)

9. Size and weight

The objective is that the animals go to slaughterhouse with an age of 6 months and a weight 110-115 kg.

10. Materials

The water used should be reused or recycled as much as possible.
The animal feed must have sustainable characteristics.
The use of antibiotics should be minimized.
Minimization of waste through systems such as hydrolysis of corpses.
Increase in recycling rates and in the use of slurry for further uses in agriculture or energy recovery.
Materials not related to the main activity (as office material) must be acquired with sustainability criteria.

11. Product life span

Breeding must be completed in 5-6 months

12. Customer

The elaboration of the products will be based on the preferences and criteria of end consumers.

13. Timescales

The formulation time should be around one month.
The quality test (weight control) must be carried out every week time.
The LCA and the living labs to know the opinion of the clients will be made in a period of time equal to one month.

14. Testing

For the testing of the products LCA's will be carried out. In the living labs it will be checked if the design of the product is related to the thoughts of the consumers.

Quality tests will be carried out. These tests will be carried out for all the production batches (6 batches that are equivalent to 6 pigs). If the results are positive, it will be carried out in the same proportion as for the rest of the products. In addition, the quality test will be compared with similar products.

SLAUGHTERHOUSE

1. **Performance**

N/A

2. **Environment**

N/A

3. **Life in Service (Performance)**

N/A

4. **Maintenance**

N/A

5. **Target Product Cost**

Pork loin: 3€/kg (-20%) = 2,40 €/kg.
Lean pork: 2€/kg (-20%) = 1,60€/kg

6. **Shipping**

Refrigerated truck

7. **Packing**

The product is conveyed and packed in boxes and pallets

8. **Quantity**

25-30 kg of meat from each pig

9. **Manufacturing Facility**

The machinery which has been used for the manufacturing of products can be used again for the repetition of the process. Other tools and auxiliary machinery will also be reused for new processes.

10. **Size**

The pork loin must have a size of 0,7-0,8m.

11. **Weight**

Pork loin:3,5 kg.
Lean pork: 20 kg.

12. **Aesthetics, Appearance and Finish**

The finish of the process must have these stages: immersion in hot water, peeling machine, flagellating machine, singeing machine, washing and cleaning.

13. **Materials**

CO2 is used in the stunning process
Materials not related to the main activity (as office material) must be acquired with sustainability criteria.

14. Product life span

3-5 days

15. Customer

The different techniques used are based on the preferences of the end consumer (e.g., less suffering of the animal)

16. Timescales

N/A

17. Testing

Organoleptic test

18. Safety

N/A

19. Processes

It will be used machinery of high energy efficiency as well as renewable energy sources whenever possible.
Machinery with low water footprint will be used.
Processes and techniques with low impacts on these aspects will be implemented.

20. Ergonomics

N/A

MEAT ELABORATES

1. Performance

Products must have specific nutritive and organoleptic properties. Both products are destined to be consumed fresh.

- Pork loin:

Description: meat product made with the "ileoespinal" muscle of the pig (practically free of external fat). It contains condiments, spices and authorized additives, subjected to a process of maturation and drying.
Ingredients: pork loin, salt, paprika and oleoresin of paprika, sugar, spices, dextrose, garlic powder, pork protein, antioxidant (E-301), preservatives (E-252 and E-250) and acidity corrector (E-331iii). Without gluten. Preservatives as surface treatment of the casing: E-202 and E-235.
Nutritional value:
Average values per 100 g of product:
Energy value 240.6 Kcal / 1010.8 KJ; Fat 9.5 g (4.4g of saturated fat) ; Carbohydrates 3.9 g (sugars: 1 g); Proteins 34.8 g; Salt 6.1 g.
Chemical and microbiological specifications:

Microbiological parameter	Maximum limits
Escherichia coli	100 cfu / g
Salmonella spp	Absence / 25 g
Listeria monocytogenes	100 cfu / g
Coagulase-positive staphylococci	100 cfu / g
Clostridium perfringens	100 cfu / g
Dioxins and PCBs	1.5 pg / g fat

