Horizon 2020 Programme
Research and Innovation Action

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme, under Grant Agreement ***No 773649***.

Efficient Carbon, Nitrogen and Phosphorus cycling in the European Agri-food System and related up- and down-stream processes to mitigate emissions

Start date of project: 2018-09-01
Duration: 54 months

D6.11. Compilation of EIP-Agri practice abstracts developed No 2

Deliverable details	
Deliverable number	*D6.11*
Revision number	*Circular Agronomics-D6.11-E-0821-EIP-Agri practice abstracts*
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Due date	31/08/2021
Delivered date	31/08/2021
Reviewed by	Victor Riau
Dissemination level	Public
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1. INTRODUCTION. MULTI-ACTOR APPROACH

As part of their communication activities, multi-actor approach projects are required to produce short "practice abstracts" (PAs) which outline their plans and main findings. The information should be easy understandable and provided throughout the project's life-cycle. This information must therefore be shared in a specific format (the "EIP Common format") which is specially made so that project info and results can be shared with those who can apply the findings. The format includes: a short and understandable title, a succinct summary of the issue tackled, and the main outcomes and recommendations produced, and contact details to find further information. The content of the submitted practice abstracts can be updated at any moment according to new findings.

The practice abstracts produced by H2020 multi-actor approach projects will be made available on the EIP-AGRI website. This will form a unique EU collection of practical knowledge. Anyone will be able to search through the information by theme, sector or region. These practical project outcomes will be easily visible for any reader and contribute to the knowledge exchange and networking activities of the EIP-AGRI, encouraging contacts and interaction across Europe. This unique EU database will also enable researchers to highlight the work they have carried out in a multi-actor environment. Such work is more likely to be taken up in practice, and this can help research institutions to show and measure the impact of their research, which is becoming ever more relevant to justify public funding.

As a multi-actor project, Circular Agronomics is aimed to produce at least 100 PAs during the course of the project, which have been split into 3 deliverables to be submitted on M18, M36 and M48, and containing 35, 35 and 30 PAs, respectively. The second set of 35 PAs prepared by those partners involved in work packages WP1, WP2, WP3, WP4 and WP5 are listed task by task in Table 2. A summary of the tasks to be performed within each WP that are liable to generate PAs, is shown in Table 1.

Table 1. Tasks to be performed within each work package

WP	Task
1. Plant-Soil-Interactions	Task 1.1: Comprehensive analysis of C, N and P stocks, flows and emissions in crop farming
	Task 1.2: Increase internal C, N and P cycling in the soil-plant interface
	Task 1.3: Fertilizer application strategies
2. Livestock emissions and residues treatment	Task 2.1: Feeding strategies, gaseous emissions and manure characteristics
	Task 2.2: Demonstration of innovative treatment technologies increasing efficiencies in valorisation and recycling of livestock/agricultural residues and minimizing emissions
3. Carbon and Nutrient valorisation from food-waste and food-processing-waste(water)	Task 3.1: Classification of food waste and wastewater streams in food industry and their recycling potential for C, N and P
	Task 3.2: Pilot Demonstration of innovative treatment technologies for recovery/recycling of C, N and P from food waste and wastewater
4. Social and Economic Evaluation	Task 4.1: Farmers dialogue
	Task 4.2: Consumer Acceptance Evaluation
	Task 4.3: Cost assessment for demonstrated technologies and business models for implementation
	Task 4.4: Effects by international trade
5. Environmental Evaluation	Task 5.1: Methodological framework for the environmental assessment
	Task 5.2: Application of environmental assessments
	Task 5.3: Governance in the field of environmental issues
	Task 5.4: Policy Impact Assessment

The Excel EIP common format, including project information, partners contact information, keywords, related websites and full PAs will be sent to the EIP-Agri for its publication. A non-editable version of the Excel file can also be downloaded from: Circular Agronomics_Practice Abstracts_2 (note that the order of the PAs differs between the Excel file and Table 2).

2. LIST OF PRACTICE ABSTRACTS FROM MONTH 18 TO MONTH 36

Table 2. List of practice abstracts per task included in Deliverable 6.11

WP	Task	Practice abstract
WP1	**Task 1.1**	**36.** On-field and lab applications of light reflectance spectroscopy methods for organic carbon and nitrogen monitoring. **37.** Effect of organic amendments on soil fertility and organic carbon stocks in agricultural topsoil and subsoil.
	Task 1.2	**38.** Performance of digestates as fertilizers in irrigated maize **39.** Improving fertilizer use efficiency through a more diverse earthworm community. **40.** Sowing catch crops after maize minimizes nitrate leaching
	Task 1.3	**41.** Microfiltered digestate in subsurface drip irrigation (SDI). **42.** Split application of manure and slurry improves performance of rainfed arable winter crops **43.** Phytotoxicity test in lettuce seeds and seedlings with digestate products. **44.** Can we decrease N2O emissions after fertilizer application by smart selection of plant species? **45.** What is the right time to fertilize silage maize with slurry or biogas digestate?
WP2	**Task 2.1**	**46.** Production and emission parameters of two different dairy cow rations. **47.** Feeding-related methane emissions from dairy farms in the Lungau region. **48.** Using bacteriophages to reduce ammonia emissions in ruminant production. **49.** Advantages of compost-bedded pack systems in cattle farms.
	Task 2.2	**50.** Efficiency of a centrifugal separator for manure management. **51.** Obtaining biofertilizers from digestates by solar drying and stripping absorption processes. **52.** Biogas from manure: from a challenge to an opportunity. **53.** Best available techniques for livestock emission reduction. **54.** Ammonia Washing Machine to recover N from the air of pig farms **55.** The agricultural performance of NH4-struvite. **56.** The recovery of P in form of Hazenite (KNa-struvite) **57.** CO2-Stripping prior to vacuum degasification of biogas digestate reduces the need of alkaline pre-treatment. **58.** Vacuum degasification of biogas digestate and its pre-treatment affect more parameters than just the nitrogen content. **59.** Catch crops as co-substrates for the anaerobic digestion of dairy manure. **60.** Ensiling as a strategy to maintain the biogas potential of catch crops throughout the year.
WP3	**Task 3.2**	**61.** P-recovery by anaerobic stage pH control without reagents. **62.** P-recovery by K-struvite after aerobic stage. **63.** Application of electrospun nanofibrous membranes (ENM) for digestate pretreatment **64.** Technical and economical evaluations for acid whey pre-treatment.
WP4	**Task 4.1**	**65.** Factors affecting farmers' adoption decision of innovative circular farming practices and solutions in EU. **66.** Factors influencing farmer adoption of sustainable behaviours
	Task 4.2	**67.** Sustainable food behaviours in consumers.
	Task 4.4	**68.** N, P, C flows into & from the EU (import/export). **69.** Reaping multiple benefits of Climate Smart Agriculture: The case of dairy farmers in East Africa.
WP5	**Task 5.3**	**70.** Analysis of legislation related to Circular Economy in Agriculture

3. COMPILATION OF 35 EIP-AGRI PRACTICE ABSTRACTS (English version)

PA36. On-field and lab applications of light reflectance spectroscopy methods for organic carbon and nitrogen monitoring.

