 

LIFE19 CCM/FR/001245

7th EU Steering Committee

LIFE GREEN SHEEP: Demonstration and dissemination actions to reduce the carbon footprint in European sheep farming

Vitoria-Gasteiz, Spain. 17th  and 18th of April 2024

Thursday: 18th of April - TECHNICAL VISIT

8:30 - Departure: Hotel General Alava.

9:30: Innovative Flock: Borda Berri Baserria (Lazkao, Gipuzkoa)

12:00: Okiturri Agricultural Tramsformation Centre

14:00 – Lunch in the Agri-Food Campus of Arkaute, Alava.

15:00: Innovative Flock: Neiker-BRTA (Arkaute, Alava)

17:00: End of the journey and return to the hotel

Issues in the Innovative Flock of NEIKER-BRTA

* + Experimental flock of Latxa - Dairy Sheep
	+ Regenerative rotational grazing
	+ Nutritional Strategies and Facilities to reduce carbon emissions.
		- On-Farm Oilseed cold-pressing and feeding cakes
		- Anti-methanogenic additives

A BRIEF HISTORY

FROM THE MODEL FARM OF ARKAUTE TO THE AGRI-FOOD CAMPUS OF ARKAUTE:

A LONG TRADITION IN INNOVATION

• 1851 – The Model Farm of Arkaute is born.

The local administration (Diputación Foral de Alava) decides to build a site with the objective of introducing innovation to local farmers regarding new techniques, machinery, practices, as well as more productive crop varieties, or better males for cattle, sheep and horse production.

There is also an education and training plan for young farmers in agriculture and livestock.

* 1940 – The property of the Farm goes to the Spanish Government.

For many years, the farm was a centre dependent on INIA, the Spanish National Institute for Agriculture and Food Research and Technology, one of the research organizations of the Ministry of Science and Innovation (MICINN) in Spain.

The Centre for the Improvement of Potatoes was funded since potato cropping has been one of the most important activities for farmers in this area.

• 1981 – The Spanish Government transfers the Centre to the Basque Government, together with the Agricultural Research and Improvement Service

• 1998 - It becomes the Public Company AZTI A.B., and later NEIKER

* 2006 – Neiker joins the Tecnalia Corporation
* 2019 – Neiker joins BRTA – The Basque Research and Technology Alliance

The R+D+I activity of NEIKER-BRTA is organized and implemented and carried out in the following Departments:

* + Animal Production
	+ Animal Health
	+ Plant Production and Health
	+ Forestry
	+ Conservation of Environmental Resources

EXPERIMENTAL FLOCK OF LATXA SHEEP

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Since 1985, there has been a flock of Latxa sheep (Black Faced) in the Campus of Arkaute for the R+D+i purposes of the Animal Production Department of Neiker.

The main objective is to keep and manage a flock of dairy sheep within the breeding scheme of the local breed (Latxa), and therefore with a genetic value similar to the commercial flocks existing in the Basque Country, and to be able to carry out experiments and trials under controlled conditions but unbiased by productive or economic purposes. In addition, demonstration and dissemination activities to the sector are also implemented around the flock.

Today here are 130 adult sheep plus 45 ewe-lambs, and 2 male lambs were taken to Ardiekin for the breeding scheme.

Conditioned by weather and the productive cycle, the ewes are kept indoors from early-middle December until the end of March (from late pregnancy). During this period, forage (on-farm made grass haylage, purchased alfalfa and other hays) and supplementary feeding is provided balanced to the animal requirements for pregnancy or milk production.

During spring (April-May), sheep graze part-time on the 12 ha available of pastures, and are provided indoors with decreasing amounts of forages and/or concentrates, according to milk yield. In late May,the sheep are shorn and also begin to be kept outdoors at night (until November-December).

After the milking season, during summer and autumn, the ewes are basically kept grazing outdoors, and forage or cereals are only provided either during the flushing (sheep with low body condition score prior to mating) or due to lack of available pasture.

Machine milking is implemented on a 2x12 milking parlour with electronic devices for individual milk recording with automatic removers.

