

# IMPLEMENTATION OF A NEW DEMONSTRATIVE BUSINESS MODEL BASED ON THE UPCYCLING OF PLASTIC WASTE FROM AGRICULTURAL ACTIVITIES IN LA RIOJA

***The ORHI project (EFA142/16) is 65% co-financed by the European Regional Development Fund (ERDF), through the Interreg V-A Spain-France-Andorra Programme (POCTEFA 2014-2020).***

# Antecedentes



**Unstoppable increase  
of plastic waste on  
the planet.**



**Process  
transformation in  
product life cycle:  
use reduction and  
circular reuse**

In the EU, 26% of  
plastic waste is  
recovered and 9.2% is  
recycled.

**España Circular 2030.  
Adapted solutions for  
agricultural plastic  
waste  
New circular  
economy model.**



**Climate emergency  
2019**

5% of the plastic  
consumed comes  
from the  
agricultural sector  
(ANAIP).

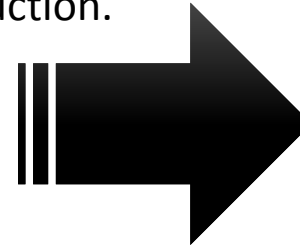
**EU Directive  
Single Use Plastics  
Ban 2021**



## Agricultural plastics uses:

- Productivity of crops increased x4.
- Crop area reduction for an equal amount of production.
- Water consumption reduced by 30%.
- Pesticide and fertiliser use reduction.
- Higher commercial quality of products
- Cost reduction for farmers and consumers

FILMS, IRRIGATION TUBE, GREENHOUSE  
PLASTICS, SEEDLING TRAYS...



“There is no short-term solution to slow the growth of agricultural plastic use.”



Biodegradable EN-17033: 90% of the polymer becomes c02.

More expensive and not suitable for all crops.  
Photodegradable becomes micro plastics.

# Plastic typology

**Films**  
Several colours and  
thicknesses



**Mushroom**

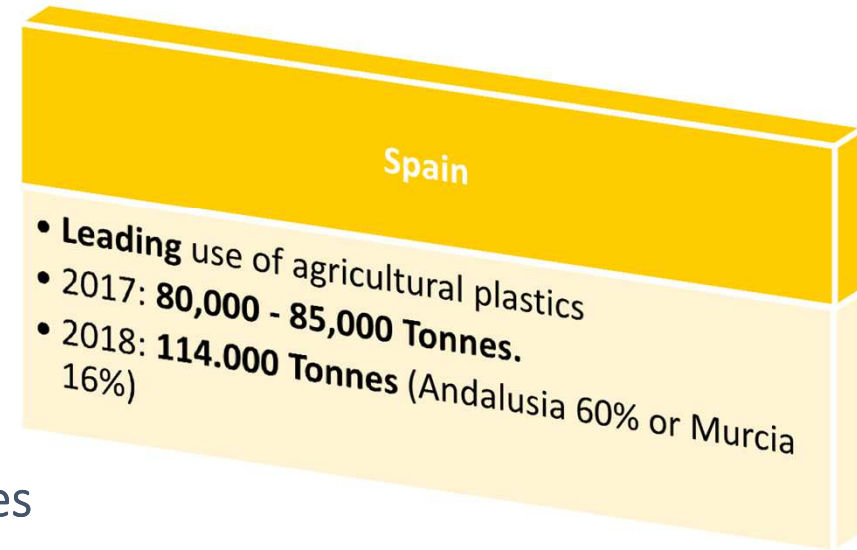
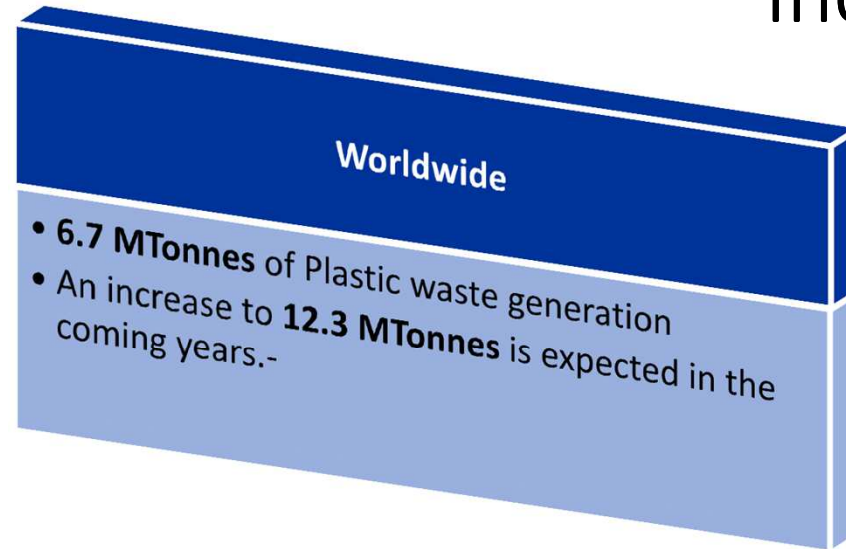


**Irrigation tube**



## SOME INDICATORS

# Indicators I



## Specific issues

**Film and irrigation pipe plastic waste** and, to a lesser extent, other waste such as boxes, tunnels or ropes.

**Mushroom plastic waste.** PRADEJON WASTE CENTRE ("Green Point")



# Indicators II

## FILMS

Horticultural crops that used plastic in La Rioja  
250 kg and 400 kg per Hectare (UAGN)  
325 kg/ha (according to Cicoplast) \* 4,721 ha.  
Recovery rate: 0.8  
Single-use plastic.  
1,532 tns - film (900 tn - mushroom)  
 $1,532 * 0.8 = 1,227.46$  tns.