Monitoring contents and distribution of soil physico-chemical properties can support decisions for sustainable agricultural production systems. Visible-Near-Infrared (Vis-NIR) spectroscopy is a method using the light reflectance properties of individual materials in the range of visible and near infrared wavelengths. This method can reduce the time and budget constraints of conventional laboratory methods. It enables soil surveyors to increase sampling density without adding substantial costs. There are two main approaches to quantify soil properties by Vis-NIR spectroscopy.

1. Classical single point Vis-NIR spectrometers are designed for easy operations and provide instant results with minimal sample preparation.
2. Hyperspectral imaging using a high-resolution camera, which is applied in the Circular Agronomics EU project (CA) to predict soil organic carbon (OC) and nitrogen (N) contents at a fine scale.

In the CA project, we collected intact core samples for scanning with a hyperspectral camera (Hyspex VNIR-1800 camera; Norsk elektro optikk, Norway 400-990 nm, 53*53 µm² per pixel). We applied machine-learning to model the OC and N contents at a fine scale. We successfully applied this approach to show the OC and N depth-distribution down to one meter in a 7-year field-trial testing various types of organic fertilization in a sandy Cambisol (IASP, Germany).

PA37. Effect of organic amendments on soil fertility and organic carbon stocks in agricultural topsoil and subsoil.

Organic amendments such as cattle-manure, slurry or biogas digestate have been widely applied to maintain soil organic carbon (OC) and nutrient contents, aiming at improving soil fertility and crop production. However, sustainable effects of organic amendments on topsoil and particularly subsoil OC stocks, and on soil nutrient cycling are still debated. In the Circular Agronomics EU project, we study the effects of mineral and organic fertilisation after seven years of application (i.e. manure, pig slurry and biogas digestate) on topsoil and subsoil OC, nutrient contents and soil structure, in a sandy Cambisol (IASP, Germany). To this end, we took soil cores down to one meter depth in a field experiment and quantified soil OC, nitrogen and nutrient contents (e.g., nitrate, available phosphorus). To detect the potential effect of the fertilization on the soil structure, we determined soil aggregate size distribution. We found that organic fertilization increased soil OC stocks from 1.16 to 1.46 kg m-2 at 0-10 cm compared with mineral fertilization. The application of biogas digestate and mineral fertilizer resulted in similar aggregation patterns down to 80 cm, and both treatments presented higher contribution of small aggregates (< 250 µm), compared with the no-fertilization treatment. For similar sandy soils, naturally having low OC and nutrients contents, the application of organic amendments can enhance soil fertility and OC storage at the medium term.

PA38. Performance of digestates as fertilizers in irrigated maize.

Anaerobic digestion is increasingly used to treat livestock manure and produce biogas. Generally, co-substrates are added to increase the biogas production. The resulting effluent (digestate) retains most of the original nutrients present in the livestock manure and in the added co-substrates. And it can be used as a fertilizer in many arable and forage crops.

In Circular Agronomics we compare the effect, on an irrigated maize crop under Mediterranean conditions, of digestates application, from biogas production plants using dairy manure, with other common maize fertilization strategies: raw slurry and mineral fertilizers. On maize crop, digestates and slurry can be applied at pre-sowing. Mineral fertilizers can also be applied at top-dressing and achieve a highest nutrient efficiency. The proportion of ammonium N (quickly available for the crop) in digestates, respect the total N (organic and ammonium), ranges between 55 % and 60 %, slightly lower than for the pig slurry used (70-80 %).

Grain maize yield achieved when digestates are used is similar to the one achieved using slurry, both applied at pre-sowing, with equivalent N rates. The split application (pre-sowing and top-dressing) of mineral fertilizers allows a higher yield and a higher nutrient use efficiency.

Using digestates form biogas plants as fertilizer on irrigated maize is as effective and efficient as fertilization strategies using livestock manure, most common nowadays. Replacing part of the N applied with digestates by mineral fertilizers at top-dressing can contribute to improving the efficient use of this nutrient.

PA39. Sowing catch crops after maize minimizes nitrate leaching.

In Mediterranean irrigated areas, maize is a common crop. It achieves high yields and has high nutrient demands, especially on nitrogen (N). Frequently, when crop ends, there is a high amount of nitrate-N in the soil available to being leached with the autumn-winter rainfalls, if there is no crop (usual management nowadays) to absorb it, affecting groundwater quality.

N catch crop implementation after maize, which occupies the land up to the moment of preparing it for the next crop, is a good environmental practice to minimize N leaching and increase N use efficiency in these agricultural systems. Several crop species can be used. Generally, a fast growth and high N uptake in the earliest crop stages are appreciated. The most interesting species to develop this function in the Catalan irrigated agricultural systems can be: forage rapeseed, Italian ryegrass, black oat and, to a lesser extent, white mustard, linen or phacelia. Choosing the right specie will mainly depend on when the maize crop is removed and when the catch crop can be sown. Cruciferous (rapeseed, mustard, …) and Italian ryegrass require, to be effective, earlier sowing than other species. They are generally best suited to fields where maize is harvested for fodder and its recollection is earlier than when it is harvested for grain. In the tests carried out, in general, dry matter productions between 2 and 7 t/ha and N uptake between 30 and 120 kg/ha have been measured for the different catch crop species.

It is key to minimize the cost of managing these N catch crops. They should not be neither fertilized nor irrigated, nor pests and/or diseases controlled. Affordable costs are those related with sowing and harvest, if they are used for fodder, or destruction, if incorporated into the soil.

PA40. Improving fertilizer use efficiency through a more diverse earthworm community.

Struvite is one of the most interesting novel fertilizers of the circular agronomy. It can be produced from a variety of “waste” streams, including dairy waste, manure and sewage sludge. Struvite is increasingly considered as a promising phosphorus (P) fertilizer, which is especially interesting as the reserves of rock phosphate (the raw material for conventional P fertilizer) are limited. One of the potential drawbacks of struvite as a P fertilizer is its low solubility, which makes it a challenge to supply plants in time with the amounts of P they need for growth. However, it is possible that soil fauna may increase solubility through their activity, resulting in a potential positive effect of soil biodiversity on P use efficiency of struvite. Earthworms are particularly interesting in this regard, as we know from other studies that they can distribute fertilizer grains more envenly through the soil, bringing them potentially closer to plant roots and available for uptake. In a field experiment, we are currently testing to what extent earthworms may increase P uptake efficiency from struvite, and whether this effect changes with earthworm species or -diversity. We hope that our work, through making a link between faunal diversity and agronomic efficiency, will give some guidelines on how to make agriculture more circular though nurturing biodiversity.

