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**Boosting Employability through
Circularity of Bio-waste in Rural Areas
BECBA**

**Research on the state-of-the-art in agricultural
waste management systems and circular
practices in rural areas**

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Desk Research

Legal/regulatory, policy and institutional framework for bio-waste management

Organic or bio-waste is defined as waste that can be decomposed in a reasonable amount of time. Biodegradable waste is green waste coming from gardens and parks, food scraps and biodegradable plastics. According to the Greek regulatory system, bio-waste is categorised into urban solid waste, however, due to its distinctive nature, it needs special management and utilisation.

The waste management roadmap for Greece, published by the European Commission back in 2012, requires the Hellenic Republic to undertake, amongst others, the following key steps:

- introduce a landfill tax, to be progressively increased to divert waste from landfill
- update regional and national waste management plans with specific policy measures on the basis of robust data and infrastructure required
- implement a strategy to divert bio-waste from landfill
- introduce door-to-door separated waste collections

According to the official website of the [Ministry of Environment and Energy](#), the legal framework governing waste management in Greece can be nowadays summed up by the following laws:

- **Law 2939/2001** (Government Gazette 179/A/06.08.2001) 'Packaging and alternative management of packaging of other products – Establishment of a National Organisation for the Alternative Management of Packaging and Other Products (E.O.E.D.S.A.P.) and other provisions', as amended by Law 3854/10 (Government Gazette 94/A/23.06.2010) 'Amendment of the legislation on the alternative management of packaging and other products and the National Organisation for the Alternative Management of Packaging and Other Products (E.O.E.D.S.A.P.) and other provisions'
- **Law 4042/2012** (Government Gazette 24/A/13.02.2012) 'Criminal Protection of the environment – Harmonisation with Directive 2008/99/EC – Framework for the production and management of waste – Harmonisation with Directive 2008/98/EC – Regulation of issues of the Ministry of Environment, Energy and Climate Change' which incorporates into national law the Framework Directive 2008/98/EU on waste
- **Law 4014/11** (Government Gazette 209/A/21.09.2011) 'Environmental licensing of projects and activities, regulation of arbitrary in connection with the creation of an





environmental balance and other provisions of competence of the Ministry of Environment' as amended and in force

- **Law 4685/2020** provides for the National Waste Management Plan (NWMP), which is approved by the Ministerial Council, following a proposal by the Minister of Environment and Energy. The new NWMP applies for the implementation period 2020-2030 and has been drafted in line with the provisions of art. 22 and 35 of Law 4042/2012, as amended by art. 83 of Law 4685/2020.

All the above-mentioned laws aim at reducing waste production in Greece, endorsing the recycling and reusing process, and penalising cases of environmental pollution through criminal law. In detail, Law 4042/2012 prioritises the issue of bio-waste management, while, simultaneously, establishing the needed framework to encourage:

- a) the separation of bio-waste in different bins, with the view of them later being composted or digested
- b) the processing of bio-waste in such a way that environmental protection can be ensured
- c) the use of environmentally-friendly materials, produced by bio-waste

Also, Law 4042/2012 aims at establishing effective and proportionate penalties for any case of environmental pollution that is or may be caused. On the second part, the law introduces important measures on environmental and human health protection, reduces the negative impact of generating and managing waste, and improves the general effect of the waste management process.

At the same time, the Greek government has incorporated key European Union Directives on waste management into the national law, such as:

- **JMD 29407/3508/2002** (Government Gazette 1572 B) 'Measures and conditions for the landfill of waste', to transpose Directive 1999/31/EC
- **JMD 22912/1117/2005** (Government Gazette 759 B) 'Measures and conditions for the prevention and reduction of environmental pollution from the incineration of waste', to incorporate Directive 2000/76/EC

The **European Waste Catalogue** (EWC) is directly applicable, in accordance with the Annex to Decision 2002/532/EC, as amended and in force.

Last but not least, there has been a series of Joint Ministerial Decisions (JMD) in order to regulate further individual issues that are worth mentioning:





- **JMD with No. 50910/2727/2003** 'Measures and Conditions for the Management of Solid Waste. National and Regional Management Planning', as amended by Law 4042/2012
- **JMD 13588/725/2006** 'Measures, conditions and restrictions for the management of hazardous waste in compliance with the provisions of Council Directive 91/689/EEC 'on hazardous waste' of 12 December 1991', as amended by Law 4042/2012
- **JMD with No. J.M.D. 146163//2012** 'Measures and conditions for the Management of Waste of Sanitary Units 1991', issued by delegation of article 38, par. 7 of Law 4042/2012.

As mentioned before, Law 4685/2020 provides for the National Waste Management Plan (NWMP) which is oriented to the following targets:

- The reduction of the amount of waste being buried in landfills to below 10% by 2030.
- The implementation of the separate collection for waste and bio-waste materials. In particular for bio-waste, article 41 of Law 4042/2012, as replaced by par. 2 of article 84 of Law 4685/2020, stipulates that from 31 December 2022, biological waste will be either separated and recycled at source, or collected separately and not mixed with other types of waste. Therefore, the separate collection of biological waste becomes mandatory as of 31 December 2022.
- The development of a network for the collection of organic waste (coffee bin) by the end of 2022.
- The recovery of energy from the treatment of organic waste (biomass) and also the production of secondary materials (compost).
- The construction and operation of Waste Treatment Plants and Bio-Waste Treatment Plants.

In addition, Ministerial Decision no. 99398/6484 (Government Gazette 4656 B'/2020) was issued in relation to the 'Classification of public and private projects and activities in categories and subcategories, according to article 1 par. 4 of Law 4014/2011'. By virtue of this Decision, Processing Facilities (recovery and disposal) of municipal solid waste (MSW) are elevated from sub-category A2 (projects and activities that are likely to cause significant impact on the environment) to sub-category A1 (projects and activities that are likely to cause very significant impact on the environment).

This ministerial decision contributes to the establishment of a unified and stricter legislative framework in terms of the environmental licensing for Waste Processing Facilities while providing for the shortening of the relevant procedures and guaranteeing a high level of environmental protection.





As far as the development of waste infrastructure is concerned, the Integrated Waste Management System of Western Macedonia (IWMS), the first Waste Management Public Private Partnership (PPP) in Greece, has succeeded in the diversion of the biodegradable fraction from landfills by over 80%, the residue that goes to landfills is less than 36% of the produced urban solid waste. More specifically, the Waste Treatment Plant is situated between



Kozani and Eordea Municipalities, in the Lignite Centre of Western Macedonia of DEI (PPC) and has capacity of 120,000 tonnes/year of Urban Solid Waste. The Plant undertakes the reception and transportation of the total waste produced in the 12 Municipalities of the Western Macedonia Region through 10 Waste Transfer Stations (WTS), the treatment in the Waste Treatment Plant (WTP) and the residue burial in the Residue Sanitary Landfill. The Waste Treatment Plant succeeds the highest possible retrieval of recyclable materials through the latest technology of mechanical and optical sorting reaching over 35%, while in parallel produces compost, in accordance with the current standards.

