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Stories of circular economy in agriculture

CIRCLE2

CIRCLE2
VET and SMEs on the road to CE

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Stories of circular economy in agriculture

The interviews we are presenting were conducted as part of the CIRCLE2 project to showcase the application of circular economy principles within the agricultural sector at various levels.

We gathered six unique stories and testimonials from all project countries: Lithuania, Italy, Turkey, Slovenia, Spain, and Scotland.

We interviewed entrepreneurs dealing with innovation in Lithuania and Spain; researchers in Italy and Turkey; and farmers in Slovenia and Scotland, providing a diverse range of perspectives.

This document is primarily intended for students and teachers in vocational education and training as an inspirational resource.

However, we believe it will also be of interest to anyone seeking a multifaceted understanding of the circular economy.

The interviews are also available on Youtube.

The CIRCLE2 team

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INTERVIEW WITH MINDAUGAS DORELIS

Interview by Panevėžys Training Centre

CASE STUDY: AGRICULTURE, CIRCULAR ECONOMY AND INNOVATION

Mindaugas Dorelis, a student of environmental engineering at the Vytautas Magnus University Academy of Agriculture and head of the company Agrodronas, shared his insights into the use of unmanned systems in agriculture. Agrodronas is the first company in the Baltic States to introduce these technologies to the market, raising awareness among agricultural operators about their benefits. The company is not only striving for its own well-being, but also creating an ecosystem that helps other companies to develop. These technologies are constantly evolving and their use is expanding rapidly.

Mindaugas Dorelis, CEO of JSC Agrodronas

USE OF UNMANNED SYSTEMS IN AGRICULTURE

Mindaugas Dorelis identified two main applications for unmanned technologies: collecting and processing data for precision farming and performing agricultural tasks, such as spraying and spreading, using drones. In the past, drones have been small devices with limited capabilities, but they are becoming more versatile and efficient. Their technology allows them to combine artificial intelligence, the Internet of Things, the cloud and autonomous systems.

SUSTAINABILITY ASPECTS AND PRECISION FARMING

According to Mindaugas Dorelis, the collection, processing, and real-time use of data are crucial aspects of sustainability. Precision is achieved through advanced information technologies. The use of unmanned systems in agriculture makes it possible to:

- Less driving in the fields
- Reduce the amount of product use
- Reduce water consumption
- Reduce CO_2 emissions, as most drones operate on electricity

AGRODRONE AND THE EU GREEN DEAL

Agrodronas technologies align with the European Union's strategies to reduce emissions and protect biodiversity and soil. Operating without internal combustion engines, the drones do not emit CO_2, making this technology fully compatible with the EU's Green Deal.

ECONOMIC BENEFITS AND CUSTOMIZATION

Unmanned technologies are applicable to both small and large farms. Drone technology helps reduce costs as it is more affordable, performs equal or superior functions, and simplifies achieving profit targets for farms.

For example, in conventional crops, the target is €400 profit per hectare, while flower and berry growers can make tens of thousands of euros per hectare.

FUTURE TECHNOLOGY AND INNOVATION

In the future, the operation of unmanned systems will involve the use of digital technologies, artificial intelligence, cloud and robotics. Mindaugas Dorelis pointed out that the Internet of Things is being used every day, even if people do not notice it. Unmanned aerial vehicle technology uses about 70% of real-time data with a centimetre error. These advancements contribute to achieving technological sustainability. In the future, drones are anticipated to operate in swarms autonomously, without human intervention, utilizing artificial intelligence.

AGRODRONAS INNOVATION EXAMPLES IN LITHUANIA

There are already innovative farmers in Lithuania who are using these technologies in cereal crops, berry growing and horticulture. Mindaugas Dorelis shared that some farmers among their clients, recognizing the potential of these technologies, have restructured their entire farm operations to fully integrate drones. Technology is expanding beyond agriculture into forestry, water engineering, and fisheries, such as in pond disinfection.