PA41. Microfiltered digestate in subsurface drip irrigation (SDI).

The microfiltered digestate can be conveniently used as a fertilizer, mixed with irrigation water in fertigation systems. The particles with a diameter greater than 50 microns are almost completely excluded by the microfilter specially developed by Saveco WAMgroup, and cannot clog nozzles or drippers.

The optimal agronomic use of the microfiltered fraction is the distribution on growing crops, because it contains most of the nitrogen in ammoniacal form, which is ready-to-use for plant nutrition.

In the Circular Agronomics project, microfiltration tests and the use of microfiltered digestate in fertigation, by means of Netafim drip lines buried 25 cm deep (SDI – subsurface drip irrigation), were organized at CAT Correggio biogas farm (Emilia-Romagna region, Italy). The fertigation system includes a safety filter and a working pressure control system.

In 2019 the fertigation trials were conducted on maize obtaining good yields of around 20 DM tons/ha, comparable to those of the Business as Usual scenario based on sprinkler irrigation and use of raw urea. In 2020 sorghum was cultivated, with the aim of verifying the possibility of obtaining a double harvest, in summer and autumn. The trial showed that it may be possible to harvest the sorghum twice over a six-month period (May-October), in this way achieving a production of 20 DM tons/ha. The sorghum benefited from available water to full express itself, with total nitrogen removals close to those of maize (around 300 kg N/ha).

PA42. Split application of manure and slurry improves performance of rainfed arable winter crops.

The form of nutrients found in each kind of livestock manure, and their characteristics, influences the moment when they can be applied and the nutrient use efficiency by crops. Rainfed arable winter crops can be fertilized at pre-sowing (before crop sowing) and/or at top-dressing (with the crop established). Solid livestock manure, for their physical characteristics, can only be applied at pre-sowing. Liquid livestock manure (slurry, liquid fractions, digestates) can be applied both at pre-sowing and at top-dressing. The high proportion of ammonium N they contain makes their use at top-dressing more advisable.

One strategy to prioritize is using solid manure at pre-sowing and complementing this application with liquid livestock manure at top-dressing. Higher yield (400-900 kg/ha of winter cereal grain) is achieved, in respect to provide the same total N rate with a single pre-sowing solid manure application. And, more important, a higher grain protein content is also achieved, more than 0.5 perceptual points. Splitting liquid manure application among pre-sowing and top-dressing does not change winter crop yield, in respect a single pre-sowing application, but it may increase the grain protein content.

Applying all the N rate at pre-sowing increases the risk of nitrate-N leaching. Crop has low N needs in the early development stages and nitrate N is highly mobile in the soil. Splitting livestock manure application among pre-sowing and top-dressing is a good practice. It contributes to reducing N leaching losses. And a part of the N is supplied when the crop has the highest needs (between tillering and heading, in cereals) on this nutrient.

PA43. Phytotoxicity test in lettuce seeds and seedlings with digestate products.

When using fertilizer products coming from organic waste such as manure for edible crops, previous phytotoxicity assays can help to elucidate whether the product is suitable for an optimal plant grow. Within the Circular Agronomics project, phytotoxicity assays was executed in lettuce seeds and seedlings with raw digestate (D) and dried digestate (DD) after the solar drying process. The germination index (Gj) was measured according to the OECD guidelines. Extracts of each product were then diluted to 100%, 75%, 50%, 25%, 15% and 0% in distilled water and the germination index was calculated. Results show that a dilution ratio of 15% of D and DD attained germination index values higher than 70 %, which are indicative of no phytotoxicity. The electrical conductivity was determined to be the main problem related to germination. Our preliminary conclusion is therefore that digestate without the appropriate dilution is unsuitable to be a fertilizer for edible crops. An alternative approach to improve the quality of the dried product as fertilizer could be a solid-liquid separation process prior to drying. Such an approach would improve the NPK concentration of this fraction, while the dissolved salts would be in a higher concentration in the clarified fraction.

PA44. Can we decrease N2O emissions after fertilizer application by smart selection of plant species?

Nitrous oxide (N2O) is, with carbon dioxide and methane, one of the three main greenhouse gases that cause global warming. Unlike both other gases, N2O emissions are mostly emitted from soils, after application of nitrogen fertilizers. Emissions from managed grasslands are especially important in countries like The Netherlands. Many management practices to minimize N2O emissions have been proposed, mostly dealing with timing, rate and type of fertilizer application. Little attention has been paid to date on the effect of grassland species composition. From ecological studies in semi-natural grasslands, we know that a higher plant species composition can lead to fewer nutrient losses, especially if the plant species are very different in aspects such as rooting depth. In a series of experiments over the past few years, we have shown that a smart combination of grass and/or legume species may indeed lead to fewer N losses through N2O emissions and leaching. Currently, we are conducting a large field experiment to test whether this principle also works for circular fertilizers such as digestates and ammonium sulphate produced after vacuum degasification of digestate. Once completed, we hope that our results will provide useful suggestions on what species of plants to seed in order to contribute to a more circular agriculture with fewer losses to the environment of harmful substances.

PA45. What is the right time to fertilize silage maize with slurry or biogas digestate?

Slurry from animals like cattle or pigs contain nitrogen in the form of ammonia and organically bound, usually in almost equal shares. Biogas digestate has similar characteristics. Before plants can take up nitrogen it has to be converted from ammonia to nitrate which may take 1 to 4 weeks depending on the weather and soil conditions. Organically bound nitrogen (fixed in carbon-containing particles) needs to be mineralized first, in order to become plant available. Only a small share of organically fixed nitrogen will be mineralized within one growing season. An early slurry or digestate application may lead to a long time available for mineralization and therefore to higher shares of plant available nitrogen. On the opposite, nitrate in the soil is prone to leaching. The longer the timespan between fertilization and plant uptake, the higher is the risk of loss of nitrate into ground water bodies. Because liquid organic fertilizers require large storage capacity, farmers may need to empty storage tanks as soon as possible after winter. This may be 2 to 3 months before planting, and 4 to 5 months before the main nitrogen demand. An application close to the time of demand (plants have developed and reached a certain height), may be too late because dry weather may restrict growth. In areas with good water supply, fertilization should be more close to the time of nitrogen demand while in dry areas, application can be made more early because the risk of leaching is much smaller and as more time the slurry spends in the soil, the more organic nitrogen mineralizes.

