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STUDY REGARDING GREENHOUSE GAS EMISSIONS AND CARBON FOOTPRINT IN ROMANIAN SHEEP FARMS

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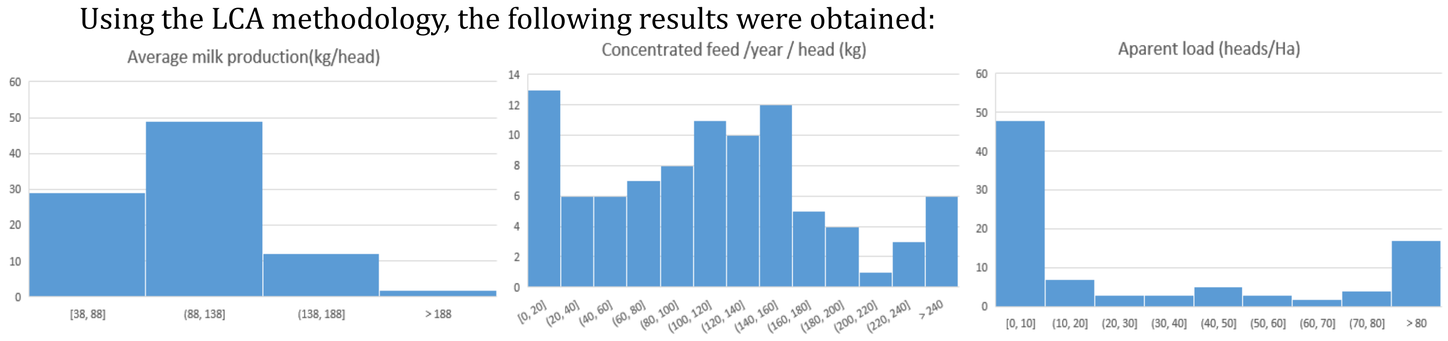
Abstract: *Greenhouse gas emissions from animal breeding contribute to the global phenomenon of climate change by about 2%. According to European Parliament statistics, Romania ranks 10th in the European Union in greenhouse gas emissions. The present study was based on the use of the life cycle assessment (LCA) methodology in 92 sheep farms in Romania. Also known as life cycle analysis, it is a methodology for assessing the environmental impact associated with all stages of the life cycle of a product, process or commercial service. Our results showed that the gross CO2 emissions at the dairy sheep farm level, related to the product unit, are about 5.17 kg of CO2 equivalent/L commodity milk. From these emissions, 3.18 are enteric emissions, 1.07 are emissions due to effluent management, 0.14 emissions are due to nitrogen fertilization of crops or pastures, 0.08 are emissions due to fuel and electricity consumption, and 0.68 are due to emissions of compound feed purchased at the farm level. As for the carbon stored at the farm level, it is at the level of 1.43 kg CO2 equivalent/litre of commodity milk. The highest amount is stored at the level of pasture (1.09) and at the level of permanently cultivated meadows (0.43).*

Introduction

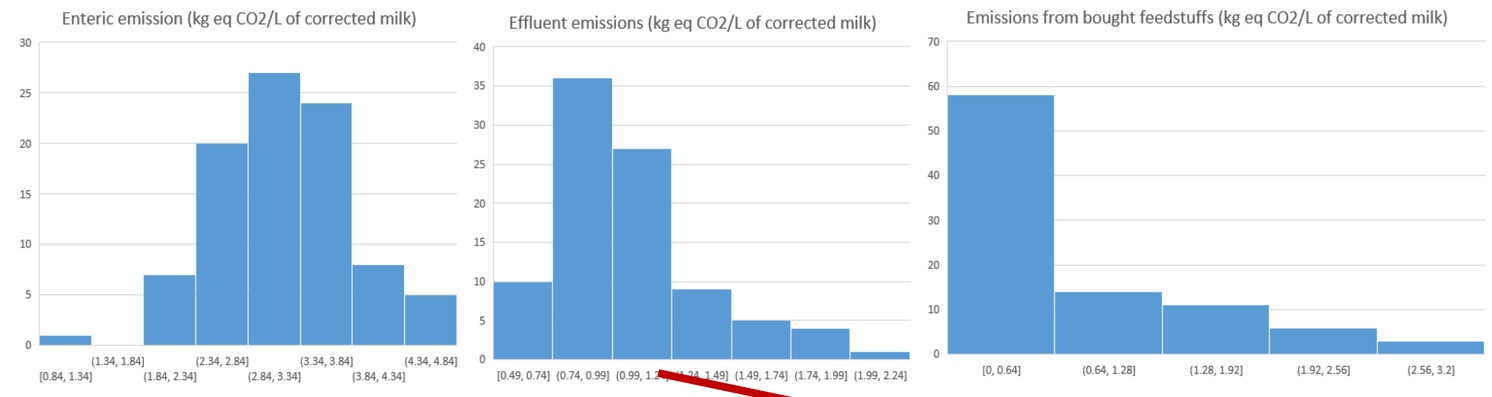
Greenhouse gas (GHG) emissions from milk production vary depending on the systems, practices, and conditions employed. To accurately assess their contributions, it is essential to apply consistent methodologies across different contexts. The calculation of the dairy carbon footprint encompasses both direct and indirect emissions of greenhouse gases—including CO_2, CH_4 (methane), and N_2O (nitrous oxide)—originating from various sources such as feed production, enteric fermentation, manure management, and manure spreading.

