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DAIRY PRODUCTION AND ENERGY CRISIS IN GOIÁS: ANALYSIS OF RURAL DEVELOPMENT AND SOLAR ENERGY

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Abstract
Dairy producers in Goiás, a Brazilian midwestern state, have been facing troubles due to poor performance of it's energy company (ENEL), which was privatized in 2017. In 2019, family farmers made serious allegations about energy supply interruptions, instability and huge delays in responding to demands because of staff cuts. This scenario let to an investigation by Goiás state Legislative Assembly, which concluded that the company did not invest the contracted amount on maintenance and caused damage to rural activity, especially those dependent on refrigeration equipment, such as dairy producers. Goiás State is one of the greater producers of dairy in Brazil, which is the fifth greater dairy producer in the world according to FAO. In Goiás, almost 50 thousand families produced more than 1,4 billion liters of milk in year 2017. Even though these families live in a region with a great capacity photovoltaic energy, they cannot avoid using traditional and non-renewable energy matrices, such as oil and hydroelectric because access to solar panels are still too expensive. To understand the challenges for expanding solar energy use in Brazil, mainly in the countryside, specifically in Goiás, in order to promote social, environmental and economic development, this research analyzes public policies for rural development and the obstacles that prevent solar energy from becoming a main source of energy in the countryside. After price analyzes, dairy farmers annual income and existing public policies to increase solar energy usage, it's deduces that the high costs for implementing photovoltaic systems and the absence of incentives by the government part are obstacles to the autonomy and better living conditions of family farmers in Goiás. Although farmers express the want to cease dependency on non-renewable energy matrices, the expansion of Goiás Solar Program is not enough to successfully resolve energy distribution crisis in the state, consequently generating a development that expands individual and collective freedoms.
Keywords: Rural development; Clean energy; Energy crisis; Public policies in Brazil; Climate change.

Introduction
This research aims to understand the challenges for expanding solar energy use in Brazil, mainly in the countryside, specifically in Goiás, in order to promote social, environmental and economic development. Considering the relationship between milk production and the use of electricity to carry out the essential procedures to meet the applicable regulations, this paper discusses the

technological development of solar energy and its use in the milk production chain in Goiás as a way to promote efficiency , productivity and savings for producers.

One of the great challenges faced by dairy producers in Goiás are the high demands of the Ministry of Agriculture, Livestock and Supply (MAPA) for marketing the product, which requires machinery and production techniques in order to guarantee sanitary conditions and to protect the population. Most of the machinery depends on the electricity supply. Therefore, milk production is necessarily dependent on electricity for productive continuity.

Although data from the Atlas of Electric Energy in Brazil demonstrate expansion of rural electrification in the state of Goiás, energy suppling constitute a considerable investment, especially when analyzing the average income of dairy producers and the fact that concessionaires do not promote investment in quality and regularity of the service. In fact, after privatization of ENEL, there were several reports of failures in the provision of services that affected agricultural activities in general. A large number of complaints and inquiries were made by milk producers and producers who depend on electricity to carry out conservation and hygiene processes without which the product cannot be marketed (ALEGO, 2019).

Renewable energy sources are identified as capable of promoting rural development, in addition to reducing the various damages caused to the planet by the emission of greenhouse gases. In the countryside, the possibility of access to clean energy consists of vectors of economic, human and social development capable of integrating, increasingly, the dynamics of the countryside into the markets and promoting the autonomy of dairy producers, who could pay less for the same energy.

Solar energy is an efficient alternative to a renewable energy matrix, because modular equipment allows installation almost anywhere, making it a powerful tool for production and autonomy even in very isolated areas.

Despite its benefits, the expansion of solar energy comes up against obstacles of a technical, economic and institutional nature. The technology has limitations regarding storage in batteries, for example, which also need specific destination after disposal and greatly increase the installation price. There are also necessary steps to integrate the system into the existing energy network, which may require technical personnel, financing and overcoming bureaucratic barriers (TILMISINA; KURDGELASHVILI; NARBEL, 2011).

Given these considerations, the objective of the research resides in the study of the viability of solar energy in the field properly focused on dairy production in Goiás. The central question is to think about solar energy as a way of promoting rural development and productive autonomy, offering an approach to agrarian issues and introducing family farmers to the productive market more actively.

Methodology

The analysis is based on a qualitative approach, supported by bibliographic and documentary research, establishing a relationship between access to sources of cheap and renewable energy and the quality of life of milk producers in the state of Goiás. For this purpose, secondary data are used obtained from the Mauro Borges Institute (IMB), the Brazilian Institute of Geography and Statistics (IBGE) and the National Electric Energy Agency (ANEEL), which are critically analyzed in the light of the concept of rural development. In addition, the authors carried out price surveys with companies operating in the Goiás market between the years 2018 and 2020 in order to collect data about the investment required to install a distributed generation system using solar energy panels in rural areas.