PA46. Production and emission parameters of two different dairy cow rations.

Two rations differing in forage composition and concentrate proportion were fed to Holstein Friesian and Simmental dairy cows to evaluate daily feed and gross energy intake, milk yield, and methane emission. Ration A (typical Austrian ration) consisted of 40% grass silage, 30% maize silage, and 30% hay, and the concentrate proportion was 24% on average. Ration B (typical ration for case study region Lungau) was a mixture of grass silage and hay (each 50%) and contained 9.5% concentrate on average. Forage was of medium to high quality, and concentrate was a mixture of cereals and by-products. Cows fed ration B had 2 kg lower daily dry matter intake and 49.3 MJ lower gross energy intake. As a consequence, daily milk yield was also 5.4 kg lower than in cows offered ration A. Furthermore, the lower feed intake of cows fed the typical Lungau ration (264.5 g) resulted in lower methane production per day compared to ration A (309.7 g). However, cows yielded similar amounts independent of the ration regarding methane production per kg energy-corrected milk yield. Based on the results on gross energy intake and daily methane production, methane conversion factors were calculated for both rations according to IPCC. The methane conversion factor gives the percentage of gross energy emitted via methane. This energy can therefore not be used for animal metabolism. Feeding ration B resulted in a methane conversion factor of 5.65 while it was 6.16 in cows fed ration A. This result shows that low methane conversion factors can be achieved if medium to high quality forage is fed and low amounts of concentrates are supplemented, while most former studies found decreasing methane conversion factor with increasing concentrate proportion in the ration.

PA47. Feeding-related methane emissions from dairy farms in the Lungau region.

The methane conversion factor (MCF) expresses the percentage of gross energy emitted via enteric methane. This energy can therefore not be used for animal metabolism. The MCF is internationally standardized by IPCC and ranges from 5.7 to 6.5 % for dairy cows, depending on their milk yield. However, these standardized values are rough estimations and disregard crucial influencing factors like, e.g., feed quality. Within a respiration chamber trial, dairy cows at AREC Raumberg-Gumpenstein were fed a typical ration for the case study region Lungau. The ration consisted of grass silage and hay (each 50%) of medium to high quality and contained 9.5% concentrate on average. Based on the results of this trial, we calculated a new MCF adjusted to the typical feeding regime in the case study region Lungau. This new MCF (5.75 %) was used to model the enteric methane emissions of dairy cows on 22 organic dairy farms in the case study region Lungau and compare the estimated emissions with the modeled methane emissions using the default MCF from IPCC (6.5 %). Results showed high heterogeneity in enteric methane emissions depending on the farms' herd size, and values ranged from 3,612 (farm 22; 26 dairy cows) to 401 kg CH_4 (farm 20; 4 dairy cows). Compared to the results estimated with the default MCF (6.5 %), the use of the new MCF (5.75 %) resulted in an average reduction of enteric methane emissions of 13 %. Further research at AREC Raumberg-Gumpenstein will focus on verifying these first results, and methane emissions will also be estimated for other (more intensive) Austrian production systems.

PA48. Using bacteriophages to reduce ammonia emissions in ruminant production.

High-ammonia producing bacteria (HAB) present in the rumen of ruminants are responsible of an important part of ammonia emissions in the livestock sector. Ammonia produced by HAB is absorbed in the rumen and it is finally excreted as urea in the urine. One potential approach to decrease nitrogen emissions in ruminants could be the reduction of HAB in the rumen. Thus, bacteriophages against HAB appears as an interesting approach to reach this objective. Bacteriophages, also known as phages, are viruses that infect and destroy bacteria. They are composed by a capsid that contains DNA or RNA. One of the most interesting properties is their host specificity, which means that using a specific bacteriophage is possible to specifically destroy only one specific type of bacteria (host bacteria). For that reason, phages have been widely studied for therapy purposes as antibiotic alternative agents against pathogenic bacteria, being promising strategy. Besides, phages are also used as food additives to prevent bacterial contamination. However, there are other fields in which the use of phages has not been explored so far. Thus, Circular Agronomics project aims to determine if bacteriophages against HAB could be a feasible approach to reduce the amount of HAB in dairy cows rumen without affecting rumen microbiota. For that, HAB and bacteriophages against HAB are being isolated and identified from the rumen of cows at different production stages (growing, lactating, dry-off). After that, the application of bacteriophages to reduce/eliminate the ammonia production will be used in an in vitro assay.

PA49. Advantages of compost-bedded pack systems in cattle farms.

Housing animal conditions are critical for animal health, welfare, and hygiene, and consequently their feed efficiency. In dairy cows, bedding is especially important to keep legs and udders in good health. Traditionally, daily bedded loose barns or cubicle barns were the most common systems, with controversial results in hygiene and lameness problems, in respectively management systems. Recently, a well-manage compost-bedded pack systems seems to accomplish both premise: hygiene and healthy legs. This consists in a loose housing system that requires periodic bedding addition and daily tilling the top 20-30 cm of the pack with a roto-tiller or cultivator. The purpose of this system is to oxygen the bedding to foster microbial activity, to heat and dry the bedding to achieve a dry surface area for lying. Key parameters to succeed managing compost-bedded pack systems are: 1) keep bedding moisture between 40-60% for cleanness, promoting barn ventilation and adding materials when moisture increases; 2) achieve 40-60ºC for drying and eliminate pathogens in the bedding; 3) achieve at least 50 cm height to promote composting; 4) keep a ratio C:N in the bedding of 25:1 or 30:1 to enhance composting; 5) keep pH < 8 to avoid ammonia volatilization; 6) keep animals at 9-15 dairy cows/m2. As all management systems, having in mind these conditions will make the difference to succeed or not in managing a compost-bedded barn.

PA50. Efficiency of a centrifugal separator for manure management.

The efficiency of the solid-liquid separation depends on several factors: the type of separator, the type of manure to be treated (type of animal and stage of the life cycle), the flow rate or the amount of organic matter. In this sense, centrifuge separation systems, although more expensive, are much more efficient than screw press systems, but require the addition of polymers. The N/P ratio in the liquid fraction increases by 708%, compared to an increase of 29% when using a filter press. The highest separation efficiencies are usually obtained when working at low flow rates and organic matter contents above 5%, which is directly related to proper water management in the farm. It has been determined that the separation efficiency to the solid fraction with a centrifuge, at a flow rate of 4 m3/h, is approximately 50% for N and 95% for P. In economic terms, for 17,600 m3 of manure to be treated, with N and P content of 3 and 1.04 kg/m3, respectively, and considering additional costs such as energy costs, depreciation or the construction of specific structures, the cost per kg of N and P treated is approximately 1.96 and 4.96 euros, respectively, for a sieve and screw press system, and 2.34 and 4.43 euros, for a combined screw press and centrifuge system.