There are companies in the private business sector that, in compliance with the regulation system, cover important aspects of waste – and bio-waste – management. Just to mention a few examples:

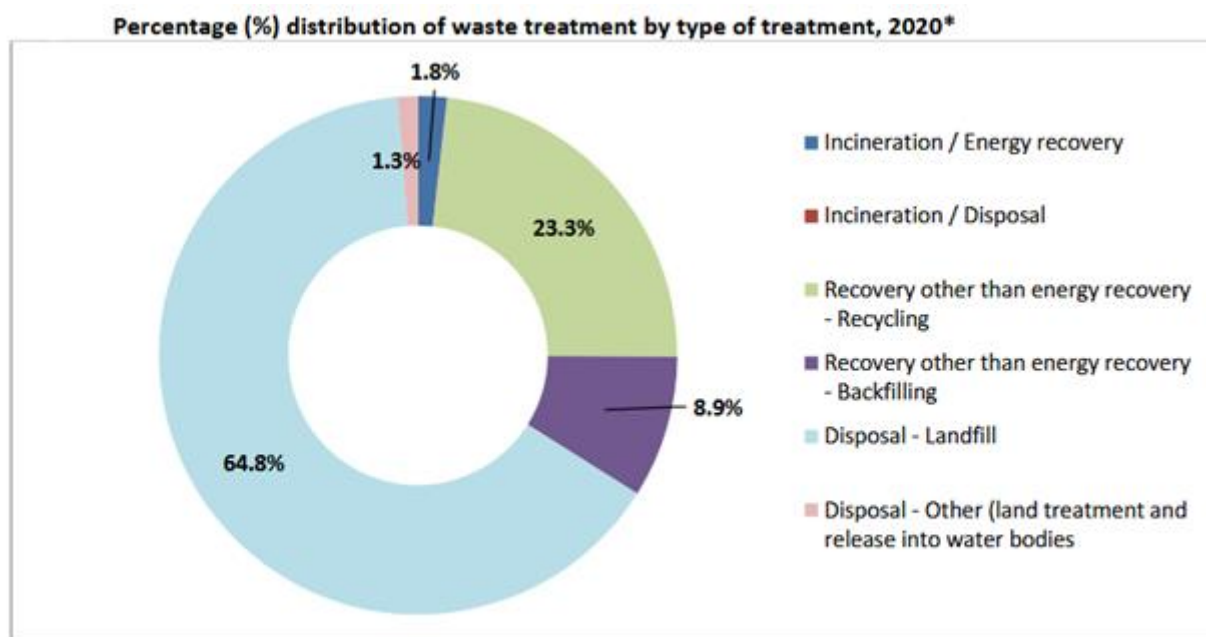
- [Diadyma S.A.](#) is a waste management company in Western Macedonia that provides knowledge on reusing techniques, mapping of recycling centres in the area, recycling of oil and educational programs. It numbers more than 10 different facilities in the area (including IWMS) and almost 250 employees. The statistics provided for the year 2021 are impressive, since 67% of the municipal solid waste was utilised, 16,330 tonnes of recyclable materials were recovered, and more that 14 tonnes of compost were produced. The company's plans for the next period includes the conversion of the Integrated Waste Management Central facilities (IWMCF) into a Circular Economy Park, in order to achieve the objectives of the National Waste Management Plan.
- [Dedisa S.A.](#) is a company based in Crete that focuses on the sustainable management of municipal solid waste. Main goal of the company is to minimize waste generation, promote reusing of materials, sort waste at the source, raise awareness and inform citizens on environmental issues.
- [Biosolids S.A.](#) is a company based in Thessaloniki that aims at providing an environmentally sustainable model of composting and organic recycling. It has managed to recycle more than 20 tonnes of bio-waste per year, selling them as compost-soil improvers, fertilisers and substrates.





In December 2022, the Hellenic Statistical Authority (ELSTAT) announced data on the generation and treatment of waste for the year 2020, which are collected from administrative sources. During 2020, the following were noticed:

- Waste generation for the year 2020 amounted to 28,943,897 tonnes and decreased by 36.0% compared to 2018. Respectively, waste treatment amounted to 22,279,515 tonnes and decreased by 47.8% compared to 2018.
- Regarding the categories of waste generated, 'Mining and other waste activities' account for 68.6% of total waste generated and 'Municipal solid waste' account for 20.9%.
- Regarding waste treatment by type of treatment, 'Disposal - Landfill' accounted for 64.8% of the total, while 'Recovery other than energy recovery - Recycling' accounted for 23.3%.
- Regarding waste treatment by category of waste, 'Mining and other waste activities' amounted to 16,655,293 tonnes and account for 74.8% of the total, while 'Municipal waste' amount to 3,756,010 tonnes and 16.9% of the total.



* Provisional data





Waste treatment by treatment category and type of waste, 2020*

In tonnes

	Incineration	Recovery other than energy recovery	Disposal	Total	Percentage distribution (%)
Chemical and Medical waste	4,557	368,982	48,580	422,119	1.9%
Recyclable waste	21,581	1,259,930	7,048	1,288,558	5.8%
Municipal waste	161,448	215,582	3,378,981	3,756,010	16.9%
Sludge	40,876	91,462	25,196	157,534	0.7%
Mining and other waste activities	174,701	5,228,185	11,252,407	16,655,293	74.8%
Total	403,163	7,164,140	14,712,212	22,279,515	100.00%

* Provisional data

Source: [Waste Generation and Treatment / 2020](#)

Greece has done many efforts to minimise the negative effects of landfilling and continuous production of waste, but there is still room for improvement.

Bio-waste management practices in rural areas

Some known practices of bio-waste management that are used in the rural areas of Greece are composting, anaerobic digestion and segregating methods. The government has tried to implement the segregation method as the easiest one in local municipalities. The Ministry of Environment and Energy has published a series of guidelines for more effective campaigns on how to recycle and compost.

Composting: Composting is considered to be the star of the bio-waste management techniques. It is defined as a controlled, aerobic process that converts organic (bio) materials into a nutrient-rich muddy product through natural decomposition. Microorganisms develop and feed from the waste, they use carbon and nitrogen to grow and reproduce, water to digest materials and oxygen to breathe. It is nature's way of recycling organic matter, such as leaves and food scraps, into a valuable fertiliser that can enrich soil and plants. It is one of the most powerful actions we can take to reduce our trash, address climate change, and build healthy soil. It can be done both indoors and outdoors.

The **Municipality of Kalamata**, located in the Peloponnese, has been awarded numerous times for its environmentally friendly approach. Beginning in 2004, 'Kalamata recycles





whatever can be recycled', meaning packaging, electrical devices, batteries, toners, cooking oil, lamps and even clothing and shoes. Next goal, that is slowly being set, is the actual bio-waste management at a municipal level, since home-composting is already on the use. As declared by the Head of the Recycling Department of the Municipality, *'We are currently doing home composting. In particular, we are turning the food that we throw away in the garbage, into organic matter, which can even be used as a soil conditioner. So the aim of the municipality is to install a network for sorting pre-sorted bio-waste, so that we can reach the targets set by the European Union. We also aim at increasing participation in the programmes we already have through various information campaigns. Finally, we will install a large green spot, a place where the citizens themselves can bring some things, such as furniture that the municipality could use, repair and give them back'*.

