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**REVISTA**
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# BIODIGESTÃO ANAERÓBIA, BIOGÁS E BIOFERTILIZANTES COMO FERRAMENTAS DE EDUCAÇÃO AMBIENTAL E SUSTENTABILIDADE EM PEQUENAS PROPRIEDADES RURAIS

## Anaerobic biodigestion, biogas and biofertilizers as tools for environmental education and sustainability in small rural properties

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**RESUMEN**

Este artículo analiza, a través de una revisión descriptiva de la literatura, las contribuciones de la biodigestión anaeróbica, el biogás y los biofertilizantes a la sostenibilidad en pequeñas propiedades rurales y a las prácticas de educación ambiental. El problema investigado está relacionado con la gestión inadecuada de residuos orgánicos agrícolas y domésticos, a menudo asociada con la contaminación ambiental, las emisiones de gases de efecto invernadero y los residuos de nutrientes. La metodología se basó en búsquedas realizadas por estudiantes becarios en Google Scholar y en repositorios institucionales, registrada en formato electrónico y organizada en una hoja de cálculo para componer el corpus inicial de la revisión. La discusión muestra que los biodigestores transforman los residuos en recursos útiles, produciendo energía renovable y fertilizantes orgánicos, además de dialogar con la economía circular. Los resultados indican que los mini-biodigestores pueden actuar como herramientas pedagógicas en escuelas y comunidades rurales, acercando la ciencia, la sostenibilidad y el protagonismo estudiantil.

**Palabras clave:** Biodigestores. Biogás. Biofertilizantes. Educación ambiental. Sostenibilidad rural.

***ABSTRACT***

*This article analyzes, through a descriptive bibliographic review, the contributions of anaerobic digestion, biogas and biofertilizers to sustainability in small rural properties and to environmental education practices. The research problem is related to the inadequate management of organic agricultural and domestic waste, often associated with environmental contamination, greenhouse gas emissions and nutrient waste. The methodology was based on searches carried out by scholarship students in Google Scholar and institutional repositories, registered in an electronic form and organized in a spreadsheet to compose the initial review corpus. The discussion shows that biodigesters transform waste into useful resources, producing renewable energy and organic fertilizer, while also supporting circular economy principles. The results indicate that mini-biodigesters can act as pedagogical tools in schools and rural communities, connecting science, sustainability and student protagonism.*

***Keywords:*** *Biodigesters. Biogas. Biofertilizers. Environmental education. Rural sustainability.*

## INTRODUCTION

The generation of organic waste arising from agricultural, domestic and agro-industrial activities represents one of the main environmental challenges associated with rural areas. On small farms, such waste is often composed of food scraps, animal manure, plant residues, domestic effluents and agricultural by-products. When not properly treated, these materials may contribute to soil and water contamination, greenhouse gas emissions, the proliferation of disease vectors, and the loss of nutrients that could otherwise be returned to productive systems. In this context, the literature reviewed indicates that the management of organic waste should not be understood solely as a sanitary or environmental issue, but also as an opportunity for energy recovery, agricultural reuse and educational development.

Among the technologies discussed in the reviewed studies, biodigesters emerge as a relevant alternative for the treatment of organic waste and the promotion of rural sustainability. Anaerobic digestion consists of the breakdown of organic matter by microorganisms in the absence of oxygen, a process that occurs through successive stages such as hydrolysis, acidogenesis, acetogenesis and methanogenesis. As a result, two main products are generated: biogas, composed primarily of methane and carbon dioxide, and biofertilizer, a stabilized residue with potential agricultural applications. Carvalho (2021) highlights that the performance of anaerobic digestion depends on operational factors such as temperature, pH, carbon-to-nitrogen ratio, type of biomass and reactor conditions, indicating that the efficiency of the process requires appropriate technical monitoring.

Biogas is presented in the articles as a renewable energy source capable of transforming organic waste into an energy resource. Its use may include electricity generation, heat production, cooking gas, vehicle fuel or, after purification, biomethane. Nascimento et al. (2019) demonstrate that the utilization of biogas generated from the decomposition of organic matter contributes to reducing methane and carbon dioxide emissions into the atmosphere, although it remains underexplored in Brazil. Carvalho (2021) also reinforces that biogas enables the conversion of an environmental liability into an energy product, adding value to organic waste and reducing dependence on fossil fuels.