PA51. Obtaining biofertilizers from digestates by solar drying and stripping absorption processes.

The solar drying process is being improved and optimized within the Circular Agronomics project. The basic system consists of 3 parts: Firstly, manure is acidified to avoid ammonia emissions. Secondly, the drying process evaporates water, and finally, the remaining emissions are treated by biofiltration. The innovation carried out during the project includes a mechanical and rotatory stirrer that moves throughout the dryer breaking the upper dried crust that naturally appears in manure storages. This device allows to improve the solar drying efficiency by increasing the contact surface between manure (or digestate) and air. However, more emissions are produced when breaking the crust, which are finally minimized by using the biofilter. In the frame of the project, we are drying digestate from pig manure with and without previous centrifugation, i.e, the raw digestate after anaerobic digestion (D) and its solid fraction (SF). Besides, a stripping and absorption unit has been installed to produce ammonium sulphate from the remaining liquid fraction (LF). Two solar dryers have been built in order to dry, not only the D and the SF, but also the mix of them with the streams coming from the stripping/absorption unit. The final objective es to produce high quality dried fertilizers with low humidity content that meet the Regulation (EU) 2019/1009 on fertilizers products.

PA52. Biogas from manure: from a challenge to an opportunity.

Livestock production has increased in recent decades. It has gone from small family farms to large intensive livestock farms. These changes have caused an exponential increase of livestock manure in certain European territories. However, manure can be a business opportunity for farmers. Associating a biogas plant with a farm brings multiple environmental and economic benefits. The emission of greenhouse gases is reduced, and biogas is generated, which is composed of approximately 65% methane. Biogas is used as fuel in cogeneration engines that generate electricity and thermal energy from renewable sources. The produced energy reduces the economic costs of the farm since it can be self-consumed or sold to the distribution network. Although the initial investment cost is generally high, the amortization is around seven years. The effluent derived from the process is called digestate. The odour of the digestate is reduced by 95% in comparison with the raw manure. As developed in the Circular Agronomics project, the digestate can be subjected to a solid-liquid separation, obtaining a solid fraction with high fertilizer properties that can be dried or composted and reused in territories far from areas with high livestock density. The liquid fraction is used to fertilize fields close to the farm or it can also be treated to obtain fertilizers such as ammonium sulfate. In this way, a real and environmentally sustainable circular economy is promoted.

PA53. Best available techniques for livestock emission reduction.

According to Directive 2010/75 / EU on industrial emissions (DIE), the best available techniques (BAT) are the most environmentally friendly way known to carry out an activity, taking into account that the cost of such BAT are within of reasonable limits. Current legislation establishes, in general, the obligation of the owners of the affected facilities to apply BAT. In relation to intensive pig production, MTD30 practices are intended to reduce emissions inside housing systems; MTD16, 17 and 18 aim to reduce or avoid atmospheric emissions during slurry storage; MTD19 avoid emissions during on-farm processing of manure; and MTD20, 21 and 22 avoid emissions during agricultural application. In the Circular Agronomics project, the MTD19-c is experimentally validated by applying an on-farm drying process. For this, an evaporation at atmospheric pressure, using solar energy, is applied to the clarified fraction of anaerobic digested slurry in the farm. To avoid NH3-gas emissions during solar drying, the initial pH is adjusted (pH <6) and a biofiltration of the outcoming air is carried out. The product of this process is a material with very low humidity (≤15% weight), whose agronomic value is validated by winter cereal cultivation.

PA54. Ammonia Washing Machine to recover N from the air of pig farms

Ammonia emissions from the house of pigs are due to the faeces and urine on the surfaces and the presence of slurry under the slatted floor. The need to improve the animal welfare, the health of workers and to reduce ammonia emissions from pig livestock was the motivation behind the "Ammonia Washing Machine" EIP-AGRI Operational Group, which created and tested an air treatment system to catch ammonia emissions from the pig house.

The prototype takes the ammonia-rich air from the pig house through the suction ducts installed under the slatted floor to improve the inside air quality, especially in those housing conditions (weaning piglets) or climatic conditions (winter) where air changes are limited. The treatment is based on the chemical absorption of ammonia present in the airflow by counter-current acid washing with sulfuric acid.

An important nutrient such as nitrogen, which in the form of ammonia emitted into the atmosphere causes health and environmental issues, can be recovered and give life to a fertilizer (ammonium-sulphate solution) in a perspective of "nutrient recovery and reuse". The activity has shown that is possible to recover 2.4 kg NH3 per animal place per year (394 litres of ammonium sulphate solution per t of live weight per year). The good nitrogen content (3.5%), of which 99% present as ammonia form, and the very low solids content are characteristics that make this solution a good nitrogen source for fertilizing purposes, in particular for fertigation.

PA55. The agricultural performance of NH4-struvite.

NH4-struvite is Ammonium-Magnesium-Phosphate. It is a mineral fertilizer derived from wastewater, slurry or digestate treatment. In field trials and in several pot trials the efficiency of struvite as mineral fertilizer was analysed.

The main results are:

-all three nutrients (N, Mg, P) are as plant available as compared to conventional mineral fertilizers.

-Struvite is a slow-release fertilizer. It is not water soluble at pH 7 but readily dissolves al lower ph (5-6). Plant roots grow to the fertilizer and dissolve it by plant induced acidification of the root environment.

- Struvite fertilization reduces Nitrate leaching and nitrous oxide emissions (a strong greenhouse gas). Because. Around 10% of the N demand of plants are covered by the N in the struvite. The struvite-N is not nitrified, as long it is part of the struvite mineral. When struvite is dissolved by root acidification, the released struvite NH4 is readily transported into the plant and there is no nitrification in the soil.

Practical recommendations:

-Struvite can replace equally water-soluble Phosphorous fertilizers.

- Struvite is a sustainable mineral fertiliser because it reduces nitrate leaching and greenhouse gas emissions by 10% each.

PA56. The recovery of P in form of Hazenite (KNa-struvite)

Struvite commonly refers to MgNH4PO4-which is a non-water soluble but excellent fertilizer. Struvite is produced in some wastewater/slurry/digestate treatment plants. It removes phosphate from the liquid. Some industrial wastewater streams do not contain ammonium (NH4) that is necessary for NH4-Struvite precipitation. In that case, potassium (K) or even sodium (Na) may replace ammonium. In a wastewater with a Na/K molar ratio of >1, the struvite specification Hazenite can be precipitated (KNaMg2(PO4)2*13H2O).

