



ClieNFarms
Climate Neutral Farms

D3.1 Demonstration farms and solutions on each farm confirmed

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List of Abbreviations and Acronyms	
CF	Carbon Farming
DF	Demonstration Farm
I3S	Innovative Systemic Solution Space
PV	Photovoltaism
SOC	Soil Organic Content
SOM	Soil Organic Matter

Contents

1	Executive summary.....	6
2	Introduction.....	7
2.1.	About the ClieNFarms Innovation Action.....	7
2.2.	Purpose of the document.....	7
2.3.	Structure of the document.....	7
3	Objective of the Demonstration Farms in the I3S	8
4	Brief description of the Demonstration Farms and the solutions being or to be implemented	9
4.1.	France – Beef.....	9
4.2.	France – Dairy.....	10
4.3.	France – Crops (NE)	12
4.4.	France – Crops (SW).....	13
4.5.	Germany – Dairy.....	14
4.6.	Italy – Tomato	16
4.7.	Portugal – Olive Oil	17
4.8.	Spain – Dairy.....	19
4.9.	France – Energy and Wine.....	20
4.10.	Romania – Sheep	21
4.11.	Ireland – Dairy	23
4.12.	Ireland – Beef.....	24
	26	
4.13.	The Netherlands – Dairy.....	26
4.14.	United Kingdom – Pigs.....	28
4.15.	United Kingdom – Crops.....	29
4.16.	Belgium – Crops.....	30
4.17.	New Zealand – Dairy.....	31
4.18.	Ukraine - Crops	32
5	Conclusions.....	33

1 Executive summary

This Deliverable provides a brief description of the 18 Demonstration Farms (DFs) involved in the I3S in ClieNFarms. The central operational focus of the ClieNFarms project is the case-study structure that will allow a strong empowerment of farmers and the supply chain accompanied by a smooth dissemination and replication of the tested innovations. Called I3S (Innovative Systemic Solutions Space), the demonstration structure is based on DFs, lead commercial farms, outreach farms and replicate farms all working together with the supply chain in a living-lab like structure approach. The DFs are experimental/research demonstration farms on which a range of climate neutrality solutions are being tested or will be tested during the course of the ClieNFarms project. The project includes 20 I3S, of which 18 have DFs. The DFs include dairy production (in IE, FR, NL, ES, NZ, DE), beef production (in IE, FR), sheep and goat production (RO), monogastric (in UK), crops (in BE, FR × 2, UK, UA), and specialist crops (in IT, PT, FR). The number of solutions identified per DF ranged from 7 to 24 solutions. Many parameters including productivity, gaseous emissions, C sequestration and storage, biodiversity, management of cropland surface albedo, etc. are being measured on the DFs as part of other projects, and the data is available to ClieNFarms. Additionally, where possible the cost of implementing the solutions will be quantified, as will the effects (synergistic or antagonist) on productivity. The solutions will be demonstrated to the Lead Commercial Farms, the Outreach Farms and the wider community through demonstration events in 2023, 2024, and 2025. The target is to hold two demonstration events on each DF each of 2023, 2024, and 2025.

2 Introduction

2.1. About the ClieNFarms Innovation Action

Supporting the Farm to Fork (F2F) strategy, contributing to the achievement of its objectives, the ClieNFarms project aims to demonstrate, evaluate and improve technical, organisational and financial solutions at the farm level that will contribute to achieving climate-neutrality of European agriculture by 2050. This will be done through a multi-actor approach, interactively integrating and improving existing solutions to achieve economically viable business models in farming systems by involving farmers, extension services, agri-food business, policymakers, finance and citizens. These solutions will be disseminated, and young farmers will be targeted through capacity building.

The central operational focus of ClieNFarms is the case-study structure that will allow a strong empowerment of farmers and supply chain accompanied by a smooth dissemination and replication of the tested innovations. Called I3S (Innovative Systemic Solutions Space), the demonstration structure is based on demonstration farms, lead commercial farms, outreach farms and replicate farms working all together with the supply chain in a living-lab like structure approach.

ClieNFarms also intends to pave the way for combined biogeochemical (reduction in GHG missions, increase C storage) and biogeophysical effects (increase in surface albedo, reduction in sensible heat flux and infrared radiation) in order to mitigate climate change more efficiently, without any negative impacts for food security or yield/product quality.

The project is vastly innovative as aims to: (1) integrate different solutions to embrace mixed crop farming systems and animal production; (2) account for biogeophysical effects associated with changes in management practices in order to promote the synergies between the biogeochemical effects and the biogeophysical effects; (3) move from farm level to (eco)system level either through farm networks or by involving supply chains in a multi-actor designed process; (4) validate integrative solutions and to develop the required financial incentives to engage farmers in the required transition.

2.2. Purpose of the document

There are 20 Integrated Systemic Solution Spaces (I3S) in the ClieNFarms Project, 18 of which have Demonstration Farms (DFs). The purpose of this document is to give a brief introduction to the DFs in the 18 I3S and the solutions being implemented on the farm to transition towards climate neutrality.

