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## BIODIGESTOR USE IN INTAMARATI SETTLEMENT: SUSTAINABILITY FOR RURAL COMMUNITY

### UTILIZAÇÃO DE BIODIGESTOR NO ASSENTAMENTO ITAMARATI: SUSTENTABILIDADE PARA A COMUNIDADE RURAL

### USO DE BIODIGESTOR EN EL ASENTAMIENTO ITAMARATI: SOSTENIBILIDAD PARA LA COMUNIDAD RURAL

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**Abstract:** The article's objective was to guide producers on the proper destination and management of agricultural waste, generating “clean” energy and helping with economic and sustainability issues for the settlement. The biodigester implantation project was carried out at the Itamarati Settlement, in Ponta-Porã, with a group of around 70 local producers, who were awarded a biodigester. A training course on construction of biodigesters was held in 2019,

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supported by the agreement signed between the city of Ponta Porã, PROEX/UFGD together with the projects approved by UFGD, where producers received initial training. The adoption of the system aims to ensure the proper disposal of waste, and also generate biofertilizer that can be used in the production of vegetables in the organic system and biogas for consumption by the settled producer. The biodigester is composed of three parts, namely the cargo box, fermentation tank and discharge box, is supplied weekly through manual filling, and it was built with low-cost materials, to provide a shorter turnaround time of investment. Visits are carried out every 30 days by a professional in the area and after closing. The evaluation will be based on the meetings and evaluation of the producers. The community demonstrated satisfaction with the implantation of the biodigester, which enables the development and permanence of man in the countryside, in addition to being a viable and efficient technology, bringing benefits to the producer and the environment, by removing possible pollutants.

**Keywords:** family farming, waste, preservation, by-products.

**Resumo:** O objetivo do projeto foi orientar os produtores sobre o destino e manejo adequado de resíduos agropecuários, gerando energia “limpa” e auxiliando nas questões econômicas e de sustentabilidade do assentamento. O projeto de implantação do biodigestor foi realizado no Assentamento Itamarati, em Ponta-Porã, com um grupo com cerca de 70 produtores locais, que foram contemplados com um biodigestor. Foi realizado um curso de capacitação em construção de biodigestores que ocorreu em 2019, com suporte do convênio firmado entre a prefeitura de Ponta Porã, PROEX/UFGD conjuntamente aos projetos aprovados a UFGD, onde os produtores receberam o treinamento inicial. A adoção do sistema visa garantir o descarte adequado de resíduos, e ainda gerar biofertilizante que pode ser utilizado na produção de hortaliças no sistema orgânico e o biogás destinado ao consumo do produtor assentado. O biodigestor é composto de três partes, sendo elas a caixa de carga, tanque de fermentação e caixa de descarga, e é abastecido semanalmente por meio de abastecimento manual e o mesmo foi construído com materiais de baixo custo, para proporcionar um menor tempo de retorno do investimento. São realizadas visitas a cada 30 dias por um profissional da área e após o encerramento. A avaliação será feita com base nas reuniões e avaliação dos produtores. A comunidade demonstrou satisfação com a implantação do biodigestor, o que possibilita o desenvolvimento e permanência do homem no campo, além de ser uma tecnologia viável e eficiente, trazendo benefícios ao produtor e ao meio ambiente, pela retirada de possíveis poluentes.