The flock is managed under very strict health conditions, so the incidence of health hazards is kept at minimum levels.

R+D+i activities focused on:

* ***Nutrition:*** impact of forages, grazing and/or supplementary feeding (quality and/or intake) on milk yield and composition, milk or cheese quality, GEI emissions, intake, digestibility, behaviour, etc.
* ***Reproduction:*** assessing the seasonality of the breed, optimization of AI, MOET techniques, ewe lambs management, etc.
* ***Genetics:*** individual milk yield and milk quality, automatic milk recording devices, udder morphology evaluation, methane emission, etc.
* ***Animal behaviour and welfare:*** impact of group size or space availability on animal behaviour and welfare, development of welfare protocols for sheep, etc.
* ***Animal Health:*** diagnostics and diseases eradicationstrategies
* ***Organic and Low-input farming***: fertilization of pastures, direct sowing, no-tillage, regenerative grazing, etc.

**Some figures (2022-2023):**

Artificial Insemination dates:

Adult sheep: 18th of August

Entrance of rams to the flock: 31th of August (5th of September for ewe lambs)

Exit of rams from the flock: 30th of September (2 cycles)

Start of the lambing seasons: ≈ 13th of January

End of the lambing season: ≈ 10th of March

Start of milking season: ≈ 20th January – 20th of February (immediately after lambing or after the suckling period)

End of milking season: ≈ 1th of July

Fertility:

 AI: 50%

 Ewe Lambs: 50%

 Flock: 85-90%

Prolificacy: 1.5 lambs / lambing (1.7 from AI)

Lamb mortality: 6%

Replacement rate: 35%

Total milk yield: ≈ 32260 l.

Number of sheep milked: 122

 Milk yield / lactation: 256 l.

Number of lactations calculated within the breeding scheme: 122

Flock free of Maedi-Visna, Q fever and Border disease, and officially Brucellosis free (M4 sanitary class)

Faecal samples to assess the incidence of gastrointestinal parasites: at the end of lactation, and prior to mating and lambing

Mastitis: < 2%

 Selective antibiotic therapy at drying off: only if SCC>250 or if milk yield is > 900 ml/d

Grass production:

 7000-9000 kg DM/ha/year (70% in spring: March-June)

**Carbon footprint (IPCC, 2019):**

* TOTAL GHG Emissions
	+ Without Biophysical allocation: 3,04 kg CO2eq / kg FPCM
	+ With Biophysical allocation: 2,29 kg CO2eq / kg FPCM
* Carbon Sequestration: 0,33 kg CO2eq / kg FPCM (10,9%)
* NET GHG Emissions
	+ Without Biophysical allocation: 2,71 kg CO2eq / kg FPCM
	+ With Biophysical allocation: 1,96 kg CO2eq / kg FPCM

**Sources of GHG Emissions**

**ACTION PLAN:**

**Mitigation Practices:**

* Substitution of soyabean for on-farm cold-pressed oilseed cakes
* Antimethanogenic aditives
* Rotational regenerative practices

**Impact**

* TOTAL GHG Emissions **(IPCC, 2019)**
	+ Without Biophysical allocation: 2,58 kg CO2eq / kg FPCM
	+ Mitigation : **15% reduction in carbon footprint**

LIFE REGEN FARMING - LIFE12 ENV/ES/000232

Regenerative agricultural practices: **Demonstration of a sustainable agricultural and livestock soil management alternative**



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**Regenerative agriculture** is an agricultural vision based on scientific and/or empirical knowledge of natural processes, the biology of soil, the physiology of plants and their relationship with animals. Maximizing these symbiotic relationships through proper management, it is possible to reduce input costs while reinforcing the local economy, gradually increase soil fertility and consequently the efficiency of the entire system. In addition, regenerative agricultural practices have a beneficial effect on carbon fixation, contributing thus to the fight against climate change.