## IRRIGATION TUBE

115 kg/ha  
115 kg/ha \* 4.721 has.  
542,9 tns.

CROP	2018 AREA ( HA)	Average irrigated yields (kg/ha)	Total Production (tn)
ASPARAGUS	96	3950	
LETTUCE	107	30000* <sup>1</sup>	2862
ESCAROLA	12	29000* <sup>1</sup>	293
PUMPKIN AND ZUCCHINI	40	66700	1452
CUCUMBER	20	25000* <sup>2</sup>	574
EGGPLANT	18	47000* <sup>2</sup>	846
TOMATO	210	73000* <sup>2</sup>	15861
PEPPER	201	29000* <sup>2</sup>	5865
GUINDILLA	6	11000* <sup>2</sup>	66
STRAWBERRY	1	4000* <sup>1</sup>	4
ONION	63	45000* <sup>2</sup>	2835
GREEN BEANS	1162	14870* <sup>2</sup>	17435
GREEN PEAS	1389	7800* <sup>2</sup>	10847
BORAD BEANS	32	4225* <sup>2</sup>	135
MUSHROOM	300* <sup>3</sup>		70668
FUNGI			6815

1. Intensive protected irrigated areas. 2. Outdoor irrigated areas. 3. 2018 data (base 2017=281 ha).

# Indicators III

<b>No. of potential beneficiary farms</b>	<b>9.519 farms</b>
<b>Agricultural work unit (AWU)</b>	<b>7.911 AWU</b>
<b>AWU Average per farm</b>	<b>0.83 AWU</b>
<b>Total agricultural production</b>	<b>27,8%</b>
<b>Horticultural area (including mushroom and fungi)</b>	<b>4.721 Ha</b>
<b>Film plastic average use per Ha</b>	<b>325 kg</b>
<b>Film plastic used</b>	<b>1.534,32 Tonnes</b>
<b>Film plastic waste</b>	<b>1.227 Tonnes</b>
<b>Irrigation tube average use per Ha</b>	<b>115 kgs</b>
<b>Irrigation tube waste</b>	<b>542,9 Tonnes</b>
<b>Total Plastic Waste (Film + irrigation tube)</b>	<b>1.769,9 Tonnes</b>



# Spanish shared concerns

Agricultural plastic removal on the farm. There is no more or less standardised system. Combination of traditional and mechanical strategies. The market does not offer ad hoc mechanical solutions.

Agricultural plastic waste management. La Rioja Waste Master Plan 2016-2026. There are no specific regulations. There is no obligation for packers to have a management system.

The farmer must be responsible for "valuing" this plastic waste with the support of the sector-COOP. To do so, he must "contract" the management of the APW (Agricultural Plastic Waste) individually. Future HARMONISATION of "Landfill" prices. Competence between Autonomous Regions.

Valorisation of film, irrigation tubes or greenhouse plastics, the plastic waste from mushrooms requires a mechanical cleaning process...

Demand reduction for plastic waste by companies, the Asian market and break in the chain with the waste manager.



**THE MARKET DOES NOT VALORISE THIS WASTE -  
EACH AUTONOMOUS COMMUNITY ADOPTS  
DIFFERENT STRATEGIES TO PUT PRESSURE ON  
FARMERS.**

**DIFFERENT COSTS FOR THE MANAGEMENT AND  
TREATMENT OF AGRICULTURAL PLASTIC WASTE  
- HARMONISATION?**

# La Rioja situation

The farmer (in practice) in La Rioja is responsible for transporting the waste to a collection centre (Coop.) or takes it directly to a treatment centre for burial or incineration. Costs of removal, transport and management in a waste treatment centre.

Disparity of prices in each autonomous community for plastic treatment. Competition between treatment centres in bordering Communities. La Rioja has the lowest prices (16 euros / tonne).

COOPs buy the different plastics for their members and also often stockpile plastic to reduce the cost of transport to the treatment centre and then spread the costs among the farmers. Stockpiling in the COOP can generate regulatory and environmental problems (risks...).

Some farmers and/or agricultural companies (the fewest...) may collect it on their farms and bring it directly to the treatment centre.