**Palavras-chave:** agricultura familiar, dejetos, preservação, subprodutos.

**Resumen:** El objetivo del proyecto fue orientar a los productores sobre el destino y manejo adecuado de residuos agropecuarios, generando energía "limpia" y auxiliando en las cuestiones económicas y de sostenibilidad del asentamiento. El proyecto de implantación del biodigestor se realizó en el Asentamiento Itamarati, en Ponta-Porã, con un grupo de cerca de 70 productores locales, que fueron contemplados con un biodigestor. Se realizó un curso de capacitación en construcción de biodigestores que ocurrió en 2019, con soporte del convenio firmado entre la alcaldía de Ponta Porã, PROEX/UFGD conjuntamente a los proyectos aprobados por la UFGD, donde los productores recibieron el entrenamiento inicial. La adopción del sistema visa garantizar el descarte adecuado de residuos, y aún generar biofertilizante que puede ser utilizado en la producción de hortalizas en el sistema orgánico y el biogás destinado al consumo del productor asentado. El biodigestor está compuesto de tres partes, siendo ellas la caja de carga, tanque de fermentación y caja de descarga, y es abastecido semanalmente por medio de abastecimiento manual y el mismo fue construido con materiales de bajo costo, para proporcionar un menor tiempo de retorno de la inversión. Se realizan visitas cada 30 días por un profesional del área y después del cierre. La evaluación será hecha con base en las reuniones y evaluación de los productores. La comunidad demostró satisfacción con la implantación del biodigestor, lo que posibilita el desarrollo y permanencia del hombre en el campo, además de ser una tecnología viable y eficiente, trayendo beneficios al productor y al medio ambiente, por la retirada de posibles contaminantes.

**Palabras clave:** agricultura familiar, desechos, preservación, subproductos.

## INTRODUCTION

The Itamarati settlement is located in the municipality of Ponta-Porã, MS, established in 2002, and currently has 2,835 settled families. These settlements are typically established by the National Institute for Colonization and Agrarian Reform (INCRA) but function independently, originating from the expropriation of rural properties intended for agrarian reform. According to the Land Statute – Article 1, § 1º, of Law No. 4,504, dated November 30, 1964 – agrarian reform is a set of measures aimed at promoting better land distribution to meet the principles of social justice and increase productivity (Brazil, 1964).

The permanence of producers in rural areas is a constantly discussed issue. Currently, there are incentive programs from social organizations and projects organized by universities, including the Federal University of Grande Dourados, to encourage settled families. However, this continuity is often at risk, attributed to attractive public policies, large urban centers, and family composition factors such as education, wealth, and gender. According to Leandro (2017), the permanence and survival of rural residents depend on developing strategies and projects for their community to achieve their goals.

In this struggle, the Itamarati settlement, through courses and projects, aims to stimulate producers' and young people's interest in new technologies and organic production systems, thereby ensuring families' permanence through improved production. This approach allows young people and producers to remain and develop within the rural community.

Brazil has one of the world's largest animal production industries, excelling in various agricultural sectors. This activity generates waste on both small and large scales, which, if improperly disposed of, can harm the environment and cause pollution. Environmental concerns have gained importance over time due to the impacts of agriculture, necessitating the development of sustainable production technologies (Santos et al., 2017). Incorrect disposal leads to several issues, including natural resource contamination, affecting both producers and the entire community. To address this, methods have been developed to reuse waste for proper disposal and generate benefits. Family farming, prevalent in settlements, is also part of this effort.

Biodigesters serve as a tool for proper waste disposal and transformation into biofertilizer and biogas. As noted by Soares et al. (2017), these products are obtained through anaerobic decomposition of organic matter. Various substrates can be used in anaerobic digestion, with animal organic waste, particularly from pig farming, being the most common. Agricultural, agro-industrial, and urban organic waste, such as food scraps and sewage, can also be utilized (Santos et al., 2017).

Waste from animal production systems on rural properties, if improperly disposed of, can contaminate water, soil, and air. Biodigesters prevent this contamination and reduce the risk of pests and diseases from direct or indirect contact with humans. Therefore, promoting environmental sanitation in agricultural activities through the use of biodigesters, which contain waste from livestock farming, is proposed to achieve sustainability by utilizing the products of biodigestion (Pasqualini, 2020).

The objective of this work is to provide producers with proper disposal methods for animal waste and guidance on correct management, enabling the generation of "clean" energy and supporting the economic, environmental, and sustainability aspects of the settlement.

## **MATERIALS AND METHODS**

The project was carried out in the Itamarati Rural Settlement, located in the municipality of Ponta-Porã, MS, with a group of approximately 70 rural producers. The group was provided with a biodigester unit, where producers had the opportunity to participate in its construction and implementation on the site, allowing them to observe its operation and understand the biodigestion process through hands-on activities.