The **Municipality of Komotini** is the first one in the Region of Eastern Macedonia and Thrace to start a separate collection of bio-waste (food waste) with the motto *'We protect the environment, we give life to our lives'*. The Environment Department is piloting brown bins, thus creating another recycling stream, reinforcing the environmental policy of the Municipality.

The distribution of the bins will be done in phases, starting from the nurseries of the Municipality, the facilities of the Democritus University of Thrace, the General Hospital of Komotini, the Nursing Home and large supermarket chains. In the next phase, mass catering businesses, hotel units, farmers' markets, food and beverage retailers and residential areas of the municipality will also be included.

In May 2010, the **Municipality of Karditsa** started a pilot project of house composting, with the distribution of a total of 85 bins (1st phase: May 2010 - distribution of 50 bins, 2nd phase: December 2010 - distribution of 35 bins) in order to strengthen the ecological awareness of the Karditsa residents. The citizens are also provided with professional help during the whole process and are closely monitored by agronomists for any occurring problems

Another municipality experimenting with bio-waste management in the form of composting is the **Municipality of Arta**, located in West Epirus. Since the end of 2019, the local authorities have given 180 garden-composting bins to interested citizens in an effort to boost environmental consciousness and promote homemade soil improvers.

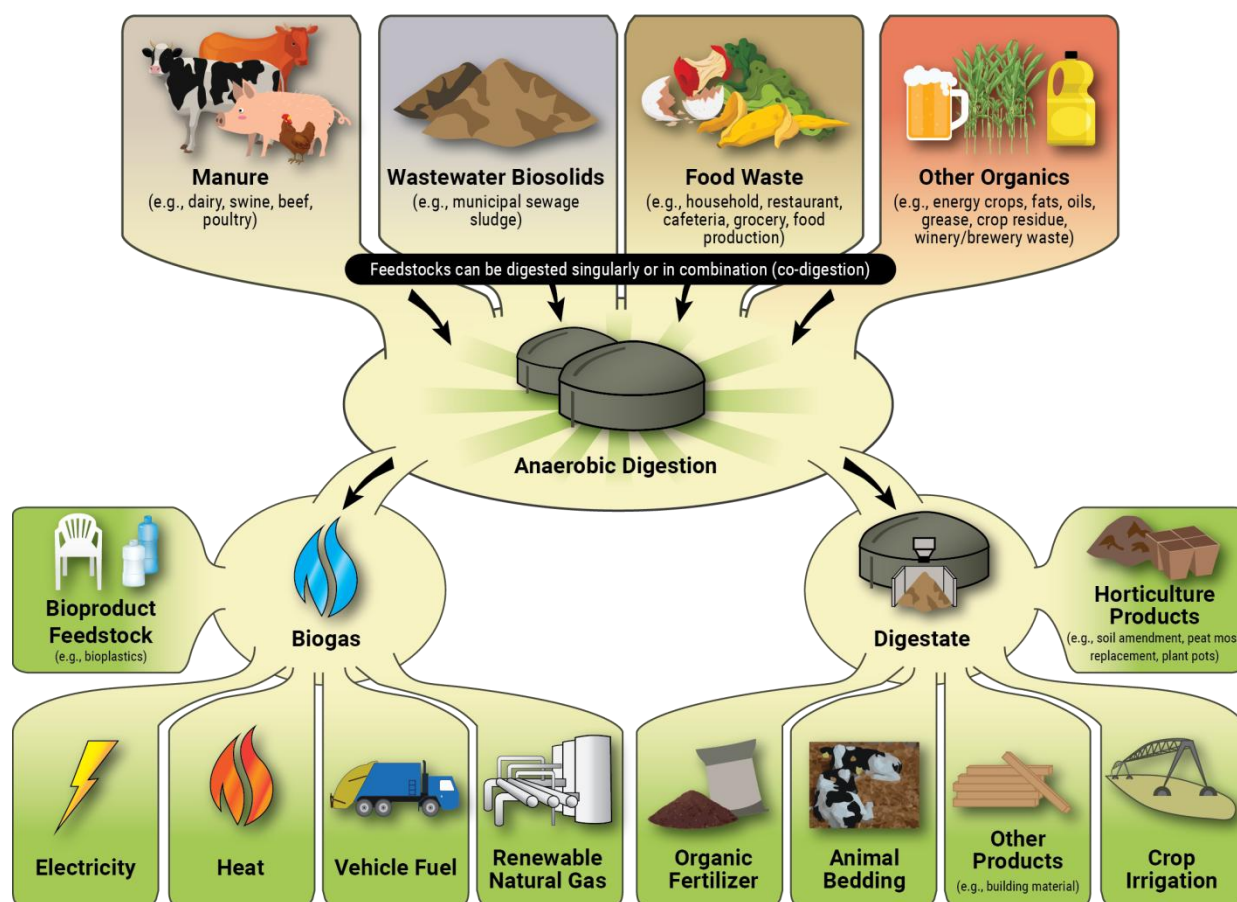
Anaerobic digestion: It is the process in which bacteria biodegrade organic materials (such as solid animal manure, bio-waste and food waste) in the absence of oxygen (O₂). The process is used for industrial or domestic purposes to manage waste or to produce fuels (biogas).

Anaerobic digestion for biogas production takes place in a sealed vessel called a reactor that contains complex microbial communities that break down (or digest) the waste and produce resultant biogas and digestate (the solid and liquid material end-products of the anaerobic digestion process) which is discharged from the digester. Biogas can be then used for electricity, heating or as vehicle fuel, whereas digestate can be used as fertiliser, as part of





biodegradable plastics or simply as soil amendment, so nothing goes to waste (see picture).



Source: [How Does Anaerobic Digestion Work?](#)

Greece’s first dry anaerobic digestion plant is located in the **Epirus region**. This was the country’s first step to recovering energy from organic waste. Around 105,000 tonnes of municipal waste are delivered to the plant every year. The organic fraction is removed in the two sorting lines of the mechanical biological treatment (MBT) system before being fed into the digestion process.

The above data show clearly that the most popular method of bio-waste management in the rural areas of Greece is composting, whether done at a municipal level, or encouraged to be conducted at a personal/home level. The rural communities in Greece seem to be taking action one after the other by raising awareness among citizens on the many advantages of recycling and composting, and by actively trying to reduce their environmental footprint.

Another bio-waste management practice is the **recovery of products from bio-waste**. This means that by the end of the process whatever was considered as waste can be used again to fulfill a different purpose, when otherwise it would be thrown away. It is a baseline process when referring to bio-waste management and it is different from recycling and reusing of materials. It is known as the essence of the circular economy theory, since it is a





process to 'transform' waste to another kind of useful material.

Finally, the **recovery of nutrients** is the practice of recovering nutrients (such as phosphorus or other useful substances from used water streams/waste sources) that would otherwise be thrown away and then converting them into an environmentally friendly fertiliser used for agricultural purposes. Phosphorus in particular can be used for both chemical and organic fertilisers when recycled from bio-waste through thermal treatment of the waste.