Results and Discussion

Photovoltaic systems and solar energy production have grown exponentially in Brazil. Between 2012 and 2016, there was an increase of 407% in installed power. In 2017, ANEEL assessed that there was a tendency for a considerable increase in the installed power for solar energy

generation until 2014, rising from 102 MW in 2017, to reach a total of 3,208 MW among residential and commercial consumers in the year 2024 (ANEEL, 2017).
In 2015, however, ANEEL made a projection that estimated production of 4,577 MW by the year 2024, which represented a reduction of about 30% in the expansion of solar power generation in Brazil. The difference was justified by the prospect of adopting the yellow flag for the analysed period in 2017. In 2015, it was expected that the red flag (that makes energy costs the highest) would be used to charge electricity until the year 2024. Therefore, with the reduction in the amount charged by concessionaires' energy, there was a drop in the expectation of consumers tending to invest in solar energy systems (figure 1) (ANEEL, 2017).
However, even if there is considerable expansion of the system in relation to previous years and there are estimates of growth in the amount of energy produced and of individuals and legal entities using solar energy, the percentage of installed power is small compared to hydroelectric and thermoelectric sources. The power generated by installed photovoltaic units represented only 1.3% of the total produced by Brazil until March 2019. Hydroelectric plants were responsible for 59.8% and thermoelectric plants, for 25.1% (ANEEL, 2019).
Even in the face of the verified growth, one of the obstacles for the implantation of photovoltaic systems in Brazil is the insufficiency of existing incentives, which asserts the economic infeasibility resulting from the need for initial investments (SILVA, 2015). In addition, those interested in investing in the generation of energy distributed through photovoltaic panels need to overcome the high costs of installation, depending on their need to afford batteries that meet the night time or overcome the bureaucracy necessary for integration with existing systems. in the country (TILMISINA; KURDGELASHVILI; NARBEL, 2011).
In Goiás, the State Program for the Development of Photovoltaic Solar Energy (Goiás Solar Program), instituted by State Decree no. 8,892, of 2017, is an incentive for those who want to join the energy alternative. In its decree, the state government recognized the expansion of the use of photovoltaic solar energy as a strategic opportunity for the generation of income and jobs, for the structuring of a new production chain, thus contributing to boost the economy of the State (GOIÁS, 2017).
In order to understand why most solar panels are destined for urban use, price surveys were undertaken by the authors between the years 2018 and 2020 with companies that serve the consumer markets in Goiás.
In 2018, budgets for two types of systems that could integrate the rural environment were analysed by the authors, the off-grid (isolated system, typical of remote areas where there is no access to another electrification network) and the on-grid (system integrated to the local power grid, allows cost reduction). The objective was to analyse the initial investment prices for the purchase, installation and generation of photovoltaic solar energy in Brazil, a factor commonly identified as one of the obstacles to the option for solar energy.
The sets of off-grid solar energy supplied by the contacted companies, with power greater than 1000Wp, which could serve an average residence of 4 (four) rooms, varied between R$ 3,000.00 and R$ 15,000.00.
The values depended on the location of the installation (type of roof, slab or soil), brand of equipment and the number of stationary batteries suitable for storing the surplus of energy generated. This calculation could also be done including some small productive tasks, such as small machinery, water pumping, water and room heating, night lighting, among others.
Obtaining on-grid solar energy equipment also considers the location of implementation, but does not use storage of the surplus in stationary batteries. In 2018, prices ranged from R$ 6,000.00 to R$ 220,000.00, suitable for homes and larger productive activities.
The authors carried out a new price survey in January 2020 for the installation of a solar energy system in the rural area of Professor Jamil, a municipality located about 70km from the capital of Goiás, for the generation of about 500 kWh in a property that, in December 2019, had an payed approximately R$ 310.00 for its energy.

Considering on-grid systems and the installation, surveyed companies costs varied from R$ 19,900.00 to R$ 24,500.00. The expected value of the energy bill after the implementation of the system would be a monthly payment of approximately R$ 30.00 referring to the minimum tariff. Thus, according to the companies, within 3 years, the producer would have saved the amount directed to the concessionaire.

The companies suggested payment through financing that could be paid in up to 60 months with installments around R$ 500.00 and offered discounts for cash payment. The representatives of the companies were unable to inform about the possibility of specific financing for agrarian establishments in better conditions than those presented by the company.

Considering the data obtained by Freitas and Wander (2017), from field research in the city of Anápolis to identify the gross monthly value consistent with the income of family farmers, it is possible to infer that the value of the financed installation makes access to solar energy unfeasible by family farmers.

Among those interviewed at open markets and at the producer market in the municipality, 5% reported gross monthly income of up to R $ 1,000.00. The income range between R$ 1,001.00 and R$ 3,000.00 housed 25% of the individuals, while 45% of the interviewees said they had an income ranging between R$ 3,001.00 and R $5,000.00 (FREITAS; WANDER, 2017) .

The data from the Mauro Borges Institute (2020), which assess the ratio between the wages of agricultural workers, vegetable extraction, hunting and fishing and the number of jobs in these activities, pointed out, in 2018, to an average monthly income of R $ 2,001.37 (IMB, 2020).

In this step, a rural family with an average gross monthly income between R$ 2,000.00 and R$ 5,000.00, can hardly commit about 20% of the value with the implementation of a photovoltaic energy system.

In order for the solar energy systems to expand among family farmers, state intervention is essential through public policies that act to reduce the price paid at the time of implementation and to grant financing through specific credit lines for this purpose. Therefore, the continuity and expansion of initiatives such as the Goiás Solar Program is a determining aspect to allow rural families access to the distributed generation system through photovoltaic equipment.

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