2.3. Structure of the document

This document presents the objective of the demonstration farm element of the I3S in ClieNFarms (Section 3) and presents each of the Demonstration Farms and the solutions being or to be implemented during the project (Section 4).

3 Objective of the Demonstration Farms in the I3S

Eighteen Demonstration Farms (TRL 5-7) with climate-neutral solutions identified and implemented across regions/countries and production systems have been identified. These farms are experimental/research demonstration farms or innovative commercial farms. The farms are dairy production (in IE, FR, NL, ES, NZ, DE, UA), beef production (in IE, FR), sheep production (RO), monogastric (in UK), crops (in BE, FR × 2, UK), and specialist crops (in IT, PT, FR). The Demonstration Farms have a range of climate neutrality solutions that are being tested, and may add more during the lifetime of the project. As the project is short and results have to be achievable in the short term, Demonstration Farms have already tested or are testing some of the proposed solutions. The impacts of the solutions will be monitored throughout the project. The Demonstration Farms are representative of the typical farming system in the partner country/region. Many parameters including productivity, gaseous emissions, C sequestration and storage, biodiversity, management of cropland surface albedo, etc. are being measured, and the data is available to the project. Additionally, where possible the cost of implementing the solutions will be quantified, as will the effects (synergistic or antagonist) on productivity.

4 Brief description of the Demonstration Farms and the solutions being or to be implemented

4.1. France – Beef

The demonstration farm is Jalogny Experimental Farm in the department of Saône-et-Loire of the French region Bourgogne in France. The farm has 215 ha (200 ha of natural grasslands, 15 ha cereals and maize silage which are consumed on the farm). There are 100 beef cows (Charolais) on the farm and 50 to 100 animals are purchased annually for experiments. The research programme on the farm is to manage a new Beef Farm production system, which has good technical and economic efficiency that involves seeking autonomy and optimisation of the use of forage, finding solutions facing climate change, and solutions that improve the environmental impacts of the production system. A range of data is being collected including soil analysis, beef production and quality, forage composition and yields (including grasslands). The solutions implemented or to be implemented during the project will focus on:

- Animal – reducing animal numbers and increasing efficiency
- Feed – increasing home grown feed, improving grassland management
- Trees/hedgerow management – to increase C capture and biodiversity
- Emissions – reduce N fertiliser use, examine the potential use of methane reducing additives

D3.1 Demonstration farms and solutions on each farm confirmed

Solutions being tested/to be tested on the Jalogny Experimental Farm during the ClieNFarms project	
Solutions implemented	Solutions to be implemented or tested during the project
Reduce age at first calving from 36 months to 30 months with a herd calving at spring	Establish an autumn calving herd (2025 for the first calving)
Fattening of all the female mainly on grass, allowing an increase in production	Establish hedgerows (500 meters in 2024)
Fattening of all heifers (culled at 31 months) and suckler cows	Reduce chemical fertilizer nitrogen application by 5 kg/ha
Consumption of home-grown barley	
Stop production of young bulls (sell as weaners)	Examine the use of additives in rations to reduce methane emissions. The types of additives tested are not yet defined and the project in which they will be tested has not yet started
Increase of grass production potential by rotating pasture and young grass in fattening rations to reduce the purchase of concentrate feeds	



Figure 1. La ferme de Jalogny and logos of Chambre d'Agriculture Saône-et-Loire and Institute de l'Évage (IDELE)

4.2. France – Dairy

The French Dairy Demonstration Farm is Trévarez farm located in “Finistère” department in Brittany. The farm has 130 ha and 66% of the land are grasslands. There are 124 dairy cows on the farm and the average production is 7,800 L/cow. The farm is focussed on investigating ways to reduce the carbon footprint of milk. The experimental farm has a number of experiments on-going. The solutions implemented or to be implemented during the project will focus on:

D3.1 Demonstration farms and solutions on each farm confirmed

- Animal – optimize age at first calving
- Feed – increasing home grown feed, increase grazing (production from grass)
- Trees/hedgerow management – establishing agroforestry to test the benefits (animal production, C capture, shade)
- Emissions – examine the potential use of methane reducing additives

Solutions being tested/to be tested on Trévarez farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Increase grazing by reorganizing the fields for better accessibility (fields exchange)	Test agroforestry
Generalize the use of the pendulum for effluent spreading on farm	Test the use of feed additives to reduce methane emissions (algae)
Replace rapeseed meal with faba bean	Test summer legume grazing
Continue to optimize the age at first calving	
Develop winter grazing (less stored forage, less corrector)	



Figure 2. Trévarez farm

4.3. France – Crops (NE)

The Demonstration Farm is based in a productive area in the North-East of France and is composed of two large-scale experimental facilities located on the same site in Grand Est region (nearby Reims):

- 1) Experimental platform of the Syppre project. Syppre is a long-term experiment of cropping systems organized through French technical institutes on the chalky soil of Champagne, which has been set up under real agricultural conditions. Located at the Terralab agricultural center, the Syppre project's experimental platform covers 13 ha and aims to compare a control cropping system, which corresponds to an existing optimized cropping system, and a promising innovative cropping system.
- 2) "Terrasolis low-carbon" zone, whose priority is to accelerate the transition to climate neutrality, with a goal of very low carbon emissions.