Circular economy activities dealing with bio-waste

Circular economy is a production-consumption model quite different from the linear model that economies have followed for years. It involves sharing, leasing, reusing, repairing, refurbishing and recycling that aim at elongating the life cycle of the materials for as long as possible. One of the key elements of circular economy is the reduction of waste to the minimum along with the recycling and reusing practices in order to create further value. However, reduction of waste is not the only solution, since waste management is also equally important as an issue.

In the Greek economy, the most popular method of bio-waste management is **composting**, both as an at-home practice and as a business activity. Composting can be described as a natural process that turns bio-waste into a thick, brown mud, known as compost or simply fertiliser. Compost owes its popularity to a lot of factors, such as the low rate of bio-substance that the greek soil suffers from (1%), desertification danger, high levels of CO² and climate change effects, and of course the low cost and easy production.

Many municipalities of the rural areas of Greece have already adopted this circular economy activity.

Another way to use bio-waste to economy's advantage is the **recovery of energy or products**. Recent research has shown that rural bio-waste (mud, manure) can be transformed into energy sources through a special venting method, and in that way help in the reduction of the energy cost of the local agricultural unit. Such methods are now being developed in Greece and, therefore, their approach is considered mainly theoretical, but at the same time in compliance with the set european standards.

As for **recovering of nutrients** there is the use of plant biomass, which is any plant substance originating from agricultural production, food waste and wood materials. Plant biomass can be used again as energy supplier (at home, greenhouses or for industrial use) or as organic soil improver in waste management units. Greece has a big production of plant biomass (7,500,000 tonnes/ agriculture and 2.700.000 tonnes/ as residues of forest origin) and uses its energy to cover 3% of the country's energy needs.

Furthermore, due to the size of the agricultural sector, Greece has managed to produce **animal feed** originating from bio-waste. The first project, '[Food 4 Feed](#)', started at 2018 and used hotel food waste as its main source. Mainly, the aim was to construct a solar drying





unit that could fit 40-50 tonnes of dry product in order to be distributed as animal feed.

Also, in September 2021, a project named '[Olivefeed](#)' started with the aim to produce high quality animal feed that would be consumed in chicken farms. The innovative part of the project was that the feed would be rich in phenilic compounds, since its coming from bioactive extracts of by-products and wastes of oil production. In the end, the project will be responsible to develop new ways of bio-waste management that are friendly for the environment, take advantage of the rich composition of olive by-products and increase the production of chicken farms through higher food quality.

It is also worth mentioning a few **initiatives** that are active in the sector of circular activities dealing with bio-waste. According to data provided by the Ministry of Environment and Energy in 2021, there is an innovative project called 'Fishbone' that aims at improving the management of waste coming by the local trout industry. In detail, they use the fishbone (after the fish being filleted and ready for consumption) to produce a substance called hydroxyapatite and can be used as bio-material and also the tails and heads to produce collagen.

Another initiative is the project '[Wastes-to-Biopolymers](#)' that aims at converting food waste into bio-plastic products. The plan is to utilise liquids originating from the cheese making industry and along with liquid waste from the fruit and vegetable industry, compose biodegradable polymers that will be used as food packaging (bottles, cups).

Last but not least, 'Eco-Park', a park dedicated to displaying recycling practices, teaching children and adults about the advantages of waste management and helping them with applying these practices in their everyday life, is due to open to public by 2025 in Heraklion, Crete.

Finally, since 1992, the LIFE Programme (the EU's funding instrument for the environment and climate action) has funded 169 projects in [Greece](#) on the topic of Circular economy and quality of life. The total investment for these projects was 250 M euros, with the EU contribution reaching 121 M euros.

Some ongoing projects under the LIFE programme are:

- [Integrated approach for exposure and health effects monitoring of engineered nanomaterials in workplaces and urban areas](#) (Project Number: LIFE17 ENV/GR/000285)
- [Nano-CATalysts for HEAVY Duty Applications](#) (Project Number: LIFE17 ENV/GR/000352)
- [Pollutant Photo-NF remediation of Agro-Water](#) (Project Number: LIFE17 ENV/GR/000387)
- [Demonstration of an advanced technique for eliminating coal mine wastewater \(brines\) combined with resource recovery](#) (Project Number: LIFE18 ENV/GR/000019)





- [Prevent Of Waste crime by Intelligence Based InspectIons](#) (Project Number: LIFE18 GIE/GR/000899)

Data (dataset, reports, peer-reviewed publications, other information) about the type of agricultural production

Greece is known as country with big agricultural production, at least for its size and population. However, the last years, although politicians constantly state their support to farmer unions, little is done to make their situation better. The agricultural sector is a key sector to increase the GDP in small economies like the greek one. It is a disappointing reality that the annual performance of the agricultural sector is steady and slowly decreasing in the past years.

Data of the Hellenic Statistical Authority (ELSTAT) are provided to support the aforementioned statement based to the agricultural census of 2021. To begin with, the **total use of agricultural area** has been decreased by 18.8% during the last 10 years, whereas every part of the production seems to be directly affected, since agricultural exploitation has dropped by 22.4%, stock-farmer exploitation by 20% and mixed exploitation was decreased by 45.7% since 2009. The **land exploitation** in the greek economy can be distributed to five big categories, such as arable crops reduced by almost 35% (34.6), vinery crops reduced by 41.3%, forest area reduced by 22,8%, greenhouses increased by 13.7% and the rest of land exploitation reduced by 31.1%.

As far as the **stock-farmer industry** is concerned, data show the same wave of reduction to every part of the industry. In detail, both the number of animal stock is decreased (chicken stock presents the biggest difference – 26.7%) and the breeding industry is also showing a decreasing trend: cuttle -34.9%, sheep -38.3%, goats -48.3%, chicken stock -66.3% and pork stock -69.4%. In addition to these, various other sectors of the agricultural industry are following the same reductive stream such as: the **beekeeping** industry reduced by 17.5% and the **biological agriculture** reduced by 23.5%, although it is worth mentioning that the land used by biological agriculture was increased by almost 20% (+19.3%) in the last 10 years. Lastly, the only sector that seems to increase its numbers as a total is that of **biological livestock breeding**: cuttle +289.8%, sheep +145.6%, goat +90.4%, pork -60.9% and chicken -17.6%.