In addition to biogas, biofertilizers constitute another important product of biodigestion and waste reuse. Studies on swine wastewater indicate that its agricultural use can supply nutrients to the soil, reduce the improper disposal of effluents and partially replace conventional fertilizers. Arantes (2020) points out that the use of wastewater in agriculture makes it possible to utilize waste for fertilization purposes, reducing costs and avoiding negative effects associated with improper disposal, such as the pollution of water bodies, groundwater contamination and eutrophication processes. At the same time, the author emphasizes that this application requires prior analysis and monitoring, particularly regarding the concentration of heavy metals and the risk of nutrient accumulation in the soil.

The studies converge in recognizing that biodigesters, biogas and biofertilizers are part of a circular economy approach, in which waste is no longer treated merely as refuse but is instead understood as an input for new productive processes. Lima, Leitão and Silva (2021) discuss the circular economy as an alternative to the linear model of "produce, use and dispose", highlighting practices aimed at reducing waste, optimizing resources and reusing materials within productive systems. Similarly, Mira and Mira (2025) relate the production of bioenergy, the use of biofertilizers and the reuse of organic waste to the principles of Green Chemistry and sustainable agriculture, indicating that these technologies can reduce environmental impacts and create new productive opportunities.

Despite this convergence, the articles also present important differences regarding focus and scale of analysis. Some studies address biogas within an urban context, particularly in sanitary landfills and municipal solid waste management, emphasizing electricity generation and emission reduction. Others focus on agricultural and livestock realities, especially pig farming, dealing with waste management, biofertilizer production and the reduction of environmental impacts in rural systems. There are also studies that broaden the discussion to new biotechnological possibilities, such as the use of microalgae as biofertilizers, highlighting promising potential but also the need for greater methodological standardization, dosage optimization and the expansion of applied research. Paris (2025), for example, indicates that microalgae may contribute to sustainable agriculture, but their large-scale adoption depends on technological advances, incentives and broader scientific dissemination.

Thus, the review of the studies demonstrates that biodigesters possess environmental, economic, social and educational relevance. Environmentally, they contribute to waste treatment, emission reduction and lower soil and water contamination. Economically, they enable energy generation, reduce fertilizer costs and improve the use of resources available on the farm. Socially and pedagogically, especially in schools and rural communities, mini-biodigesters can function as environmental education tools, allowing students to practically understand the cycles of organic matter, renewable energy production, waste reuse and the importance of sustainability in rural areas. Therefore, this study seeks to analyze, through a descriptive literature review, how anaerobic digestion and products can contribute to the sustainability of small rural properties and to environmental education practices in rural communities.

## METHODOLOGY

This study is characterized as a descriptive bibliographic review with a qualitative approach, aimed at analyzing studies on anaerobic digestion, biodigesters, biogas, biofertilizers, rural sustainability and environmental education. The choice of a descriptive review is justified by the objective of gathering, organizing and interpreting information available in the literature, without the intention of conducting a systematic review with a rigid protocol, while maintaining thematic coherence, critical reading and articulation among the analyzed studies.

The development of the article was based on the results of bibliographic research carried out by scholarship students within the project *Mini Biodigesters: Empowering Young People for a More Sustainable World*, linked to the public call *FUNDECT CALL No. 14/2024 – PICTEC MS – Edition 4*. To guide this stage, an electronic form was created using Google Forms, which served as an instrument for cataloguing and recording the searches. The students conducted searches on Google Scholar and institutional repositories, recording in the form information such as the researcher's name, date of completion, article theme, title, year of publication, authors, type of source, objective of the study, main concepts, possible application within the mini-biodigester project, access link and justification for inclusion.

The responses recorded in the form were exported to a spreadsheet and used as the initial corpus of the review. This procedure had a dual purpose: to support the production of the article and to promote, among the scholarship students, practical learning regarding bibliographic surveys, source selection, scientific reading and reference organization. After organizing the records, the materials were checked and selected according to their relevance to the study's main themes: biodigester operation, biogas production, application of biofertilizers, organic waste management, pig farming, circular economy, sustainability in small rural properties and environmental education.