Each crop in both systems is grown every year. The system consists of 15 modalities, with 3 replications for each rotation term, or 45 plots. In addition to grain quality and improved soil fertility, this innovative system aims to significantly reduce greenhouse gas emissions.

The solutions implemented or to be implemented during the project will focus on:

- Crop management – reduce N fertiliser, increase N use efficiency, intercropping, crop selection, soil preparation, soil fertility
- Emissions – reduce methane emissions

Solutions being tested/to be tested on the French NE crop farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
N form (with urease inhibitor, green ammoniac)	Legumes as harvested crops
N localisation (or burying)	Legumes in intercropping
Crops with low N demand	Optimized and frequent intercropping
Organic input	Methane reduction
Simplified soil preparation	Amendments for soil mineral balance
	Other fertilisers to enhance N input



Figure 3. Syppre platform, Champagne region

4.4. France – Crops (SW)

The region of Lauragais is located in South-West of France and is an area where cereals are grown. The soil on is limestone and clay, and is on hillsides. The farmers in the region grow durum wheat and sunflower with tillage. There is almost no irrigation used in the region, and there is a high risk of soil erosion. The demonstration farm is part of a network called Syppre. In this network, on different sites in France, two systems are compared: the first one represents the most common practices, and the second one is an innovative one. In the demonstration farm in Lauragais, the common production system is durum wheat and sunflower, and the innovative one is one with more crops: wheat, sunflower, rapeseed, peas, etc. In order to deal with the erosion issue, the soil is covered for as much of the year as possible and the tillage is reduced as often as possible. Legumes are grown so that the use of chemical nitrogen fertilizers can be reduced. Many observations are made each year on the crops grown in order to monitor yield, soil fertility and carbon storage. Innovations are valued locally.

The solutions implemented or to be implemented during the project will focus on:

- Crop management – reduce N fertiliser, increase N use efficiency, intercropping, crop selection including energy crops and legumes, soil preparation, soil fertility
- Emissions – reduce methane remissions, reduce machinery use

D3.1 Demonstration farms and solutions on each farm confirmed

Solutions being tested/to be tested on the French SW crop farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Introduction of chickpeas to the rotation	Introduction of lentils as intercrops
Introduction of winter peas to the rotation	Introduction of clover as an intercrop
Growing cover crops between cash crops	Introduction of a crop for energy production (anaerobic digestion)
Reduction of soil work/cultivation – reduce machinery use	Adjustment of nitrogen fertilization so it better fits with the needs of the crops



Figure 3. Syppre platform, Lauragais region

4.5. Germany – Dairy

The research farm Gladbacherhof is an organic farm since the late 1980's. In an area of ca 185 ha the Gladbacherhof has dairy farming and seed production as the main activities. The system of dairy and plant cultivation should form a closed operational nutrient cycle. The dairy production at the farm has about 100 lactating cows with the goal to increase the herd number up to 128 cows by the end of 2023. The new research stall has an automatic milking system as well as automatic feeding, which provide real time precise and numerous data to be used for the farm management and research. The research project "GreenDairy" (integrated – animal, plant, system) started in 01/2022 at the Gladbacherhof with the main objective of investigating the impact of two feed intensity levels in organic dairy production systems linked to the value chains of milk, meat and plant-based human food. The solutions implemented or to be implemented during the project will focus on:

- Animal – genetics, increase efficiency, reduce stock numbers
- Feed – increasing home grown feed, optimise feed rations

D3.1 Demonstration farms and solutions on each farm confirmed

- Crops – residues, green manure, reduce tillage
- Grassland – reduce fertiliser N use, rotation, biomass production
- Trees/hedgerow management – establishing agroforestry to test the benefits (animal production, C capture, shade)
- Emissions – reduce chemical N, manure management, fertiliser type
- Energy – use renewables

Solutions being tested/to be tested at the Gladbacherhof research farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Optimize feed ration/balanced rations – comparing a high and low intensity feeding regime	Genetic selection to increase cow longevity
Use of renewable energy	Keep less young stock, only replacements
Grow own protein feed crops	Remove empty or less productive cows
Leave crop residues	Biomass production
Optimise grass-maize rotation	Crop residue incorporation
Green manures	No chemical fertiliser used
Improved forage varieties	Low emissions slurry spreading
Increasing grazing season length	8-year crop rotation (the aim of this crop rotation is to provide nitrogen input through legumes, cultivate various cereal crops for animal feed, and generate additional revenue by selling the seeds. Will also incorporate green manure and produce biomass through catch crops.)
Reduced or no tillage	Use plant varieties with improved N-use efficiency
	Cover slurry tanks
	Sufficient manure storage capacity
	Solid-liquid separation
	Agroforestry system integrated with crop production and cattle grazing



Figure 5. Organic field day at Gladbacherhof research farm.

