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Activity/case study 1

From waste to value: the case of chocolate

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This work has been developed under the ERASMUS-EDU-2022-PI-FORWARD Project "*Glocal Ecosystems and Expanded Knowledge for green skills and capability in the Food Sector*" (**G4F**) - Project n° 101087203.
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Scenario

The chocolate confectionery industry is very broad, including chocolate bars, chocolate blocks, boxed chocolates and other chocolate products.

Chocolate itself includes dark, white and milky chocolate, but it is frequently combined with other components such as nuts, dried or candied fruit, or other confectionery.

Chocolate is a dense solid made up of 60-70% particulate solids (Afoakwa, 2008), with cocoa, sugar, vegetable fats or cocoa butter or both as main ingredients, obtained from a highly complex process.

Confectionery products	Raw materials	Product chemical composition	Nutritional content
Chocolate	Sucrose, Cocoa, Vegetable fat/ Cocoa butter, Milk, Lecithin	Free fatty acids, Polyphenols, Lactose, Protein, Potassium, Magnesium, Copper, Iron	Energy 507 calories Water 1.1% Carbohydrates 57 g/100 g Protein 4.2 g/ 100 g Fats 35.7 g/100 g

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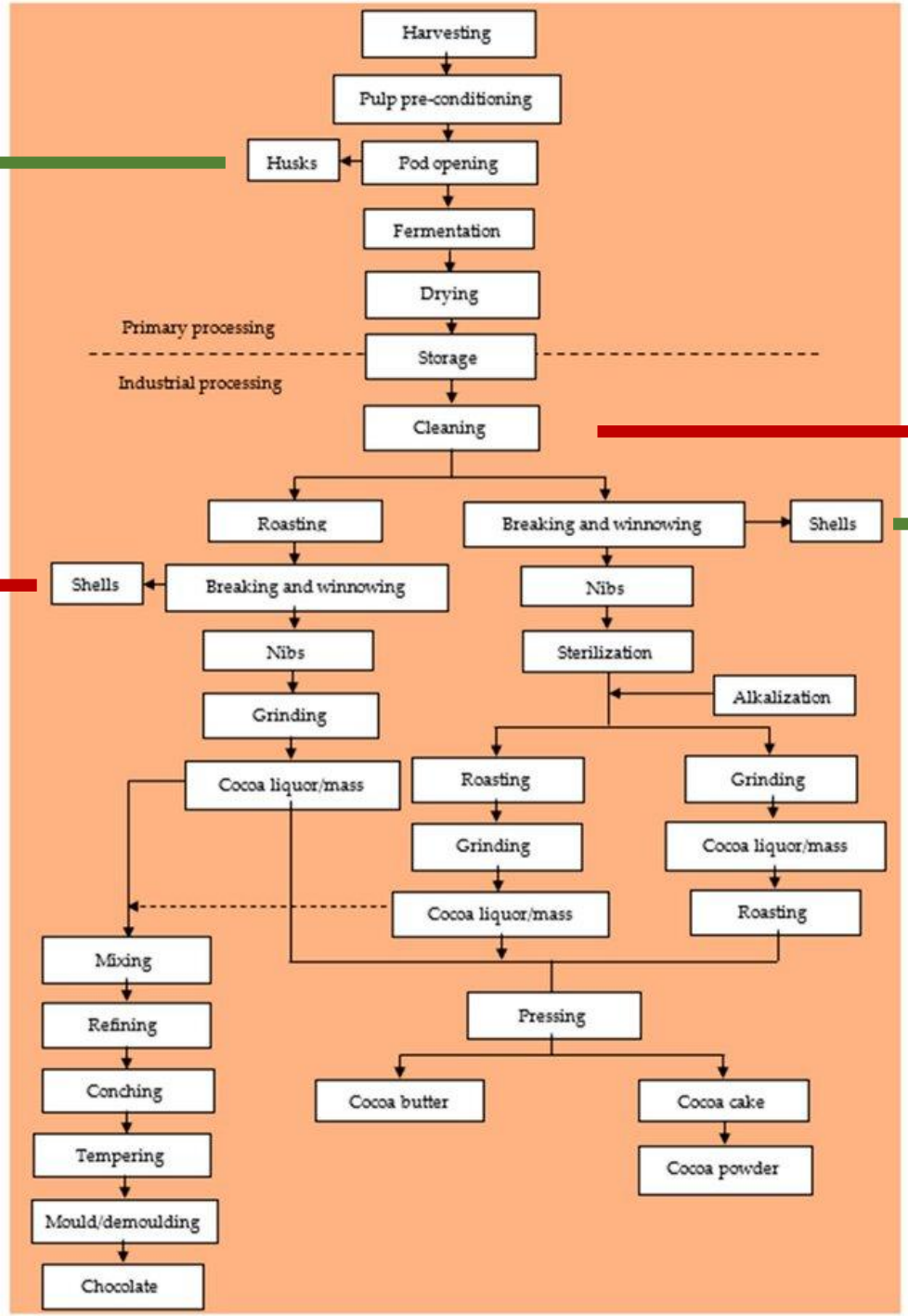
Fibers, bioactive compounds