Scientific articles, undergraduate dissertations, master's dissertations, technical documents and bibliographic reviews related to the subject were considered. The selection prioritized studies with accessible full texts, identified authorship, direct relevance to the research objectives and contribution to answering the guiding question: how can the use of biodigesters contribute to rural sustainability and environmental education in rural communities? This organization is aligned with procedures commonly used in descriptive and qualitative bibliographic reviews, aimed at the collection, selection, analysis and synthesis of scientific and academic information on a given topic (SOUZA, 2025; MIRA; MIRA, 2025).

Following the selection of the materials, exploratory and analytical reading was carried out, identifying the objectives, methodologies, results, conclusions and contributions of each study. The information was organized into a comparative framework and subsequently analysed in an interpretative and descriptive manner. The analysis sought to identify convergent and divergent points among the authors, relating the findings of the literature to the reality of small rural properties and to the educational use of mini-biodigesters in rural school communities, figure 1.

## RESULTS

The bibliographic survey carried out gathered studies addressing anaerobic digestion, the energy use of biogas, the production and application of biofertilizers, the management of agricultural waste, the circular economy and rural sustainability. In general, the analyzed works converge in recognizing that organic waste, when managed inadequately, can generate environmental impacts; however, when treated through technologies such as biodigesters, it can be converted into useful products, such as renewable energy and organic fertilizers.

The question guiding this study, "how can the use of biodigesters contribute to rural sustainability and environmental education in rural communities?", finds partial and complementary answers in the reviewed articles.

More technical studies explain the functioning of anaerobic digestion and the conditions required for biogas production; studies focused on pig farming and rural waste demonstrate the potential for the reuse of waste and by-products; and studies on the circular economy and biofertilizers broaden the discussion to include waste reduction, nutrient cycling, soil fertility and sustainable agricultural practices. Carvalho (2021) highlights that biogas production through anaerobic digestion depends on operational factors such as temperature, pH, carbon-to-nitrogen ratio and type of biomass, while Nascimento et al. (2019) demonstrate that biogas remains underutilized in Brazil despite its potential as a renewable energy source, Table 1.

Comparative analysis shows that the articles converge on three main points. The first is the understanding that organic waste has reuse potential and should not be viewed merely as refuse. The second is the recognition of biogas as a renewable energy source, capable of reducing dependence on fossil fuels and mitigating emissions. The third is the appreciation of biofertilizer as an alternative for soil fertility and for reducing the use of synthetic fertilizers. As a point of divergence, it is observed that the studies differ mainly in terms of scale and subject matter: some focus on urban landfills, others on intensive pig farming, others on microalgal biofertilisers, and few directly address the pedagogical use of mini-biodigesters in rural school communities. Thus, the educational dimension emerges as a possible application derived from the technical and environmental results presented in the literature, which constitutes one of the distinguishing features of the present study, figure 2.

## DISCUSSION

### 2.3 anaerobic digestion and the functioning of biodigesters

Anaerobic digestion is the biological process through which organic matter is broken down by microorganisms in the absence of oxygen, resulting in the formation of biogas and a stabilized residue with fertilizing potential. Carvalho (2021) describes this process as dependent on a set of microorganisms and operational factors that directly affect system performance, such as temperature, pH, carbon-to-nitrogen ratio, organic load and retention time. The author also highlights that co-digestion, that is, the combination of two or more substrates, can contribute to increasing biogas yield, provided that appropriate operating conditions are maintained.

