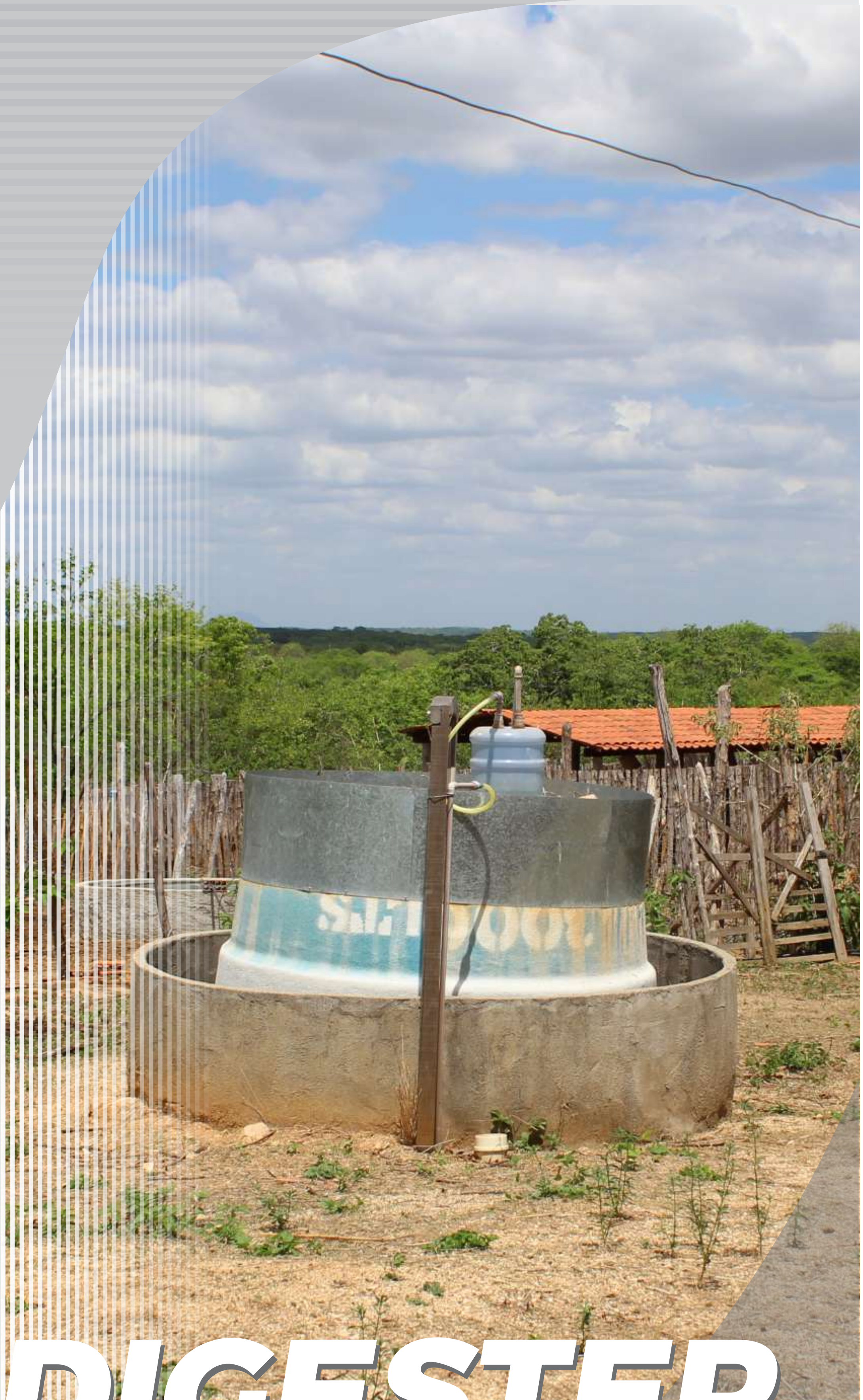
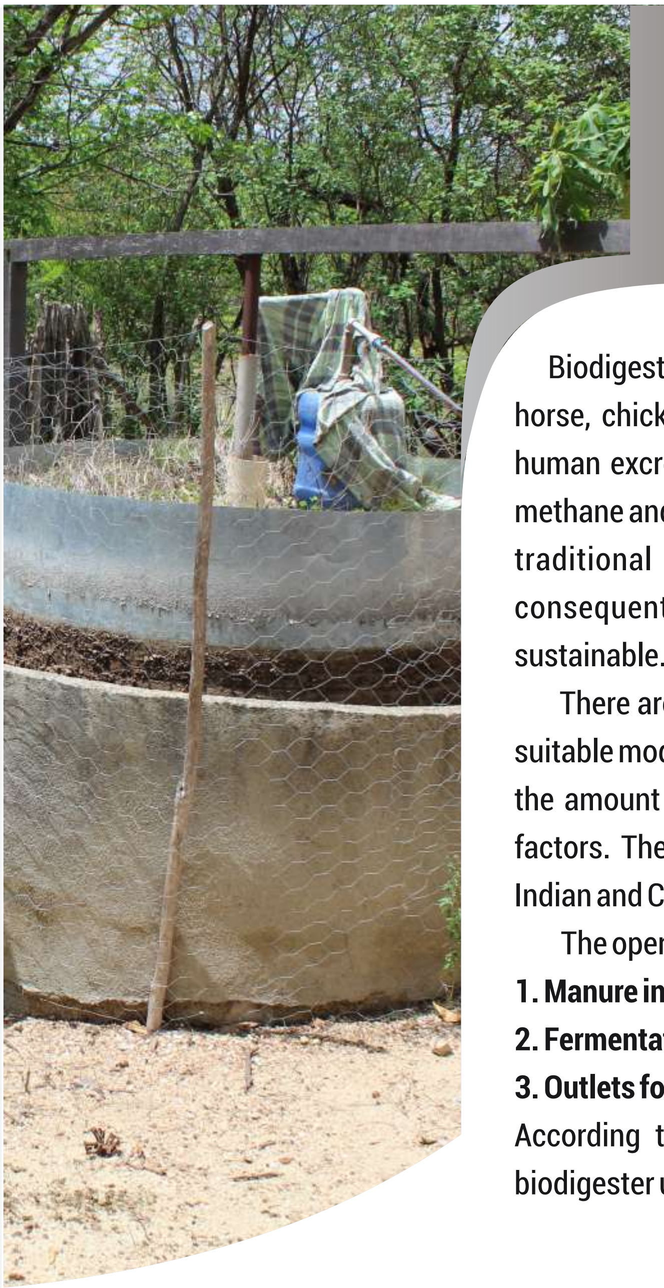
DIGITAL
PORTFOLIO