Through a training course on biodigester construction, held in 2019 with support from an agreement between the Ponta-Porã city hall, PROEX/UFGD, and projects approved by internal and external bodies of UFGD, the producers received initial training. The course involved groups of invited settled producers from various regions of the state of Mato Grosso do Sul, and technicians responsible for teaching biodigester construction in practice. The adoption of biodigester technology in communities aims to ensure the proper disposal of waste generated from animal husbandry, producing biofertilizer for organic vegetable production and biogas for the settled producers' consumption.

The biodigester consists of three parts: the loading box, the fermentation tank (which also houses the biogas storage chamber), and the discharge box. The biodigester is fed through the loading box, and the liquid end product is removed through the discharge box. The biodigester was constructed using low-cost, simple materials to provide producers with a shorter return on investment, as shown in Figures 1, 2, and 3.



**Figure 1.** Model of the biodigester built in the Itamarati Settlement

Source: Prepared by the project authors.

The biodigester is refilled weekly, or whenever the producers deem necessary, by collecting the waste from two cows three times a week and manually feeding it into the system. The activities are ongoing, with regular visits every 30 days by a professional in the field to facilitate producers' understanding and address any questions that may arise. Upon completion of the actions, evaluations will be based on meetings with the producers and their assessments, using a panel of qualitative and quantitative data collected through participatory methods.

## **RESULTS AND DISCUSSION**

Through the biodigester construction course, supported by the "Participatory Construction of Knowledge in Agroecology and Organic Production" and the "Vocational Technological Center in Agroecology and Organic Production, in Mato Grosso do Sul/CNPq," there was significant participation from settlers, totaling 26 participants, all with basic knowledge in construction and masonry. The activity included settlers from various settlements in Mato Grosso do Sul.

The course lasted one week at the Itamarati settlement, and subsequently, the technology was replicated in several settlements, including Itamarati itself. One of the first examples was a participant who, after the course, implemented the construction of a biodigester in the P.A. Savana settlement and then in the Indiana settlement, both in the municipality of Japorã/MS. They not only built it on their property but also expanded the acquired practice to other settlements. This characterizes extension, with the settler himself spreading the knowledge acquired in the extension course: "How to Build a Biodigester?" This is the true meaning of university rural extension, teaching the community to walk independently. In response to a question about how he was seeing the installation of a biodigester on his property, the following answer was given: "We are using it, it's enough to make a complete lunch, cook beans, rice, meat, make cake, basic cooking, it's enough for everyday use, besides we are using the biofertilizer as organic fertilizer in the production of garlic and onions."



**Figure 2.** First Biodigester made after the course, in the P.A. Saraiva settlement.  
Source: Prepared by the project authors.



**Figures 3 and 4.** Energy and biofertilizer production.  
Source: Prepared by the project authors.

Another important achievement of the extension action is that this settler, through the Vocational Technological Center in Agroecology and Organic Production in Mato Grosso do Sul/CNPq/UFMG, in partnership with the Agroecology Center/UFMS and Camponesa, was invited to develop and assist in a biodigester construction course in Três Lagoas, benefiting several settlers from another region. Thus, the results of gas production combined with biofertilizer production are helping the local economy in an environmental sustainability system and providing involvement in group work.

In general, the producers involved show great interest in following and building the biodigester during the activities. It was observed that, broadly, many producers welcomed the proposal and will adopt the technology on their properties in the future.

One of the problems with technical information that arises for the field is testing it in real conditions for the properties, ensuring it brings actual benefits and is viable for construction and implementation. In this case, the biodigester's implementation demonstrates that this activity can be profitable and sustainable, assuring producers of its benefits.

Several studies evaluate the use of biodigesters on rural properties. According to Chaves et al. (2021), when evaluating the construction of a simple, low-cost biodigester in the rural community of Zé Doca, it was found to be a viable option, both economically and environmentally. At the end, a questionnaire showed that 50% of the community intended to use the biodigester, and 50% responded that they might use it.