During the last decades, **grazing practices have been abandoned** in many livestock systems, while the problems of the sustainability of agricultural/livestock activities have become increasingly evident. At the same time, growing environmental concern and the need to produce food in a sustainable and environmentally-friendly way make the agri-food sector a key sector for society. LIFE REGEN FARMING project worked in this context, to try to determine the viability of regenerative practices as an alternative for the sustainability of farms.

The **regenerative practices tested in the project** during 2013-16 were: (i) direct sowing with perennial species to keep permanent pastures, (ii) organic fertilizers with manure or compost made in the farm, and (iii) grazing plans, that consist of planning the use of grasslands with high livestock units and enough resting time for the soil and vegetation to recover. This last practice has been carried out since 2013 until now (2024).

**The main objective** of LIFE REGEN FARMING was to show the viability of regenerative practices and their beneficial effects on the quality of soil and the environment at different agro-climatic scales. The project focused on:

* Testing regenerative practices as a sustainable agricultural and livestock soil management alternative.
* Turning simple, rapid and inexpensive methods for evaluating soil quality.
* Monitoring the environmental and socio-economic impact of regenerative practices.
* Raising awareness among different stakeholders of the benefits of regenerative practices.
* Contributing to the LIFE programme and the “Thematic Strategy for Soil Protection” to generate knowledge and raise awareness about the importance of soil.

During the project, a major effort was made to combine scientific knowledge, with the turning of simple, rapid and inexpensive evaluation methods for farmers or technicians, combined with other laboratory techniques. These methods enjoyed great acceptance and their ease of use, usefulness and the desirability of continuing to work on their expansion was verified by farmers. The work methodology of **participatory research action**, in which researchers, rural development technicians and farmers actively took part in research, was fundamental to assure the continuity of these practices.

The regenerative practices tested during 2013-16 demonstrated that they enhance both environmental and socio-economic aspects. The most relevant results showed that the practices implemented maintained livestock production, **reduced the carbon footprint** per unit of output (-10%), **improved soil fertility** (+7% particulate organic matter) and, finally, **increased the botanical diversity of grasslands** (+3%) and **increased grass production** (+15-25%).

Later, regenerative grazing implemented for six years (2019) showed higher **springtime grass production** (+30%) and **topsoil carbon storage** (+3.6%) and **water flow regulation** (+7.7%). All these parameters showed relatively **narrower dispersion**, possibly because the more homogeneous pasture use by the ewes that avoid the negative consequences of over- and undergrazing (Diaz de Otalora et al, 2021) and means that sheep excreta and urine are more evenly distributed, reducing the need for fertilization. Moreover, nine years after the establishment of the trial, topsoil under regenerative grazing management showed 6, 18 and 4 % higher values of **microbial biomass carbon**, **particulate organic matter** and **mineral-associated organic matter**, respectively (Mandaluniz et al, 2022). Finaly, enhanced soil structure and increased levels of organic matter may be the reason for the positive effects observed on **soil nutrient cycling**, with a general tendency for higher relative abundances of functional genes involved in the soil C, N, P and S cycles; five of these genes showed statistically significant differences in topsoil (FAO document, in review).

These results are aligned with the “Initiative 4/1000: soils for food security and climate” to enhance the implementation of climate action which objective is to ensure the role of agriculture against the climate change (proposal of the “Lima-París Action Agenda”).

 

Nutrional strategies to reduce dairy sheep enteric methane emissions: use of anti methanogenic additives

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Climate change is a prominent threat to human well-being and biodiversity. Enormous increase in anthropogenic greenhouse gas (GHG) emissions is considered the primary driver of this existential threat. Within GHG, methane represents the second largest gas contributor to climate change following CO2 considering their atmospheric concentrations. This CH4 is mostly produced as a natural product of enteric fermentation of feed in ruminants, thus reduced emissions of CH4 can be achieved through feeding strategies decreasing the extent of microbial methanogenesis. Several dietary approaches based on feed supplements have been proposed to minimize the production of CH4 of enteric origin with a greater or lesser degree of efficacy, persistence and inconvenience. Here, we present a couple of examples of the research that has been conducted in the facilities of NEIKER-BRTA in the Campus of Arkaute to reduce enteric methane emissions.