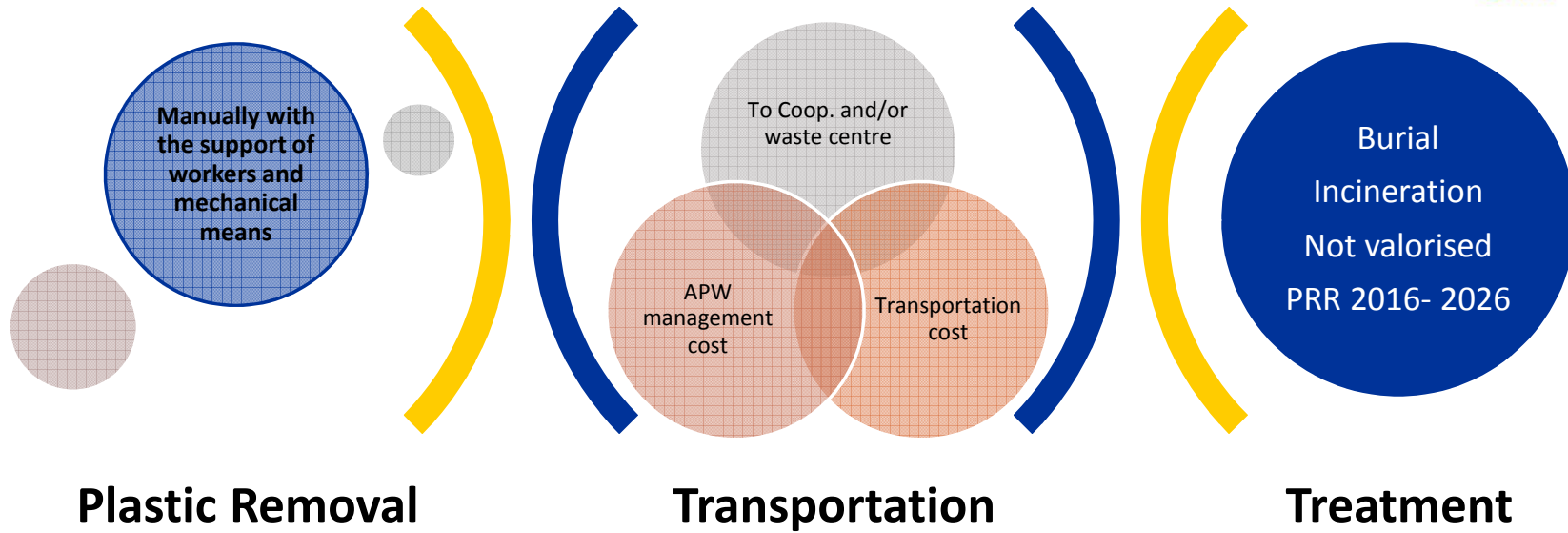
There are no sectoral indications and there is no entity leading the situation at the moment, although the concern in the sector is evident. There is no data on agricultural plastic waste going to "landfill".

The Regional Administration emphasises the need for plastic waste to disappear from professional farms, although it is obviously not recovered. Waste master plan 2016-2026

In addition to this, we must add the more specific problem of plastic mushroom waste. Only the spent substrate is to be recovered; the demand for plastic waste has been gradually decreasing.

In amateur agriculture, more diverse practices can be used to avoid these costs (burning, containerisation, burying, etc...).

# APW Management in La Rioja



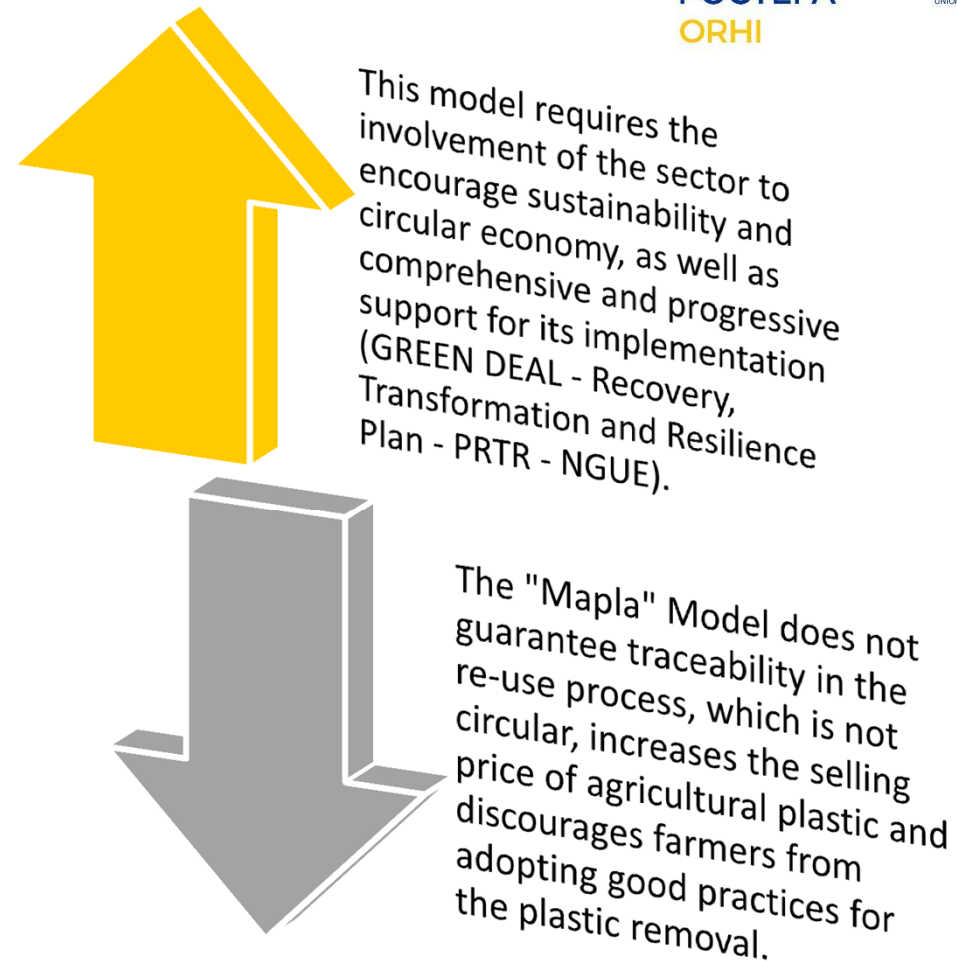
- Lack of measurable management indicators.
- Monitoring and traceability needs.

