

The Agro-ecological Pattern of Animal Husbandry as a Sustainable Food System

Alessandro Scuderi¹, Giuseppe Timpanaro¹, Mariarita Cammarata¹, Luisa Sturiale², Claudio Bellia¹ and Vera Teresa Foti¹

¹ Department of Agriculture Food and Environment Di3A- University of Catania, Via S.Sofia 100, Catania, Italy

² Department of Civil Engineering and Architecture DICAR - University of Catania, Via S.Sofia 16, Catania, Italy

Abstract

The need to satisfy agroecological principles, in order to restore the environmental balance without neglecting the economic benefits for producers, makes the sustainability assessment of fundamental importance. The study is based on the application of Environmental and Economic indicators, developed on the basis of the SAFA methodology, to assess the state of sustainability of organic meat farming in Sicily (Italy). For the dimension related to the Environment the results were on average positive due to the growing commitment to a rational use of resources and the implementation of environmentally friendly practices, but improvements are needed to make the sector more sustainable. In the Economic Area the results were quite high due to the investments that allowed farmers to increase their economic resilience in the long term. The research demonstrates the importance of assessing production processes and the difficulties of methodological application and the detection of certain aspects of business management. In the agri-food system there are opportunities to achieve ambitious objectives, in a market with high consumer needs, where economic and environmental sustainability is increasingly strategic.

Keywords

Agroecology, livestock, environment, economics, lab meat

1. Introduction

Agricultural production, due to its contribution to climate change, exploitation of natural resources and the loss of biodiversity, needs to follow the path of sustainable development. The European Commission's aims towards a complete reduction in net emissions of greenhouse gases in 2050 in the whole Union [1]. In this context the livestock sector assumes particular relevance, if on the one hand it is considered of fundamental importance for the population's livelihood on the other hand it is the main producer of greenhouse gases (GHG). In recent decades the livestock sector has been characterised by an increase in the number of animals and production units connected with the rise in feed production and the modernisation of stables, as well as the excessive use of antibiotics and vaccines administered [2]. It is an important user of natural resources and has a significant influence on air quality, global climate, soil quality, biodiversity and water quality, altering the biogeochemical cycles of nitrogen, phosphorus and carbon, giving rise to a series of environmental conflicts [3]. In this scenario there is a strong need to affirm the application of the agroecology concept, with the primary aim of reducing the use of chemical inputs and the impact of agriculture on the environment [4]. It evolves to counter the concept of conventional agriculture based on the exploitation of resources, emphasising the context-specific nature of agroecosystem [5].

Proceedings of HAICTA 2022, September 22–25, 2022, Athens, Greece

EMAIL: alessandro.scuderi@unict.it (A. 1); giuseppe.timpanaro@unict.it (A. 2); mariarita.cammarata@phd.unict.it (A. 3);

luisa.sturiale@unict.it (A. 4); c.bellia@unict.it (A. 5); v.foti@unict.it (A. 6)

ORCID: 0000-0003-2511-6205 (A. 1); 0000-0002-0119-2644 (A. 2); 0000-0002-7507-8422 (A. 3); 0000-0002-3838-2978 (A. 4); 0000-

0003-0007-0714 (A. 5); 0000-0002-6659-752X (A. 6)

© 2022 Copyright for this paper by its authors.

Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).



CEUR Workshop Proceedings (CEUR-WS.org)

Fundamental is to educate farmers about the importance of producing in an environmentally and economically sustainable way [6], not achieving quantity over quality with the production of food surpluses as well as irreversible damage to the environment and the economic issue [7,8]. In this context the aim of the research is to provide a framework on organic livestock farming in Sicily (Southern Italy), where, especially in mountain areas, it is characterized by adult cow unit lower than normal admitted which perform important functions such as maintaining the landscape, avoiding that many areas remain uncultivated due to the impossibility to access them, and reducing the possibility of fire thanks to the feeding of grazing livestock for most of the year. For this purpose its environmental and economic sustainability is analysed in order to highlight strengths and weaknesses of the sector in this area.

2. Materials and Methods

The study is based on the identification of environmental and economic sustainability indicators in order to evaluate the livestock farms' efficiency in Sicily. On the basis of the “Sustainability Assessment of Food and Agriculture Systems” (SAFA) framework realized by the FAO [9], indicators used in the survey have been created. The cattle farms identified for this research are located in Sicily (South Italy). The sample is composed of 6 farms with a surface from 60 to 350 hectares and characterized by a family management system as this is the main activity carried out by the interviewed farmers. All farms in question follow the principles of organic farming and agroecology in relation to the characteristics of the reference territory. The topic considered in relation to the environmental dimension and the relative indicators are reported in table 1.