In the region of Thrace and East Macedonia, where 80.2% of the **agricultural production** is based on arable crops, a reduction of 10.8% of used land was monitored, when at the same time in the region of Central Macedonia, where the majority of the production is also based on arable crops, the reduction was even bigger (-15.5%). Almost the same amount of decrease is monitored for the region of West Macedonia (-15.7%), while the situation is worse for the region of Epirus. The statistics indicate that the agricultural sector is shared almost equally among arable crops, forest area and rest of agricultural activity, but in the end, the use of land for these purposes was also decreased by 31.3%. Moving on to the region of Thessaly, the decrease percentage is lower (-11.5%) and in the region of Central Greece with less arable crops (49.6%) the reduction of agricultural land is -25.5% since the

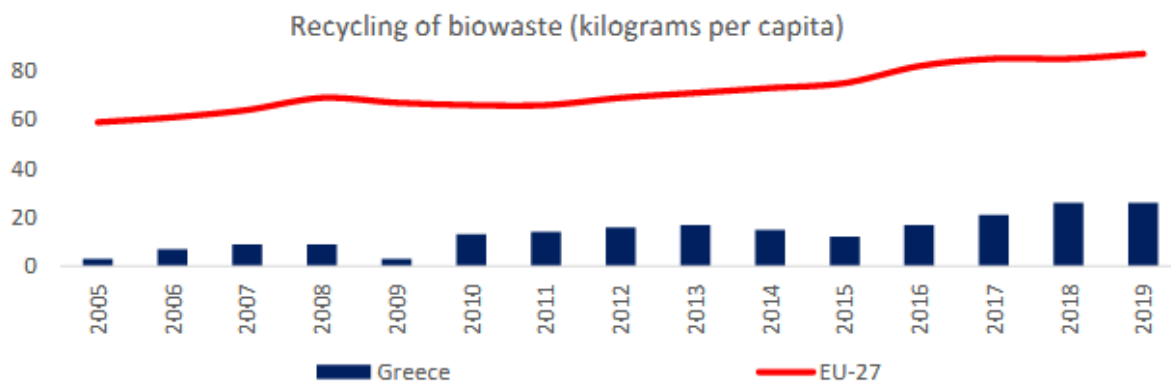




year 2009. In the region of the Ionian Islands almost half of the land exploitation is on forest land (49.4%), while in total amount it was also decreased by 27.1%. As for the region of West Greece, arable crops have a higher percentage of land exploitation (37.9%) and so do forest regions (37.7%), but the results remain the same. The total land used for agricultural purposes has fallen by 19.7%. In the region of the Peloponnese, the situation is again similar (total decrease of 24.1%), but there the majority of land exploitation is for forest areas (71.1%). Even in the region of Attica, where the agricultural sector is not of important value, a decreasing trend is being monitored (-13.6%). The rest of the Greek regions (North Aegean, South Aegean and Crete) indicate that the agricultural sector is not thriving in the country. Although they have small agricultural production, the land exploitation for agricultural purposes was also decreased: North Aegean -25,4%, South Aegean -34% and Crete -18.4%.

Lastly, there is in Greece the so called [Electronic Waste Register](#) (EWR), which is a service, provided by the Ministry of Environment and Energy, that business and organisations can use to register their activities and declare their waste management policies. According to data provided by the official website of EWR, there are 37,069 businesses registered and active on the waste management sector, 341 registered municipalities, 37,541 active facilities and a total of 138,375 waste reports submitted.

A research conducted by Alpha Bank in December 2021, on circular economy and applications in various sectors shows some data regarding the recycling of bio-waste:



According to the graph, Greece stands far below the EU-27 average (87 kg/capita) in terms of bio-waste recycling: in 2019, the ratio stood at 26 kg/capita, although it has increased significantly since 2005 (3 kg/capita).

The recycled output of bio-waste materials are compost and digestates, soil improving materials and fertilisers, as well as biogas, which is a renewable energy source. The basic treatments of biodegradable materials, including organic waste, such as food and garden waste, are aerobic composting and anaerobic digestion.





Best-practices of circular bio-waste management

Though bio-waste management is a developing sector in the Greek economy, there are a few projects and entrepreneurial activities that are heading in the right direction:

- a) [LIFE-F4F \(Food for Feed\): An innovative process for transforming hotels' food wastes into animal feed](#) (Project Number: LIFE15 ENV/GR/000257): This is a project coordinated by the [United Association of Solid Waste Management in Crete](#), and funded by the European Commission under the LIFE Programme. The main aspiration of the project was to evaluate, through a pilot-scale demonstration, an innovative and simple technology, and a low-emission process that enables the safe transformation of food waste, mainly from hotels (and more generally from the hospitality industry and restaurants), into animal feed. The process included the pasteurisation of food scraps through enhanced solar drying, the manual sorting and eventually shredding of the residues. Main goal of the project was for the final product to be evaluated both for use in productive animals and in companion animals.
- b) [Olivefeed](#) is a project that also aims to produce an innovative animal feed product, this time generating from waste and residues of the olive oil industry.

The results of the project will be the following: 1) Collection and monitoring of the stability of olive oil by-products/waste oils, based on their phenolic content, 2) Application of green extraction techniques to oil industry by-products and wastes - Analysis of produced extracts and enriched fractions - Isolation and identification of chemicals, with emphasis on hydroxytyrosol, 3) Study of the biological activity of the extracts/enriched fractions/isolated substances produced, 4) Pilot production of innovative biofunctional feeds, evaluation of their quality characteristics and identification of target-indicator compounds, 5) In vivo experiments for the evaluation of innovative feeds in the rearing of laying and broiler hens, 6) Oxidative stability control and identification of target marker compounds in finished poultry products, and 7) Analysis of the feasibility of production and commercialisation of finished products.

- c) [Circular Greece](#) (Project Number: LIFE-IP CEI-Greece - LIFE18 IPE/GR/000013) is a project developing in Greece with a duration of 8 years (2019-2027) and aims to contribute towards the implementation of the National Waste Management Plan, the National Waste Prevention Plan and the National Strategy for Circular Economy.

The project has mainly the following objectives: 1) Development of actions to promote the practical implementation of waste hierarchy (integrated waste management, preparation for reuse and segregate waste, hazardous waste produced in houses and implementation of financial tools), 2) Actions to eliminate food waste and development of Agro-Food waste management alliances, 3)





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Reinforcement of the use of circular economy tools, 4) Raising awareness on the general topic of waste management in relation to the concept of circular economy and 5) Actively search for funding resources that could support the National Waste Management Plan.

The project results can be found [here](#).

The project is co-funded by the LIFE programme and the Green Fund, and supported by the Ministry of Environment and Energy, the Hellenic Recycling Agency, the Green Fund, the Natural Environment and climate Change Agency, a number of municipalities across the country and other organisations.

At a municipal level, the **Municipality of Kozani** (Western Macedonia) has been exploring the potential for creating new growth and employment through better bio-waste management.

The Western Macedonia has traditionally been reliant on mining and energy production. However, now that the age of coal is coming to an end, authorities are focused on developing a green, circular bio-economy in the region. Members of the recently launched 'Kozani Biowaste Club' will work together to revolutionise the Integrated Regional Waste Management System, making the city a circular economy pioneer in Greece. The Biowaste Club is managed locally by [CluBE](#), the Cluster of Bio-energy and Environment of Western Macedonia.

A pilot project collecting organic waste from 100 households was launched in 2016, in collaboration with the Waste Management company of Western Macedonia (DIADYMA). Due to its success, the scheme has been expanded, and in 2019, over 50 tonnes were collected from more than 500 households. Organic waste is currently treated to produce compost, which is made available for use by residents. The Biowaste Club supports the Municipality to roll-out separate collection in pilot neighbourhoods across the city, and explore opportunities to transform bio-waste into valuable products such as bio-plastics and fertilisers.

The initiative is part of a project called [SCALIBUR - Scalable Technologies for Bio-urban Waste Recovery](#) (Project Number: 817788), which has received funding from the European Union's Horizon 2020 Research and Innovation Programme.