VALORISATION OF BIOBASED SIDESTREAMS IN AGRICULTURE

INTERVIEW WITH ALESSANDRO ARIOLI

Interview by Bluebook srl

CASE STUDY: ORGANIC SIDESTREAMS IN AGRICULTURE

Alessandro Airoli Agronomist, University Professor, CEO of DAFEES

Alessandro Arioli is a qualified agronomist with a PhD in Environmental Economics. He practices as an agronomist, specializing in rural skills, and as an environmental scientist, focusing on the integration of systemic and ecosystemic elements. Additionally, he is a university professor, former rector of the University of New Hampshire (USA), and the CEO and founder of a private university department, DAFEES, which stands for Department of Agriculture, Food, Energy and Environmental Sciences.

CIRCULAR ECONOMY AND BIOMASS: DISTINGUISHING BETWEEN RESIDUE AND WASTE

Within the circular economy, a significant niche is the circularity of biomass. Biomass is a broad term encompassing materials containing organic carbon. Biomass is the result of complex biochemical reactions involving living organisms throughout the production chain. Biomass classified as residues or waste exhibits great diversity, and its classification can vary significantly depending on local context and economic interpretations.The classification of a biomass as a ‘residue’ or ‘waste’ is influenced by logistical factors, such as the availability of treatment infrastructure, and socio-cultural factors, including consumption habits and local perceptions. The term ‘biomass’ is both global and local, as its practical application varies according to cultural and geographical context. For example, the composition of municipal solid waste varies significantly depending on latitude and longitude. This is particularly evident in Africa, a continent we have extensively studied through numerous projects covering over two-thirds of African countries. We have a vast dataset on the composition of municipal solid waste in cities, which shows a clear predominance of minimally processed organic material. In contrast, in residential areas, metropolises, and megalopolises, while a significant organic component persists, we observe a significant increase in other fractions, particularly plastics and inorganic materials. In these contexts, municipal solid waste is characterized by a greater variety and a lower organic component compared to rural areas.

BIOMASS VALORIZATION CASE STUDY

A prime example of a comprehensive approach to biomass valorization is anaerobic digestion. Anaerobic digesters, often likened to artificial rumens, are enclosed systems consisting of large bioreactors typically recognized by their dome-shaped structures. These vessels, often made of plastic, expand due to biogas production, primarily methane, and can reach considerable sizes, resembling large circus tents. Anaerobic digesters are frequently installed in batteries, or groups of units operating in coordination. Over a cycle lasting five to eight weeks, these systems utilize anaerobic fermentation to treat organic materials, offering a sustainable solution to the complex problem of managing livestock waste. Untreated livestock manure releases significant amounts of greenhouse gases into the atmosphere, contributing to the greenhouse effect. Anaerobic fermentation offers two major advantages. Firstly, it produces biogas, with 50-60% of the organic matter being converted into methane, the main component of biogas. This biogas can be used as a fuel in gas engines, similar to those powered by LPG or purified methane, used in automobiles.
During the process, the hydrogen and carbon atoms present in the residual biomass (a material resembling a dense cream) are converted into biogas. The residue of this process, called digestate, is much more stable and less polluting than the initial biomass. If the biomass had not been treated, it would have released significant amounts of greenhouse gases into the atmosphere.
Another issue related to the disposal of livestock manure and digestate is the percolation into the groundwater, with the risk of contaminating aquifers. To mitigate this risk, regional Agricultural Use Plans (PUA) are in place in Italy. These plans, based on soil characteristics (permeability, geological composition), define the maximum amounts of manure and digestate that can be spread on fields, thus preventing groundwater contamination.
The liquid fraction of digestate, separated from the solid fraction through centrifugation, is rich in nutrients and can be distributed in fields through irrigation systems, providing crops with the necessary minerals for healthy growth. Additionally, the microbial component present in the digestate improves soil fertility, benefiting future crops.
The solid fraction of digestate, separated from the liquid fraction through centrifugation, is primarily composed of undigested plant fibers. These fibers, originating from animal feed, especially cattle, are largely indigestible even by the microorganisms present in biodigesters. Therefore, they accumulate in the final solid residue. This solid fraction can be further valorized through compaction and compression processes. In this way, pellets or briquettes are obtained, solid fuels ideal for pellet or wood stoves. This is a completely natural fuel.
We have seen how the management of a problem, such as the disposal of livestock waste, can create two valuable opportunities: the production of biogas and the valorization of digestate as a fertilizer. The latter, in particular, represents a remarkable resource for agriculture, as it can almost completely replace synthetic chemical fertilizers. An analysis of the chemical composition of digestate shows that it contains all the nutrients necessary for plant growth. Therefore, its use in agriculture not only improves soil fertility but also reduces the environmental impact associated with the production and use of synthetic fertilizers.
In many cases, careful management of the biogas plant and related farms has allowed for the complete elimination of the purchase of chemical fertilizers, demonstrating how anaerobic digestion technology can contribute to the creation of more sustainable and circular agricultural systems.