Table 1
Environmental indicators (*)

Environmental Indicators	
Atmosphere	Animal Welfare
Greenhouse gas emission reduction target	Practices implemented to promote the health of the animals
Practices implemented to reduce GHG emissions	Share of healthy animals
Air pollutants emission reduction target	Practices implemented to reduce the suffering and injury risk of animals
Practices implemented to reduce air pollutant	Freedom from stress
Water	Biodiversity
Target for reducing water consumption or water withdrawals	Description plan for the conservation and rehabilitation of the reference habitat
Practices implemented to increase the efficiency or reduced freshwater consumption in the operations	Practices implemented to enhance ecosystem functionality
Target to improve the water quality affected by operations	Practices implemented to protect and maintain the integrity of wild plants and animal populations
Practices implemented to reduce or prevent the release of pollutants into water	Share of the utilized area with diverse crop rotations
Soil	Materials and Energy
Practices implemented to increase soil quality and fertility	Share of renewable energy in total energy used
Share of utilized land in good conditions of soil physical structure	Practices implemented to reduce energy demand in operations

Plan to preserve soil quality and reduce soil degradation	Target to reduce the generation of waste
Conservation techniques and soil rehabilitation measures implemented	Practices implemented to reduce waste generation

(*) our elaboration on SAFA indicators

In relation to the economic area, table 2 show the thematic areas and the indicators developed.

Table 2

Economic Indicators (*)

Investment
Activities in which the company has invested over the last 5 years to improve its performance
Contribution of enterprise investments to the community's needs
Maintaining the company's profits in the long term
Business plan or up-to-date document
Revenues in the last 5 years adequate to cover expenses
Processes to determine the total costs of the products
Vulnerability
Actions to reduce the negative impact on production volume and quality standards
Product diversification
Actions to reduce the risk of input shortages
Stable business relationships
Actions implemented to consolidate and diversify income
Net cash flow in the last five years
Formal or informal financial sources
Risk management plan
Product quality and information
Hazardous pesticides
Food contamination
Share of food products complying with quality norms
Traceability system
Certified production
Local Economy
Other employees hired in the last five years
Payment of taxes
Local procurement

(*) our elaboration on SAFA indicators

The indicators were included in a questionnaire and administered to the farmers interviewed. They have been developed in the form of open-ended questions and each answer received has been given a score ranging from high too low to which corresponds a numerical value [10]. The SAFA framework also provides for the attribution of a score expressed as "high", "good", "moderate", "limited" and "low" [11]. To each of them the researchers have attributed a numerical value, according to the Likert scale, specifically, the "high" score corresponds to the value 5, the "good" to the value 4, the "moderate" to the value 3, the "limited" to the value 2 and the "low" to the value 1, therefore we pass from 5 to 1 when the answer indicates a worse result. After assigning a score for each of the indicators analysed, the average value of the farms surveyed was calculated and represented in the following bar graphs. Each farm, indicated by alphabet letters, represent an agroecological peculiarity (table 3) that does not mean they have reached the maximum level of sustainability, all of them can still be improved from many points of view. However, they represent a starting point and a model for other live-stock farms. All of them are characterized by a livestock unit (LU) of less than 1. The reasoned and stratified choice

of the farms under investigation was made in order to identify 6 livestock farms expression of the different models present in the territory. The selection of the sample was initially made considering 20 farms, located in Sicily and more specifically in the province of Enna, but not all of them provided reliable data for the study and therefore still under review. The data obtained by the farms excluded from the sample, once revised and made coherent, will be used for future studies in which the analysis will be upgraded.

Table 3
Characteristics of livestock farms (*)

Denomination	Surface (ha)	No. of animals	LU	Agroecological characteristic
A	87	35	0.4	Self-production of all livestock feedstuffs
B	150	35	0.2	Environmental-friendly crop management
C	350	285	0.8	Use of renewable energy
D	80	50	0.6	Slow growth in the natural environment
E	100	35	0.4	Correct water management
F	60	41	0.7	Circular economy and recycling of materials

