Management the new innovation source of energy biogas: a project spider case study

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Abstract: This study aims to analyse the impact of agricultural waste on the environment and its use for energy production. Thanks to the help of R&D biogas plants, it is possible to produce thermal energy, electricity and biological compost, which can be used for the cultivation of agricultural areas. This study aims to represent what the situation is following the installation of a network of biogas plants 'C.d. Project Spider' and the benefits that the environment would derive from it. For this research, two brands have been designed: 'BioMoz' and 'For Nature For Earth For You'. The company using these brands must meet established standards to demonstrate the low environmental impact of the finished product, the production of thermal and electrical energy, and the consequent production of organic fertiliser at the end of the process; thereby fully developing the concept of a circular economy.

Keywords: innovation; R&D; biogas; agricultural waste; energy; managerial innovation environmental; renewable energy; livestock manure; fertiliser.

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Biographical notes: Luca Esposito holds a Master's degree in Economics and Environmental Administration from the University of Salerno, with a thesis on technological innovation and sustainable development, entitled *Energy and Climate: The Challenge of the Future*. In 2019, he graduated in international Relations with a thesis in geography and environmental policy entitled *Renewable Energy: Energy of the Sea*. In 2021, he won the call 'Transitions', 'Remote Future' announced by Città Della Scienza (Naples, Italy) and then he took a postgraduate course in sustainability management and green finance. His interest in the themes of sustainability and the circular economy led him to organize a conference with the University of Salerno, entitled: *The new Energy Front in the European Context*.

1 Introduction

This study aims to analyse the impact of agricultural waste on the environment and its use for energy production. Such waste, which is very harmful to the environment, can become a valuable resource. In fact, thanks to the help of biogas plants, it is possible to produce thermal energy, electricity and biological compost, which can be used for the cultivation of agricultural areas. Starting from the tastes of consumers, statistical surveys

have been conducted, aimed at monitoring their choices and their point of view, analysing them from various points of view. This study aims to represent what the situation is following the installation of a network of biogas plants 'C.d. Project Spider' and the benefits that the environment would derive from it.

For this research, two brands have been designed: 'BioMoz' and 'For Nature For Earth For You'. The company using these brands must meet established standards to demonstrate the low environmental impact of the finished product. The contribution that this article will tend to make to existing literature is twofold on the one hand, to provide energy projections on the Project Spider model, examining the benefits that the environment would derive from it, and to evaluate through a survey conducted on a sample of people living in the Province of Salerno the importance of two structured brands to meet the needs of companies and consumers.

2 Literature review

In recent years, technological innovation has allowed the development of strategic operations aimed at improving industrial processes and reducing environmental impact. Since the first industrial revolution, we have seen how technological innovation improves people's lives; in fact, it is able to significantly influence the economic growth of countries, with the consequent increase in consumption and productivity. Technological innovation generates growth and facilitation of trade, it is advisable for the various actors to be linked together, in order to create an exchange of knowledge and facilitate the development of technological innovation (Anyigba et al., 2019). The research, proposed below, highlights the evolution of the concept of innovation. Some studies distinguish four types of innovation: process innovation, service innovation, strategic innovation and managerial innovation (Hamel and Breen, 2007). In the 1960s, the concept of 'administrative innovation' or 'organisational innovation' was introduced to enable proper personnel management and administrative planning [Evan and Damanpour, (1984), p.51]. Subsequently, 'managerial innovation' was introduced, revolutionising standard industrial process patterns and identifying itself as a tool to ensure competitiveness and monitor future business events, marked by a strong margin of unpredictability (Frédéric et al., 2013).

Managerial innovation, in fact, has as its main objective to improve performance, in terms of effectiveness and efficiency of a company (Birkinshaw et al., 2008). According to these scholars, such innovations are more difficult to trace, as they are more 'tacit', than technological innovations. In the 21st century, the relationship between the entrepreneur and the environment became increasingly marked, the new forms of corporate social responsibility, aimed at harmonising the relationship between the environment and the company, the need to create certification marks with the aim of implementing competitiveness and encouraging companies to align themselves with standards aimed at guaranteeing cutting-edge industrial processes. The entrepreneur defined as the buyer of unquantifiable risks (Knight, 1921), is forced to stand at the pace of a fast-paced society is the one who absorbs the risk of being a self-employed worker, who must guarantee business innovation processes, a fundamental element to allow the growth and survival of organisations (Damanpour and Gopalakrishnan, 2001). The entrepreneur himself takes on the role of innovator and social agent of change (Barth, 1967), and by harnessing the power of technological innovation, he can open up new

landscapes and consequently generate employment and economic development, become competitive in the market, producing new cutting-edge products. It is inevitable that entrepreneurial activity will be accompanied by strong political impulses. R&D activity in Italy is discreet. Studies conducted by ISTAT (National Institute of Statistics, Italy) show that R&D spending in 2020 fell by –4.7%, mainly due to the domino effect of COVID-19. Already in 2018, there was a sharp decline in the participation of universities in R&D, while small and medium-sized enterprises and Made in Italy seem to offer better results. Recent studies show that Russia has heavily invested in R&D in recent years in order to carry out a transition process to achieve the country's development (Aldieri et al., 2018).