Main findings:

- Hazenite is only precipitated in the absence of ammonium.
- Hazenite seems to form smaller cristals as compared to NH4-struvite.
- In pot experiments the nutrients Mg, K, Na, P have the same fetrtilizer efficiency as compared to conventional mineral fetrtilizers
- Because of the lack of N in Hazenite, it could be a very interesting fertilizer for organic farming. Organic farming tries to fertilize nitrogen via legumes and not via mineral fertilizers.

Pracitcal recommendations:

- Industrial wastewater plants with high salt concentrations may precipitate P from waste water even in absence of ammonium.
- The precipitated Hazenite is not soluble in water at pH 7. It is a fertilizer equal to water soluble P-fertilizers
- Hazenite could be an excellent P-fertilizer for organic farming as it does not contain nitrogen.

PA57. CO2-Stripping prior to vacuum degasification of biogas digestate reduces the need of alkaline pre-treatment.

To remove ammonium (NH4+) from biogas digestate, it has to be converted to its gaseous form (NH3). Both forms are present in the liquid phase with their distribution being dependent on the pH-value. Naturally, digestate from biogas plants has a pH-value around 7.5. When pH is around 9.2, equal amounts of ammonium and ammonia can be found. To achieve

this, caustic soda is added to the digestate. The amount needed varies from substrate to substrate and has been found to be around 4.5 – 7.5 grams per litre of substrate. This value is inflated by carbon dioxide species, which act as a buffer in that pH-range. When caustic soda is added, carbon dioxide is fixed in the liquid phase as hydrogen carbonate and additional caustic soda is needed to overcome the hydrogen carbonate – carbonate buffer capacity.
In our batch experiments we found air stripping of CO2 prior to vacuum degasification an effective way to reduce the need of alkaline pre-treatment, because it allows carbon dioxide to escape from the liquid phase and consequently lowers the buffer capacity. Additionally, it leads to a natural pH-increase to approximately 8.6. The amount of NaOH needed was reduced to 1.5 – 3 g/L. The stripping was conducted with 75 L air per litre of substrate at a pressure of 800 mbar at 70 °C. Additionally, the concentration of ammonia already sees some reduction in this phase.

PA58. Vacuum degasification of biogas digestate and its pre-treatment affect more parameters than just the nitrogen content.

The pre-treatment of digestate before vacuum degasification includes the addition of alkaline substances and heating of the substrate, both with the objective of increasing the ammonia removal efficiency. In our trials we found those actions to be impacting more parameters than just the nitrogen removal.
Adding bases like sodium hydroxide raises the dry residue percentage and increases the alkalinity and salinity. Consequently, it's adding to the electrical conductivity of the substrate while simultaneously preventing CO2 from being removed due to the increased pH. If no caustic soda is added, the process is able to eliminate most of the carbon dioxide, lowering the acid capacity and electrical conductivity. Some chemical compounds like calcium and magnesium form insoluble salts with phosphates when the pH value rises and are moved from the liquid to the solid phase this way. Volatile fatty acids (VFA) tend to increase in the process. This is due to the thermo-alkaline hydrolysis, where long hydrocarbon chains are broken down and cell boundaries of intact microorganisms are destroyed. In combination with the removal of ammonium, which is an inhibitor of anaerobic digestion depending on concentration, this could mean a valuable gain in digestion efficiency for biogas plants if used as a side stream application.

PA59. Catch crops as co-substrates for the anaerobic digestion of dairy manure

Biogas production through anaerobic digestion has become significant as an efficient manure treatment in the European agricultural sector since, besides the obtention of a renewable fuel, it also improves manure fertilizer quality and reduces odours, pathogens as well as greenhouse gas emissions. One of the main disadvantages of this process is the low energy content of manure that makes necessary to use high energy content co-substrates, such as energy crops, in order to optimize the process and improve the economic feasibility of biogas plants. Catch crops biomass, grown without cultivation efforts and irrigation between successive rotations of maize to reduce nitrogen leaching due to maize fertilization with digested dairy manure, has demonstrated to be a good co-substrate for the anaerobic digestion of animal manures since it notably improves the process performance because, on the one hand, manure provides buffering capacity and essential nutrients for anaerobic microorganisms, while on the other hand, the high carbon content of catch crops balances the carbon to nitrogen (C/N) ratio of the influent, thus reducing the risk of ammonia inhibition. The implementation of anaerobic co-digestion of dairy manure and ensiled catch crops is feasible since methane production is increased by 43 %, 35 % and 48 % when using catch crops such as ryegrass, forage rape or black oat, respectively, in comparison to the single anaerobic digestion of dairy manure.

PA60. Ensiling as a strategy to maintain the biogas potential of catch crops throughout the year

Since catch crops are seasonally sown (autumn) and harvested (spring), it is necessary to find a storage method that guarantees the availability of this co-substrate for biogas production throughout the whole year. Silage has been proved to preserve over 90% of the energy content of crops, which ensures a good nutritional value when used as animal feed. The advantages of ensiling include its low cost, its small energy footprint, the small amount of waste produced and the fact that it is a particularly environmentally friendly method, because no chemical additives are required. However, the chemical composition of the crop or its dry matter content are important factors for a success ensilage and also for the subsequent anaerobic digestion, it might therefore be expected that methane yield is affected if previous ensilage of the substrate is carried out. Ensiling is demonstrated to be an economically viable storing method, that can act as a form of chemical pre-treatment for biogas production. Ensiling improves the biodegradability and methane yield of catch crops under anaerobic conditions. The anaerobic biodegradability of ryegrass, forage rape and black oat may increase by 10 %, 14 % and 10 %, respectively, which results in an increase of methane yield by 40 %, 46 % and 50 %, in terms of LCH_4 per tonne of waste, and 19 %, 25 % and 27 %, in terms of methane production per volatile solid added. Methane production per hectare is increased by 14 %, 36 % and 34 % for ryegrass, forage rape and black oat, respectively.

PA61. P-recovery by anaerobic stage pH control without reagents.