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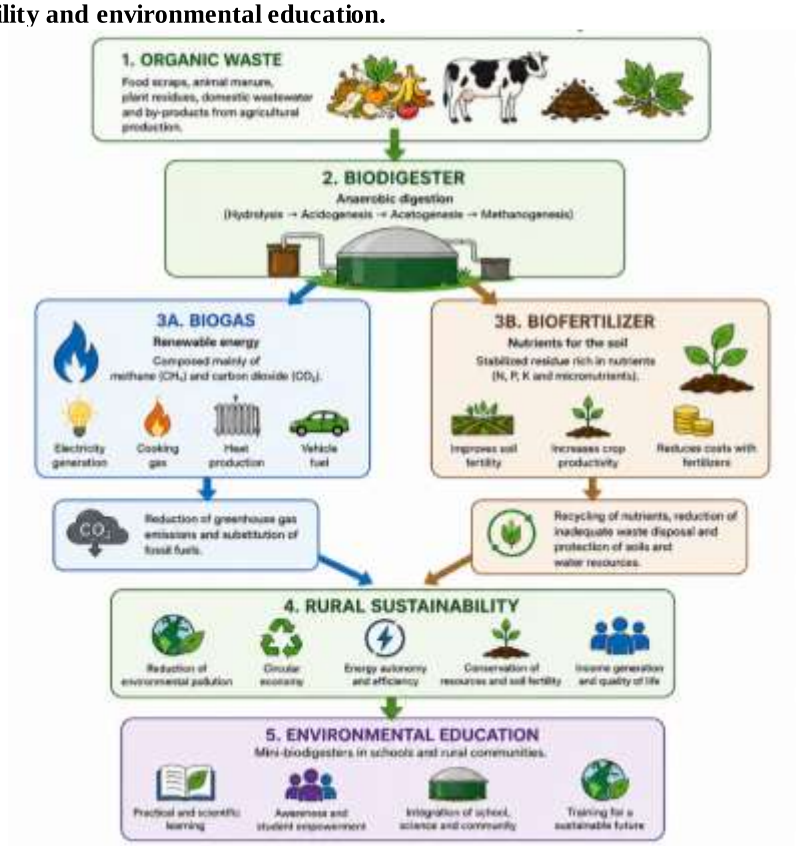
**Table 1 – Selected articles and their relationship to the objectives of the study**

| Selected Article | Main Focus | Convergence with the Objectives | Relationship to the Research Question |
|---|---|---|---|
| **CARVALHO (2021)** – Perspectives on Biogas Production from the Co-digestion of Sewage Sludge and Food Waste | Anaerobic digestion, co-digestion, biogas production and operational factors | Contributes to describing the anaerobic biodigestion process and the technical functioning of reactors. | Shows that biogas production depends on the type of biomass, operational conditions and system control. |
| **NASCIMENTO et al. (2019)** – State of the Art of Urban Solid Waste Landfills that Utilise Biogas | Energy use of biogas in sanitary landfills | Contributes to presenting biogas as a renewable energy source and to discussing greenhouse gas reduction. | Demonstrates that biogas is an energy alternative that remains underexplored, reinforcing the importance of disseminating this technology. |
| **ENSINAS (2003)** – Study of Biogas Generation at the Delta Landfill in Campinas – SP | Energy potential of biogas generated in landfills | Contributes to understanding the energy potential of decomposing organic matter. | Supports the idea that organic waste can generate energy, although the focus is urban. |
| **LIMA; LEITÃO; SILVA (2021)** – Practices Adopted in Pig Farming Aligned with the Circular Economy | Circular economy, pig farming, waste reuse and impact reduction | Contributes to discussing rural waste, pig farming and the circular economy. | Shows that the use of biodigesters fits within circular practices, transforming waste into new productive resources. |
| **ARANTES (2020)** – Swine Wastewater: A Bibliographic Review | Wastewater, fertigation, reuse and environmental impacts | Contributes to discussing biofertilisers, soil fertility and the proper management of pig farming waste. | Indicates that treated waste can be used in agriculture, reducing costs and impacts, provided that appropriate management is adopted. |
| **SOUZA (2025)** – Utilisation of Pig Products and By-products | Sustainability, innovation and technological applications in pig farming | Contributes to relating pig by-products, biogas, organic fertilisers and the circular economy. | Reinforces that agricultural by-products can be valorised, reducing waste and adding value to rural production. |
| **GARCIA et al. (2023)** – Biodigester | Management of pig waste through biodigesters, biogas and biofertiliser | Directly contributes to explaining biodigesters, energy production, fertilisers and pollution prevention. | Identifies biodigesters as a practical alternative for rural properties, with environmental, energy and agricultural potential. |
| **SANTOS et al. (2022)** – Three Methods for Implementing Sustainable Livestock Farming in Brazil | Sustainable livestock farming, biodigesters, integrated crop-livestock-forestry systems (ICLF) and input substitution | Contributes to discussing biodigesters as a sustainability strategy in livestock farming. | Presents biodigesters as one of the possible strategies for making livestock farming less harmful to the environment. |
| **PARIS (2025)** – Microalgae as Biofertilisers | Microalgal biofertilisers, agricultural sustainability and bioeconomy | Contributes to broadening the discussion on biofertilisers and alternatives to synthetic fertilisers. | Shows that biofertilisers can support sustainable agricultural practices, although the focus is on microalgae. |
| **MIRA; MIRA (2025)** – Green Chemistry Applied to Agronomy | Green chemistry, sustainable agricultural inputs, biofertilisers and circular economy | Contributes to contextualising biofertilisers, the reduction of chemical inputs and agricultural sustainability. | Relates the use of organic products and sustainable technologies to the need to reduce the environmental impacts of agriculture. |