4.6. Italy – Tomato

The Italian Tomato Demonstration Farm is UCSC Experimental Research Farm. The farm is 40 ha. The research programme is called NUTRISOM: an operational and integrated “closing C and nutrient loops” strategy. Three agronomic resources have been identified for re-building SOM stocks and tackling soil nutrient imbalances: C-rich crop residues, root-C input and organic fertilizers such as biogas digestate/animal slurry. The aim is to be pioneer in making operational and integrated use of these resources through the adoption of a set of carbon farming (CF) practices. In large scale experiments there are two main research programmes: precision N organic fertilization of cereals and CF practices adopted across the industrial tomato crop rotation. The latter is the core of the research programme: the crop rotation is extended to three years (winter wheat-cover crops-grain maize-cover crops- industrial tomato) and is characterized by a continuous plant C input into the soil across the entire year and by pulse C inputs at crop residue incorporation (wheat straw and maize stover). To favour a faster humification of residues, supplementary fertilization of digestate is included to balance the nutrients stoichiometry of added residues-C to better match that of stable SOM. A range of data is being collected including soil mapping over time of SOM/SOC and nutrients content/stocks, soil microbial biomass, nutrient dynamics and crop soil balance, crop and residues yield and quality, crop inputs and diesel consumptions.

The solutions implemented or to be implemented during the project will focus on:

- Crops – minimum cultivation, residue management, rotation management
- Emissions – manure management, fertiliser type

D3.1 Demonstration farms and solutions on each farm confirmed

Solutions being tested/to be tested on the Italian Tomato Demonstration Farm at UCSC Experimental Research Farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Minimum tillage	N stabilizer in slurry
Extended/enriched crop rotation	
Crop residues incorporation	
Targeted residues: nutrients management	
Cover cropping	
N precision fertilization	
Top dressing organic fertilization of cereals	

4.7. Portugal – Olive Oil

The Olive Oil Demonstration Farm is Nutrifarms' Outeiro Farm, located in Beja, Portugal. The farm has 371 ha with 314 ha of modern irrigated olive groves. The olive groves were planted in 2015 and the chosen varieties are Arbequina (201 ha) and Oliana (112 ha). The orchard is sown in a hedgerow layout to permit full mechanization of operations (pruning and harvest). It is also fully irrigated with drip irrigation and fertigation system.

Two very similar plots of the Arbequina variety were chosen to implement the solutions to reduce GHG emissions or increase C sequestration. Both are approximately 7.5 ha each.

The solutions implemented or to be implemented during the project will focus on:

- Crops – minimum cultivation, residue management, rotation management
- Emissions – manure management, fertiliser type

D3.1 Demonstration farms and solutions on each farm confirmed

- Energy – renewables

Solutions being tested/to be tested on the Olive Oil Demonstration Farm at Nutrifarms' Outeiro Farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Permanent herbaceous cover crop in interrows - Spontaneous cover vs. seed mix rich in legumes	Interrow management - No tillage vs. localized corrective tillage (to improve soil structure)
Incorporating pruning residues in soil	Evaluate the potential of local subproducts (olive pomace, manure, other crop residues) as compost
Apply low emission fertilizers	Produce and use renewable energy (solar)
	Apply PGPR (plant growth promotion rhizobacteria)



Figure 6. Olive Oil Demonstration Farm is Nutrifarms' Outeiro Farm

4.8. Spain – Dairy

The experimental farm is located in Mabegondo (Abegondo, A Coruña, 100 m above the sea level) on a silty loam soil with an area of 305 ha, of which 73 ha are used for the dairy herd. There are about 85 cows in the herd (Holstein-Friesian breed, with an average milk yield of 7,000-8,000 kg/lactation, and fed 1,500 kg of concentrate per cow) and an average of 35 heifers per year (average age at calving is 26 months). Cows calve in two calving periods (January-February or July-August) in order to have cows to select for trials from March or September (usually with a duration of 3-4 months) during mid-lactation. Excluding the cows in trials, the management of cows depends on the time of year, since there are usually two grazing periods in Galicia, spring (March-June) and autumn (October-mid-December), in which cows go outside. Even in the grazing season, cows are fed a total mixed ration (TMR) with maize silage, grass silage and hay harvested on the farm and purchased concentrate. The forage area is divided into permanent grasslands dedicated exclusively to grazing (24 ha), permanent grasslands dedicated to grazing and silage (21 ha) and arable land (28 ha) with a rotation of maize and ryegrass (+25% legumes). Fertilization is exclusively with farm manure (no imports or exports) and mineral fertilization.

The main goal of the CIAM experimental farm is to furnish dairy cows for trials, which are mainly related to nutrition, milk quality and GHG emissions and are measured in groups of 24-30 dairy cows.