- Cured pork sausage:

Description: meat product prepared by selecting, chopping and mincing meat. It contains condiments, spices and authorized additives, subjected to a process of maturation and drying.
Ingredients: Pork, salt, dextrin, sodium caseinate (MILK protein), LACTOSE, spices, dextrose, aroma (contains smoke flavor), garlic, flavor enhancers (E-621 and E-635), antioxidant (E-316), acidity corrector (E-331iii), preservatives (E-252 and E-250) and coloring (E-120). Without gluten.
Nutritional value:
Average values per 100 g of product:
Energy value 423,6 Kcal / 1779.8 KJ; Fat 34g (13g of saturated fat); Carbohydrates 6.0 g (sugars: 2.9 g); Proteins 23.4 g; Salt 4 g.
Chemical and microbiological specifications:

Microbiological parameter	Maximum limits
Escherichia coli	100 cfu / g
Salmonella spp	Absence / 25 g
Listeria monocytogenes	100 cfu / g
Coagulase-positive staphylococci	100 cfu / g
Clostridium perfringens	100 cfu / g
Dioxins and PCBs	1.5 pg / g fat

The products must have a certain hardness, so that they can be cut easily.

2. Environment

The products must maintain their properties for a period of 90 (cured pork sausage)/180 days (cured pork loin). The whole piece (as it is acquired at the point of sale) must hold a period of 90/180 days if it is in a cool and dry place. Once the product has been opened, it must hold a period of 90/180 days in the refrigerator.
The cured pork sausage should have an edible protective layer for this purpose, the protective layer of the cured pork loin will be inedible.

3. Life in Service (Performance)

It has already been included in last section. It has to have a certain period of time of life in service when it is kept in the appropriated environment.

4. Maintenance

The product does not need to be cooked before eating it.
At the point of sale: store in a cool, dry place. At room temperature the product may lose organoleptic qualities such as hardening and rancidity or alteration of the surface flora, although it remains microbiologically stable.

5. Target Product Cost

The manufacturing of the cured pork sausage must have a maximum total cost of 5,20€/kg. At the selling point, 2,19€ each piece of cured pork sausage (250 g).
The manufacturing of the cured pork loin must have a maximum total cost of 6,00€/kg. At the selling point, 10,95€ each piece of pork loin (900 g).

6. Shipping

During transport and storage: temperature between 0ºC and 5ºC.

- Pork loin:
  - Type of Packaging: Box
  - Number of pieces per box: 8

- Net Weight: 8 Kg (approx.).
- Length: 360 mm
- Height: 190 mm
- Width: 210 mm
- Weight Box: 0,210Kg.
- Boxes per wooden pallet: 55
- Total height (including wooden pallet): 1100 mm
- Total weight (including wooden pallet): 475kg.

- Cured pork sausage:
  - Type of Packaging: Box
  - Number of pieces per box: 12
  - Net Weight: 3 Kg.
  - Length: 355 mm
  - Height: 120 mm
  - Width: 210 mm
  - Weight Box: 0'280 Kg.
  - Boxes per wooden pallet: 108
  - Total height (including wooden pallet): 1300 mm
  - Total weight (including wooden pallet): 376,24 kg.

7. Packing

The cured pork sausage must have a package that allows checking the texture of the product without touching it directly and making it possible to aerate the product.
The pork loin should be vacuum packed with a protective atmosphere that should protect it from water, air and other external agents.

8. Quantity

For each pig you will get 50 pieces of cured pork sausage and 4 pieces of cured pork loin.

9. Manufacturing Facility

The machinery which has been used for the manufacturing of products can be used again for the repetition of the process. Other tools and auxiliary machinery will also be reused for new processes.

10. Size

The cured pork sausage must have a diameter about 4-5 cm and a length about 30-35 cm.
The cured pork loin should have a diameter 5,5-6,5 cm and a length 25-35 cm.

11. Weight

The weight of the cured pork sausage must be of 250g.
The weight of the cured pork loin must be of 900 g.