**Source: prepared by the authors, based on the bibliographic survey.**

**Figure 1 – Simplified flowchart of anaerobic digestion and its contributions to rural sustainability and environmental education.**




**Source: prepared by the authors, based on the bibliographic survey.**

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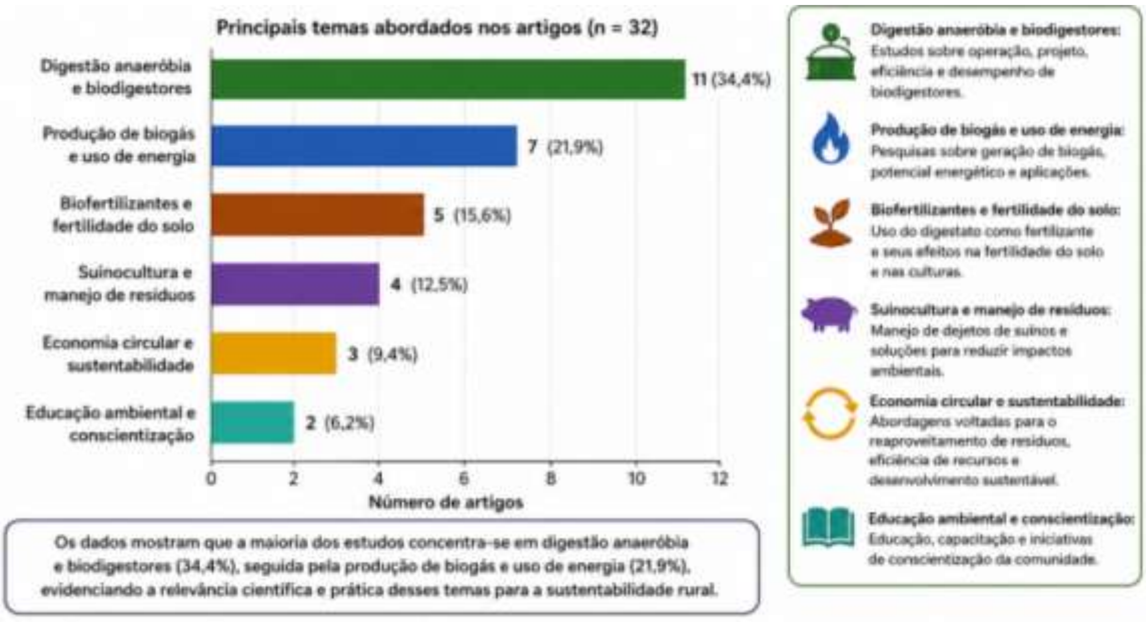
**Figure 2 – Thematic distribution of the analyzed articles.**




**Source: prepared by the authors, based on the bibliographic survey.**

In biodigesters, organic waste is placed in a closed chamber where anaerobic fermentation takes place. Garcia et al. (2023) point out that biodigesters can be used in the management of pig waste, aiming at the production of energy, fertilizers and the prevention of environmental pollution. This aspect is important because it brings technology closer to the reality of rural properties, where animal waste, plant residues and domestic effluents can be transformed into useful products.