The solutions implemented or to be implemented during the project will focus on:

- Animal – genetics, increase efficiency, reduce stock numbers
- Grassland – rotation, soil fertility, sward species
- Emissions – manure management, fertiliser type
- Energy - renewables

Solutions being tested/to be tested on the Olive Oil Demonstration Farm at Nutrifarms' Outeiro Farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Improving/maintaining high soil fertility	Using protected urea
Establishing grass-legume swards	Covering slurry storage
Reducing chemical N fertiliser application	Reducing crude protein in concentrate feeds
Optimising soil pH	Establishing multi-species swards
Remove empty or less productive cows	Produce and use (or purchase) renewable energy (wind and solar)
Reduce lactation length to approx. 300 days	Precision feeding dairy cows
Low emissions slurry spreading	



Figure 7. CIAM research Centre

4.9. France – Energy and Wine

The French I3S that demonstrates the impact of AgriPhotoVoltaics (or Agrivoltaics) on vineyards is the Vitisolar project. The Demonstration Farm is located at the ISVV institute (Institut des Sciences de la Vigne et du Vin), in Bordeaux, in the middle of the Grande Ferrade vineyard, where low environmental impact vineyard processing is studied.

The Vitisolar project is on 20 vineyard rows spaced 1.6 m from each other, and 65 m long, 50% of this length is covered with a photovoltaic superstructure that can rotate PV modules around a horizontal axis, in order to follow the sun and vary the shading according to the needs of the vineyard.

The research programme aims to assess the amount of energy that can be produced and the positive and negative effects a partial shading may cause on the underlying grapevines. Further tests will be implemented based on the initial results and may include adding grass in between vineyard rows, use of plants with specific albedo to enable radiative forcing modifications.

The PV system on the field is designed to allow agricultural benefits as a priority and electricity producing is a secondary target. The time of year at which grapes will be harvested as well as the hydric stress reduction observed will be measured and reported. Additional measurements including soil organic matter content will be assessed as per the project requirements.

The solutions implemented or to be implemented during the project will focus on:

- Crops – shade, productivity, cover crops
- Energy - solar

D3.1 Demonstration farms and solutions on each farm confirmed

Solutions being tested/to be tested in the Vitisolar project during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Avoiding heat stress on grapes and on leaves through shading	Improving/maintaining biodiversity both on the microscopic scale, in the soil and on fruits, and bird wildlife
Reducing hydric stress	Using cover crops in between the grapevines
Protection against frost, typically in spring	Adoption by farmers
Improved shade management for agricultural benefits (1 st priority before electricity production)	
Produce renewable energy (solar photovoltaics)	
Optimal rainwater management	



Figure 8. Vitisolar project at the ISVV institute, in Bordeaux.

4.10. Romania – Sheep

The Romanian Demonstration Farm (AnimBio) comprise a vegetal farm (250 ha) and a multispecies animal farm: large ruminants, small ruminants, pigs and farm birds. It is located in South Romania (44.59 latitude, 26.08 longitude), in a flat and non-irrigated area, on a forest red-brown soil. The 250 ha are mostly used

D3.1 Demonstration farms and solutions on each farm confirmed

as arable land (for providing experimental feeds) and a limited surface of grassland. The farm has facilities (machinery system) for forage harvesting and preservation either as silage (classical) or hay (natural drying). Soil analyses are done occasionally (e.g. as support for fertilisation-related decisions). The small ruminant's sector has a capacity of 30 heads and it was designed for performing feeding trials as well as reproducing the conditions of an average ruminant farm in Romania. It hosts either sheep or goats, depending on the specific requirements of the ongoing RDI projects. Their feeding is determined by the objectives of the ongoing projects and relevant activities are organised mainly as feeding trials (comparisons of dietary ingredients / comparisons of feeding strategies). In this respect, various data (feed intake, milk, faeces) are recorded individually and, currently, the following analyses are performed: chemical composition (proximal and fine) of dietary ingredients, milk, meat and faeces, main parameters of rumen fluid (VFA, pH, NH₃). Depending on project objectives, some metabolites / biomarkers are also analysed. Between feeding trials, animals are fed hay or silage, complemented with tailored compound feed.

The solutions implemented or to be implemented during the project will focus on:

- Animal – genetics, increase efficiency, reduce stock numbers
- Feed – increasing home grown feed, optimise feed rations, feed supplements
- Grassland – rotation, biomass production
- Trees/hedgerow management – establishing agroforestry to test the benefits (animal production, C capture, shade)
- Emissions – nutrient management, feed supplements
- Energy - optimise

Solutions being tested/to be tested on the Romanian Demonstration Farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Optimal use of protein-rich feeds	Use of specific feed additives (e.g. anti-methanogens, saponins, plant extracts)
Inclusion of lipids in diet	Manipulation of rumen environment by valorising active substances from certain feedstuffs
Reduction of nutrient losses	Optimising the nature of energy supply
Fine tuning of the diets upon animals' requirements	
Synchronising the dynamics of energy and protein supplies	