1

Circular management integral system based on public-private collaboration with agents/companies from the COMMUNITY OF LA RIOJA itself.

2

Extended Responsibility Systems as may exist in other types of waste (packaging, tyres...).



# UPCYCLING TRIAL

# Justification



La Rioja's mushroom sector produces around 78,000 t of mushrooms, being the largest producer region in Spain, with 50% of the national production and 8% of the European production.

## Waste:

Exhausted substrate 200,000 tns.

Perforated polyethylene 900 - 1,200 tns.



Waste Recycling Centre



# UPCYCLING trial phases

PHASE 0: ADER



Technical preparation of all the work phases to be performed and their monitoring.

PHASE 1: CTICH - ASOCHAMP



Film selection - plastic already separated from the exhausted substrate to perform a consistent trial (plastic typology and components for the mixture). 12 tonnes.

PHASE 2: SOLTECO



Transportation and pre-treatment for valorisation

PHASE 3: SOLTECO



Industrial treatment and 100% re-usable and recyclable products manufacturing

CLOSING PHASE



Final report of incidents and technical, economic and environmental indicators.

Public-Private  
Partnership  
to  
INNOVATION



# Phase 0: Start-up

CALL	MEETING: ORHI PROJECT - UPCYCLING TEST - PLASTIC MUSHROOM WASTE
MATTER	To assess the situation of plastic waste generated by mushroom cultivation.
GOAL	To define the tasks to be performed for the upcycling trial.
PLACE	Sustratos de La Rioja. Centro de Tratamiento de Pradejón.
DATE/TIME	09/02/2021 08:30 - 10:30
ATTENDANTS	Francisco Sáenz López. President of ASOCHAMP
	Pablo Martínez Martínez. CTICH
	José Vicente Sainz. Manager of Solteco Madera Plástica SL.
	Arturo Ferrer: Iter Investigación SL.

## 1 Visit the facilities of the Pradejón Mushroom Waste Recycling Center..

- Presentation of the Orhi Project, coordinated in La Rioja by ADER - Economic Development Agency of La Rioja.
- On-site visit to the facilities to learn about the work process and the situation of the plastic waste generated. The center has its own system using a Tromel which separates the exhausted substrate from the plastic, achieving the elimination of the maximum level of impurities.
- The on-site assessment of the plastic condition is good and, therefore, it is possible to carry out the trial at Solteco's facilities. As we have been able to verify, most of the plastic or film is colorless (90%), although there is a smaller amount of black color (10%). The black color only generates products of the same color, since it cannot be dyed in any other color, although beyond this market issue, it does not pose any additional problem. According to the information provided by the people in charge of ASCHOAMP and CTICH, the components of the different plastics are the same: LDPE, LLDPE and HDPE. These components are all valid for the multi-compaction together with other polymeric materials necessary in the industrial process.
- Until now there was a determined demand for this plastic due to the existence of a considerable request of plastic coming from Asia. Now that this trend is disappearing, the lack of recyclers that can manage this plastic is a socio-economic and environmental problem for the sector. .
- We agree to review the plastic consumed by the sector and the plastic that arrives at the Recycling Center, although most of the plastic is delivered by the farmer to this Center, once its cycle in the cultivation process is finished.
- The President of ASOCHAMP raises the current problem of plastic and the possibility of evaluating a product for the sector, within a process of circular economy, from the plastic waste generated with the cultivation of mushrooms.
- On the other hand, we have specified certain aspects to carry out the test:.
- From the Project, we are in charge of providing a specific transport (truck) to collect around 8-10 tons of the plastic waste that we have already seen.
  1. Drafting of different worksheets for the follow-up of the test.
  2. Identification of possible sector-related products from this plastic waste..
  3. Solteco SL's invitation to ASOCHAMP - CTICH to check in situ the manufacturing process from the plastic waste
  4. To agree on the dates, although it is proposed to collect plastics and carry out the test in two weeks..

## 2 Tasks and commitments:

- Minutes mailing and approval. Arturo Ferrer. Iter Investigación SL.
- Truck to be sent for plastic waste collection. Arturo Ferrer. Iter Investigación SL.
- Worksheet creation for the pilot trial follow up.