Use of biochar. Biochar is a porous carbon rich by-product sourced from the incomplete pyrolysis of residual animal and vegetable biomass in an oxygen limited environment. The ability of this low-cost product to detoxify toxic substances, adsorb gasses, and increase the population ratio of methanotrophs to methanogens has made it appealing for use in livestock feeding systems to reduce the environmental impact of enteric CH4 emissions. Nevertheless, despite the increasing number of studies that has been devoted to this topic in recent years, the effectiveness of using biochar as a CH4 mitigator in ruminants has not been firmly established due to inconsistency of CH4 responses. The inclusion of biochar in the diet of dairy sheep increased daily net CH4 production by improving apparent digestibility of dietary OM and especially that of NDF. However, it showed a great potential to mitigate enteric CH4 production per kg of digested DM and increase milk fat content, without impairing feed intake or milk yield.

Spent coffee grounds. Food waste and livestock systems have a significant impact on greenhouse gas (GHG) emissions. In the EU, nearly 59 million tons of food waste is generated each year, accounting for about 7% of total GHG emissions according to the European Commission. Coffee, one of the most consumed popular beverages in the world with about 10 million tons each coffee year between 2018 and 2021 according to the International Coffee Organization statistics, generates huge amounts of waste throughout its production chain, including spent coffee grounds (SCG) which is the insoluble residue left after the preparation of instant coffee. In Europe, it is estimated that the management of SCG waste through landfilling or incineration releases approximately 650 million kg CO2eq/year to the environment. Spent coffee ground has proven to be an important source of bioactive phenolic compounds such as gallic acid, protocatechuic acid and chlorogenic acid, which confers added value to this by-product. These phenolic compounds have antimicrobial properties, influencing ruminal microbial populations, and inducing changes in bacteria, fungi, and protozoa. In the literature, no information is available regarding the effects of SCG on enteric methane production when included in ruminant rations so far. According to our results with sheep, feeding SPG increased dry matter intake, and as a consequence daily methane emission (g/d). However, feeding SCG decreased methane emissions per unit of DMI due to a decrease in feed apparent digestibility. In addition, feeding SCG induced shifts in the milk fatty acid profile towards healthier ones without impairing productive performance, milk composition or final product consumer perception.

Integral use of oil seeds to reduce Green-house gases emissions associated with farming activities: oil seeds can be used to obtain biofuels and feedstuffs for livestock

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The idea of the project **LIFE SEEDCAPITAL** (2013-16)was to develop a new production model based on replacing raw materials, that are imported from outside and have a high cost in terms of their carbon footprint and financial cost, with others produced locally which also have competitive advantages over the current raw materials. The advantages of using rapeseed include the benefits provided by rotating cereal grains with rapeseed on soil characteristics, on a smaller carbon footprint compared to that of cereal crops and the comprehensive use that can be made of the seed. This is based on using the oil resulting from cold-pressing the seed as a biofuel for agricultural machinery and the pressed cake as animal feed.

In terms of the introduction of the crop in head of the rotation we were able to see that, in the absence of technical implementation problems and pests, the rapeseed crop gave optimum returns and that, although data were scarce, the production yields of the cereal crops improved in the rotation following the rapeseed. We were able to determine that the emissions associated to the purchase of fertilizers and soil emissions represented about 70% of the total, emphasizing the importance of using the correct amount of fertilizer and the choice of fertilizer. We found that, provided that agricultural holdings obtained a normal production output, they would comply with Directive 2009/28/EC which, from January 1, 2017, will set the reduction of GHG emissisions for the use of biofuels and bioliquids at 60% from January 1, 2018.