Below standard
Degraded/spoiled

Fibers, bioactive compounds

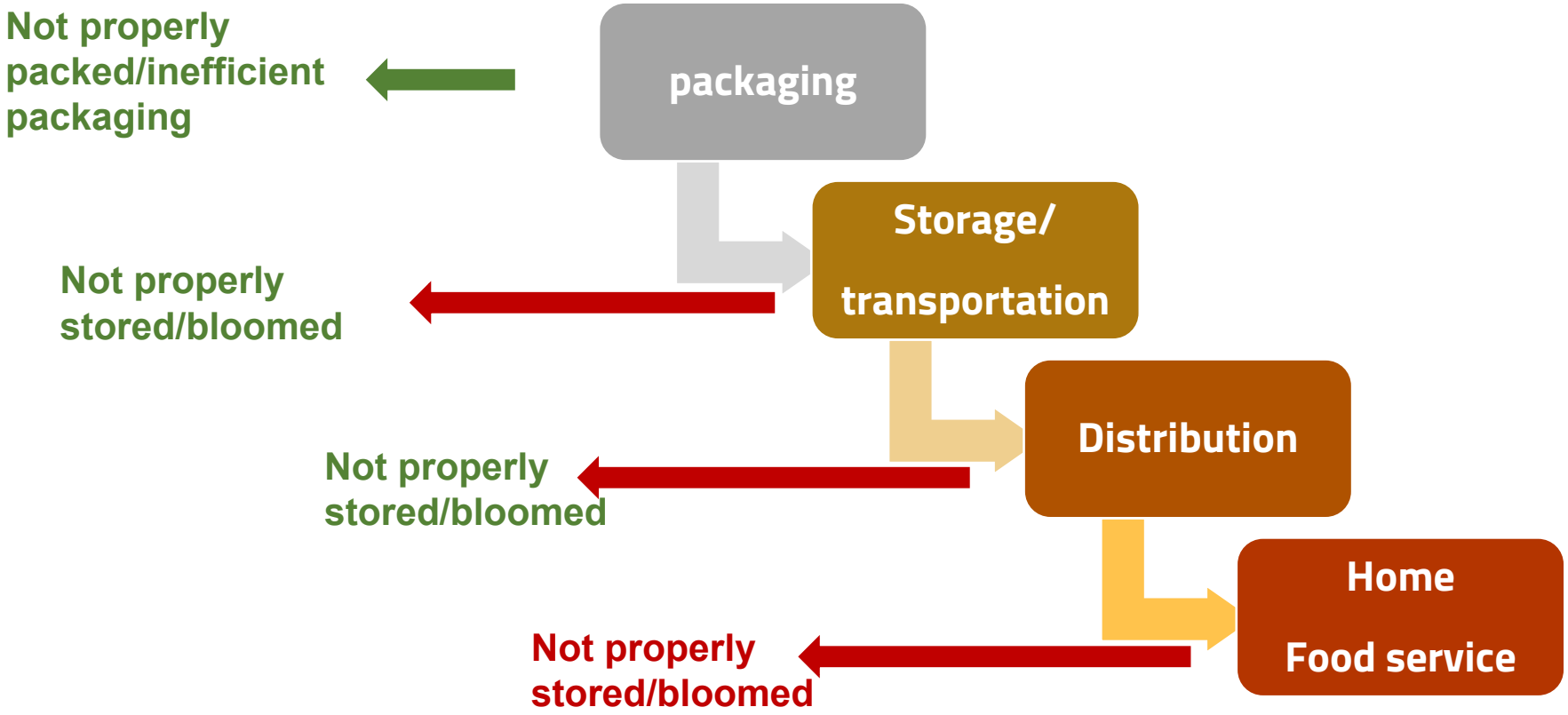
Fibers, bioactive compounds

Sugars, other ingredients

SUPPLY CHAIN WASTE

Various products and composition
High energy
High nutritional value products /intermediate products

After chocolate production



Defective beans (germinated, insect-damaged, etc…) : ca. 5%

The waste stream(s) consists of:

- un-used raw materials,
- wastes from the pre-processing stages (e.g. forming chocolate)
- production wastes in the form of chocolate mass.

In the production chain (ca. 2%):

- products that are misshapen or do not meet specifications
- waste generated when the high-speed production lines are interrupted or fail, when there is a change of product production
- Wasted material that cannot be re-worked/re-processed into product.

AFTER PACKAGING: ca. 5.7% of chocolate products become waste products (= disposal, to landfill as food waste)