4.11. Ireland – Dairy

The Irish Dairy Demonstration Farm is Teagasc Curtins Research Farm. The farm is 60 ha and has 150 cows. The research programme on the farm has three farmlets examining three pasture-based systems – grass-only receiving 225 kg N/ha, grass-white clover receiving 150 kg N/ha and multispecies swards receiving 125 kg N/ha. The system on the farm is spring-calving pasture based. Cows are at grass from calving until late November, when they are housed and fed grass silage from their respective farmlets harvested during the summer. Young stock are reared off farm. A range of data is being collected including soil OM content, soil P, K and pH, annual herbage production, herbage quality, purchased feed, concentrate fed, animal health measurements, milk yield and milk solids yield.

The solutions implemented or to be implemented during the project will focus on:

- Animal – genetics, increase efficiency, reduce stock numbers
- Feed – optimise feed rations
- Grassland – legumes, multispecies, soil fertility
- Trees/hedgerow – planting and management
- Emissions – manure management, fertiliser type
- Energy - renewables

Solutions being tested/to be tested at the Curtins Research Farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Low emissions slurry spreading	Planting trees and hedgerows
Using protected urea	Covering slurry storage
Planting trees and hedgerows	Establishing multi-species swards
Improving/maintaining high soil fertility	Produce and use (or purchase) renewable energy (wind and solar)
Reducing crude protein in concentrate feeds	
Establishing grass-legume swards	
Establishing multi-species swards	
Reducing chemical N fertiliser application	
Optimising soil pH	
Use sexed semen	
Remove empty or less productive cows	



Figure 9. Cows grazing multispecies swards at Curtins Research Farm.

4.12. Ireland – Beef

The Irish Beef Demonstration Farm is the Kildavin Herd at Teagasc Johnstown Castle. The Kildavin Herd is dairy-calf to beef with dairy-beef calves purchased onto the farm at weaning and reared to slaughter at approx. 24 months. There are two pasture based systems – multispecies swards only (receiving 75 kg N/ha) or multispecies within an agro forest. The research farm is implementing a range of measures to transition towards climate neutrality. A range of data are being collected including soil OM content, annual herbage production, soil P, K and pH, herbage quality, purchased feed, live-weight gain, concentrate fed, animal health measurements.

The solutions implemented or to be implemented during the project will focus on:

- Animal – genetics, increase efficiency, reduce stock numbers
- Feed – increasing home grown feed, optimise feed rations
- Grassland – legumes, multispecies swards
- Trees/hedgerow – planting and management, establishing agroforestry to test the benefits (animal production, C capture, shade)
- Emissions – manure management, fertiliser type

D3.1 Demonstration farms and solutions on each farm confirmed

Solutions being tested/to be tested at the Kildavin Demonstration Farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Low emissions slurry spreading	Genetic selection for improved performance and low enteric methane
Using protected urea	Establishing multi-species swards
Planting trees and hedgerows	Utilise commercial breeding value
Improving/maintaining high soil fertility	Improved forage varieties to increase NUE
Optimise feed rations	Precision fertilisation
Establishing multi-species swards	Reduce concentrate feed
Reducing chemical N fertiliser application	Reduce age to slaughter
Optimising soil pH	Reduce crude protein content of concentrate feed
Improve young stock management	
Agroforestry	
Multispecies swards	
Minimum cultivation for sward renewal	
Improve grass utilisation	
Plant and manage hedgerows and trees	
Clover to reduce chemical N fertiliser use	
Avoid soil compaction	
Improve animal health	



Figure 10. Dairy-beef herd at Teagasc Johnstown Castle

4.13. The Netherlands – Dairy

Dairy Research Farm De Marke researches and demonstrates technologies for clean and sustainable dairy farming. De Marke tries to attain this by minimising losses of ammonia, nitrate, phosphate and greenhouse gases. At De Marke manure and minerals are used as efficiently as possible in order to reduce the amount of raw materials and energy needed for production. By doing this, the ecological footprint of the farm is reduced significantly. Accurate nutrient management is a prerequisite for further development of dairy farming, particularly in the Netherlands. The amount of milk that can be produced will increasingly be defined by the extent to which farmers succeed to limit nutrient losses. On Demonstration Farm De Marke innovative measures are designed and tested to minimize nutrient losses and reduce GHG emissions while exploring the technical limits of efficient nutrient management. The knowledge we obtain is applied by Dutch dairy farms involved in the project Koeien en Kansen (Lead Commercial Farms).