12. Aesthetics, Appearance and Finish

The sausage must have a package that allows to see the layer of flora that covers it for its protection. In the case of the pork loin, the package must allow the product to be seen.

Cured pork sausage: red (because of pork meat) and white (because of flora) surface and red and white (because of fat) meat.
Pork loin: orange surface and between red and orange meat.

13. Materials

The cured pork sausage should be composed of 50% of lean pork and 50% of 60-40 lean pork.
The cured pork loin must be 100% pork loin.
The corresponding spices are added to both products.
Materials not related to the main activity (office material) must be acquired with sustainability criteria.

14. Product life span

The label of the product should contain the information of the best-before date.

15. Customer

The elaboration of the products will be based on end consumers preferences.

16. Timescales

The formulation time must be around a month.
The quality test must be done once a month.
The LCA and the Living Labs carried on to know the opinions of the customers will be done in one month.

17. Testing

For the product testing, LCAs will be done. In the Living Labs, it will be checked if the product design is related to the preferences of the consumers. Quality tests will also be carried out.
These tests will be carried out for all production batches. If the results are positive, it will be carried out in the same proportion as for the rest of the batches. In addition, the quality test is compared with similar products.

18. Safety

The product must be cut by an adult person as the utensils that will be used for it are sharp.
The intake of these products is not recommended for children under one and a half years old due to the risk of choking.

19. Processes

It will be used machinery of high energy efficiency and renewable energy sources whenever possible.

20. Ergonomics

The size of the curated pork loin should allow its firm grip with one hand for handling and cutting it easily. The size of the sausage should also allow that

Second Version.

ANIMAL FEEDING

1. **Performance**

The animal feed has to conserve its nutritional properties depending on the stage of the feeding.

2. **Environment**

The product has to be kept in a fresh and dry environment and to conserve its properties during 3 months in there.

3. **Life in Service (Performance)**

It has already been included in last section.

4. **Maintenance**

N/A

5. **Target Product Cost**

The cost of the product was 177 €/Tn. Should be a maximum of 250 €/ton.

6. **Shipping**

The sale of feed should be in bulk for the reduction of its environmental impact. However, as for in bulk modality a big quantity should be produce, ergonomic size sacks were used.

7. **Packing**

The sacks have to be made with eco-friendly materials whenever possible. For pilot characteristics, it was not possible to use alternative materials for the sacks. Paper was used, which is actually a good option.

8. **Manufacturing Facility**

The machinery used for the manufacturing of products can be used again for the repetition of the process. Other tools and auxiliary machinery will also be reused for new processes.

9. **Size**

The granulate of the feed must have a dimension of 3,5 mm.

10. **Weight**

The density of the feed has to be about 700 kg/m^3.

11. **Aesthetics, Appearance and Finish**

The feed has to be compacted in a percentage between 95-97%.

12. **Materials**

The sustainable nutritional formula was developed in accordance with the preidentified rules: use of probiotics instead of antibiotics, use of by-products and use of ingredients with sustainability criteria. According to LCA results, soy flour had the biggest environmental impact, so it was avoided. The sustainable and traditional formula are shown below. The sustainable formula was about a 28,5% more sustainable than the traditional one. Similar materials and criteria should be done in further activities.

Sustainable formula		
Element	**%**	**Origin**
Corn 13%	20,77	Europe 70%, America 30%
Soft wheat F10	15	Europe
Barley	13,53	Europe 50%, Spain 50%
Peas	12	America 50%, Europe 50%
Middlings (from wheat)	11,03	Spain (by-product)
Sunflower cake	10	Spain (by-product)
Rapeseed flour	10	Spain (by-product)
Lard F10	3,52	Spain (by-product)
L-threonine	1,6	Asia
L-Lysine 50	0,83	Asia
Calcium carbonate	0,72	Spain
Salt	0,3	Spain
FIT	0,3	Spian
Monocalcium phosphate	0,25	Spain
L-methionine	0,11	Asia
L- TRYPTOPHAN	0,02	Asia
HOSTAZYM X MicroGranulate	0,01	Spain