The use of the biodigester provides producers with an efficient way to reuse waste, producing biogas and biofertilizer, which can be applied on the property itself.

Its product has significant value, as it generates biogas, which, due to the presence of methane gas, can be used to generate electricity in gas-powered generators and as cooking gas (if produced on a large scale), and biofertilizer, which can be used to improve crop quality or be commercialized, generating income. Additionally, it benefits the environment by using gases that would be harmful to the atmosphere and is an alternative to fossil fuels for energy generation (Oliveira et al., 2019).

Analyzing the behavior of the settlement families, it can be observed that it's not just these profits they seek; the experience with something new stimulates and encourages some producers to improve their work environment. This indirectly promotes the permanence of producers in the community. Being something new, a new way to use these residues, allows them to preserve the environment and improve their family's quality of life, health, and well-being. It was found that the implementation of these devices is a viable alternative that promotes environmental benefits, improves the quality of life of rural producers, and had a positive socioeconomic impact on the region's development (Menegheti, 2021).

During the actions, the interest of some producers is evident, and the reports of one producer confirm that rural extension work, courses, and projects offered by organizations and universities are widely used. The producers themselves use the technique at their residence and expand the acquired practice and knowledge to other producers, who will soon reap the benefits of this technology. According to Menegat et al. (2019), when researching the relationship between the rural environment and the university, it is characterized that, during the actions, a crucial factor has been the organization of people into groups, forming collectives to implement activities, strengthening social bonds among neighbors, as well as solidarity, and thus gathering energies and forces to act in the scales of work and companionship among group participants.



This methodology extends dialogues with institutions outside the rural environment, such as the partnership with UFGD professors, in a joint effort, enabling the multiplication of extension actions.

Following this reasoning, Alves et al. (2020), in studies focused on university extension experiences, where fertility, fertilization, texture, and soil preparation factors were evaluated and discussed, observed that the settlers better understood soil use and management. This factor is of great importance as it is their main natural resource, in addition to promoting environmental awareness in the area. In the case of rural settlements, it can be said that this path can achieve what we can call social technology and social bonds, which translate into two senses: first, a technology, since the university, through technical vision, proposes new production possibilities for a range of agricultural products; second, it is social because it meets the desires to improve the quality of life of settled people. This interaction between settlement groups/university professors leads to new production and consumption processes, as well as scientific discoveries, forged in the communities' doing, generating new social bonds (Menegat et al., 2019).

Additionally, the work of the Extension Center for Territorial Development of the Federal University of Grande Dourados (NEDET - UFGD) with the Cone Sul Citizenship Territory focused on supporting the development of family farming in the Cone Sul Citizenship Territory, disseminating and encouraging access to public policies by family farmers, aiming to improve production, processing, and marketing of healthy foods, food and nutritional improvement, social inclusion, and income generation for the permanence of families in the field, with better living conditions (Heling et al., 2016).

In general, the data collected and factors analyzed show that the activities carried out in the settlement brought greater efficiency within the property for the producers involved, in addition to bringing gains for themselves and the environment. According to Durães et al. (2021), the practice of building biodigesters in settlements has proven to be extremely viable and positive in the rural environment, especially in organic production, as it transforms what would be an environmental problem into an economic means, benefiting both the community and the end consumer. The significant improvement in the quality of life of rural families becomes a differential.

## CONCLUSION

The use of biodigesters in the Itamarati Rural Settlement has proven to be a viable and efficient technology, bringing benefits to producers through the production of biogas and biofertilizer, and to the environment by removing potential pollutants. Thus, with the advantages obtained through biodigestion and its products, the implementation of the biodigester in the community enables the development and permanence of people in the rural area, in addition to generating profit.

It is also concluded that extension projects have a significant influence within the settlements, showing a path and sharing experiences, observing that all investment, time, and work are valued, as there is a response to all the knowledge passed on to the producers.

The work in the Itamarati settlement promoted the strengthening of agriculture through cooperative action among families, and fortified the use of extension practices, contributing to the community's development, being a tool that can be considered a social mediator.

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