(*) our elaboration

3. Results and Discussion

The survey carried out in order to assess the environmental and economic sustainability of livestock farms in Sicily gave the following results, summarised in Figures 1 and 2. The first one shows the results for the environmental dimension, within which in the atmosphere topic the results obtained by the companies are average with good opportunities for improvement. They do not have written plans to communicate to stakeholders, but their commitment translates into the implementation of eco-sustainable practices, proper management of solid and liquid manure, land control activities to avoid the risk of fires and the application of minimum processing. The same result can be observed in the water theme, in which farmers commit to implementing practices that do not allow the waste of this resource, such as the cultivation of species that do not require irrigation and the correct management of water inside the cattle sheds. In the soil topic, the results are positive and tending towards the maximum value. Farmers implement the controlled application of organic fertilizers to improve nutrient deficiencies, reduction of tillage and cultivation of nitrogen-fixing crops. They pay a lot of attention to soil management and they declared that the land is in excellent condition without signs of compaction and degradation, due to soil conservation and improvement practices. Another topic in which the results are very high is the Animal Welfare. Farmers are committed to reduce the use of veterinary medicines and to ensuring the satisfaction of all animals' needs. The 100% of the animals are in good health, they are supported in their normal needs and sources of stress are reduced e.g. for the slaughterhouse places are chosen near the farm so that the journey is short and all animal transport regulations are respected. Biodiversity is another topic considered within the environmental indicators. In this context the results are lower than the average value, which means that farms are not very careful about maintaining biodiversity, so a process of awareness-raising and improvement is necessary. They only commit to crop rotations. The same results are reported in materials and energy topics. Only one farm uses renewable energy therefore the need for improvements is underlined. The farm's practices for reducing energy use concern the cleaning of stables and the feeding of livestock when it is not grazing, but a particular commitment to reduce energy effort and waste reduction was not reported by any of the interviewed farmers.

Another important dimension of sustainability is the economic area (Fig. 2). The first topic refers to the investments made by farm to extend sustainability, for example the use of human resources or funds provided by agricultural policies. In this context, the results are positive and higher than the average value. Farmers are creating a relationship between the activities and the enterprise's investment. In general, all the companies analysed refer to other activities in the territory for the supply of inputs not produced directly. All interviewed made investments to improve financial and natural capital in the

long term, such as the purchase of new land or the modernisation of machinery to improve production performance and reduce pollution. All livestock farms have a business plan drawn up with the help of professional figures and they declared to have a positive net profit demonstrating the farms' profitability and financial sustainability over time. Moving on to the vulnerability area, all farms have obtained a high score as they are able to guarantee the production quantity and quality by reducing the risks that could threaten the production process. Farmers, in addition to meat production, also deal with cereal and forage production through the practice of crop rotations to diversify their activities. All the interviewed declared to have stable relationships always with the same suppliers, with the exception of one farms, because it was sometimes forced to find inputs in companies other than the usual ones because the latter were not able to supply it. All stated that the level of liquidity to meet the farm's financial commitments over the last 5 years is very positive, and they are able to obtain loans both formal (from banks or credit institutions) and informal (from families or friends) to face difficult situations or to improve production performance. The ability of enterprises to cope with internal and external risks was also reported, so the company can implement action plans to reduce the negative effects, such as the creation of farm roads that can be used in the event of flooding or the necessary fire prevention measures in crops. The area of interest “Product quality and information” obtained high scores. All farms have declared the non-use of pesticides, no one has contaminated products, and all the products produced are in conformity with the regulations. All interviewed uses the traceability system and certification bodies that periodically carry out checks in the farms. The last topic in the economic area is “Local Economy”. This refers to the use of local workforce in production process, in which farmers have a low commitment, because they are family businesses and rarely use seasonal workforce. The results are more positive in other indicators, in fact they regularly pay all taxes and all inputs are found in the pertinent territory.