The **Municipality of Rethymno** (Crete) has adopted a new smart collection system to optimise the Used Cooking Oil (UCO) to biodiesel value chain. This action aims at increasing the UCO recycling rate and enhance its safe disposal by expanding and optimising the collection network with 'smart' bins, integrating sensors with GSM technology and a web-based monitoring platform.

The platform allows real-time monitoring of the bins' fulling level and optimisation of the





collector drivers' routes. It sends alerts at selected fill rate, temperature raise, unauthorised movements or vandalism incidents. Through the smart management system, the collection efficiency is increased and operational costs are reduced. Fewer collection trips mean less fuel consumption and less greenhouse gas emissions. Targeted communication activities for citizens and schools challenge a behavioural change towards UCO proper recycling.

Support mechanisms for entrepreneurs in the field of circular economy

The [Common Agricultural Policy \(CAP\)](#) supports rural areas and their economic stability and viability through various actions of funding. It is important to mention that rural development is the second pillar of CAP and it contributes to sustainability of rural areas through three main objectives: the increase of competitiveness levels of agriculture and forestry, the assurance of the viable management of natural resources and climate action, and the balanced development of rural economies through boosting the employment sector.

As part of the EU, Greece can also take advantage of the EAFRD funding through **Rural Development Programs (RDP)**. RDPs are co-funded by the national budget and can be formed at a national or regional basis. Each RDP should be committed to at least four of the following objectives:

- 1) promotion of knowledge and innovative techniques on the field of agriculture, forestry and rural areas
- 2) improvement of the viability and competitiveness of all kinds of agriculture and promotion of innovative rural technologies and forest management
- 3) promotion of the organisation of the food chain, of the treatment of animals and of risk management situations in the agricultural field
- 4) promotion of the efficient use of available resources and support to a less coal-dependent and climate change resistant economic model
- 5) restoration, maintenance and boosting of rural and forest ecosystems
- 6) promotion of social inclusion, reduction of poverty and economic development of rural areas.

The European Rural Development Network (ERDN) is supporting the effective implementation of the RDPs through knowledge sharing all over rural Europe.

The **European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-Agri)** also has a supportive role in the rural development and the encouraging of innovation in rural communities. EIP-Agri aims at bringing together developing innovative research products with the increasing use of new technologies by people living and working in rural areas. The goal is to accelerate the change of techniques used and the improvement of the agricultural production.

The new [National Strategy for Circular Economy](#) (December 2018), in compliance with the European one, involves 73 actions per year until 2025 and the initiatives that need to be





taken by businesses (product implementation), by consumers (sustainable consumption), by waste management agencies and by the state (ministries involved) in order to bring funding from national and European programs with a total value estimated in more than 3 billion euros.

This further supports Greece's economic strategy in its key quest to 'Green' the economy in a way that creates jobs, especially for women and youth, and supports long-term equitable and inclusive growth based on resource efficiency, promotion of SMEs, innovation and investment in new technologies, and strengthening of the 'social economy' potential. The long-term (2030) goals of the National Action Plan on Circular Economy can be summarised as follows:

- moving up the waste hierarchy by focusing on preventing waste and improving recycling
- supporting circular entrepreneurship by promoting 'industrial symbiosis' and business clusters
- supporting circular consumption patterns of re-using, re-storing and re-pairing rather than buying new products, especially for electrical and electronic devices
- enhancing multi-stakeholder partnerships across industry, academia, and civil society
- monitoring progress towards a circular economic model through SMART (specific, measurable, achievable, relevant and time-bound) indicators.

The National Strategy includes the following pillars and elements:

- Sustainable Resource Management, basically aiming at increasing their efficiency, reviewing value chains, rational waste management, reuse of buildings and re-usage of water or the collection of rainwater and spring-water
- Support of Circular Economy, encouraging the idea of eco-design, producing long life span products, repair, innovation, re-usage, regeneration, promotions of industrial symbiosis (clusters, innovation parks, business incubators, knowledge-information exchange platforms), promotion of innovative entrepreneurship models (e.g., sharing economy), support of bio-economy, promotion of green and circular public procurement, support of secondary material use.
- Circular Consumption, with full notification of citizens, use of the Eco Mark and other incentives, training and basic aspirations for sustainable food consumption (deter rejections, urban cultivation), deterring overuse of resources (food-drinks, garments, packaging, EEE), prevention of waste generation through preparing for re-usage, repair and maintenance, auditing retail e-commerce and, finally, promoting use/usage services rather than product supply.

It is the belief of the Ministry of Environment & Energy that the circular economy model can be easily adapted to the Greek economy due to the multitude of opportunities and the





potential for using the country's resources, the knowledge and specialisation of young Greek professionals, as well as the changes currently taking place in the country with respect to the economy and growth in general and the waste management industry in particular.

According to recent research done on the '**New plan of Greece – road map for circular economy**', there are 11 innovative Greek initiatives that can lead the way to more ideas and practices contributing to the circular transformation of the country's economy.

To mention a few:

- 1) The '[Research Infrastructure for Waste Valorization and Sustainable Management of Resources - INVALOR](#)' has been created to promote the concept of the circular economy.
- 2) The Materials Reuse Center 'We Can' in Kastoria is a facility of the Integrated Waste Management System (IWMS) that aims at preventing the production of waste and its reuse. It is a place where there will be participation and interaction of citizens in order to prevent waste production through the exchange of objects and to give these objects a second chance to be reused.
- 3) [Boroume \('We Can'\)](#) is a non-profit organisation whose mission is to reduce food waste and to fight malnutrition in Greece. Through their '[Saving & Offering Food](#)' program, they save food on a daily basis from many sources and they offer it to charities that help people who are facing food insecurity. Their actions help the most vulnerable in the society as well as the environment by reducing organic food waste.
- 4) The [Cluster of Bioeconomy and Environment of Western Macedonia \(CLuBE\)](#) is a platform for cooperation of the three pillars of the regional economy: the public sector, research and entrepreneurship. The Cluster seeks to develop synergies between local and regional players and businesses in bioenergy and the environment, aiming at introducing and developing innovation in the sector and increasing its added value.
- 5) The '[REPLACE -REgional PoLicy Actions for Circular Economy](#)' project aims at improving management, implementation and monitoring of regional policy instruments targeted at facilitating the transition towards a CE, while boosting sustainable development. The main operative target refers to the development and application of policies and actions focusing on identification, valorisation, assessment and financing of circular value chains, resulting in new local and interregional projects.
- 6) PHOTOREC - Integrated Management of Photovoltaic Panels for Maximum Materials Recovery: The main expected outcome from the implementation of the PHOTOMEGA project (PHOTOREC) is an integrated PV management system for maximum recovery and utilisation of materials/metals at the waste electrical and electronic equipment (WEEE) sector.