BIODIGESTER



IACOC Compromisso com o desenvolvimento socioeconômico do Semiárido paraibano
PaqTcPB Fundação Parque Tecnológico da Paraíba
UFCG Universidade Federal de Campina Grande
INSA Instituto Nacional do Semiárido
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÕES
PÁTRIA AMADA BRASIL GOVERNO FEDERAL
FIDA Investindo nas populações rurais



Biodigester is a device that decomposes organic matter, such as cattle manure, horse, chicken, pig, vegetable remains of crops (straw, grass and leaves) and human excrement for the production of biogas. Biogas is mainly composed of methane and carbon dioxide, and due to this composition it can be used to replace traditional cooking gas, bringing an economic return for the user, and consequently, a beneficial environmental impact, as it is a technology sustainable.

There are several models available on the market, but the choice of the most suitable model of biodigester will depend on the need of the producer, for example, the amount of organic matter to be processed, the investment cost and other factors. The best known models of biodigesters in the world are the Chinese, Indian and Canadian.

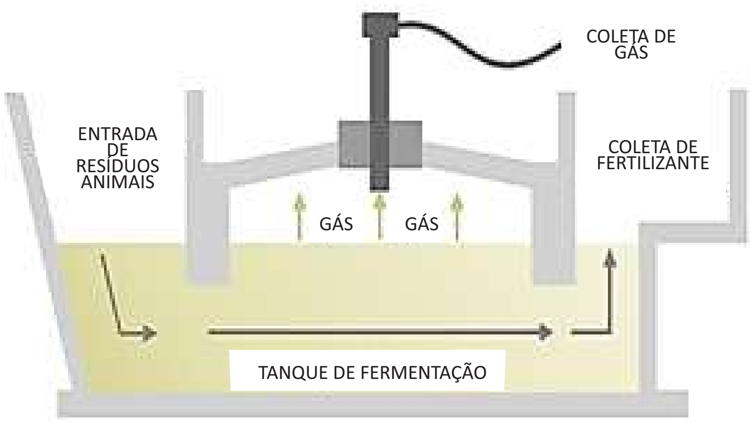
The operation of biodigesters has the following steps:

1. Manure inlet;

2. Fermentation tank;

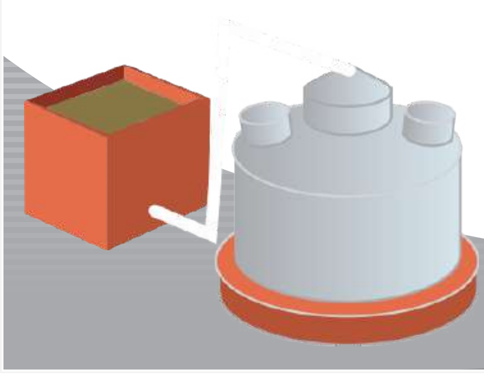
3. Outlets for biogas and processed waste.

According to the steps shown, we can present the physical structure of a biodigester using the Indian model, as shown in the following illustration:



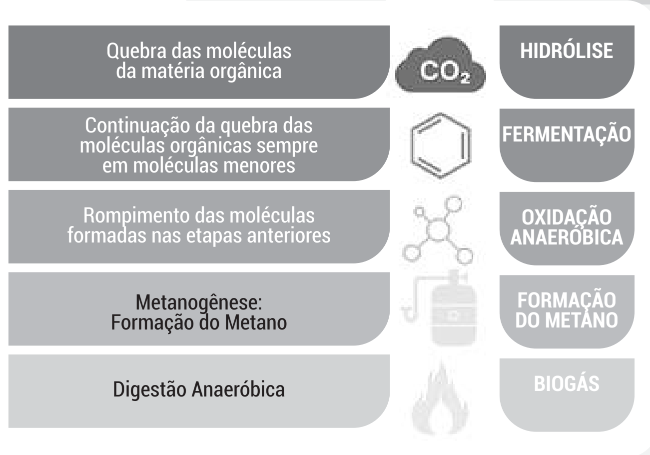
SALOMOM, K. R.; FILHO, G. L. T. Biomassa. 1ª ed. Itajubá, MG: FAPEPE, 2007

We see in the figure above that there is an entrance for animal waste, which is where the farmer puts animal waste every day; a fermentation tank, which is where the magic of transforming organic matter into biogas takes place; and we have two outlets: one to collect the biogas produced in the fermentation tank and the other to remove the rest of the organic matter that has undergone the transformation.



How is biogas made?

As mentioned, the magic of biogas production occurs in the fermentation tank. But who are responsible for this process? The magicians of this show are called microorganisms, very numerous living beings, but so small that we cannot see with our eyes, only with the help of a microscope. Each group of these microorganisms has a special job in the stages of the process of transforming organic matter into methane and carbon dioxide, and it is necessary to provide an anaerobic environment, that is, without oxygen. In the following illustration, it is possible to analyze the steps involved in this process and what happens



It is important to note that only anaerobic bacteria participate in the methanogenesis phase (formation of methane), in which methane gas is produced. These bacteria have a sensitivity to temperature variations, operating at a temperature between 10 and 45 ° C.

What is the justification for it to fit into this project

Considering IFAD's mission and challenges and highlighting the technology, the biodigester consists of a sustainable and economically viable technology for rural producers with an economic and environmental return. The biofertilizer can be used to enhance crops, eliminating the need to purchase industrial fertilizers. The biogas produced can be used to replace cooking gas (LPG), which saves users financial resources. In addition, the use of the biodigester can contribute to reducing greenhouse gas emissions when compared to energy sources used by family farming (such as burning firewood), following the objectives of the United Nations Framework Convention on mitigating gas emissions responsible for climate change and collaborating to reduce problems with issues such as the desertification of the Caatinga biome, in search for energy alternatives.