# Phase 1: Sorting and logistics



- Waste Typology**
- Plastic waste: Black microperforated film.
  - Colorless shrink film.
  - Black industrial film.

**Quantity** 8-10Tm (prueba piloto upcycling)

**Pick-up location** Centro de Reciclaje del Residuo del Champiñón Pradejón

**Date / time** 18 de febrero de 2021

**Final destination** Planta de valorización y transformación de la empresa SOLTECO madera plástica, Alfaro, La Rioja.

**Trasportation** Solteco SL

**Practical guidelines for use in logistics for delivery to Solteco (developed by Asochamp and ratified by Solteco warehouse managers).**

The plastic bales must be properly compacted and strapped, optimizing the space required for transport and minimizing the carbon footprint caused by transport from the storage or packaging area to the Recovery and Transformation company.

All plastic bales must be provided with a work sheet including the origin, quantity and type of waste, as well as the name, surname and mushroom production company from which it comes from.

It will also be identified if the transport to the consolidation plant is carried out by their own means or by a third party's transport. The general condition of the waste and an on-site assessment of the degree and type of impurities which can be made from a visual inspection should be included in the form.

The farmer will collect a copy of the receipt where the referred data will be collected, amount, origin, type of plastic, etc... validating its good practice for registration and possible participation in bonuses or projects of positive reinforcement to good circular practices of the APW.

# Phase 2: Pre-treatment

## Waste Tipology

- Plastic waste: Black microperforated film.
- Colorless shrink film.
- Black industrial film.

Amount	8.200 Kgs + 3.280 Kgs = 11.480 Kgs (TOTAL)
Place	SOLTECO's valorization and transformation plant
Date/time	22,23,24 February and 11-12 March (2021)
Invested time	<ul style="list-style-type: none"> <li>• 38 hours in Valorization, trommel screening and separation, first shredding and sorting of plastic materials + silo storage.</li> </ul>

Machine Cost	Screening and separation trommel, crusher, sorting belts, silo. 540 €
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Staff	1 Machine officer 2 Pre-treatment/valuation factory operators
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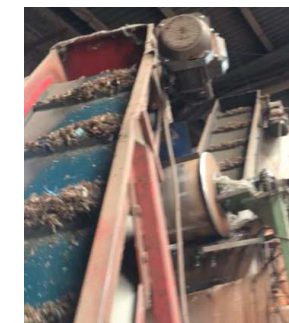
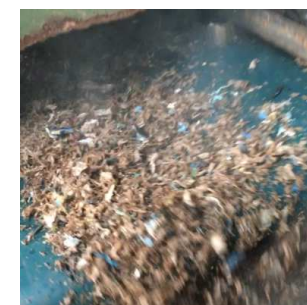
Staff Cost	1.080 €
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Tonnes of pre-treated material (valorized) per day	2.400 Kgs per working day (8 horas)
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Rejected amount in kg, due to its non-viability in the valorization process.	97% of the total amount of plastic waste shipped is reused and recycled.
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## Process Description

- Unloading transport bales
- Disassembly and separation of plastic bales.
- Separation by plastic typology and impurities,
- First shredding
- Second revision of impurities
- Storage and shipment to the first stage of transformation.





# Phase 3: Industrialisation

## Raw Material

- Plastic waste: Black microperforated film.
- Colorless shrink film.
- Black industrial film.

**Amount** 8.200 Kgs + 3.280 Kgs = 11.480 Kgs (TOTAL)  
**Place** SOLTECO's valorization and transformation plant  
**Date/time** 22,23,24 February and 11-12 March (2021)

**Invested time in processing**

- 48 hours total: 1 furnace machine operator, material cake generation, second phase crushers, extrusion and two transformation operators..

**Required machines** 1st extrusion furnace, Mixing mill, 2nd extrusion furnace feed, 2nd extrusion furnace, Mold filling and finished profile ejection.

**Costs** 960 €

**Staff**  
1 Officer  
3 factory operator

**Costs** 1.364 €

PROFILE 230X80X2500 BLACK, 64 PCS OF 42,55 KGS, WEIGHT 2.723,20 KGS  
 PROFILE 230X80X1500 BROWN, 22 PCS OF 25,53 KGS, WEIGHT 561,66 KGS  
 PROFILE 160X60X60X2000 BROWN, 118 PCS OF 18,65 KGS, WEIGHT 2.200,70 KGS  
 PROFILE 160X60X60X2000 BLACK, 44 PCS. OF 18.65 KGS, WEIGHT 820.60 KGS.  
 PROFILE 125X35X2000 BROWN, 240 PCS OF 8.50 KGS, WEIGHT 2,040 KGS  
 PROFILE 125X35X2000 BLACK, 60 PCS. OF 8.50 KGS, WEIGHT 510 KGS.  
 PROFILE 110X50X2000 BLACK, 19 PCS OF 10.68 KGS, WEIGHT 202.92 KGS  
 FENCE POST BASIN 106X106X1500, 40 PCS OF 14,94 KGS, WEIGHT 597,60 KGS  
 ROUND PROFILE DIAMETER 100X2000, 76 PCS OF 25,78 KGS, WEIGHT 1.959,28  
 TOTAL WEIGHT 11.615, 96 KGS

## Resulting Profile

- Mixing ratio: 60% ( mushroom plastic) and 40% (other materials) for products in black, grey or dark brown (the most sold), for other colours (green or red), the mixing ratio is 30% (mushroom plastic) and 70% (other materials).
- Collection of shredded material at first grinding- Adding the mixture with colourant.
- Dumping of the plastic shredded material in the oven.
- Collection of the resulting cake (plastic emulsion) and transfer to cooling zones.
- Second crushing of plastic cakes.
- Production of plastic granules- Second baking and feeding to extruder moulding machine- Profile output from the moulds
- Storage and cooling of profiles.

