INNOVATIVE FOOD SUPPLY CHAINS AND NEW BUSINESS MODELS FOR SLAUGHTERHOUSE WASTE: BS GREEN® CASE-STUDY

Maria F. Caratzu[1], Fabio Correddu[1], Mondina F. Lunesu[1], Sara Sechi[1], Andrea Massidda[2], Salvatore Mastio[2] and Giuseppe Pulina[1]

[1]Department of Agriculture Sciences, University of Sassari, Viale Italia 39a, 07100 Sassari, Italy

[2]BS Green srl, Piazza Deffenu 12, 09125, Cagliari, Italy

*Corresponding author email: mfcaratzu@uniss.it

I. INTRODUCTION

With growing consumer interest in the environmental impact of food and new EU policies, the agricultural and livestock sectors will be required to promote a more sustainable production model. In addition, the disposal of animal by-products (ABP) is an operational cost for companies in the meat supply chain and, if not well managed, can be an environmental issue. The creation of a label for the environmental certification of local production seems to be an opportunity to raise awareness of the sustainability of plant and animal products. To certify these products, it is necessary to calculate the balance between the emission of greenhouse gases and the removal of carbon dioxide within the supply chain. BS Green® has developed a strategy for the total sustainability of meat production chains, with the aim of certifying carbon neutral production and placing the disposal of ABP at the centre of the system. The BS Green® system has been placed in a circular economy and regenerative agriculture model, with the use of bio-digestion to produce effluent from ABP treatment. Organic pellets are used to offset the excess greenhouse gas (GHG) emissions from beef and lamb production, reducing the gap to reach the carbon neutrality for these products. Furthermore, to promote the valorisation of local agro-industrial co-products (AIC) in the feed industry, the heat steam produced by the BS Green® plant will provide the energy required for the drying process, allowing the storage and reuse of AIC in livestock farms (Figure 1). The aim of this work is to illustrate the engineering of the BS Green® system for sustainable agriculture as a case study. In particular, the research has been carried out with the aim of i) assessing the environmental balance of the ruminant farms involved in the BS Green® project, ii) characterising some of the AIC generated by the main local agro-industrial processes.

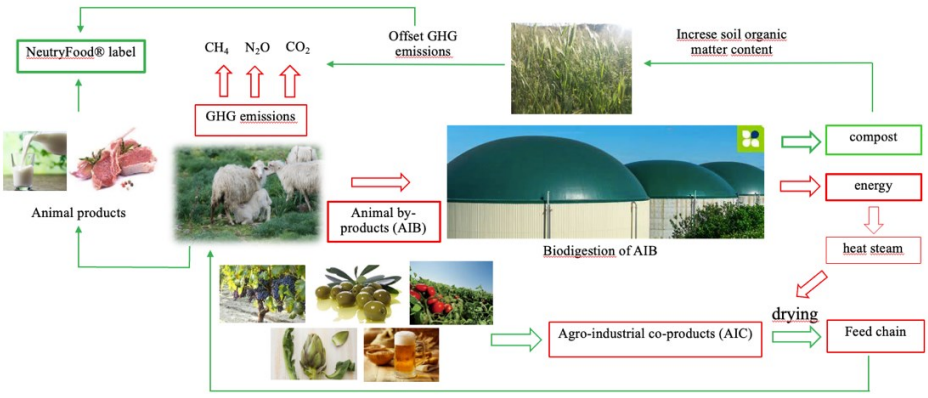

Figure 1. Schematic representation of the implemented circular economy model.

II. MATERIALS AND METHODS

The environmental performance of thirteen dairy sheep and two beef farms located in Sardinia was assessed using the carbon footprint (CFP) methodology. The IPCC [1] emissions model was used to quantify the amount of carbon dioxide equivalent (CO_2e) associated with suckling lamb and beef production. A "cradle to farm gate" system boundary was adopted, while the functional unit chosen was 1 kg live weight sold (LWS). Carbon sequestration rates available in the literature [2,3] were used to estimate

the annual CO_2 sequestered by the farms. Information on farm characteristics, flock and herd size, inputs used, purchased feed, fuel and energy use for the last 5 years (from 2016 to 2021) was obtained through direct interviews with farmers.
For the second objective, the analysis of official databases [4] and the percentage of co-products available in the literature allowed to estimate the annual amount of AIC coming from the winery, olive oil, tomato processing, artichoke and beer industries on the island of Sardinia. A literature review was carried out to assess the chemical composition of these AIC and to estimate the amount of nutrients potentially available as feed ingredients.

III. RESULTS AND DISCUSSION

Without considering the contribution of soil carbon sequestration, the average CFP of suckling lambs on the thirteen dairy sheep farms studied was 8.1 ± 1.6 CO_2e per kg LWS (mean ± SD). The CFP value is lower than that reported in the literature, which ranges from 10.8 to 51.6 kg CO_2e per kg LWS [5,6]; it should be noted that most of the studies assessed the environmental impact associated with heavy lamb production. Preliminary estimates in beef farms showed a gross GHG of 15.4 kg CO_2e per kg LWS in a cow-calf system, while the gross GHG of a closed-cycle beef farm resulted in 11.7 kg CO_2e per kg LWS for the cow-calf phase and 9.8 kg CO_2eq per kg weight gain for the finishing phase. Considering the estimated amount of carbon stored annually in the soil, all the farms studied offset their GHG emissions associated with the production of suckling lamb and beef meat. These results allowed all the farms to be certified with the NeutryFood® label, which certifies the carbon neutrality of suckling lamb and beef production.
The estimated amount of AIC produced annually was more than 18,000 tonnes (t) for grape pomace, 14,000 t for olive cake, 27,000 t for artichoke by-products, around 1,600 t for tomato pomace and more than 28,000 t for brewer's spent grains. The AIC studied had an interesting chemical composition, particularly in terms of protein and fibre content. It has been estimated that these AIC produce more than 3,000 t of crude protein per year in the Sardinia region, which can be used in animal feed, thus reducing the purchase of vegetable protein sources, with an estimated emission saving of around 20,000 t of CO_2e, taking the soybean extraction floor as a baseline.

IV. CONCLUSION

The BS Green® case study shows how agriculture and livestock farming can effectively move towards a more sustainable production model. This can be achieved by combining different aspects of sustainability involving livestock production, recovery and valorisation of agro-industrial co-products and efficient recycling of animal by-products. BS Green® is thus itself an example of a circular economy model.

ACKNOWLEDGEMENTS

This paper was elaborated with the support of a grant of the BS Green®, Anaergia group, for VERSOA project.

REFERENCES

1. IPCC, Intergovernmental Panel on Climate Change. (2019). Emissions from livestock and manure management, in: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Geneva, Switzerland, Volume 4, Chapter 10.
2. Vleeshouwers, L.M., & Verhagen, A. (2002). Carbon emission and sequestration by agricultural land use: a model study for Europe. Global Change Biology 8:519-530
3. Freibauer, A., Rounsevell, M. D. A., Smith, P., & Verhagen, J. (2004). Carbon sequestration in the agricultural soils of Europe. Geoderma 122:1-23.
4. ISTAT (2021). Istituto Nazionale di Statistica, https://www.istat.it
5. Jones, A. K., Jones, D. L., & Cross, P. (2014). The carbon footprint of lamb: Sources of variation and opportunities for mitigation. Agricultural Systems 123:97-107.
6. Edwards-Jones, G., Plassmann, K., & Harris, I. M. (2009). Carbon footprinting of lamb and beef production systems: insights from an empirical analysis of farms in Wales, UK. The Journal of Agricultural Science 147:707-719.