Results and discussions

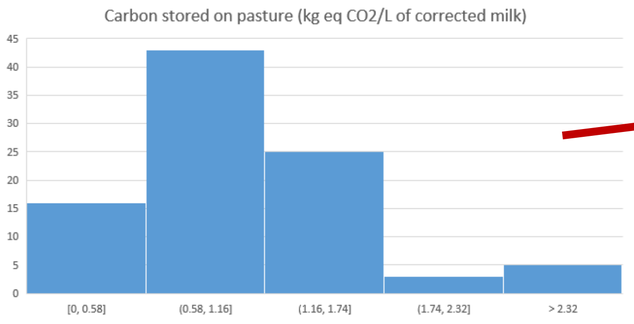
Using the LCA methodology, the following results were obtained:



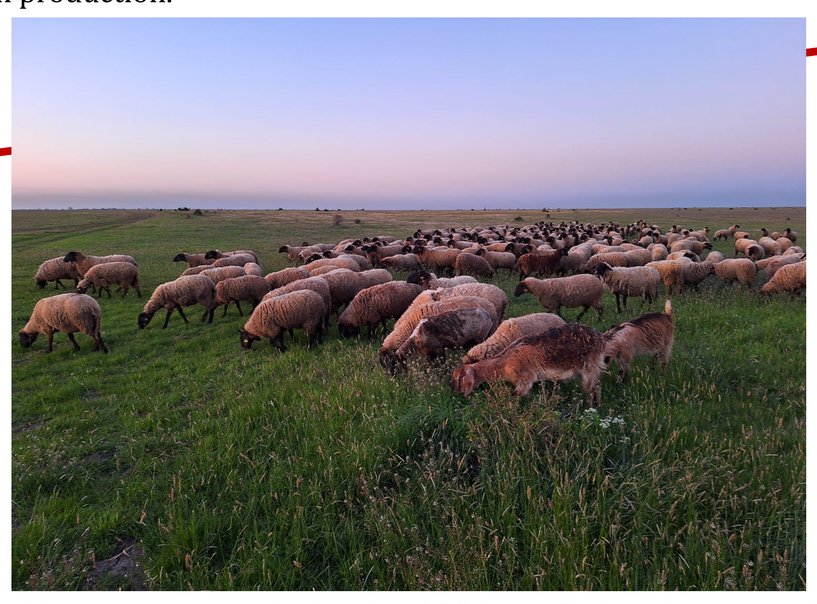
As can be seen, the average individual milk production is relatively low (especially compared to European specialized breeds). This leaves room for reducing the carbon footprint, which is directly correlated with productivity. Also, the average quantity of concentrates is reduced, this limiting the productivity of the animals. The apparent average load of sheep per hectare is very high, this suggests that most sheep are raised on unallocated areas (roadside or unregistered pastures), which reduces the ability to estimate soil carbon sequestration. The consumption of concentrates on most farms is extremely low, this excludes the productive performance. Although the average apparent load is high, it is observed that most farms show an apparent load of 10 animals/ha. Farms where the apparent load is higher can be directed to look for solutions to reduce the load and, implicitly, the carbon footprint.



Enteric GHG emissions follow a normal distribution, showing a character dependent on genetic information. The GHG emission from the effluents is located between 0.7 and 1.24 kg of CO2/L raw milk for most farms. Another component of the gross emissions is the GHG emission introduced into the farm through the purchased fodder. As can be seen, most farms are at the level of 0.64 kg of CO2/L commodity milk. This component can be reduced by increasing feed self-sufficiency, using own production.