From a technical perspective, the studies indicate that the efficient functioning of biodigester depends not only on the presence of organic matter, but also on the control of internal environmental conditions. Sudden changes in ph, temperature or waste composition may compromise the activity of microorganisms and reduce methane production. Therefore, although biodigesters are often presented as simple and accessible technologies, their proper application requires technical guidance, monitoring and an understanding of the factors that interfere with the process.

**2.4 Biogas as a Renewable Energy Source**

Biogas is one of the main products of anaerobic digestion. It is composed primarily of methane and carbon dioxide, with methane being the component of greatest energy interest. The utilization of biogas makes it possible to transform organic waste into a renewable energy source, which can be used for heat generation, electricity production, cooking and, after purification, biomethane production.

Nascimento et al. (2019) highlight that the utilization of biogas generated from the decomposition of organic matter, in addition to constituting a renewable energy source, contributes to reducing the release of methane and carbon dioxide into the atmosphere. However, the study points out that biogas remains underexplored in Brazil, especially when comparing the estimated potential with the projects that have been implemented.

Although the article by Nascimento et al. (2019) addresses urban solid waste and sanitary landfills, its contribution to this study lies in demonstrating that organic matter has significant energy potential. This logic can be transferred, with the necessary adaptations, to small rural properties, where animal manure, food scraps and plant residues may be used as substrates for biodigesters. Ensinas (2003), in studying biogas generation at the Delta sanitary landfill, also contributes to this understanding by demonstrating that biogas can be analyzed as an energy resource rather than merely as an undesirable by-product of decomposition.

In the rural context, the utilization of

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biogas may promote energy autonomy, especially on properties with a constant availability of organic waste. Although production in mini-biodigesters has a more demonstrative and educational character, understanding the process allows students and communities to visualize real possibilities for generating energy from resources already available in the local environment.

**2.5 Biofertilizers and Soil Fertility**

In addition to biogas, anaerobic digestion also generates a stabilized effluent that can be used as a biofertilizer. This product retains important nutrients for plants, such as nitrogen, phosphorus and potassium, and may contribute to improving soil fertility, reducing costs associated with chemical fertilizers and reusing nutrients present in organic waste.

Arantes (2020), when discussing swine wastewater, highlights that liquid waste from pig farming activities may have potential for agricultural use through fertigation, provided that appropriate management practices are adopted. The author emphasizes that the improper disposal of these residues may cause environmental impacts, whereas their controlled use may represent an environmentally and economically attractive alternative.

The discussion on biofertilizers also appears in Paris (2025), although from a different perspective. The author addresses microalgae as biofertilizers and points out that these organisms have the potential to partially replace synthetic fertilizers, offering both economic and environmental advantages. This approach broadens the understanding of organic fertilization and demonstrates that there are different technological pathways for reducing dependence on chemical inputs in agriculture.

Across the articles, biofertilizers are presented as instruments for the transition towards more sustainable agricultural practices. However, the authors also indicate limitations and necessary precautions. The agricultural use of treated organic waste requires attention to chemical composition, dosage, the presence of pathogens or contaminants, and soil characteristics. Therefore, biofertilizer should not be understood as the indiscriminate application of waste, but rather as a product that must be managed in a technical and responsible manner.

**2.6 Rural waste, swine farming and circular economy**

Swine farming appears in several studies as an activity of high economic relevance, but also as an important source of waste and environmental impacts. When improperly managed, swine manure can contribute to soil and water contamination, greenhouse gas emissions and sanitary problems. On the other hand, these residues can also be converted into biogas and biofertilizers through anaerobic digestion.

Lima, Leitão and Silva (2021) discuss the circular economy as an alternative to the linear model of production, consumption and disposal. In the context of swine farming, the authors identify practices aligned with the circular economy, in which waste and by-products are reused, reducing waste and environmental impacts, figure 3. The use of biodigesters fits directly into this logic, as it allows the transformation of waste into energy and fertilizer, closing productive cycles and increasing efficiency in the use of resources,

Souza (2025) also contributes to this discussion by addressing the use of pig products and by-products from the perspective of sustainability, innovation and technological application. The author highlights that the valorization of by-products can reduce environmental impacts and create economic opportunities, bringing the production chain closer to the principles of the circular economy.