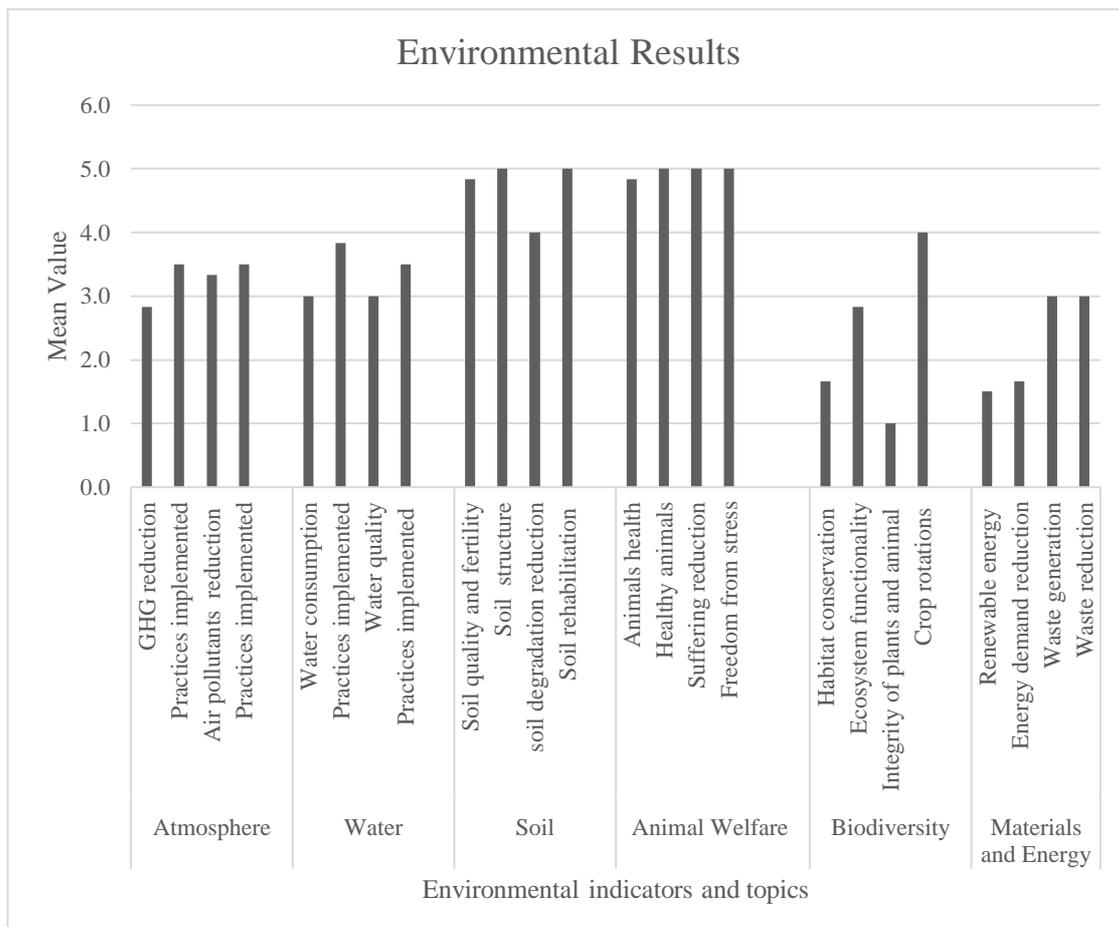


Figure 1: Results of the environmental sustainability assessment in livestock farms