Anaerobic digesters have experienced significant growth, especially in rural areas, where the availability of biomass as a byproduct of agricultural activities makes them particularly advantageous. Currently, there is a good balance between the demand for biogas and the supply, thanks also to the need to constantly supply these plants with an adequate quantity of quality biomass.

TWIN TRANSFORMATION IN AGRICULTURE

INTERVIEW WITH ERKAN AKTAŞ

Interview by Tarsus Ticaret ve Sanayi Odasi

CASE STUDY: AGRICULTURE AND CIRCULAR ECONOMY

Prof. Dr. Erkan Aktaş Mersin University

Erkan Aktaş is a faculty member at Mersin University, Faculty of Economics and Administrative Sciences, Department of Economics. His areas of expertise are agricultural economics, environmental economics, rural development and rural transformation. Although he has an agricultural background, he adopted a multidisciplinary approach in his academic life by also doing a master's degree in economics. He shifted direction. Currently - he says - we see that multidisciplinary studies are becoming more prominent; global climate change, the crises experienced in agriculture and food in particular, have brought our work in this area to the forefront even more.

HOW CAN THE CE APPROACH BE APPLIED TO REDUCE CARBON EMISSIONS IN THE AGRICULTURAL SECTOR? WHAT SPECIFIC SOLUTIONS, PARTICULARLY RELATED TO WASTE REUSE AND RECYCLING, DO YOU SUGGEST?

Now, it should be said that, unfortunately, with the rapid increase in mechanisation in agriculture, fossil fuel use has also started to increase rapidly in agriculture. Of course, industrial agriculture too. With the introduction of industrial agriculture into our lives we have faced more technology-intensive production. This situation has increased fossil fuel consumption and therefore carbon emissions in industry as well as in agriculture. Of course, serious problems await us with increasing carbon emissions. It is also necessary to state what kind of processes await us and what we should do. The main issue is: especially with the spread of industrial agriculture, the increase in chemical inputs and the rapid developments in agricultural technologies, the introduction of genetically modified organisms (GMO) and special seed technologies into our lives, causes serious problems in terms of food safety. We are also faced with problems caused by agriculture. While climate change affects the agricultural sector the most, if the necessary changes are not made in the agricultural sector, this situation will increase the effects of climate change even more. Therefore, serious problems await us in this area.

WHAT ARE THE MAIN SOURCES OF CARBON EMISSIONS IN THE AGRICULTURAL SECTOR AND WHAT ARE THE MOST EFFECTIVE METHODS TO REDUCE THESE EMISSIONS?

The main problem: With the rapidly increasing mechanisation in agriculture, we see that industrial agriculture has gained an important place in our lives. Another important issue is access to water. The ease of access to water has significantly increased the water consumption of products. This situation causes the water footprint of the products to grow every day. This increase leads to the depletion of water resources. In addition, a fundamental problem emerges with global climate change, drought and water shortages caused by drought. This situation causes serious problems in the production of products that require a lot of water. That is why the fundamental issue that needs to be done is this: In order to use limited water resources efficiently, limited irrigation systems need to be expanded. In addition, serious steps must be taken in terms of water management of dams and preventing water loss. Technological solutions that reduce evaporation need to be developed and implemented for dams and irrigation channels. So, water shortage is a fundamental problem. Therefore, we need to turn to methods that use water more efficiently, such as drip irrigation systems, and focus on products with low water consumption. If we can achieve this, the agricultural sector can better protect itself against global climate change. Otherwise, of course, it should be said that agricultural waste products should also be evaluated in terms of circular economy. Some of these can be used in the energy sector, while others can be re-evaluated. For example, we do this in compost fertiliser. Some agricultural products in particular are re-evaluated and made useful. For example, these wastes can be turned into fertiliser and recycled into the soil. Thus, the soil can gain a more nutritious and more organic structure.