Traditional formula		
Element	**%**	**Origin**
Corn 13%	32	Brazil, Eastern Europe
Soft wheat F10	15	Brazil, Eastern Europe
Barley	13,42	Spain
Peas	13,24	Spain
Soy flour 46%	8,79	Brazil
Cookie flour 5%	7	Spain (by-product)
Sunflower cake	5	Brazil, EE
Grease 3-5 F10	1,32	Spain
Calcium carbonate	1,15	Brazil, EE
Lard F10	0,8	Brazil, EE
Sunflower flour 34%	0,66	Spain (by-product)
L-Lysine 50	0,53	Asia
Monocalcium phosphate	0,31	Spain
Salt	0,3	Spain
FIT	0,3	Spain
L-threonine	0,09	Asia
L-methionine	0,07	Asia
Veterinary medicines	0,03	Asia
Additives	0,0029	Asia

13. Product life span

The label of the product should contain the information of the best-before date.

14. Customer

The elaboration of the products is based on the preferences of the end consumers.

15. Timescales

The formulation time should be a month.
The quality test must be done in a month.
The LCA and the Living Labs should influence the nutritional formula.

16. Testing

For the product testing, LCA was done and, prior to the nutritional formula manufacturing, the LCA of the nutritional formula was done in order to check the sustainability improvement. Similar protocol should be followed in further activities.

17. Safety

These tests were carried out for all production batches and results were positive.

18. Processes

Machinery of high energy efficiency and renewable energy sources (biomass and solar energy) should be used.

19. Ergonomics

The sacks should have an appropriated size for its handling.

The weight of the sacks complied with the cargo handling legislation.

LIVESTOCK FARMING

1. Performance

The different stages of growth and fattening of the animals must be defined by the following periods of time:

- Birth to end of weaning of piglets – 21 days.
- End of weaning to fattening transition – 42 days.
- Fattening – 118 days

The weight of the pig at the end of the three must be between 110-115 kg.

2. Animal welfare

An occupation of animals in each cage allowing the free movement of animals must be allowed.
The temperature must be regulated so that it complies with the comfort conditions of the animals.
It should be chosen the specific breeding species in the farm according to the climatic conditions of different periods of the year and animal needs.
The animal welfare certification has to be guaranteed.

3. Prevention of pests and diseases

Preventive treatments by the use of natural products should be prioritized instead the use of antibiotics.

4. Life in service (performance)

The animals must go to the slaughterhouse in a period of time between 5 and 6 months, and a weight of 110-115 kg.

5. Target Product Cost

The farm must not spend more than a certain amount of money: 1,05 €/kg of pig.

6. Shipping

The transport must be carried out in an adapted truck for animal transport and must be as sustainable as possible in terms of CO_2 emissions.

7. Quantity

A total of 50 pigs were grown. The quantity could vary for further activities.

8. Manufacturing Facility

The energy sources should be as clean as possible.
The tools used in the process must be reusable (silos, cages, water troughs)

9. Size and weight

The objective is that the animals go to slaughterhouse with an age of 6 months and a weight 110-115 kg.

10. Materials

The water used should be reused or recycled as much as possible.
The animal feed must have sustainable characteristics.
The use of antibiotics should be minimized.

Minimization of waste through systems such as hydrolysis of corpses.
Increase in recycling rates and in the use of slurry for further uses in agriculture or energy recovery.
Materials not related to the main activity (as office material) must be acquired with sustainability criteria.
Slurry should be correctly manage to reduce the environmental impact of the activity.

11. Product life span

Breeding must be completed in 5-6 months

12. Customer

The elaboration of the products will be based on the preferences and criteria of end consumers.

13. Timescales

The quality test (weight control) must be carried out every week time.
The LCA and the living labs to know the opinion of the clients will be made in a period of time equal to one month.

14. Testing

For the testing of the products LCA's will be carried out. In the living labs it will be checked if the design of the product is related to the thoughts of the consumers.
Quality tests will be carried out. These tests will be carried out for all the production batches (6 batches that are equivalent to 6 pigs). If the results are positive, it will be carried out in the same proportion as for the rest of the products. In addition, the quality test will be compared with similar products.