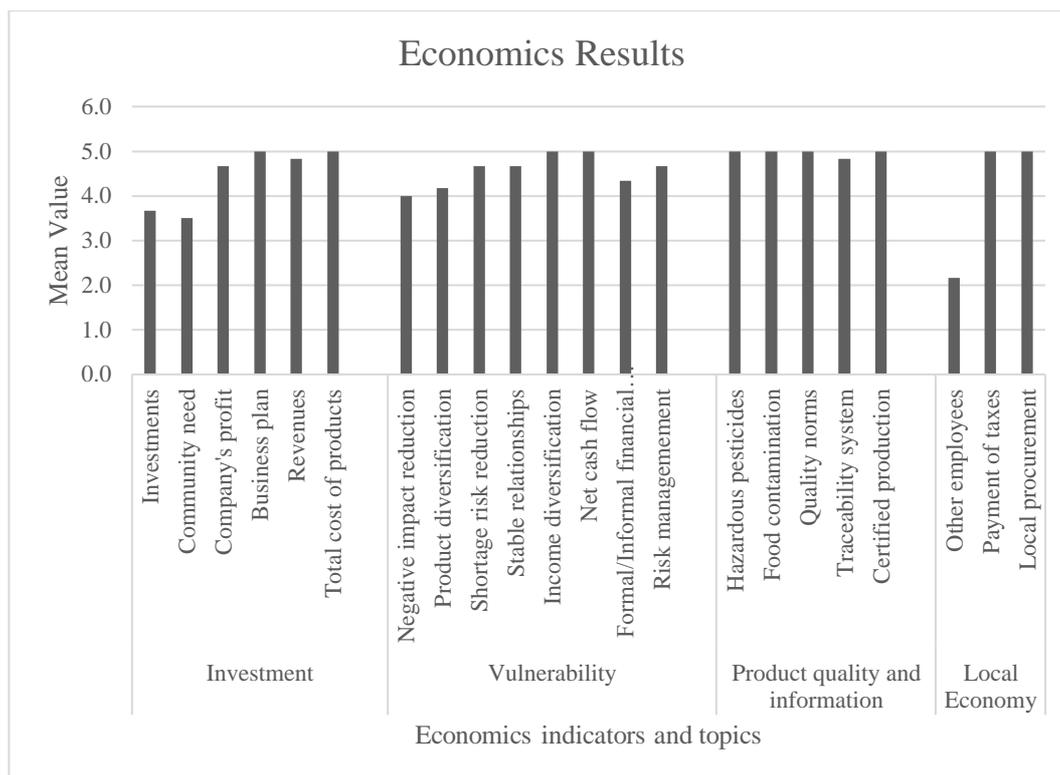


Figure 2: Results of the economic sustainability assessment in livestock farms

The results of the sustainability levels suggest that the peculiarities presented by the analysed farms can be the key to achieve an environmentally and economically sustainable livestock farming. Agroecological principles, supported by organic farming, aim to improve production and ecological performance. Sicily lends itself to sustainable farming and this is the message we want to disseminate in order to increase the number of farms that follow the principles of agroecology.

4. Conclusions

Respect for ecosystem balance, ensuring the product's quality, the health of the consumer and of the animals reared, as well as guaranteeing an adequate income for the producer, are aspects that need to enter into synergy to ensure a sustainable livestock farming system. Significant improvements in both the environmental and economic spheres can only be made by respecting the principles of organic farming and agroecology. The study highlights the strengths and weaknesses of organic livestock farms in Sicily. Regarding the environmental aspect, farms certainly still need to concentrate their efforts to achieve significant sustainability levels, especially for biodiversity, use of renewable energy sources and the reduction of waste produced during production process. On the other hand, very positive results have been achieved in the economic area thanks to the commitment of farmers to use the EU agricultural policy aid by increasing investment in the sector. In conclusion, it is possible to affirm that in spite of the numerous improvements that the Sicilian livestock sector still needs, an elected model of sustainability is certainly beginning to emerge for the companies operating in Sicily.

5. Acknowledgements

This research was funded from the research project “Sostenibilità economica, ambientale e sociale del sistema agroalimentare del mediterraneo”, Principal investigator Prof. Claudio Bellia funded by PIAno di inCENTivi per la Ricerca di Ateneo (PIACERI) UNICT 2020/22 line 2, UPB: 5A722192154, University of Catania.

6. References

- [1] European Commission. Communication No. 640. (2019). The European Green Deal. Brussels, Belgium, 2019.
- [2] N. Ramankutty, Z. Mehrabi, K. Waha, L. Jarvis, C. Kremen, M. Herrero, L.H. Rieseberg. "Trends in global agricultural land use: implications for environmental health and food security". *Annual Review of Plant Biology* (2018): 69:789–815.
- [3] A. Leip, G. Billen, J. Garnier, B. Grizzetti, L. Lassalet, S. Reis, D. Simpson, M. Sutton, W. de Vries, F. Weiss. "Impacts of European livestock production: nitrogen, sulphur, phosphorus and greenhouse gas emissions, land-use, water eutrophication and biodiversity". *Environmental Research Letters* (2015): 10:115004.
- [4] M. Altieri. "The ecological role of biodiversity in agroecosystems". *Agriculture, Ecosystems & Environment* (1999): 74:19-31.
- [5] N. Clay, T. Garnett, J. Lorimer. "Dairy intensification: Drivers, impacts and alternatives". *Ambio* (2019):49:35–48.
- [6] L. Sturiale, A. Scuderi, G. Timpanaro, B. Matarazzo. "Sustainable use and conservation of the environmental resources of the Etna park (unesco heritage): Evaluation model supporting sustainable local development strategies". *Sustainability* (2020): 12: 1–16.
- [7] P. Guarnaccia, S. Zingale, A. Scuderi, E. Gori, V. Santiglia, G. Timpanaro. "Proposal of a Bioregional Strategic Framework for a Sustainable Food System in Sicily". *Agronomy* (2020):10: 1546.
- [8] A. Scuderi, C. Bellia, V.T. Foti, L. Sturiale, G. Timpanaro. "Evaluation of consumers' purchasing process for organic food products". *AIMS Agriculture and Food* (2019): 4:251-265.
- [9] Food and Agriculture Organization of the United Nations (FAO). Sustainability Assessment of Food and Agriculture Systems: SAFA Guidelines, Version 3.0; Food and Agriculture Organization of the United Nations: Rome, Italy, 2013. Available online: http://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/SAFA_Guidelines_Version_3.0 (accessed on 5 December 2020).
- [10] V.T. Foti, A. Scuderi, G. Timpanaro. "The economy of the common good: The expression of a new sustainable economic model". *Quality - Access to Success* (2017):18:206-214.
- [11] M. Cammarata, G. Timpanaro, A. Scuderi. "Assessing sustainability of organic livestock farming in Sicily: A case study using the FAO Safa framework". *Agriculture* (2021): 11: 274.