HOW CAN THE INTEGRATION OF CLIMATE-SMART AGRICULTURAL TECHNOLOGIES AND CE PRINCIPLES MOST EFFECTIVELY INCREASE SUSTAINABILITY IN FOOD PRODUCTION?

In fact, we can summarise it as follows: A concept called 'twin transformation' has emerged recently. This includes both digital transformation and green transformation. The agricultural sector also needs to use digital transformation and green transformation together. So, we need to direct this process in agriculture towards a more environmentally friendly and sustainable agriculture, especially with green transformation. We can achieve this by integrating digital transformation into the agricultural sector and effectively using technologies in agriculture with green transformation. Actually, when we say green transformation, we mean the following: With green transformation, a new paradigm is needed. We need to take serious measures against excessive chemical use in agriculture. We need to take serious measures regarding water restrictions and take careful and strategic steps regarding product preferences. While doing all these, we should make this process more effective, especially by integrating technological support and digital transformation. We should start by raising the awareness of the producer and the consumer on this issue. We can increase our work in this direction.

WHAT ROLE CAN THE INTEGRATION OF FORESTRY AND AGRICULTURE SECTORS, WITHIN THE PRINCIPLES OF THE CE, PLAY IN THE FIGHT AGAINST CLIMATE CHANGE?

First of all, we always emphasise this: our forests are very important to us. In fact, green transformation starts with protecting our natural forest areas. We should clearly state this point. A society that cannot protect its forests cannot take steps in green transformation anyway. In that case, our first priority should be to protect these points that are side by side with agriculture. Perhaps acting together to protect our forests should be the most important part of the green transformation. Because the imminent drought caused by climate change, as well as extreme meteorological events, have increased rapidly in the world and Turkey in recent years.

HOW CAN YOU REDUCE FLOODS AND DROUGHT?

You can achieve this by keeping your vegetation intact and protecting green areas. Increasing forest areas is very important in this respect. In recent years, forest areas have been increasing in Turkey, but forest cover is decreasing. Forests are important carbon sink areas, especially in the global fight against climate change. In order to protect these areas, we need to avoid damaging the quality of the forest. Turkey and the world should not see forests as a source of fuel or raw materials for other sectors. I think steps should be taken and awareness should be raised at this point.

A CENTURY OF PRODUCTION WITH A VISION OF NO WASTE

INTERVIEW WITH JAKA AŠKERC

Interview by Solski Center Celje

CASE STUDY: NO WASTE IN THE PRODUCTION PHASE

Sadjarstvo Aškerc is a family-run business with a tradition of apple production dating back more than a century. Their story dates back to the mid-19th century, and today they combine modern techniques, sustainable approaches and innovative methods to reduce waste and offer quality fresh apples and natural apple juice.

HOW LONG HAVE YOU BEEN GROWING APPLES AND WHAT IS YOUR HISTORY?

Our tradition dates back to the mid-19th century. The farm has evolved over the generations - from meadow orchards to modern plantations. We focus on sustainable production methods and innovation in apple processing through continuous training.

HOW DO YOU PLAN THE PLANTATION DESIGN TO MINIMISE CROP LOSSES?

We start by choosing the optimal micro-location, as sunlight and warmth are crucial for tree growth. The soil is levelled, analysed and prepared by deep tillage. We also make sure that there is adequate drainage. Trees are planted in rows to achieve optimum light for all parts of the canopy.

HOW DO YOU PREVENT YIELD LOSS DURING THE SEASON?

We use hail nets, irrigation systems and advanced technology such as weather stations to protect against the elements. We work with the Hop Institute to tackle diseases and pests. Harvesting is carried out carefully and in two stages to ensure optimum ripeness. Harvesting trailers are used for transport to prevent damage to the fruit.

HOW ARE APPLES STORED AND PROCESSED?

Apples are stored in cold stores at a temperature of around 1°C, which allows them to stay fresh until late spring. To produce the juice, the apples are washed, ground, pressed and then the juice is pasteurised with chips from our trees. A small proportion of the rotten apples, branches, leaves and processing residues such as pomace are used for animal feed or as organic compost, which reduces waste and improves soil quality.