Just think of the Megascience Programme, which aims to build important infrastructure on Russian territory. It is interesting to observe the trend of the fallout from knowledge (Griliches, 1979). An analysis using spatial econometric techniques shows that innovation has achieved more in smaller regions and that positive external flows have occurred in neighbouring areas (Aldieri et al., 2018).

As we have examined earlier, the entrepreneur must also play a leading role. Leadership, identified as an innate endowment, capable of influencing subordinates and developing new innovations and organisational models (Johne and Harbone, 2003). Organisational learning itself plays a fundamental role, many studies show that the combination of learning and innovation is strongly positive (Calantone et al., 2002; Tushman and Nadler, 1986). In addition to the leadership role, another key piece to enable the implementation of innovative processes in the various industrial sectors and generate innovation is the sharing of knowledge between employees, entrepreneurs and specialists (Bartol and Srivastava, 2002). A study documents various mechanisms to implement knowledge sharing, including encouraging teamwork by incentivising the team with rewards, in order to be inclined to use their knowledge as a tool to achieve the result (Bartol and Srivastava, 2002).

Some studies carried out by the University Dubai, UAE Murdoch University, Dubai, Hamdan Bin Mohammad Smart University, Dubai, UAE 'Faculty of Marketing', Symbiosis School of Banking and Finance, Symbiosis International University, Pune, Maharashtra India, investigated how a public institution can successfully assist relationships with companies, partners in order to allow technological innovation.

The research conducted was carried out thanks to a series of interviews administered to employees of the Dubai Corporation for Ambulance Service, the study highlights how DCAS has created 'an ecosystem of innovations', aimed at creating value (Parahoo et al., 2020).

3 Data and methodology

The mission of this study is to analyse the environmental impact of livestock waste produced by buffalo and cattle farms, present in the Province of Salerno (Campania) and to outline a disposal process through the help of biogas plants. Through these systems, it is possible to produce thermal energy, electricity and biological compost, to be used to feed the farms themselves and the camps. The concept of circular economy is completely absorbed. In order to observe a decrease in the CO_2, N_2 and methane emission curve, large-scale statistical projections must be performed in order to monitor energy performance. Project Spider is a solution aimed at the capillary installation of pilot plants

in biogas, in order to involve the various managers of farms in this project. In the area under consideration, the data were provided by the Campania Region and some studies conducted by the Experimental Zooprophylactic Institute of Teramo. All data presented will be expressed in the reference unit, which is cubic metres. The total amount of sewage produced is approximately 240,600 m^3 (IZS Teramo).

Since it is established that 1 m^3 of sewage produces 10–15 m^3 of biogas, and considering that taking into account the variable MIN biogas, approximately 18 kWh are produced, whereas considering the variable MAX biogas approximately 27 kWh are produced, two important results have been obtained, through the mathematical proportions that will be proposed below:

liq_{tot} total sewage

$b_{\min}$ minimum biogas yield

liq_{rif} reference sewage

b_{rif} reference biogas.