SLAUGHTERHOUSE

1. Performance

N/A

2. Environment

N/A

3. Life in Service (Performance)

N/A

4. Maintenance

N/A

5. Target Product Cost

Pork loin: 3€/kg (-20%) = 2,40 €/kg.
Lean pork: 2€/kg (-20%) = 1,60€/kg

6. Shipping

Refrigerated truck

7. Packing

The product is conveyed and packed in boxes and pallets

8. Quantity

25-30 kg of meat from each pig

9. Manufacturing Facility

The machinery which has been used for the manufacturing of products can be used again for the repetition of the process. Other tools and auxiliary machinery will also be reused for new processes.

10. Size

The pork loin must have a size of 0,7-0,8m.

11. Weight

Pork loin:3,5 kg.
Lean pork: 20 kg.

12. Aesthetics, Appearance and Finish

The finish of the process must have these stages: immersion in hot water, peeling machine, flagellating machine, singeing machine, washing and cleaning.

13. Materials

CO2 is used in the stunning process
Materials not related to the main activity (as office material) must be acquired with sustainability criteria.

14. Product life span

3-5 days

15. Customer

The different techniques used are based on the preferences of the end consumer (e.g., less suffering of the animal)

16. Timescales

N/A

17. Testing

Organoleptic test

18. Safety

N/A

19. Processes

It will be used machinery of high energy efficiency as well as renewable energy sources whenever possible.
Machinery with low water footprint will be used.
Processes and techniques with low impacts on these aspects will be implemented.

20. Ergonomics

N/A

MEAT ELABORATES

1. Performance

Products must have specific nutritive and organoleptic properties. Both products are destined to be consumed fresh.

- Pork loin:

Description: meat product made with the "ileoespinal" muscle of the pig (practically free of external fat). It contains condiments, spices and authorized additives, subjected to a process of maturation and drying.
Ingredients: pork loin, salt, paprika, citrid acid.
Nutritional value:
Average values per 100 g of product:
Energy value 240.6 Kcal / 1010.8 KJ; Fat 9.5 g (4.4g of saturated fat) ; Carbohydrates 3.9 g (sugars: 1 g); Proteins 34.8 g; Salt 6.1 g.
Chemical and microbiological specifications:

Microbiological parameter	Maximum limits
Escherichia coli	100 cfu / g
Salmonella spp	Absence / 25 g
Listeria monocytogenes	100 cfu / g
Coagulase-positive staphylococci	100 cfu / g
Clostridium perfringens	100 cfu / g
Dioxins and PCBs	1.5 pg / g fat

- Cured pork sausage:

Description: meat product prepared by selecting, chopping and mincing meat. It contains condiments, spices and authorized additives, subjected to a process of maturation and drying.
Ingredients: Pork, salt, pepper, dextrine, citrid acid, milk powder, sugars (from beet), Potasium phosphate (stabilizers, pentasodium, sodium polyphosphate).
Nutritional value:
Average values per 100 g of product:
Energy value 423,6 Kcal / 1779.8 KJ; Fat 34g (13g of saturated fat) ; Carbohydrates 6.0 g (sugars: 2.9 g); Proteins 23.4 g; Salt 4 g.
Chemical and microbiological specifications:

Microbiological parameter	Maximum limits
Escherichia coli	100 cfu / g
Salmonella spp	Absence / 25 g
Listeria monocytogenes	100 cfu / g
Coagulase-positive staphylococci	100 cfu / g
Clostridium perfringens	100 cfu / g
Dioxins and PCBs	1.5 pg / g fat

The products must have a certain hardness, so that they can be cut easily.

2. Environment

The products must maintain their properties for a period of 90 (cured pork sausage)/180 days (cured pork loin). The whole piece (as it is acquired at the point of sale) must hold a period of 90/180 days if it is in a cool and dry place. Once the product has been opened, it must hold a period of 90/180 days in the refrigerator.
The cured pork sausage should have an edible protective layer for this purpose, the protective layer of the cured pork loin will be inedible.