HOW DO YOU MEET THE DEMANDS OF CONSUMERS AND TRADERS?

Consumers and retailers expect high quality, so production has to be very precise and apples are carefully sorted according to colour, size and firmness. We deliver locally to schools, nurseries, spas and businesses within a 30 kilometre radius, ensuring freshness and reducing our carbon footprint.

WHAT IS YOUR MESSAGE ON FOOD AND SUSTAINABILITY?

Food should be valued and handled responsibly. We believe that by taking small steps, such as careful production, we can contribute to a more sustainable future. We also encourage local communities to support home-grown produce. We have enough food for now, but if times get tough, that will change quickly.

MICROALGAE HIGH TECHNOLOGY

INTERVIEW WITH FIDEL DELGADO RAMALLO

Interview by ACCI

CASE STUDY: FARM INPUTS

Fidel Delgado Ramallo

neoalgae

WHAT IS NEOALGAE AND WHAT DO YOU DO?

We're a bio-technology company located in Gijón and dedicate ourselves to growing and extracting different products from microalgae. We have a 2000 square meter plant with all the required systems for the cultivation of microalgae under a greenhouse. There, we grow different species of microalgae for different purposes and future usage. Over the last few years, we've been particularly focusing on the ingredient sector. Ingredients for agriculture, for the cosmetic industry and nutraceutical ingredients.

All of them from growing microalgae. I always say that microalgae provide more than 50% of the oxygen we breathe in our planet. By consuming Neoalgae products, you'll be mitigating the effects of climate change. As microalgae need CO_2 to grow, so through our crops, we're feeding them with CO_2.

And we're capturing CO_2 and emitting oxygen to the atmosphere. All our products are completely sustainable. We utilise production systems that are duly recognised by different Quality standards. Therefore, we always work under a fully sustainable mindset.

YOU PRODUCE A NATURAL FERTILISER, RIGHT? WHAT´S ITS PRODUCTION PROCESS LIKE AND WHERE DO YOU GET ITS RAW MATERIALS FROM?

SPIRAGRO is the generic brand name for the whole product range. It is produced from a bacteria of microalgae and botanical extracts.

What does Spiragro have in particular? What's peculiar about it is that, from the moment of its cultivation, we're capturing CO_2.

AND WHAT HAPPENS NEXT IN THE PROCESS, WHEN THE PRODUCT IS APPLIED IN THE FIELDS?

Well, it boosts production in a natural way and without using chemical products. The legislation for production of fertilisers and bio-stimulants has changed. Since last year, the UE has “opened its umbrella”, allowing the inclusion of natural products developed in a natural and sustainable way. And that’s where microalgae have played a relevant role in terms of this change of legislation. As there were many products in the market which could not be commercialised as bio-stimulants because they didn’t have that change made, that has changed since last year.

And from that moment on, every item produced from microalgae and other botanical extracts is able to be sold as a bio-stimulant. Here, we’re trying to stimulate the plant to grow better, in a natural way. With a higher capacity to grow, enhancing its yields as it improves the soil’s characteristics. Within the surface of 1 ha, with one single application we’re using only 5 litres.

There won’t be any issues, there won’t be need for any high nitrates added. It’s simply a natural product which will boost and favour the auxinic capacity of the plant therefore generating a higher balance.