Thus, the comparison of the studies indicates that anaerobic digestion is a strategic technology for rural sustainability because it simultaneously acts in three dimensions: it reduces the environmental impact of improper waste disposal, generates renewable energy and returns nutrients to the soil. In small rural properties, this logic can be particularly relevant because it allows the use of locally produced waste, reduces costs and strengthens practices of productive autonomy.

**2.7 Environmental education and mini-biodigesters in the rural school context**

Although most of the analyzed articles have a technical, environmental or agricultural focus, the findings provide a basis for considering biodigesters as tools for environmental education. In the rural school context, mini-biodigesters make it possible to transform abstract concepts, such as anaerobic decomposition, methane production, nutrient recycling, renewable energy and circular economy, into observable experiences for students, figure 4.

The construction and monitoring of

**Figure 3– Circular economy applied to the use of biodigesters in sustainable rural systems.**


**Source: prepared by the authors, based on the bibliographic survey.**

**Figure 4 – Pedagogical scheme of mini-biodigesters. From organic waste to energy and biofertilizer.**


**Source: prepared by the authors, based on the bibliographic survey.**

mini-biodigesters encourage practical learning, in which students can relate Natural Sciences content to real problems in their communities, such as the disposal of food scraps, animal manure and plant residues. This approach is aligned with the project proposal, in which the prototypes were designed as pedagogical tools to demonstrate the basic operating principles of biodigesters and to allow home-based monitoring of biogas and biofertilizer production.

Thus, environmental education emerges as a bridge between technology and social transformation. By understanding that waste can be reused, students begin to perceive rural areas as spaces of innovation, science and sustainability. More than simply demonstrating a technology, mini-biodigesters make it possible to discuss consumption, waste disposal, rural sanitation, energy production, soil fertility and environmental responsibility.

Therefore, by relating the findings of the literature to the research question, it can be observed that biodigesters contribute to rural sustainability by transforming organic waste into biogas and biofertilizers, reducing environmental impacts and strengthening the circular economy. At the same time, when adapted to the school context through mini-biodigesters, they become educational tools capable of promoting environmental education, student protagonism and a practical understanding of sustainable cycles in rural areas.

### 2.8 Interpretative synthesis of the review findings

The analyzed articles make it possible to understand that anaerobic digestion acts as a point of integration between different dimensions of rural sustainability. While studies focused on biogas emphasize the energy potential of organic waste, works on biofertilizers highlight the possibility of returning nutrients to the soil and reducing dependence on synthetic inputs. Texts addressing swine farming and the circular economy show that waste reuse can reduce environmental impacts and, at the same time, add value to productive systems.

The points of convergence become more evident when observing that all studies, even when based on different contexts, recognize the need to overcome the logic of disposal. Organic matter, whether originating from food waste, animal manure, wastewater or agricultural by-products, appears as a potential resource for energy production, soil fertilization and reduction of environmental liabilities. This interpretation reinforces the relationship between biodigesters and the circular economy, since the technology allows matter and energy cycles to be closed within the property or community.

The divergences are mainly related to the scale of application, the type of waste studied and the degree of technological complexity. Some authors analyze sanitary landfills and large-scale urban systems, while others focus on swine farming, sustainable agriculture or micro-algal biofertilizers. This diversity does not weaken the topic; on the contrary, it demonstrates that anaerobic digestion and its products can be discussed at different levels, from industrial systems to educational prototypes developed in school environments.

Considering the research question that guides this article, the results indicate that biodigesters contribute to rural sustainability both through the practical dimension, by treating waste and generating useful products, and through the educational dimension, by allowing students and communities to visualize scientific processes applied to everyday life. Thus, the use of mini-biodigesters in rural schools constitutes a relevant pedagogical possibility, as it brings environmental education closer to local reality and encourages the development of individuals capable of understanding and proposing sustainable solutions.