Phosphorus (P) recovery via struvite formation requires addition of the limiting reagent usually magnesium (Mg). The other key process parameter is pH. However, soybean processing wastewater has an interesting feature that instead of magnesium, phosphorus is the limiting parameter. Anaerobic stage effluent analysis reflected the P levels in the range of 3 – 3.5 mM whilst for Mg around 6 mM. The implemented wastewater treatment (lagoon) resulted in a pH at the lower spectrum of anaerobic operation of 6.5 to 7. A simple pH increases by either addition of some caustic reagent (NaOH) or induced by CO2 stripping resulted in a significant reduction of the P level (PO4-P) from 3-3.5 mM down to 1 mM or concentration wise from about 100 ppm PO4-P down to 30 ppm. The latter approach of inducing the pH increase by CO2 stripping is very interesting as no additional reagents are required. However, this opportunity only arose due to the low pH operation of the anaerobic stage unlike the modern anaerobic treatment systems. High pH systems develop the risk of unwanted struvite scaling in reactor piping and/or reactor internals causing serious maintenance issues. However, for the particular case of anaerobic processing soybean wastewater the situation becomes profitable. The anaerobic stage can be run at pH suboptimal condition but still achieve the needed conversion into biogas, NH4-N and PO4-P and reactive Mg. Adding a CO2 stripper with struvite recovery is known and a proven technology. The practical case under the Circular Agronomics project can potentially yield 500 to 600 tonnes struvite/year. Recent trails for several crops show that struvite acts as a slow-release fertilizer (low dosage 20 kg/ha) in close interaction with plant root exudates and soil microbiology. Such a type of slow-release precision fertilizers could be key contributor to reduces GHG emissions currently resulting from standard fertilizer production and use.

PA62. P-recovery by K-struvite after aerobic stage.

Fertilizer reuse will be mandatory in future to ensure food safety as phosphorus is a limited resource and is essential for food/feed production. Besides nitrogen, the other key fertilizer compound is potassium, and it is a mined resource with limited supply. Although Potassium is not major constituent of biomass unlike N and P yet is a key element in terms of metabolic activity as it ensures good cation/anion equilibria and transmembrane transport mechanisms. The latter is inherently coupled with the high-water solubility of K. This high-water solubility is a challenge as precipitating K as a solid is limited to only a few waters insoluble K-salts. One of these few waters insoluble K-salt is a struvite analog where NH4 is replaced by K. The absence of NH4-N is vital to produce K-struvite thus it is typically produced after the aerobic stage considering substantial amount of reactive magnesium is available in the wastewater. However, the required pH for K-struvite formation is near to 9 so an additional pH correction is needed. Trials done with the aerobic stage effluent spiked with extra phosphate showed that reductions from 100 ppm to 30-40 ppm of PO4-P are possible with pH control and limited or no extra reagent addition. However, the resulting residual PO4-P levels still exceed the current discharge levels for surface water so an additional tertiary PO4-P removal will be needed. An approach to avoid this is to apply the K-struvite formation on purified wastewater that will be reclaimed for reuse. The interest for farmers is the availability of a slow release K-containing fertilizer compared to the standard chemical fertilizer. The combination of both NH4-struvite and K-struvite enables to produce a more customized fertilizer with an improved NPK ratio.

PA63. Application of electrospun nanofibrous membranes (ENM) for digestate pretreatment

Electrospun nanofibrous membranes (ENM) are proper alternative of recently used flat-sheet, tubular or ceramic membranes in the area of separation processes, e.g. filtration, mechanical pre-treatment, thickening. Unique technology of electrospinning production of nanofibrous membranes produces membranes with holes up to 200–400 nanometers to ensure efficient separation or thickening of media. Digestate is recently widely spread problematic solution that need to be handled before its other applications, e.g. sprinkling on the fields or utilization in composting. Our hypothesis verified thickening of digestate by ENMs. We worked with sample of 8 m2 of ENM and ca. 500 liters of digestate and membrane flux between 2-4 LMH. Digestate was thickened from 5.8 % TSS to 9.3% TSS during 15 hours of operation without necessary membrane backwash and addition of coagulants. We made balance of main nutritional elements (C, N, P, K) in raw digestate, membrane concentrate and membrane permeate. COD was reduced from 44 g/L to 9.2 g/L in permeate. Concentration of total nitrogen was reduced from 5.57 to 4.16 g/L in permeate showing 25% of nitrogen removal. N-NH4 has been reduced from 4.89 g/L to 3.52 g/L showing 18% N-NH4 removal. Total phosphorus was reduced from 234 mg/l to 74 mg/l in permeate showing 68% TP removal. Concentration of TK was 5.05 g/l and remained splitted the same for concentrate and permeate. Tests with organic coagulant was also made and dosage 2.2 L of coagulant (active part: polydiallyldimethylammoniumchloride) per 1 m3 of digestate was determined as efficient dosage for successful floc creation. Calculated energy consumption was 17.6 kWh/m3 of thickened digestate in pilot-scale, it will be lowered in the full-scale.

PA64. Technical and economical evaluations for acid whey pre-treatment.

The activity creates new business potential of valorisation food waste via its processing into agricultural field. Acid whey, i.e. waste product from cottage cheese and cream cheese production is processed by acid whey storage tank then microfiltration, centrifuge for fat removal and, if necessary, acid whey thickening to ca. 16 - 18 % TSS for further use (e.g. animal fodder preparation). Farmers could use acid whey to enrich their soil not only by carbon, but also by nutrients (nitrogen, phosphorus and potassium). It can create win-win scenario between dairy industry producers and farmers to create market with this commodity. Our innovation includes application of electrospun nanofibrous membranes instead of centrifuge for fat removal from acid whey. Electrospun nanofibrous membranes are proper alternative of recently used flat-sheet, tubular or ceramic membranes in the area of separation processes, e.g. filtration, mechanical pre-treatment, thickening, etc. Unique technology of electrospinning production produces nanofibrous membranes with holes up to 200 – 400 nanometers to ensure efficient separation. Our study was triggered by overall acid whey management evaluation at real full-scale plant and pilot-tests were carried out to compare efficiency of fat removal from acid whey at full-scale (centrifuge) and pilot-scale (nanofibrous membranes - NM). NM showed comparable separation of fats as centrifuge and produced clear permeate in comparison with turbid centrate from centrifuge. Turbidity was thoroughly analyzed and it is caused by calcium and magnesium phosphate and/or calcium lactate. NM showed competitive operational and investment costs to centrifuge at pilot-scale.

PA65. Factors affecting farmers' adoption decision of innovative circular farming practices and solutions in EU

The agricultural and livestock sectors are facing several challenges to achieve the current EU environmental objectives. Reducing Greenhouse Gas (GHG) emissions and ensuring that a great share of nitrogen, phosphorus and potassium coming from renewable sources are one of the major policy goals. In this context, farmers are continuously looking to adopting innovative technologies and solutions that may ensure sustainable food production systems. The adoption process of innovations at the farm level based on the circular economy concept may improve resource efficiency, allow the reuse and recovery of nutrients and reduce the negative effect of emissions on soils, water and air. The farmers' decision to accept and adopt the innovative solutions depends mainly on the initial investments and return, benefits and costs, farm structure, farmers' socio-economic characteristics, farmers' attitudes, opinions and behaviour and, external markets conditions among other determinant reasons. This study aims at identifying the determinant factors and barriers that affect farmers' adoption of several Circular Agronomy Solutions using a semi-structured questionnaire on an exploratory sample of farmers in 5 EU countries. Preliminary results showed that the level of acceptance of the proposed innovations is highly related to farmers' economic motivations and objectives. The cost of the investment, the return rate, the institutional support, risk and environmental attitude play a relevant role in the adoption decision. Results of the adoption preferences may assist policy-makers in designing more specific and efficient measures and tools that may help farmers to face the current environmental challenges and social needs.