The solutions implemented or to be implemented during the project will focus on:

- Animal – genetics, increase efficiency, reduce stock numbers
- Feed – increasing home grown feed, optimise feed rations
- Grassland – rotation, biomass production
- Emissions – manure management, fertiliser type
- Energy - renewables

D3.1 Demonstration farms and solutions on each farm confirmed

Solutions being tested/to be tested at the De Marke Farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Anaerobic slurry digestion	Biorefinery
Addition of nitrate/sulphate to the ration to change digestion in the cows	Improving slurry/digestate separation
Increase the lifetime production of the cattle by breeding robust cows	Daily manure transport to digester
Replacing part of concentrates with brewers grain	Solar panels
Extra conditioning of silage grass to enhance digestibility of silage grass	
Use of supplements to enhance the digestibility of silage grass	
Protein in feeds carefully tuned to requirements	
Optimal timing of fertilization	
Fertilization tuned to crop requirements	
Only young stock to replace milking cows	
Precision fertilization	
Crop rotation with alternating grass and maize	
A high lifetime production of milking cows	
Large manure storage	
Homegrown feeds	
More manure in grass, less in maize	
Restricted grazing	
Rotational grazing	



Figure 11. De Marke Farm

4.14. United Kingdom – Pigs

The UK University of Leeds Demonstration Farm includes the National Pig Centre and arable farming. There is an outdoor breeding herd of 250 sows, which produce piglets for finishing on other farms and an indoor herd of 400 sows producing finished pigs. Research focusses on pig nutrition, behaviour, welfare, health and production systems and slurry management and use. The farm covers 320 ha in total with 230 ha of arable land in rotation. The arable rotation includes wheat, peas, barley, oilseed rape, maize and outdoor pigs. Research is carried out into soil carbon from hedge planting, emissions from manure and fertiliser, underplanting and farm energy. There are 7.7 ha of Agroforestry, and 36 ha of pasture leased to a sheep farmer. The farm is also used for crop trials run by NIAB (National institute for Agricultural Botany).

The solutions implemented or to be implemented during the project will focus on:

- Feed – increasing home grown feed, optimise feed rations
- Trees/hedgerow – planting and management
- Crops – crop type, rotation
- Emissions – manure management
- Energy - renewable

D3.1 Demonstration farms and solutions on each farm confirmed

Solutions being tested/to be tested at the University of Leeds Demonstration Farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Improve feeding efficiency (Precision feeding)	Enriching slurry N via plasma processing
Change to diet composition	Production of solar thermal energy and electricity
Slurry acidification	Production of wind energy
Slurry cooling	Use purchased renewable electricity
Cultivation of energy crops	Use of electric farm vehicles
Under sowing (with clover)	
Use low emission feed ingredients	
Managing field margins	
Planting trees and hedgerows	

4.15. United Kingdom – Crops

The GWCT Allerton Project is a 320 ha mixed lowland farm on the Leicestershire/Rutland border in the English East Midlands. We are predominantly an arable farm (245 ha) but also have permanent pasture (40 ha) and woodland (20 ha). It is a conventional farm, but have a strong focus on Integrated Pest Management (IPM). The rotation consists of wheat, barley, oilseed rape, oats and field beans, but also integrates grass leys and diverse legume fallows into the arable area. Direct drilling is used to reduce soil disturbance, but inversion tillage is not used where agronomically beneficial. The farm is on heavy clay/silt clay soil, and the terrain is undulating and steep in places. Yields are unexceptional at 7.7 t/ha as a ten-year average winter wheat yield. The permanent pasture is unimproved and low/no input, on which a neighbouring farm grazes a flock of commercial sheep. A field-scale silvopasture project (5 ha) is also present on the site and there is a wide variety of habitat on the farm, supported by a comprehensive agri-environment scheme. It is a research and demonstration farm, and a wide variety of data over thirty years on biodiversity, soil and water has been collected.

The solutions implemented or to be implemented during the project will focus on:

- Crop – rotation, cover crop, species, legumes, leys, fallow
- Field margins
- Emissions – fertiliser type

D3.1 Demonstration farms and solutions on each farm confirmed

Solutions being tested/to be tested at the GWCT Allerton Project Demonstration Farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Diversification of crop systems	Replace synthetic fertilisers with biostimulants
Cultivate cover crops	Establish & maintain field margins
Reduced tillage	Spread biochar on the land
Cultivate harvested legume crops	
Integrate grass leys into arable rotations	
Adapt fertiliser application	
Include fallow in the production system	
Precision sowing	

4.16. Belgium – Crops

The Belgian crop Demonstration Farm is the Walloon Agricultural Research Center (CRA-W)'s long term experiment (LTE) called « **SyCI** » which aims to test and compare innovative cropping systems (**Sy**stèmes de **C**ultures **I**nnovants). The LTE is 15 ha, with loamy soils. The valorization of the crop production for food purposes is a priority and addresses three major current issues: conservation of soil capital; maximum reduction of greenhouse gas emissions; maximum reduction of the use of synthetic inputs (pesticides, fertilizers). To address these three issues, three crop systems have been developed, as well as one control system.