$$liq_{tot} : b_{\min} = liq_{rif} : b_{rif}$$

$$b_{\min} = \frac{liq_{tot} \times b_{rif}}{liq_{rif}}$$

$$b_{\min} = 2,406,000 \text{ m}^3$$

$$kWh_{\min} = 4,330,800 \text{ kWh}$$

liq_{tot} total sewage

$b_{\max}$ maximum biogas yield

liq_{rif} reference sewage

b_{rif} reference biogas

$$liq_{tot} : b_{\max} = liq_{rif} : b_{rif}$$

$$b_{\max} = \frac{liq_{tot} \times b_{rif}}{liq_{rif}}$$

$$b_{\max} = 3,609,000 \text{ m}^3$$

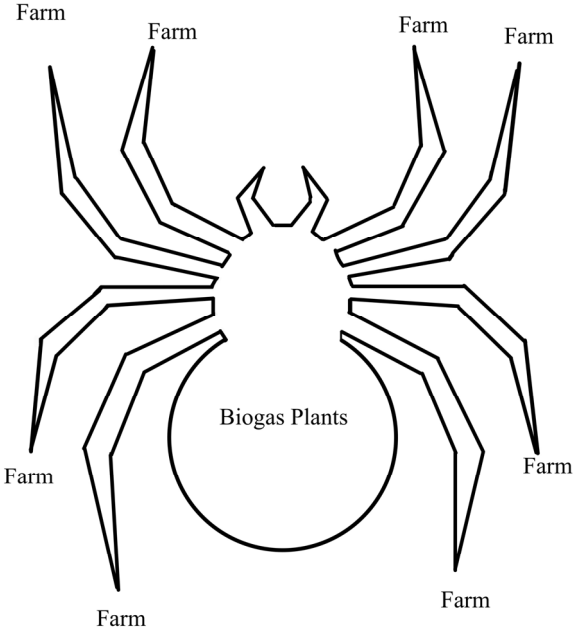
$$kWh_{\max} = 6,496,200 \text{ kWh}$$

As you can see from the results, the energy supply structured through the creation of a Project Spider model, is very large, to the point that it is necessary to insert a part into the national electricity network.

The disposal of waste from biogas plants, for the purposes of energy production, has not received criticism from the environmental aisle, unlike biogas plants fed through particular types of wood, such as algae, corn, wheat, which, when subjected to a certain production cycle, produce biofuels. Some studies show that the use of certain types of cereals generates food shortages, creating chaos and conflict (Pimentel et al., 2019). That is why we need to generate energy from waste that becomes a huge potential for exploiting unusable waste. While the aim was to observe the development of energy production and the consequent environmental impact, the development of the demand curve should be analysed as well. Absorbing the processed data, a questionnaire has been

constructed structured in such a way as to examine the tastes of consumers and their reaction, in the presence of two brands 'Biomoz' and 'For Nature For Earth For You'. Dairy companies that manage their energy needs, through the energy produced exclusively by biogas plants, can obtain Biomoz certification. These certifications tend to outline the environmental process of the finished product (LCA), taking into account the entire production cycle, from the extraction of raw materials to the packaged product. Through the use of brands, it is possible to enhance the company and make it competitive on foreign markets, with a different business card, as it goes to identify a product that comes from a given company and that has specific characteristics to enhance and protect excellence. Modern biogas technologies allow to produce large quantities of organic compost, which can be used by the agricultural supply chain, especially in the production of products classified in GAMMA IV (salad, arugula, lettuce, etc.) that are consumed without preventive cooking. Some farms decide to allocate a part of their crop through organic compost, organic fertiliser and vermicompost, which is obtained through the breeding of 'families' of earthworms on treated wastewater. These biofertilisers, enjoy some important features, including defending the roots of plants and ensure the regeneration of the cultivated land. The company that uses this method can use the For Nature For Earth For You brand. From a three-dimensional perspective, the use of compost is beneficial to nature, the land and consumers.

Figure 1 Spider project model structure



Informing the consumer about what they are buying is a key element. The data that will be presented are the result of a questionnaire, administered to a sample of about 100 people residing in the Province of Salerno, aged between 17 and 60 years. The sampling was structured through a hypothetical-inductive methodology through which this methodology, we have previously determined the variables surveyed, preferring those that would have allowed to represent an exhaustive picture. We present each

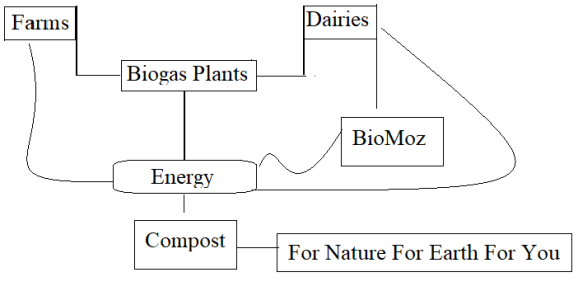
observation in percentage terms, in order to clearly represent the analysis carried out. Our analysis examines the topic of discussion, namely the trend of the purchase of organic products. The result was decidedly positive, in fact, about 93% of respondents said they preferred the purchase of organic products, while only 7% said they had not bought them. From the each of respondents, almost 40% said that they did not observe the presence of the brands testify how to drink. In addition, the respondents are unaware of the environmental impact of certain food products it consumes. Recent studies conducted by Oxford University testify to how to drink a glass of milk a day for 365 days, can pollute as much as a burning car for 941 km (Poore and Nemecek. 2018).

To confirm the importance of brands, the majority of respondents say they recognise the brand's product on packaging and only a small part, from the specialised store, still not present in our territory, confirming how the impact of Italian policy is still too slow and unable to guarantee guidelines to implement innovation processes and inform the public. The creation of the two pilot brands, aimed at certifying the purchase of a 100% organic product, was welcomed by most respondents.

The results obtained are the following, are in favour of the introduction of the brand For Nature For Earth For You, 82% of respondents, while for the introduction of the brand Biomoz the favourable are 84.9%.

The pearl of the south, known all over the world, for its unique and unmistakable flavour, already equipped with the PDO certification 'protected designation of origin product', could acquire the brand designed in this study: 'Biomoz', aimed at certifying that buffalo mozzarella has been produced at zero CO_2 emissions.