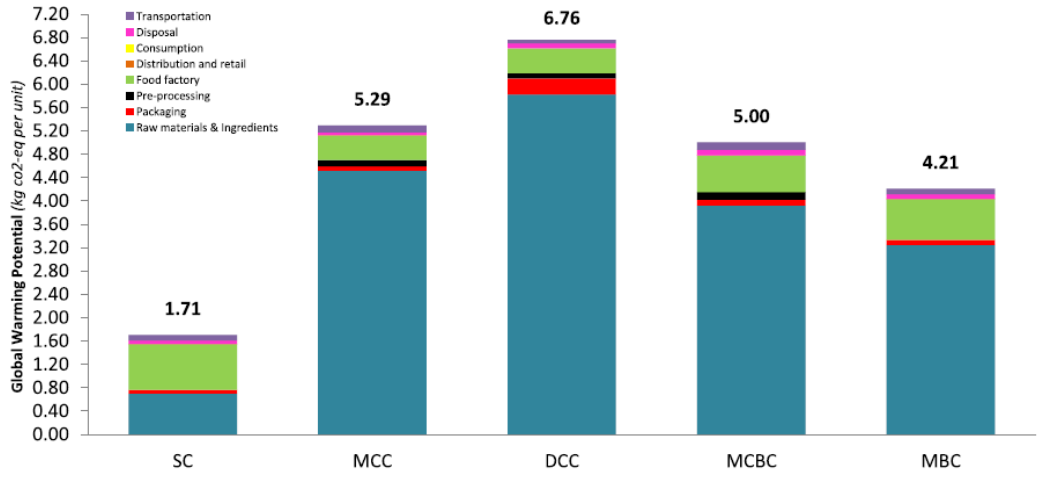
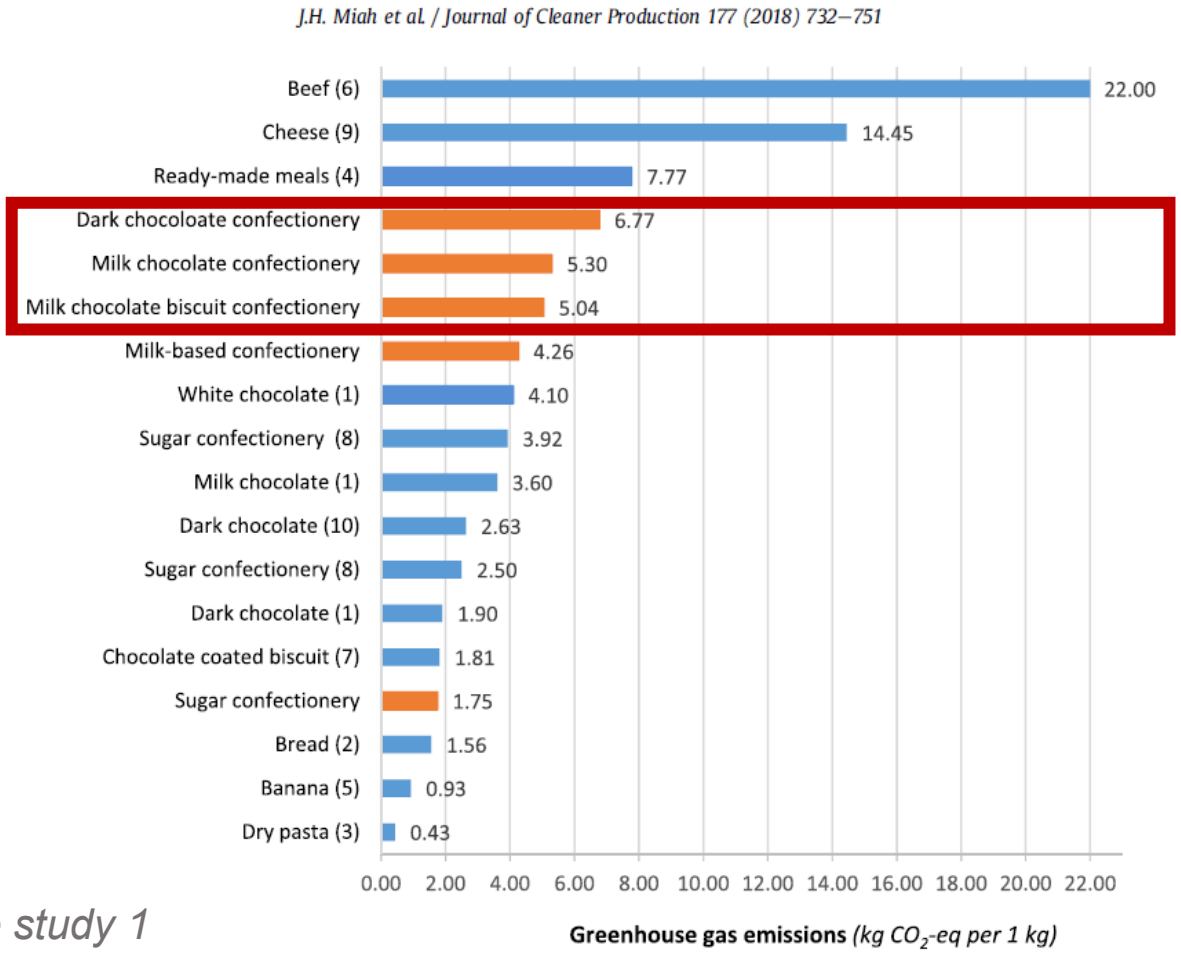


Fig. 2. A comparison of the GWP impact for different confectionery products. (SC = Sugar confectionery, MCC = Milk chocolate confectionery, DCC = Dark chocolate confectio MCBC = Milk chocolate biscuit confectionery, and MBC = Milk based confectionery).



Source: Miah et al., 2018

Activity/case study 1

Question 1

FROM THE FULL PROCESS DIAGRAM, IDENTIFY THE POTENTIAL OF

- UP-CYCLING

- RECOVERY

of the wasted products/intermediate products.