## Process Description



Insulation for the construction of culture chambers.

**Some ideas for  
mushroom sector  
final products:**

Mushroom racks.

Palots.

Technical, environmental  
and economic feasibility.

Resulting products &  
Upcycling test.



## Technical feasibility:

- Adequate polymer composition (LDPE, LLDPE, HDPE).
- Proper level of impurities for treatment.
- Excessive humidity due to long periods outdoors.
- 97% efficiency of the 12-tonne test.



## Economic Feasibility:

- 900 tonnes per year: Landfill tonnage fee (16 euro-tns) and logistics (20 tonnes per trip).
- 900,000 kg of material
- Agreement with Sustratos de la Rioja (deposit and return).
- 1,5€/kg of plastic profiles - 2,5€/kg of final product



## Environmental feasibility:

- Leachate-free system in the industrial process.
- 100% renewable and recyclable.
- Circular economy for the sector and for other areas from the generated plastic waste.

# UPCYCLING PRODUCTS



# Profiles

**Perfilería**  
*simil madera*

**solteco**  
madera plástica



**Interreg**  
POCTEFA  
ORHI



UNION EUROPEA  
UNION EUROPÉENNE

ELABORADO A PARTIR DE  
RESIDUO PLÁSTICO DEL  
CULTIVO DEL CHAMPIÑÓN

100% RENOVABLE Y  
RECICLABLE



[www.solteco.es](http://www.solteco.es)

# Fence "Black"



**Vallado Black  
solteco**

**solteco**  
madera plástica



**Interreg**  
POCTEFA  
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## AN INTEGRAL APW MANAGEMENT SYSTEM





# 1. Plastic waste source



FARMER

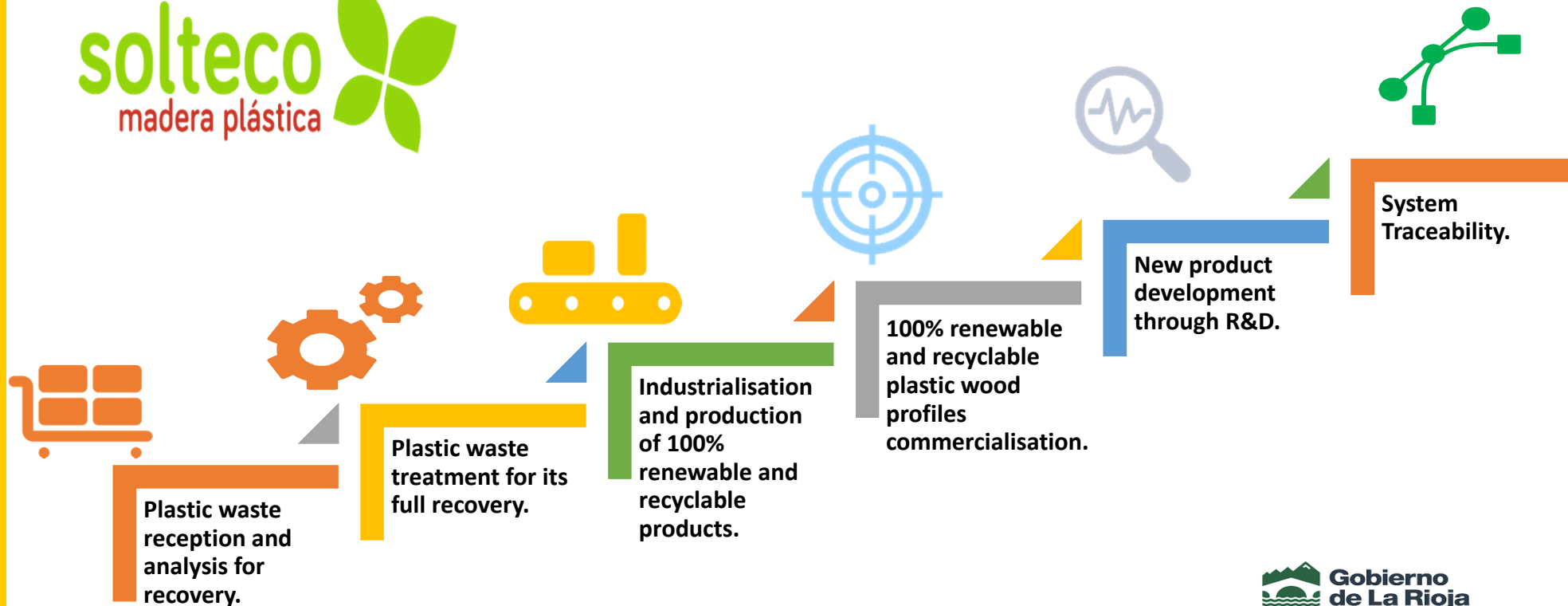


- Agricultural associations' agreement to integrate the sector.
- Good practices in the sector to improve the removal of plastic. Plastic delivery to the defined Smart Green Point (identify Smart Green Point).
- Payment of the corresponding fee for its recovery by the system ( previously landfill) through the Smart Green Point (coop.).
- Fiscal and economic incentives for the purchase of 100% recycled and recyclable materials from the plastic waste generated in the sector.