The International Fund for Agricultural Development (IFAD) aims to assist poorer populations in developing countries. In relation to the challenges that IFAD seeks to overcome, there are extreme poverty and malnutrition, scarcity of water for human consumption and productive use, low agricultural income, climate change and environmental risks, difficulties in accessing markets, public policies and programs with coordination problems, few non-agricultural activities for rural families, lack of access to agricultural and social welfare policies and programs, among others.

Factors that promote or limit technology adoption

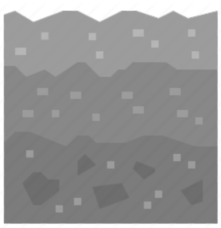
Parameters such as temperature, pH, concentration of nutrients, frequent maintenance and other factors, directly influence the performance of the biodigester and are fundamental and useful for the design and operation of efficient digesters and for understanding how adverse conditions can occur and how to get around them. It is important to emphasize that the factors mentioned are subject to external control in the process of anaerobic digestion.

TEMPERATURE

Temperature is an important factor for the production of biogas, the main product generated in the biodigester. The process can take place at a temperature between 10 ° and 60 ° C, depending on the type of bacteria. The biogas production process is not affected by the temperature increase by a few degrees. However, a decrease in some degrees can impair production of methane. It's necessary emphasize that the action of acidifying bacteria is not affected by the decrease in temperature, and because of this a possible accumulation of acids may occur resulting in a structural failure in the biodigester. A decrease in the production of biogas may occur during the cold seasons, due to the operating range of the microorganisms involved in the anaerobic digestion process. Mesophilic systems are quite sensitive to the issue of variation in ambient temperature, with the possibility of stopping or decreasing the production of biogas in the winter period in colder climates.

PH

The anaerobic process is directly affected by small fluctuations in pH values . Methanogenic microorganisms, responsible for the production of methane, are more susceptible to these pH variations than other microorganisms.



BIOMASS COLLECTION PLACE

In corrals where the floor is made of earth, there may be contamination of the biodigester with other materials, and influence the production of biogas.

BIOMASS SHAKE

It is necessary to agitate the organic material to facilitate the contact of the microorganisms with the biomass. However, shaking too much can cause biomass dragging, and with that, there is a loss of production efficiency.

PREVENTIVE MAINTENANCE GUIDE

The maintenance of the structure of the biodigester is important due to the wear of the integral parts of the biodigester, such as, for example, valves, pipes and tanks, that can cause leaks of the biogas.

Methane under normal conditions of temperature and pressure consists of a colorless, odorless, flammable gas. The leakage of this gas in contact with the air can cause explosions, if handled indoors and in the presence of an ignition source.

As the biodigester is exposed to the sun and most parts of the biodigester are made of plastic, such as rubber hoses, PVC pipes, valves and others, the sun is going to cause over the years discoloration and dryness of the pipe, making it fragile structure. Therefore, any external impact can cause crack, break or some damage to the structure of the pipe, valve, hose and the like.

Due to these risks, frequent maintenance is essential to maintain the conservation of tanks, pipes of machinery and equipment, and thus, ensure that there are no leaks that may result in environmental contamination and damage to human and animal health (GOMES et al., 2015).

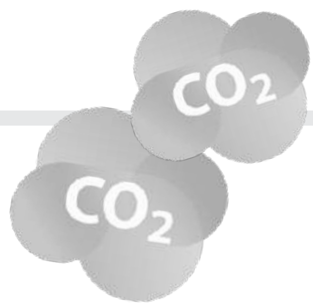
SOCIAL IMPACTS (ON WOMEN AND YOUNG PEOPLE, FOR EXAMPLE)

In the daily lives of large urban centers, technologies are used to assist and bring returns in the economic or welfare sphere, facilitating people's work. The use of adapted technologies should also be extended to rural areas, in order to help small farmers in their tasks. Because of various work difficulties that arise in the countryside, the small rural producer frequently needs to seek his source of income in the cities, being obligated to leave the place where he lived most of his life.