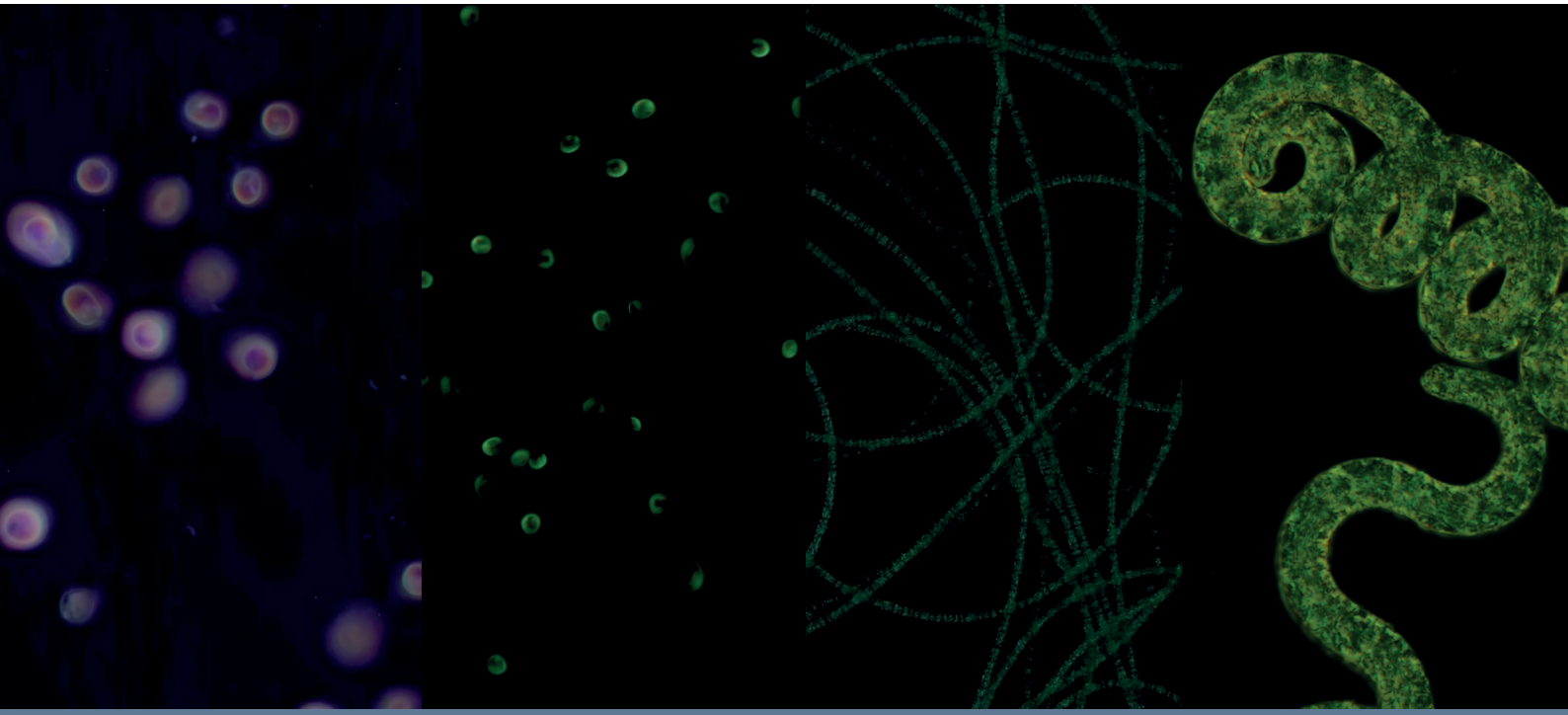
HOW CAN YOUR PRODUCTS BE CONSIDERED A GOOD EXAMPLE OF CIRCULAR ECONOMY?

Because after all, all the products that we’ve been developing have been inserted within a LIFE project. We’ve developed a biofungicide, which is also something that has changed in the EU.

It’s trying to diminish the use of pesticides and fungicides in the crops so that trophic chains in the ecosystems are not heightened. And we have developed a natural product from different vegetal extracts and different algae extracts which, when applied in a foliar via, will control the emergence of botrytis and mildew, which are the most current fungus and pests present in intensive agriculture, such as the tomato crops, for example.

WHERE DOES THE ENERGY YOU USE ON-SITE COME FROM?

We have a photovoltaic plant here in our facilities. We produce approximately 60% of the power we consume by means of photovoltaic panels. And the remaining energy, we try to obtain it from suppliers who will only commercialise energy from proven renewable sustainable sources.



FARMERS' COMMITMENT TO SUSTAINABILITY

INTERVIEW WITH BRYCE CUNNINGHAM

Interview by GCU

CASE STUDY: AGRICULTURE AND CIRCULAR ECONOMY

Bryce Cunningham

Farming is one sector that can do much to promote sustainability and the circular economy. It provides us with meat, cereal and dairy products and the cyclic nature of farming, where the land is used in the past, present and in the future, means farmers need to ensure their practices are sustainable.