PA66. Factors influencing farmer adoption of sustainable behaviours

Modern practices of industrial farming, such as mineral fertilization, have caused concerns regarding degradation of agricultural land and water bodies in Europe. Different farm management strategies exist to reduce the impact of mineral fertilization while preserving soil productivity. A recent review of 23 scientific articles published in the last 17 years summarized main factors and conditions affecting EU farmers' adoption of such popular sustainable practices as organic farming, manure treatment technologies and manure fertilization, as well as soil and water conservation methods. Among the main findings is the one showing a significant impact of farmers' environmental and economic attitudes on the adoption of organic farming, although there is a lack of evidence of their impact on adopting manure treatment and conservation measures. It was revealed that environmentally oriented farmers have better chances to become organic producers than farmers with a strong economic orientation. Similarly, older and better educated farmers are found to be more prone to organic farming adoption, but not adoption of other reviewed technologies. There is also very limited evidence that farm physical characteristics or technological attributes may affect adoption of new technologies by farmers. To craft better policies for the development of sustainable agriculture, policy makers have to learn directly from the experiences of successful farmers who adopted these technologies despite the lack of governmental support or adverse climate.

PA67. Sustainable food behaviours in consumers.

Sustainable food consumption behaviors include various activities such as purchasing and consumption of sustainably produced food, for example, organic or free-range food. In addition, all routines contributing to reduction in household food waste can be also treated as sustainable behaviors. It is theoretically assumed that consumer personal attitudes, societal norms, and the ability to control own behavior may govern people's intentions to consume in a sustainable way. A preliminary review of 28 consumer studies in Europe has revealed that both the consumer attitudes and societal norms towards organic food are the two important factors that define people's intention to purchase or consume organic production. On the other hand, people's ability to control own behavior was not found to affect either their intention to consume or consumption itself in a definite way. Several studies also found that Europeans may buy or consume organic food being guided by certain moral norms or the sense of self-identity. In terms of food waste behavior, this review found an important role that consumer attitudes play in food waste reduction behavior, while the effect of societal norms on the intention to reduce waste was rather less pronounced. Also, the consumer's ability to control their food waste behavior, through such means as refrigeration or efficient cooking, should be helpful in keeping the levels of household waste low. Policy makers who plan to stimulate the demand for organic food in Europe as part of the Green Deal strategy, may take these results into account to design more targeted information campaigns.

PA68. N, P, C flows into & from the EU (import/export).

Worldwide nutrient flows are not only related to political dependencies, but also to resource efficiency and closing nutrient cycles. Mainly the product value chains and international trade of fertilising products, feed and food products are responsible for significant local nutrient imbalances.

The analysis based on FAO data shows that imported proteins related to feed products for European animal husbandry mainly from South America, but also from North America and Ukraine cause a significant reallocation of the key nutrients carbon (C), nitrogen (N) and phosphorus (P). From 2013 to 2017, about 51 % with more than 10 Mt proteins were imported mainly as soy and soy cake from South America dominated by Argentine, Brazil and Paraguay. The high protein content of soy products contributes almost 90 % to the nutrients imported to the EU: approx. 5 600 kt C, 1 860 kt N and 150 kt P. The production of animal products and derivatives lead to atmospheric and terrestrial losses of nutrients. The overall nutrient efficiency is low which results in additional costs for producers.

Wheat contributes the main share of exported proteins from the EU to Africa (69 % of the 3,1 Mt proteins), followed by barley (6%), dried skimmed milk and chicken meat. The key destinations in Africa are Algeria, Egypt and Morocco where the imports from the EU causes disadvantages for locally produced foods and damages the environment through, among others, higher transport and storage emissions.

PA69. Reaping multiple benefits of Climate Smart Agriculture: The case of dairy farmers in East Africa

Eastern Africa farmers are not producing enough to feed themselves and trade the surplus due to many challenges: low input/technologies use and limited economic support services. The problem is intensified by African agriculture's extreme vulnerability to climate change. With the effects of climate change already being felt, many projects are seeking solutions. Climate-smart agriculture (CSA) is among integrated approaches that have proven to address the interlinked challenges of food security and accelerating climate change. Several organizations have done a significant amount of work in CSA. The major challenge is that this work has not been effectively disseminated to farmers in Africa. Eastern Africa Farmers Federation is currently scaling up CSA approaches such us: nutrient management, integrated livestock management and soil and water conservation to help farmers achieve the triple win of CSA: increasing productivity, enhance resilience and reduced emissions. Specifically, in the dairy sector, after strengthening the capacity of farmer on CSA and advocacy campaigns pushing for supportive policies for CSA; incoming data shows that among 12,548 farmers of which 60% adopted various CSA, demonstrated that the uptake of fodder shrubs and herbaceous legumes into mixed farming systems increase dairy productivity by 50 – 100%, improve food security and eventually reduced emissions through zero-grazing that improved manure management. Installation of biogas units in some farms allowed rural households to generate alternative energy thus reaping multiple benefits of CSA. We call on governments to support multistakeholder partnerships that will have business-incentive approach to achieve sustainability and scale.

PA70. Analysis of legislation related to Circular Economy in Agriculture

The three key policy areas defined in Circular Agronomics are agriculture, waste and emissions to the environment such as CO2, methane, nitrous oxide or ammonia. Along the value chains various barriers and gaps were identified for the practical solutions to improve nutrient cycling in European agro-ecosystems.

One focus was on the EU Fertilising Product Regulation (2019/1009/EC) which boosts the use of organic and bio-based fertilisers e.g. from municipal biowaste. It sets EU-wide quality, safety and environmental criteria for EU fertilisers. However, producers can choose between European and national certification. The regulation still excludes industrial or sewage sludge as component material for fertilisers and notified bodies are not bound by any mandatory timeframe for giving their assessment to requesting manufacturers. Hence, the procedure is risky for producers and will depend on repeatability and product nature.

The legislative analysis contributes to the potential market uptake of innovations and European initiatives. A novel approach in policies for nutrient life-cycling and bio-based products is mandatory like quality (not source) related definitions and declarations. Waste should be managed as secondary raw materials that are financially supported wherever possible. In parallel, the enforcement of existing European legislation and the development of effective joined up policy are facilitated - further steps towards integrating agriculture in circular economy.