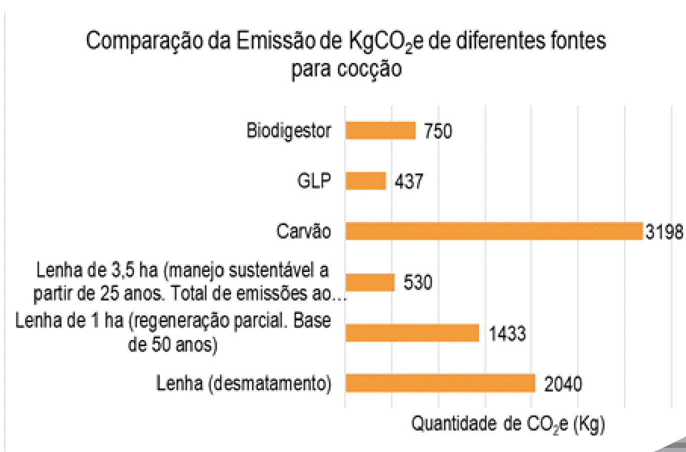
With this in mind, technologies can be used to reduce or eradicate possible problems that prevent the development of work in the field, as well as, they can be beneficial in economic and environmental terms. Most of the production of food available to the Brazilian population is produced by family farming, consisting of small rural producers, traditional peoples and communities. In view of this, it is verified the importance that the rural person has for society and, therefore, more tools must be made available in order to add value to rural work.

Projects like the ones that IFAD supports, in addition to bringing technological assistance and knowledge to the person working in the field, also positively impact the lives of women. The installation of the biodigester, in addition to the economic and sustainable return, brings a quality of life and generates a source of income for the farmers through, for example, the manufacture of cakes and bread from the use of the biogas generated on their property, in replacement to cooking gas (LPG). These projects also encourage the creation or strengthening of women's groups in the communities, so that they can generate income together. The biofertilizer produced in the biodigester can be used as organic fertilizer in fruit trees, vegetables and seedling nurseries, the product of which can be sold or subjected to a processing, as in the production of sweets and pulps from fruits produced on the property of these women. In addition, the manufacturing procedure is carried out in community kitchens in which all participate in the preparation of secondary products.

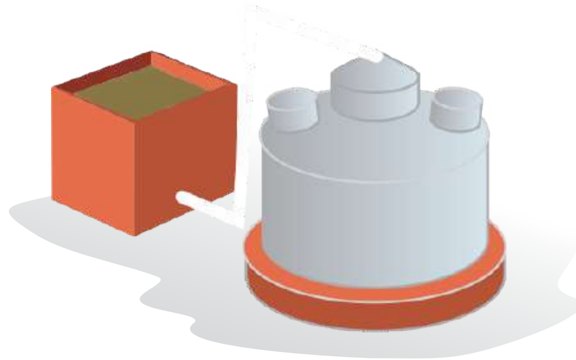
CO_2 EMISSION ANALYSIS



The biodigester has the advantage of generating biogas (CH_4) by anaerobic digestion of animal and vegetable organic matter. Among domestic fuels, biogas is considered to have the least environmental impact. In order to obtain CO_2 emissions by the biodigester, a case-by-case study is necessary to carry out an inventory considering the amount and type of organic material added (poultry, pork, cattle, plant material) and the chemical analyzes of the biofertilizer produced. The quantity emitted by the burning of biogas in comparison with traditional cooking gas (LPG) for cooking, within the scope of stationary combustion must count in the computation of the reduction of CO_2 emissions in the biodigester.



TOTAL QUANTITY INSTALLED



Installed Quantity (total value): 259

Quantity to be Installed (total value): 274

Municipalities (total value): 25 MUNICIPALITIES BENEFITING FROM TECHNOLOGY IN FOUR STATES

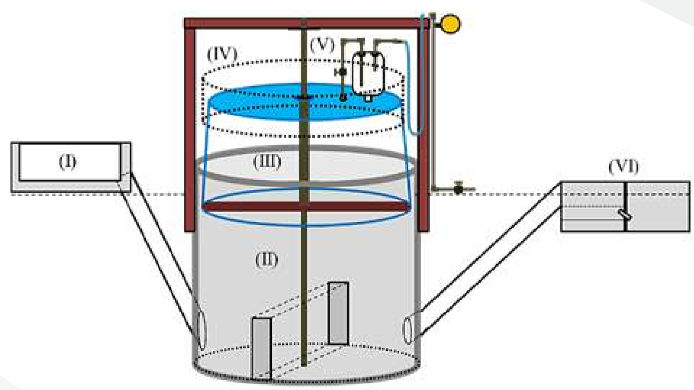
DID YOU KNOW...?