Question 2

FROM wasted products/intermediate products, IDENTIFY THE POTENTIAL of the wasted products considering their potential technological properties

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Thank you

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Case Study 2. Mushroom production and the circular economy

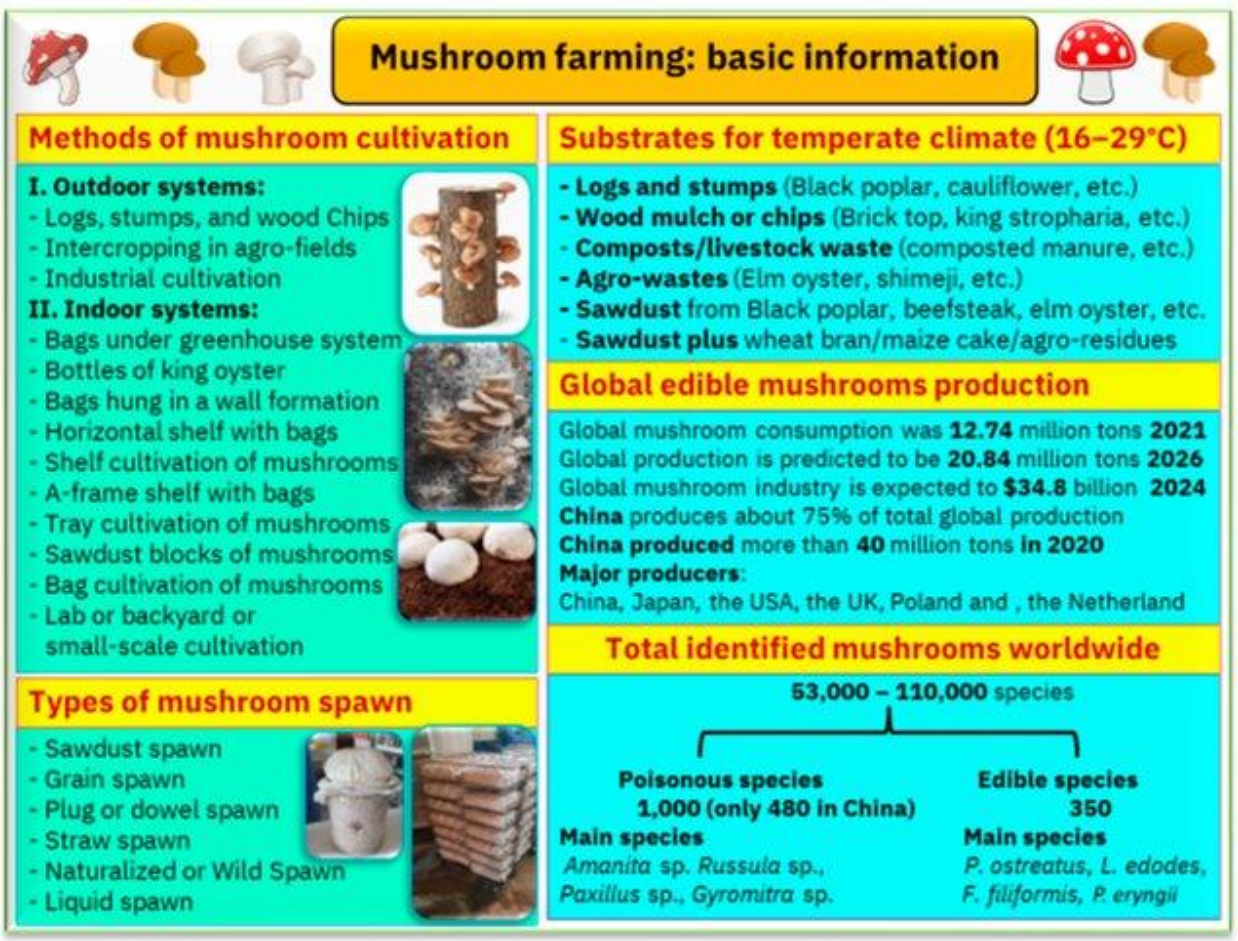
Jesus Frias, Technological University Dublin

Objectives

1. To identify the circularity components in mushroom production and propose potential increments.
2. To understand the systems related to mushroom production.

Mushroom farming fundamentals

From DOI: 10.3390/foods12142671



Activity 1 Mushroom production and circular economy (15 mins)

Discuss the following increments in circularity of the edible mushroom production chain from DOI: https://doi.org/10.18011/bioeng.2024.v18.1241

Table 1. Relationship between the Circular Economy and the edible mushroom production chain.