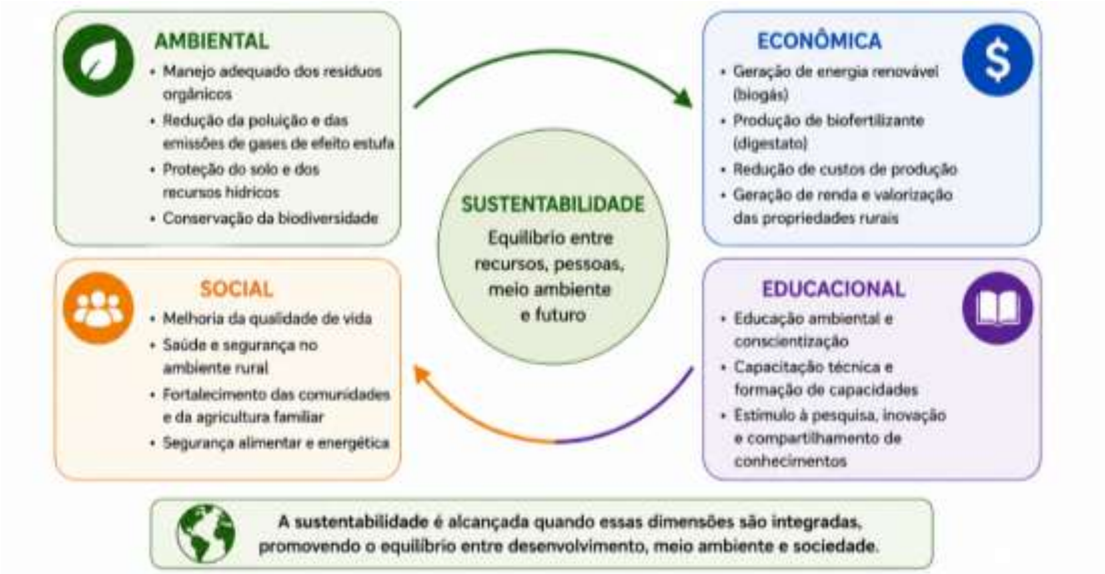
## CONCLUSIONS

The bibliographic review carried out indicates that biodigesters constitute relevant technology for the sustainable management of organic waste in small rural properties. The analyzed studies converge in demonstrating that anaerobic digestion allows materials that would often be discarded, such as animal manure, plant residues, food scraps and organic effluents, to be transformed into products with environmental, energy and productive value.

Among the main findings, it is highlighted that biogas can contribute to the generation of renewable energy and to the reduction of greenhouse gas emissions, especially when methane is no longer directly released into the atmosphere and starts to be used as an energy resource. Likewise, biofertilizer appears as an alternative to return nutrients to the soil, reduce dependence on synthetic fertilizers and strengthen more sustainable agricultural practices, figure 5.

The reviewed studies also demonstrate that anaerobic digestion is directly related to the circular economy, as it proposes the reuse of waste within productive systems themselves. However, the analysis authors present differences regarding scale, type of waste and

**Figure 5 – Dimensions of sustainability. Integration of environmental, economic, social and educational aspects in the use of biodigesters in rural areas.**




**Source: prepared by the authors, based on the bibliographic survey.**

context of application, ranging from urban landfills and swine farming to microalgal biofertilizers and rural properties. This diversity reinforces the need to adapt technology to local conditions and to expand studies applied to the context of family farming and rural education.

As a limitation, this study did not carry out a systematic review with a rigid search and selection protocol, since it was based on a descriptive review developed from the bibliographic research conducted by the scholarship students involved in the project. Even so, the organization of the data made it possible to identify relevant contributions from literature in understanding biodigesters both as an environmental technology and as a pedagogical resource.

It is concluded that mini-biodigesters can be used as environmental education tools in rural schools and communities, as they bring students closer to scientific concepts related to the decomposition of organic matter, renewable energy production, soil fertility, waste reuse and sustainability. Thus, in addition to their technical potential, biodigesters assume an educational role by encouraging youth protagonism, scientific investigation and the appreciation of sustainable solutions in rural areas.

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