Last but not least, the [EIT Climate KIC Greece Hub](#) is a connector between policymakers, innovators and the society, seeking the transformation of the society. This process is ensured through implementation research, participatory workshops, educational training, capacity building, local actions and innovation support and communities of practice. Through its network, EIT Climate-KIC Greece Hub can offer seminars and training to stakeholders at the municipality level, as well as the co-responsible public authorities (Ministries of Environment and Agriculture or Port authorities), at the business sector (entrepreneurs, farmers, ship-owners, investors and bankers) about the meaning and importance of implementing the Systems Innovation Approach and more importantly why it is relevant for protecting the economy while at the same time integrating the new technologies into the market.

In particular, the EIT Climate KIC Hub aims at bringing to surface the potential of Greece for innovative solutions in CleanTech, WaterTech, Circular Economy & innovative financing innovative financing schemes.

Ongoing or recent projects BECBA can synergise with

[Start Up Bio](#): This Erasmus+ project (Project Number: 2019-1-IT01-KA202-007492) aims at supporting and facilitating transition and innovation processes of rural enterprises, accompanying them to the conversion from a traditional production to an organic production. It offers high quality training opportunities, promoting ICT-based learning (self-tutorial and e-learning paths).

The project seeks that new well-trained farmers could be the agents for change management processes in the agricultural sector, actively participating as ambassadors in dissemination of a culture of organic production and sustainable development.

The Academy of Entrepreneurship was the Greek partner in this project.

[SOSUSK – Social and Sustainable skills for young NEET population](#): This Erasmus+ project (Project Number: 2021-1-EL02-KA220-YOU-000029015) is meant to face the pivotal challenge of mobilising a transnational population of European young Neither in Employment or in Education or Training (NEETs), providing them with social and green entrepreneurship skills and competences. The purpose is to ease their match with sustainable opportunities for employment or self-employment.

The Academy of Entrepreneurship is the Greek partner and the coordinator in this project.

[GreenY - Promoting Youth-led Women Entrepreneurship for the development of Inclusive Green Economy](#): This Erasmus+ project (Project Number: 618886-EPP-1-2020-1-EL-EPPKA2-CBY-ACPALA) aims at fostering cooperation between countries in Europe, Latin America, and Asia by training women youth workers and young people belonging to vulnerable contexts





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with key competencies and practical skills that promote their entrepreneurial spirit and increase their employment opportunities within the various sectors related to the green economy model. The development of these capacities will allow them to be empowered in the face of the challenges of the global context and can be considered as active agents of change within the framework of emerging sustainable development models.

The Academy of Entrepreneurship is one of the Greek partners and the coordinator in this project.





Primary Research

Organisations & Companies that could synergise with BECBA

Feréikos: Feréikos is based in Ancient Corinth, Greece and was founded in 2007 by sisters Maria and Penny Vlachou. The name 'Feréikos' derives from the Greek words 'fero' to carry, and 'ikos' house, which when combined, translates literally as 'I carry my own house', an apt description of the snail. Feréikos manages the end-to-end snail process, from the first soil analysis of the snail farm through its production until its delicious taste reaches your palate.

More specifically, Feréikos, through standardisation, produces waste and, in particular, removes the empty snail shells which are rich in calcium. It uses a large part of them for sale to a fish bait company in Austria. The rest of them is used for gastronomy as empty shells to be filled with meat.

In the future, Feréikos would like these shells to go as an ingredient for animal feed because, if crushed, they are a rich source of calcium. Also, they could be appropriately utilised as fertilizer for plots to enrich the soil with an alternative source of calcium.

Regarding BECBA, Feréikos would be interested in participating in and learning further about the potential utilisation of the products being produced through the production process. They could also look into the potential of snail residues (droppings) within the farms and the rich nitrogen they produce.

Eutropia: The property, [Ktima Antonopoulos](#), started olive cultivation in 2016. The purpose is to produce extra virgin olive oil through the cultivation of local varieties, such as Koroneiki, Nemutiana, Botsikoelia and Kollireiki varieties. Their purpose is both the creation of a visitable olive grove and the design of olive oil processing and product packaging facilities.

Regarding the management of agricultural waste in the olive groves that are the property of Eutropia, one way is the use of composting to convert the waste into compost, which can be used as biological fertiliser in olive groves.

In addition, the recycling of materials such as olive leaves and branches that are now found in the 'waste' of olive presses or even in the field after pruning through a crusher can be used. In this way, they have the possibility of returning nutrients that would have been lost. This indirectly enables them to reduce the use of ready-to-use fertilisers. Recycling these materials can lessen the impact of the carbon produced on the environment.

Hellenic Recycling Agency (HRA/EOAN): The HRA constitutes a public interest nonprofit independent entity that is responsible for the promotion and implementation of waste management policies in Greece. They work with municipalities and other organisations to develop sustainable waste management strategies, including the management of bio-waste in rural areas.





Green Fund: It is a Public Legal Entity, associated to the Ministry of Environment and Energy, that allows a wide distribution of funds (coming from environmental taxes, fees for environmental damage, auctioning of EU ETS allowances etc.) to targeted environmental conservation programs. Practically, the GRFU financing is the only national fund dedicated to environmental purposes during the last five years. It has supported several projects in rural areas that focus on the management of bio-waste, including the development of composting facilities and the implementation of separate collection programs.

HELECTOR: It is one of the leading companies in Southeast Europe, with expertise in the fields of waste management and power generation. It provides a range of services related to the management of bio-waste, including composting, anaerobic digestion, and recycling. HELECTOR was a subcontractor for the Design and Construction of the Integrated Waste Management Project in the Region of Western Macedonia.

Terna Energy: It strengthens its leading role in the fields of sustainable development and the circular economy with integrated waste management projects, such as those of the **Epirus** and **Peloponnese** regions, while claiming every relevant project from the new generation of waste management projects that is announced in Attica, Thessaloniki and in all regions of the country.

Ecological Recycling Society: It is a non-profit, non-governmental organisation with almost 30 years of experience in implementing sustainable waste management projects in Greece and abroad. Since 1990, it is the main NGO in Greece that addresses issues pertaining to sustainable waste management, and promotes through a variety of actions, waste prevention, re-use, recycling activities as well as actions supporting sustainable development within the framework of the Circular Economy locally and abroad.

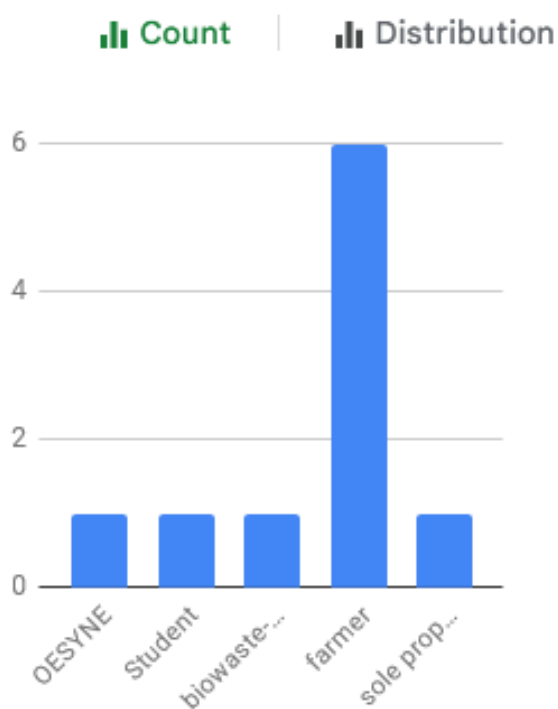




Questionnaire

The target group of this online survey was farmers or other biowaste-producing actors in the value chain who were asked about their current practices. In total, we received 10 responses.