Farmers are at the start of the food supply chain and in the growing processing transporting and consuming of food it's thought to represent 30% of our Global greenhouse gas emissions. Thus farms play a significant part in promoting a more circular approach from the materials used, the farm practices which can improve and maintain soil quality, promote local produce and manage farm waste through good land practices such as composting and digestion of waste. However, the emergence of large-scale farming can lead to practices that involve industrially produced fertilizer and pesticides - a far cry from how farms were once operated and the drive towards efficiency can take its toll on the local ecosystem through the destruction of a biodiverse environment.

One farm that sees the opportunity to rethink current practices is Mossgiel Farm. Located in Ayrshire in Scotland, Mossgiel is embedding sustainability in everything they do. The farm where Scotland's most love poet Robert Burns wrote many of his songs, aims to be sustainable.
One area of circular opportunity is the containers used for the milk. Milk is delivered to the customer in green or blue plastic containers, or glass bottles and returned to the farm.
Bryce Cunningham runs the Family Farm which is principally an organic dairy farm, delivering 1.5 million litres of milk annually.

MOSSGIEL FARM NO LONGER USES SINGLE-USE PLASTIC. HOW DID YOU ACHIEVE THIS GOAL?

In 2019, we decided to stop using single-use plastics entirely. The reason for that was that becoming an organic farm, we had transitioned to grazing outside, from inside all year round and we felt we were doing a lot for the environment through all these different ways of dairying and all the milk was ending up the single-use plastic bottle that, 10 days after use, was ending up either in landfill or if lucky, in a recycling bin.
So we decided to ban single-use plastic at that point and moved to sustainable glass packaging which can be used endlessly until they break.
We also have a large BPA-free plastic container that can be reused 50 times as well and at the end of the day they are recycled buckets to start with and recycled during their lives as well.
So we use these 50 times and the glass bottles endlessly until they break overall we have saved 26 million pieces of single plastic since we started that plan.
Our customers are interested in the recyclable approach. Since 2019 we have grown the business by four times, so the volume is increasing.
One of the main aspects of what we do is a single-use plastic-free part of it and a lot of customers are asking us for that side of things we're now attracting customers like Baxter Storey for example that supply Glasgow Caledonian University and they have seen a massive reduction of their single-use plastic waste since moving to us.
Farmers often cooperate through the shared use of major equipment through machinery rings, a recognized circular economy business model.

WHAT ARE OPPORTUNITIES FOR NEIGHBOURING FARMS TO WORK CO-OPERATIVELY IN PROMOTING ORGANIC DAIRY FARMING?

We brought five other organic farmers here to Mossgiel so far and the big aspiration we have is to grow the business to 10 million litres a year and support a further 10 Scottish organic dairy farms.
The whole aspect of that is so that we can supply sustainable food prices to farmers and keep food prices sustainable for consumers as well, to link that food chain up from grass to glass to ensure sustainability at every step.

WHAT ARE THE CONCERNS THAT CONSUMERS MIGHT HAVE ABOUT INTENSIVE MILK PRODUCTION?

So here at Mossgiel, we operate a cow-with-calf system. We're one of only two dairy farms in Scotland. So there's ourselves here and Ethical Dairies in Dumfries.
What we try to do is keep cows and calves together - something that's very unusual in our industry. And the reason we've done that is actually for two reasons.
First of all, there's an ethical concern from some dairy consumers about calves being removed from their mothers.
We wanted to see if it could be done within the industry and yes it can be done.
That's why we've done it.
Second of all, we want to encourage new entrants into dairy farming and use new and innovative ways of farming to do so.
But also people who are perhaps closer to retirement age - they don't want to have hundreds of cows anymore and they want to do something a little bit different.
They can have a smaller herd and operate the cow-with-calf system and have a premium through ourselves as a platform, to engage with consumers and follow that way of practice.
So as we enjoy our milk and all the other products that farms produce remember circular economy thinking has an important role in making our farms sustainable.

Agrodonas is not only striving for its own well-being, but also creating an ecosystem that helps other companies to develop.

Mindaugas Dorelis

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Bryce Cunningham

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