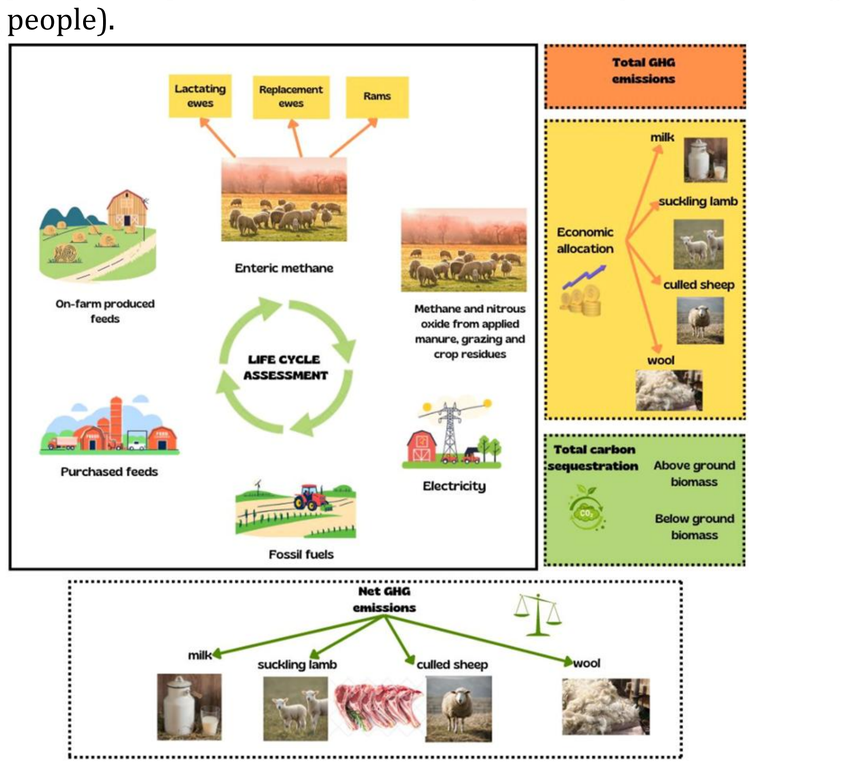


Regarding carbon storage, it is clearly observed that most of the GHG is stored at the level of pastures and permanent meadows.
Most farms fall within the range of 0.5-1.74 kg of CO2/L commodity milk.



Material and method

Life cycle assessment (LCA), also known as life cycle analysis, is a methodology for assessing the environmental impact associated with all stages of the life cycle of a product, process or commercial service (The picture bellow). An LCA study involves a thorough inventory of the energy and materials that are required throughout the supply chain and value chain of a product, process or service and calculates the corresponding environmental emissions. LCA thus assesses the cumulative potential impacts on the environment and is largely used in carbon footprint estimation tools.
The carbon footprint was estimated using the CAP'2ER® tool, using data from 100 sheep farms, distributed throughout Romania. CAP'2ER® is a farm-level assessment tool covering mixed cropping and ruminant farming. (Milk, Meat, Mixed, Sheep, Goat). It is widely used in France (about 30,000 ratings and 1,500 users). It is also used in other countries Switzerland, Italy, Germany, Spain, Romania, etc. The tool assesses environmental impact (GHG emissions, nitrogen loss, energy consumption) and positive contribution (biodiversity, carbon storage, feeding people).



	Gross GHG emissions (kg eq CO2/L milk)	Total Carbon stored (kg eq CO2/L milk	The net carbon footprint of the farm (kg eq CO2/L milk)
Average	5.17	1.43	3.75
Standard Deviation	1.26	1.31	1.33
Minimum	1.87	-0.22	0
Maximum	8.73	6.78	7.22

The average footprint of the analyzed commercial farms was 3.75 (kg eq CO2/L milk) with a minimum of 0 and a maximum of 7.77 (kg eq CO2/L milk).

Conclusions

- The carbon footprint at the dairy sheep farm level is, on average, at the level of 3.75 kg of CO2 equivalent/L of commodity milk, slightly higher than the European average (3.55).
- Farms where the apparent load is higher can be directed to look for solutions to reduce the load and, implicitly, the carbon footprint.
- Many farms record production values below the average, offering room for improvement and decreasing carbon footprint.

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