The implementation of the first biodigestors in Brazil took place in the 1970s after the oil crisis that started in the end of 1973. This crisis affected many oil-importing countries, especially those in development, such as Brazil. Therefore, there was a need to use other methods to obtain energy.

In Brasilia in 1979, the first biodigestors were built through the Energy Mobilization Program (PME) project, which consisted on a set of actions aimed at energy conservation and the replacement of petroleum products with alternative fuels.

The sertanejo (inner) biodigester, as shown in the following illustration, originated from the Indian model and the adaptation was carried out aiming at issues such as the availability of materials for its construction in building materials stores in the inner cities of Brazil.

I. Feeding box;
II. Fermenter;
III. Gasometer;
IV. Primary water filter / adapter;
V. Biogas outlet tank;
VI. Output of waste.



In the feed box, the organic material is placed that will later supply the fermentation tank (fermenter), in which the biogas will be produced. This will be stored in the gasometer. In the outlet tank, a liquid product or residual material that can be called biofertilizer will be eliminated, that is, an organic fertilizer that can be used for liquid or solid fertilization. The biogas produced can be used for thermal heating, as fuel for engines and generators and as gas for cooking.

The production of biogas varies according to the type of manure that is placed in the biodigester. Thus, it is estimated that **BIRDS** can produce about 0.014 (m^3 / head / day) of biogas, taking into account that the animal has a mass of 2.5 kg; **PIGS** can produce about 0.240 (m^3 / head / day) of biogas, taking into account that the animal has a mass of 90 kg; **CATTLE** can produce about 0.240 (m^3 / head / day) of biogas, taking into account that the animal has a mass of 500 kg.

REFERENCES CONSULTED

ALVES, E. E. N .; INOUE, K. R. A .; BORGES, A. C. Biodigestores: construção, operação e usos do biogás e do biofertilizante visando a sustentabilidade das propriedades rurais (Biodigesters: construction, operation and uses of biogas and biofertilizer for the sustainability of rural properties). II Brazilian Symposium on Sustainable Agriculture, 2010.

BERNI, M. D .; BAJAY, S. V. O contexto dos biocombustíveis para o transporte rodoviário no Brasil (The context of biofuels for road transport in Brazil). Energy Meeting in Rural Areas, v. 6, 2006.

BIOGAS. Available at <https://www.agencia.cnptia.embrapa.br/gestor/agroenergia/arvore/CONT000fbl23vn102wx5eo0sawqe3qf9d0sy.html>. Accessed on: Nov 5, 2020;

BRAZIL [LAWS ETC.]. Decree No. 87.079, of April 2, 1982. Brasília: Department of National Press, 1982.

CASTRO, L. R. DE; CORTEZ, L. A. B. Influência da temperatura no desempenho de biodigestor com esterco bovino (Influence of temperature on the performance of biodigester with bovine manure). Brazilian Journal of Agricultural and Environmental Engineering, v. 2, p. 97–102, 1998.

CHERNICHARO, C. A. D. L. Anaerobic Reactors. 5. ed. Belo Horizonte: Department of Sanitary and Environmental Engineering - UFMG, 1997.

ENVIRONMENTAL COMPANY OF THE STATE OF SÃO PAULO (CETESB). Methane Technical Sheet. São Paulo, 2020.

EMBRAPA. Biofertilizer. Available at <https: //www.agencia.cnptia.embrapa.br/gestor/agroenergia/arvore/CONT000fj1gh4ku02wyiv802hvm3jd85f37c.html#:~:text = Under% 20form% 20l% C3% ADquida% 2C% 20o% 20biofertilizer, eradicating% 20 pests% 2C% 20doen% C3% A7as% 20e% 20insects>. Accessed on: Dec 8, 2020.

FARIA, R. A. P. Avaliação do Potencial de Geração de Biogás e de Produção de Energia a partir da remoção da carga Orgânica de uma Estação de Tratamento de Esgoto - Estudo de Caso (Evaluation of the Potential for Biogas Generation and Energy Production from the removal of the organic load from a Sewage Treatment Plant - Case Study). State University of Western Paraná, 2012.