Figure 2 Cycle of the disposal process, materials obtained and brands that can be used by the production chain



The dairy, in fact, through underground pipes and electric vehicles, transports the serum to the nearby plant, which transforms it into clean energy, ready to be retransmitted. This brand could be introduced experimentally in Piana del Sele (Salerno, Italy) in order to verify the market trend. From the point of view of cost-benefit analysis, it is inevitable that, consumers, agricultural managers, and biogas plants will be involved. They all have their share of profit, including the environment. The analysis carried out shows that only 56% are aware of the impact that the production of dairy products has on the environment, in a country where about 23 kg of cheese per capita is consumed, ranking among the largest producers of PDO cheeses (Central Food Milk Lendirana, Rovigo, Italy).

The second brand certifies the products of the agricultural supply chain, grown through the use of organic compost, compost worms and biofertiliser, all obtained following the anaerobic digestion process.

In Campania, the so-called Fertisele is born which with the collaboration of local companies operating in the sector, proceeds to experiment with products of the fourth range, with results beyond expectations, aimed at studying soil fertility, their regeneration, waste disposal and its beneficial impact on the agri-food sector.

4 Discussion

The production of green energy, coming from biogas plants, has the potential to be one of the elements to break down the wall towards the energy and ecological transition.

The installation costs are not excessive, but the performance is extraordinary, ranking among the plants with the widest range of GHG, greenhouse gas reductions.

In recent years, there has been a parallel increase in crops for energy production, so-called energy crops, although the primary objective should be to produce energy from waste.

An example of this is the Waste to Fuel Project by Nation Hydrocarbon Corporation (ENI) Joint Stock Company S.P.A., which, although experimentally, has the potential to produce biofuels from waste.

Another interesting research, aims to analyse the potential of biogas in Brazil, examining both the disposal of vinaccia (alcohol) and slurry, the analysis shows how the energy needs that can be met are both 1.05%–1.13% (Salomon and Lora, 2009).

5 Limitations of the study and future directions

Each research project has its limits.

The construction of biogas plants has been very successful in recent years, the sphere inherent in the disposal of waste water through such plants, in order to produce thermal energy, electricity and compost, until a few years ago, was an unexplored island.

All pollution data are not easy to study, as they are characterised by a large fluctuation in technical data. In the following study, the limits are methodological in nature, since the sample of subjects available to respond to the survey is 105. It would be interesting to deepen this research using a larger sample of respondents, this is essential in order to make a more complete and reliable statistical measurement, in order to consider the sample as representative. Although progress has been made in this area, there is still a shortage of facilities available to allow waste water disposal. We are acting – as if the whole thing was still in the experimental phase, but this phase has already been outdated for years, now we have to implement it. The widespread installation of biogas plants (so-called Project Spider) can take place, only after the implementation of state incentives, aimed at promoting training and training programs for professionals. It is also important to act in R&D by ensuring continuity of funding for young researchers, in order to study the agro-energy supply chain of biogas, and the impacts of wastewater on the environment and groundwater, acting in this way would inevitably generate employment and progress. With the exception of the few institutional sources, there is a lack of data to research the impaction the environment, such data are often incomplete or unavailable.

Through research, databases could be created to analyse the feasibility of such large-scale processes. Part of the study should inevitably be devoted to the agrifood supply chain.

Protecting the soil is a priority for everyone, implementing new forms of sustainability thanks to the help of technological innovation, favouring forms of regenerative agriculture, so as not to impoverish the subsoil; modifying agricultural techniques, can be fundamental elements to rewrite different scenarios.

It would be advisable to involve farmers, milk producers and consumers themselves in order to create a flow of knowledge and ensure the development and implementation of a technology of the type C.d. Project Spider. We were able to examine how the strengths of biogas plants are manifold, the same installation takes place quickly and does not involve exploiting the soil area for installation.

The aim is to 'repair' and design a sustainable future.

Table 1 Authors of the articles cited in this publication

Year	*Author*
1921	Knight, F.
1967	Barth, F.
1979	Griliches, Z.
1984	Evan, W.M. and Damanpour, F.
1986	Tushman, M.L. et al.
2001	Damanpour, F. and and Gopalakrishnan, S.
2002	Calantone, R.J. et al.
2002	Bartol, K.M. and Srivastava, A.
2003	Johne, A. and Harborne, P.
2005	Dana, L.P. and Dana, T.E.
2007	Aragon-Correa, J.A. et al.
2007	Hamel, G. and Breen, B.
2008	Birkinshaw, J. et al.
2009	Salomon, K.R. and Lora, E.E.S.
2009	Pimentel, D. et al.
2013	Jaouen, A. and Le Roy, F.
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