- The GHG system: focuses on reducing greenhouse gases emissions. To achieve this, two approaches are implemented: minimizing synthetic fertilisers and mechanization, and maximising biomass outputs that can be used in biomethanisation.
- The SOL system: focuses on conserving the different forms of soil fertility (physical, chemical and biological). Practices that activate eco-services or have a lower impact are used (e.g. cover crops, direct seeding, crops associations)
- The ZEROPHYTO system: is built to reduce the use of plant protection products (PPP), or even eliminate them. Therefore alternative, preventive or substitution solutions are implemented such as mechanical weeding, crop association, variety selection, temporary grasslands. A Control system is also monitored which is based on conventional agriculture.

The LTE began in autumn 2019 and will continue for at least 12 years.

The solutions implemented or to be implemented during the project will focus on:

- Crop – rotation, cover crop, species, legumes, leys, energy crops
- Soil fertility
- Field margins

D3.1 Demonstration farms and solutions on each farm confirmed

- Emissions – fertiliser type, reduce fossil fuel consumption

Solutions being tested/to be tested at the Demonstration Farm at the Walleon Agricultural Research Center during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Legumes/pulses as a pure crop in the rotation, in association with other plants, and in the cover crops	Reduce use of synthetic N fertiliser and other chemical fertilisers
Maximum use of cover crops	Catch crops use for energy production
Localised fertilisation	Crop diversification, long rotation (6 years)
Incorporation of 2 years temporary grasslands in the rotation	
Direct sowing (reduction of fossil fuels consumption)	
Improving and maintaining high soil fertility	
Limiting the depth of tillage (max 15-18 cm) (reduction of fossil fuels consumption)	

4.17. New Zealand – Dairy

The New Zealand Dairy Demonstration Farm is the Southern Demonstration and Research Farm of the Southern Dairy Hub, located near Invercargill, Southland, New Zealand. The farm is ca 300 ha and has ca 715 cows. The research programme on the farm has four farmlets: examining grass-white clover pasture-based systems with either standard or low intensity (180 kg N/ha fertiliser applied and 3 cows/ha vs 50 kg N/ha and 2.5 cows/ha) and crop- or grass-based wintering systems (winter grazing outdoors on crop (both intensities), wintering indoors on grass silage (standard intensity), and winter grazing outdoors on pasture (low intensity). For the ClieNFarms project these farmlet systems are being used to examine the effect of intensity and wintering on GHG emissions. In addition, scenario modelling will be conducted to assess the impact of additional mitigations for each farmlet on GHG emissions.

The solutions implemented or to be implemented during the project will focus on:

- Animal – genetics, increase efficiency, animal health
- Feed – increasing locally grown feed
- Grassland – reduce inputs
- Trees – plant

D3.1 Demonstration farms and solutions on each farm confirmed

- Emissions – manure management, fertiliser type

Solutions being tested/to be tested at the Southern Demonstration and Research Farm during the ClieNFarms project

Solutions implemented	Solutions to be implemented or tested during the project
Higher genetic merit animals at reduced stocking rate (SR)	Replace PKE with locally sourced feed
Higher genetic merit animals at the same SR	Reduced pasture area and plant production trees (for C offset)
Higher genetic merit animals at reduced SR and no N fertiliser	Reduced pasture area and plant alternative cash crop
Improving animal management (improved BCS and animal health)	

4.18. Ukraine - Crops

The innovative farm is 300 ha in the south of Kyiyv oblast. The owner is strongly focussed on regenerative practices. He is growing winter wheat, corn, sunflower, soy, buckwheat and cover crops. He is using no till technology for more than eight years and plants cover crops after wheat.

The solutions implemented or to be implemented during the project will focus on:

- Crop – cultivars, species, crop residue manner
- Hedgerow management
- Emissions – fertiliser type

D3.1 Demonstration farms and solutions on each farm confirmed

- Energy – investigate renewables

Solutions being tested/to be tested at the Ukrainian Demonstration Farm during the ClieNFarms project	
Solutions implemented	Solutions to be implemented or tested during the project
Improve the evaluation methods and agree the solutions which will help farmer to improve humus content and prevent soil erosion	Balanced reduce of N-fertilisers usage on corn
Implementing the precise planting elements in the technology	Hedgerows management – as agreed with local authorities (Hromada)
Additional cover crops management after late crops (corn, sunflower, soy)	Improve efficacy of insect control via biological methods (mites on soy and some other)
Crop residence management improvements	Soil bio protection (weeds and fungus)
	Increase renewable energy elements in the farm operations

5 Conclusions

All of the Demonstration Farms have been identified and the suite of solutions being implemented/to be implemented and examined have been identified. The solutions will have benefits in reducing GHG emissions and increasing C sequestration, but will also have other co-benefits including production, reducing nutrient losses to water and increasing biodiversity. The solutions range across crop management, animal management, investment in and use of renewable energy, soils management and reducing emissions. The solutions are also captured in Task 1.4, catalogue of solutions. The solutions will be demonstrated to the Lead Commercial Farms, the OutReach Farms and the wider community through demonstration events in 2023, 2024, and 2025 giving confidence to farmers and those supporting farmers in implementing systemic solutions. The data collected on the Demonstration Farms in WP3 will be available for WP1, 2 and 4.