As for the use of oil as biofuel we found that it is more advisable to store oil than seeds. It is also more expedient to store oil without blending it with diesel. Moreover, oil degradation is more pronounced if overheating occurs, which suggests locating the oil tank inside a warehouse, where the temperature range will be lower, and not outdoors. Using a blend of rapeseed oil with diesel at 25.8% means a 25.9% decrease in kg CO2 eq emissions, along with financial savings that range between 16.1% and 19.1%. By contrast, any mechanical problems found would be limited to the appearance, in specific cases, of soaps from the reaction of biofuel with zinc coatings on pipes that run from the biofuel storage tank to the pump. An analysis of different parts of the tractor suggests that major changes in the mechanical properties and dimensional stability that occur in polymeric materials in contact with different proportions of rapeseed oil-diesel oil are not significant or are acceptable. In addition, the metal materials and coatings analysed performed correctly, with no loss of thickness, sporadic chipping or pitting having been detected.

Finally, the formulation of 20% cold pressed rapeseed cake for dairy cattle and 40% for dairy sheep results in a reduction in production costs, obtaining a healthier profile of fatty acids in milk from the point of view of the consumer, reducing enteric emissions by more than 8% without involving a reduction in the yield from the animals, a decrease in the quality of milk or a loss of acceptability of the milk produced.

**THE LATXA DAIRY SHEEP SYSTEM**

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The local dairy sheep breed is called Latxa in the Spanish Basque Country and Navarra (NA), and *Manech* in the French Basque Country. Although they are basically the same breed, due to administrative, orographic and political reasons the evolution and development of the R+D programmes has been different in each side of the border.

There are three main different ecotypes of Latxa breed: Blond-faced Latxa, Black faced Latxa of the SPB and Black-faced Latxa of NA. The differences are due to the skin colour and the presence or absence of horns. There is also another population of Blond-faced Carranzana featured by a bigger size and more convex face profile. The figure 1 shows the population census and geographical distribution of these breeds.



Figure 1: Population census and geographical distribution of the Laxa and Carranzana breeds in Spain

The live weight of the Latxa sheep ranges between 50 and 65 kg in females and between 75 and 90 Kg for males. The ewes show a distinctive coarse long wool fleece, and are recognised as being rustic, resistant and well adapted to the local orographic and climatological conditions. This is evident in the marked seasonal reproductive behaviour and the capability to graze and feed from grass and shrubby resources within humid and cold conditions in the sloping grasslands of mountain pastures.

Although until 1980 it was considered to be a multipurpose breed, nowadays it is widely recognized as a dairy breed, achieving more than 200-250 l/lactation.

Milk is basically used for Idiazabal cheese-making, a traditional product which origin, production process and outstanding quality features are protected and certified by the Protected Designation of Origin (PDO) of Idiazabal. This label and the high degree of structuration of the sector existing in the Basque Country have significantly helped to maintain the breed and the production system.

Mountain pastures: Traditional grazing management during summer time for dairy sheep in the Basque Country

Traditional grazing practices

* Communally managed pastures (*parzonerías*, managed by the surrounding villages)
* Mountain grazing period during summer and autumn:
	+ end of the milking
	+ dry period
	+ most of matting and pregnancy
* Mixed grazing: beef cattle, mares, sheep and goats, plus wildlife (roe dear, wild boar, etc.) etc.

Current Problems:

* Abandonment of the activity
	+ Decrease in the number of flocks and heads
* Abandonment of milking and cheese-making in mountain areas
* Reduction of sheep stocking rate
* Higher proportion of cattle and mares (and longer grazing period) than sheep
* Breed change in favour or more productive foreign breeds: beef meat (Charolais) or dairy sheep (Lacaune or Assaf), which do not attend to mountain pastures
* Lower stay in mountain areas (only dry sheep)
* Growing conflicts with wildlife and predation (wolf)

Consequences:

* Brush encroachment
	+ Higher risk of fire
* Biodiversity changes
* Landscape changes
	+ Impact on lanscape utilization for leisure activities (walks) or sport (running, cycling, etc.)

Partial solutions and innovations:

* GPS to make livestock geolocalization and management easier
* Mechanical brush clearing
* Attraction points for livestock: water and salt points
* Solar panels for shepherds’ huts: light (mechanic milking and cheese making)
* Guarding dogs to reduce the impact of predation
* …