IFAD. Investing in Rural Populations. Available at: <https://www.fida.org.br/>. Accessed on: Nov 12, 2020a.

GIACOBBO, G. et al. Influência da variabilidade da temperatura ambiente na co-digestão anaeróbia de dejetos de bovinocultura de leite e cama de aviário Acta Iguazu (Influence of room temperature variability on anaerobic co-digestion of dairy cattle and poultry litter Acta Iguazu). Rattlesnake, 2013.

GOMES, F. C. DE S. P. et al. TECHNICAL ENVIRONMENTAL GUIDE FOR BIOGAS IN AGROINDUSTRY. Belo Horizonte, State Environment Foundation, 2015.

GUNNERSON, C .; STUCKEY, D. Integrated Resource Recovery Anaerobic Digestion: Principles and Practices for Biogas Systems. Washington - USA: The World Bank, 1986.

JÚNIOR, F. A. DE O. RURAL BIODIGESTOR CONSTRUCTION MANUAL. Available at: <http://www1.pucminas.br/imagedb/documento/DOC_DSC_NOME_ARQUI20140917140023.pdf>. Accessed on: Dec 5, 2020.

KARLSSON, T. et al. Basic Biogas Manual. 1st ed. Lajeado: Univates, 2014.

KLUMB, A. et al. 12 Passos para Construir um BIODIGESTOR (Steps to Build a BIODIGESTOR). Diaconia ed. Recife - PE: Banco do Brasil Foundation, 2019.

MACHADO, C. R. Biodigestão anaeróbia de dejetos de bovinos leiteiros submetidos a diferentes tempos de exposição ao ar (Anaerobic biodigestion of milk cattle waste submitted to different times of exposure to air). PAULISTA STATE UNIVERSITY "JÚLIO DE MESQUITA FILHO", 2011.
MARTINS, D. S .; ASSIS, E. G. Estudo da viabilidade econômica da implantação de um biodigestor em uma granja de Perus (Study on the economic feasibility of the implementarion of a biodigestor in a turkey farm). Foz do Iguaçu - PR. XXVII National Meeting of Production Engineering, 2007.

MATTOS, L. C .; JÚNIOR, M. F. Biodigestor Sertanejo Manual. Recife - PE: Dom Helder Câmara Project Edition, 2011.

MINISTRY OF THE ENVIRONMENT. National Solid Waste Policy. Available at: <https://www.mma.gov.br/cidades-sustentaveis/residuos-solidos/politica-nacional-de-residuos-solidos.html #: ~: text = Law No. 12.305% 2F10, inadequate handling of solid waste.>. Accessed on: Nov 14, 2020

MORENO, M. T. V. Manual del Biogás (Biogas manual). Santiago de Chile: FAO, 2011.

OSORIO, R. H. et al. Avaliação de um Sistema de Biodigestores (Gtz E Taiwan) em série em clima frio na etapa de estabilização (Evaluation of a Biodigester System (Gtz E Taiwan) in series in cold weather in the stabilization stage). Cuiabá, XL Brazilian Congress of Agricultural Engineering - COMBEA, 2011.

SALOMOM, K. R .; FILHO, G. L. T. Biomass. 1st ed. Itajubá, MG: FAPEPE, 2007.

SANTIAGO, F. DOS S. et al. Estimativa na redução de gbases do efeito estufa com biodigestor no semiárido (Estimate in reducing greenhouse gases with biodigestor in the semiarid). X National Congress of Environment of Poços de Caldas, v. 5, p. 1–6, 2013.

SEIXAS, J .; FOLLE, S .; MARCHETTI, D. Construction and operation of biodigesters. Brasília - DF: Embrapa: Agricultural Research Center of the Cerrados, 1981.

SILVA, E. M. C. A. et al. Project for the Rural Unit for the Generation of Biogas Distribution. Environmental Education & Biogeography, v. 2, p. 1675–1685, 2016.

SOUZA, A. D .; HERCULANO, M. C. R. Biodigesters: management booklet. Cartilha Técnica (Technical Booklet), v. 3, n. 1, p. 14–19, 2016.

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