## 2. SMART GREEN POINT (Coop.)

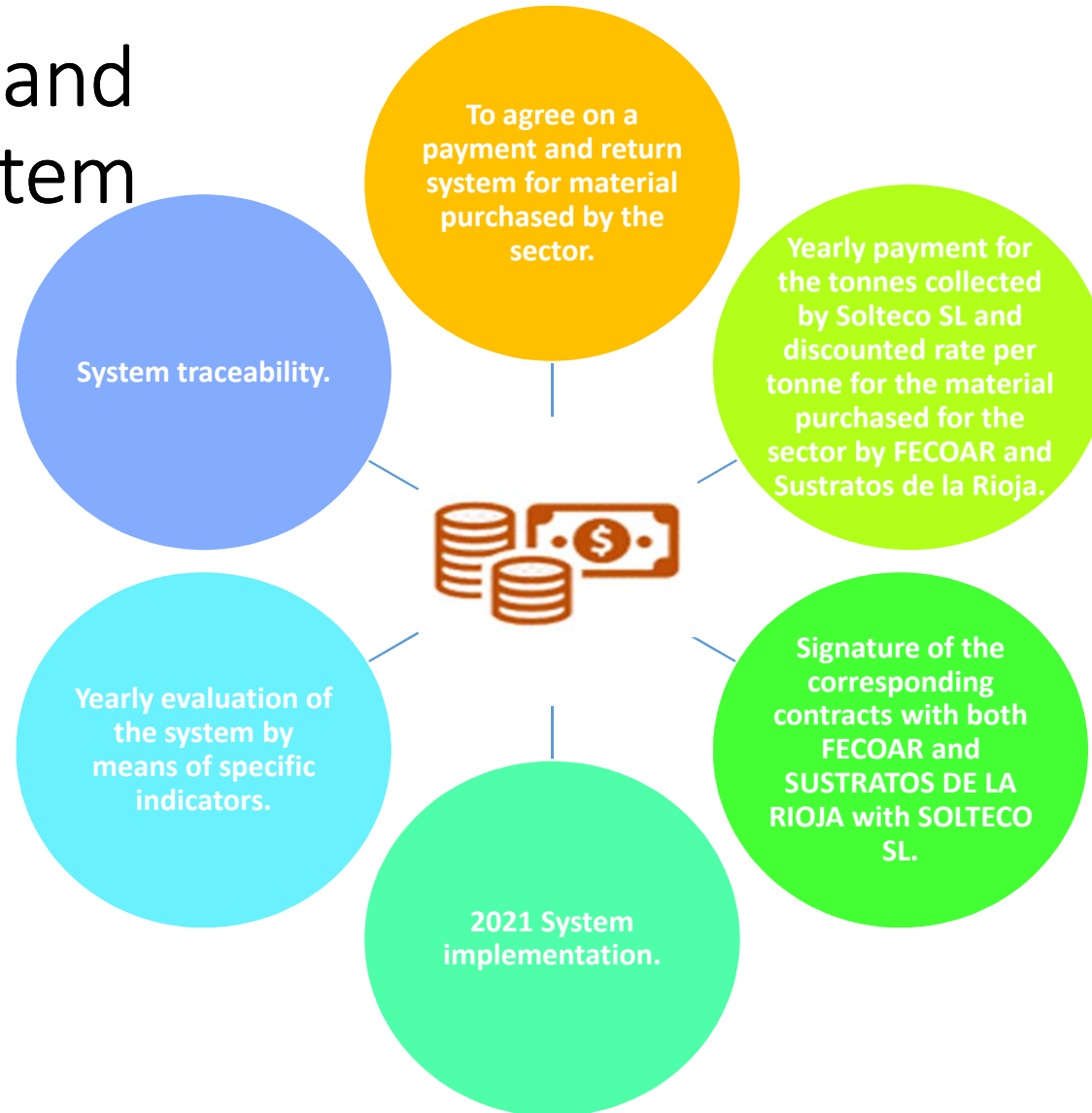


### 3. Re-use of plastic waste for recovery





# 4. Storage and Return System



# 5. Compra pública verde incentivada



Design of an incentive-based green public procurement system in collaboration with the local authorities of La Rioja (plastic profiles and street equipment).

Financial support to each local entity, once the purchasing model has been approved, by the Government of La Rioja.