3. Life in Service (Performance)

It has already been included in last section. It has to have a certain period of time of life in service when it is kept in the appropriated environment.

4. Maintenance

The product does not need to be cooked before eating it.

At the point of sale: store in a cool, dry place. At room temperature the product may lose organoleptic qualities such as hardening and rancidity or alteration of the surface flora, although it remains microbiologically stable.

5. Target Product Cost

The cost of the product should be about a 10% more than the traditional version, in order to be affordable for the citizenship.

6. Shipping

During transport and storage: temperature between 0ºC and 5ºC.

- Pork loin:
  - Type of Packaging: Box
  - Number of pieces per box: 8
  - Net Weight: 8 Kg (approx.).
  - Length: 360 mm
  - Height: 190 mm
  - Width: 210 mm
  - Weight Box: 0,210Kg.
  - Boxes per wooden pallet: 55
  - Total height (including wooden pallet): 1100 mm
  - Total weight (including wooden pallet): 475kg.

- Cured pork sausage:
  - Type of Packaging: Box
  - Number of pieces per box: 12
  - Net Weight: 3 Kg.
  - Length: 355 mm
  - Height: 120 mm
  - Width: 210 mm
  - Weight Box: 0'280 Kg.
  - Boxes per wooden pallet: 108
  - Total height (including wooden pallet): 1300 mm
  - Total weight (including wooden pallet): 376,24 kg.

7. Packing

The cured pork sausage must have a package that allows checking the texture of the product without touching it directly and making it possible to aerate the product. For the sustainable version, a bioplastic or biodegradable solution should be used.
The pork loin should be vacuum packed with a protective atmosphere that should protect it from water, air and other external agents. If there is a possibility to use a sustainable packaging, it should be used. However, for pilot activities it was not.

8. Quantity

For each pig you will get 50 pieces of cured pork sausage and 4 pieces of cured pork loin.

9. Manufacturing Facility

The machinery which has been used for the manufacturing of products can be used again for the repetition of the process. Other tools and auxiliary machinery will also be reused for new processes.

10. Size

The cured pork sausage must have a diameter about 4-5 cm and a length about 30-35 cm.
The cured pork loin should have a diameter 5,5-6,5 cm and a length 25-35 cm.

11. Weight

The weight of the cured pork sausage must be of 250g.
The weight of the cured pork loin must be of 900 g.

12. Aesthetics, Appearance and Finish

The sausage must have a package that allows to see the layer of flora that covers it for its protection. In the case of the pork loin, the package must allow the product to be seen.
Cured pork sausage: red (because of pork meat) and white (because of flora) surface and red and white (because of fat) meat.
Pork loin: orange surface and between red and orange meat.

13. Materials

The cured pork sausage should be composed of 50% of lean pork and 50% of 60-40 lean pork.
The cured pork loin must be 100% pork loin.
The corresponding spices are added to both products.
Materials not related to the main activity (office material) must be acquired with sustainability criteria.

14. Product life span

The label of the product should contain the information of the best-before date.

15. Customer

The elaboration of the products will be based on end consumers preferences.

16. Timescales

The formulation time must be around a month.
The quality test must be done once a month.
The LCA and the Living Labs carried on to know the opinions of the customers will be done in one month.

17. Testing

For the product testing, LCAs will be done. In the Living Labs, it will be checked if the product design is related to the preferences of the consumers. Quality tests will also be carried out.
These tests will be carried out for all production batches. If the results are positive, it will be carried out in the same proportion as for the rest of the batches. In addition, the quality test is compared with similar products.

18. Safety

The product must be cut by an adult person as the utensils that will be used for it are sharp.
The intake of these products is not recommended for children under one and a half years old due to the risk of choking.

19. Processes

It will be used machinery of high energy efficiency and renewable energy sources whenever possible.

20. Ergonomics

The size of the curated pork loin should allow its firm grip with one hand for handling and cutting it easily. The size of the sausage should also allow that