Circular Economy aspects	Description	Interview
Refuse (R0)	Avoid the use of non-renewable and toxic materials from the outset	The producer does not use chemical pesticides in his production, seeking alternative bio-inputs if necessary
Rethink (R1)	Redesign processes to maximize efficiency and minimize waste	Producer implements sustainable cultivation techniques, but faces challenges in some aspects to make the process more sustainable
Reduce (R2)	Reduce consumption of natural resources and energy	Efficient use of water and energy through a semi- artesian well and solar panels, but there are limitations in reducing plastic packaging
Reuse (R3)	Reuse products and components whenever possible	Reuse growing substrates for compost and manure, large bags of substrate as garbage bags
Repair (R4)	Repair products to extend their useful life	Cultivation equipment undergoes constant preventive maintenance and was built by the producer (humidifier, fan)
Renovate (R5)	Renovate old products for continuous use	Adaptation and construction of equipment used in production
Remanufacturing (R6)	Remanufacturing products to restore their functionality	Products that have not been marketed are used to produce antipasto or mushroom quibbles, these are not marketed
Redefine (R7)	Redirect materials to new uses	Used substrates are redirected to compost and manure
Recycling (R8)	Recycling materials to create new products	Recycling organic waste into compost and manure, but recycling plastics is still a challenge
Recover (R9)	Recover energy from waste through processes such as incineration	Energy recovery is not practiced due to a lack of infrastructure.

Identify three potential more effective and the more feasible potential improvements of circularity.

Activity 2 Mushroom sector as part of circular economy (15 mins)

From https://www.interregeurope.eu/good-practices/mushroom-sector-as-part-of-circular-economy

Discuss this good practice and identify the key elements of the circular economy that are associated to the integration of mushroom production.

About this good practice

In Castilla-La Mancha there is an agricultural-based economy specializing in wine production, cereals, olives, etc. In the 70s, people looked for complementary activities to reinforce the economy. Connected to that, in Villamalea the production of mushrooms was developed, using straw from cereal production and locally available chicken manure.

From the end of the 90s until the present day, this complementary activity has created a steady business based on mushrooms, linked to a logistics and distribution network to supply the supermarkets and retailers of the country. In consequence, and due to the specialization of the business and the cooperation between the different companies, Villamalea has substantially improved the local economy.

The mushrooms are one of the main agents responsible for decomposing the dead organic material. This practice takes advantage of the ability of mushrooms to make use of secondary products obtained from agriculture and farming (straw, chicken manure) which create a specific compost ready to produce mushrooms. At the ends of the growing period, mushrooms have not used up all the nutrients of the substrate. For this reason, this material is ideal for adding to the fields as fertilizer, because it improves the water holding capacity of the soil. It is rich in nitrogen, humus, and other minerals and nutrients and it does not contain heavy metals or the seeds of competitor grass.

Resources needed

The company set up as an agricultural cooperative was recognized as an organization of fruit and vegetable producers. Thanks to that, they benefit from European funds (FEOGA), and have around 50 mushroom facilities, 2 compost yards, warehouses, specific logistics and more than 800 direct employees.

Evidence of success

It provides a solution for some residual materials, such as straw, chicken manure, etc., transforming them into mushrooms. In the composting process employment is required and also many people are needed to pick mushrooms in the farms, so it provides a living for one thousand families in the region.

The current volume of compost is 130,000 tons per year, producing around 35 M kg of mushrooms, and generating 87 M kg of spent mushroom compost with a total turnover of 70 M€ per year.

Potential for learning or transfer

In every part of the world there are different kinds of residual materials coming from agricultural and other food industries, and most of these products can be composted, to get a substrate ready to produce mushrooms.
Therefore, this experience of good practices can easily be exported to other regions, which translates into economic wealth and circular economy boost in line with current policies.

Further information

Website

Website

Good practice owner

You can contact the good practice owner below for more detailed information.

Organisation

Champinter Cooperative Society - Sociedad Cooperativa Champinter

Spain Castilla-La Mancha

Contact

María Caberta

Environmental technician

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