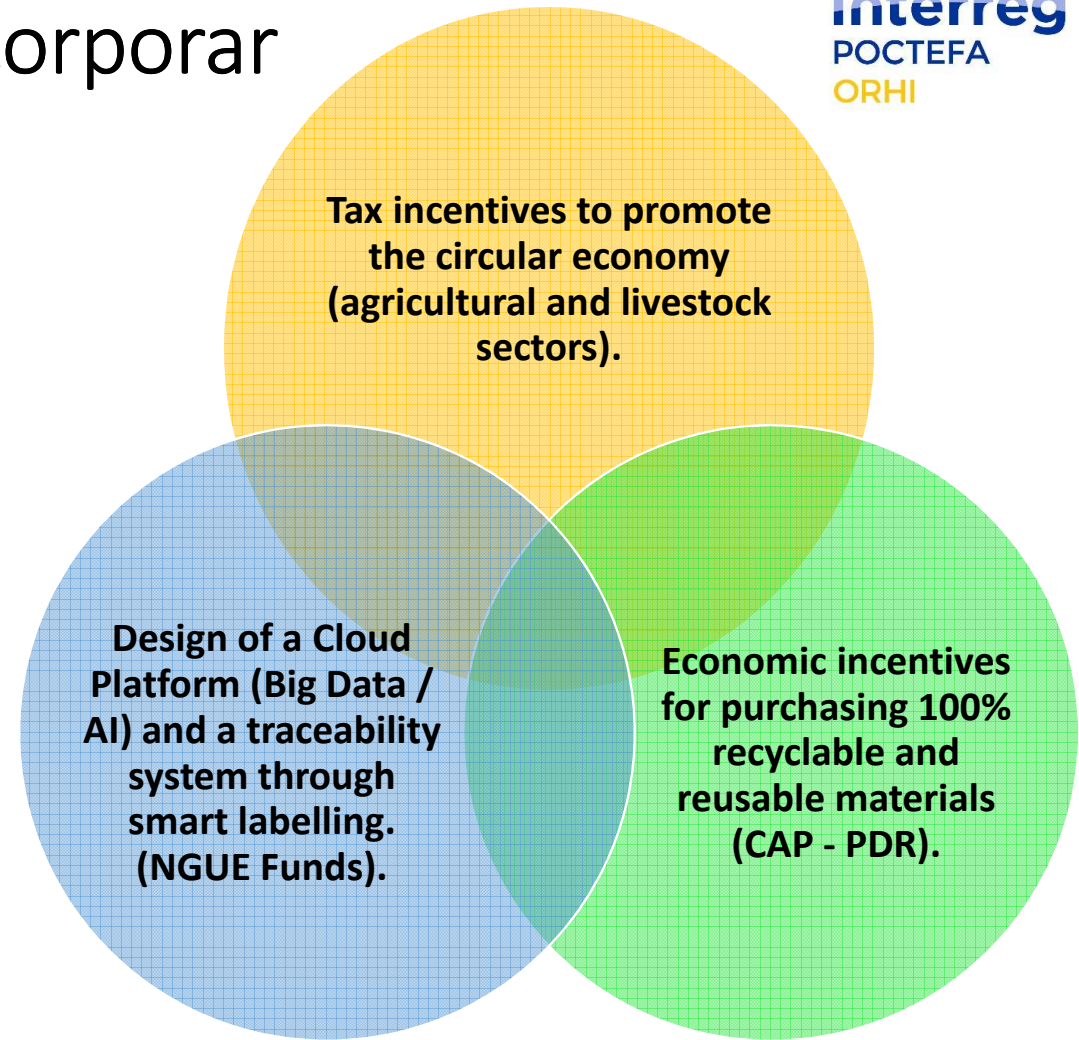
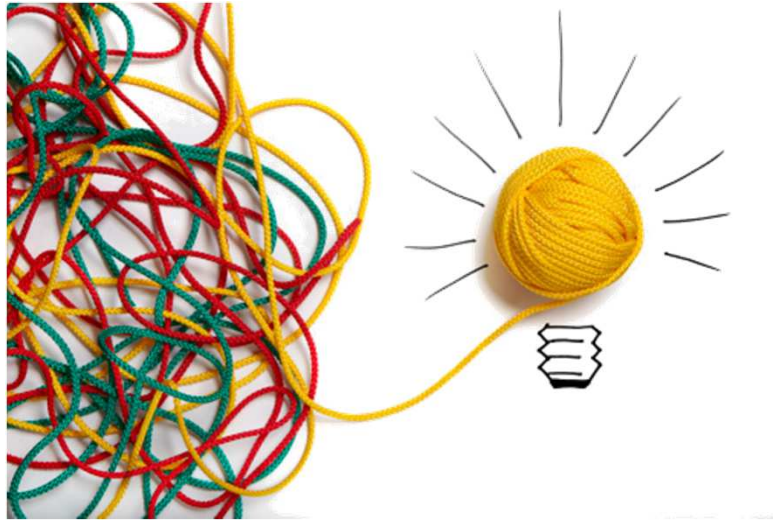
Programme communication and awareness with the local entities in the region.

Programme evaluation and indicators.

System traceability.



## 6. Otras acciones a incorporar al sistema





## Economical Development Agency of La Rioja (ADER) contact:

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