Profile



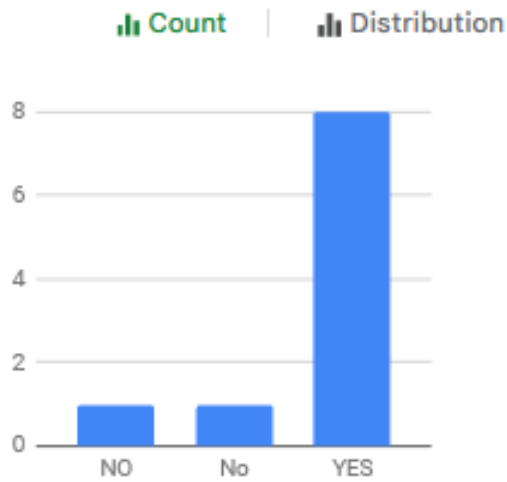
What do you produce?

1. Snails fillet in standard packaging waste. I have the shells
2. mushrooms growing on olive branches
3. meat of sheep & goats, and ovine and caprine animals, milk
4. NO
5. bio olive oil
6. Alfalfa, Corn, Sunflower seed, wheat
7. Cotton, Pumpkins, Wheat, Sesame, Hemp
8. olive oil
9. aromatic medicinal plants - essential oils
10. chestnuts

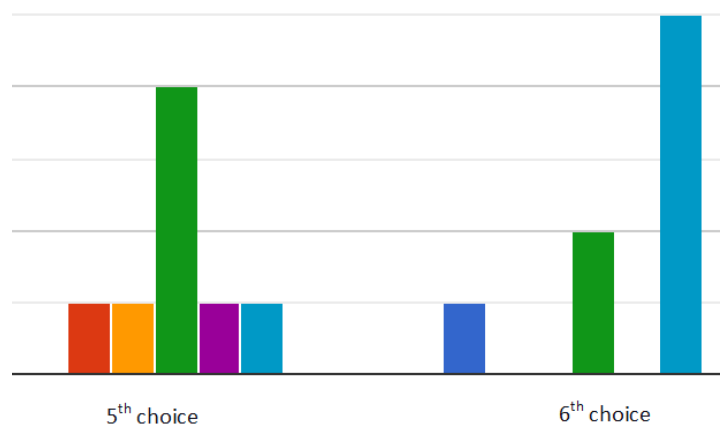
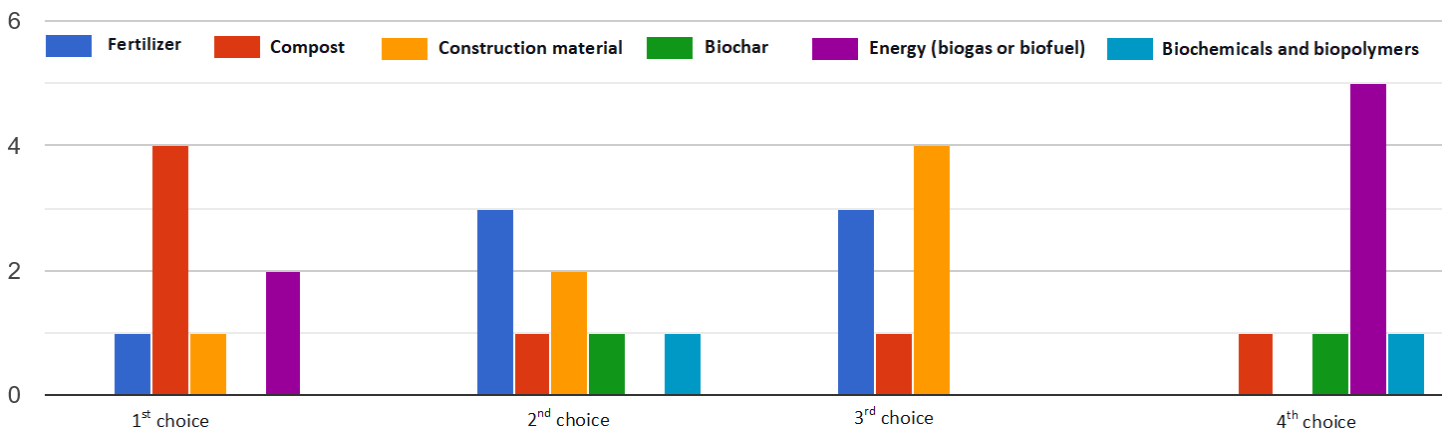




Are you interested in commercial products that could be produced from your agricultural waste?



(For those who answered positively) I am interested in the following product groups (ranking):





What do you currently do with the residues of crops? (e.g., non-edible plant parts of food crops, residues of crops)?

1. Compost
2. mushrooms
3. The crop residues are ploughed and mixed with the soil, after having been sufficiently grazed by the livestock.
4. I don't know
5. Fragmentation of the branches with a shredder
6. absorption into the soil
7. Incorporation as fertiliser for the next crop.
8. The remains of productive trees (olive trees), branches, leaves, weeds, and the remains of other forest trees and shrubs located on the borders of the crops are usually treated with soil stripping, burning or herbicides
9. Mulch
10. They are transported to specialised factories to be converted into other materials, e.g. (energy or for the production of materials)

What would you like to do with your crop residues?

1. Compost, animal feed
2. substrate for mushroom cultivation
3. I don't know what options exist
4. create recyclable raw materials
5. I would like to be able to manage the leaves from the oil press after separation from the fruit so that they can go back to the olive grove and be assimilated into the soil.
6. incorporation into the soil for fertiliser
7. A more sustainable solution. For example, creating compost, biofertiliser, etc...
8. I would like to learn about compost practices and the incorporation of residues into the soil for enrichment or the production of other products from them
9. mulching, soil conditioning
10. leave them in the field to become fertiliser

What do you currently do with livestock manure?

1. Fertilisation
2. I don't have livestock manure
3. I remove it at my own expense and scatter it in the fields where I grow the livestock feed. The rest, I remove at my own expense to any interested party.
4. soil for gardens and fields
5. In specific cases, as fertiliser
6. in the fields as fertiliser
7. I use manure (from poultry) as fertiliser every 3-4 years for soil conditioning.
8. I don't use it





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9. We don't have livestock
10. I add it to the field to feed the tree in a quantity that the tree needs

What would you like to do with livestock manure?

1. Compost
2. Fertilizer
3. Use as much as I need and sell the rest for other crop fields or for home use in small packages
4. Using recyclable products
5. Use it as a fertiliser
6. in the fields as fertiliser
7. I would like to be able to create manure naturally from agricultural residues.
8. Compost
9. if we had, soil conditioning
10. leave them in the field to become fertiliser

You can also find information concerning the online questionnaire at: [BECBA questionnaire \(Responses\) EN](#)





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