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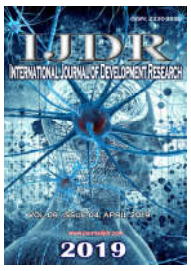

RESEARCH ARTICLE OPEN ACCESS

ENVIRONMENTAL IMPACTS ORIGINATING FROM A PILOT PROJECT IN RENEWABLE ENERGY AT THE FEDERAL UNIVERSITY OF CAMPINA GRANDE

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ABSTRACT

Due to the growth of overall energy consumption, alternatives for sustainable development are being heavily invested, as is the case of solar photovoltaic power plants. However, it is important to conduct the study of environmental impacts that are generated with such technology, seeking to prevent environmental damage expressive and ensuring more viable alternatives to the projects. With this, aims to raise the main environmental impacts on the physical, biotic and socio-from a deployment of a mini solar photovoltaic power plant in the Federal University of Campina Grande. For this reason, visits were made to the scenario of this study, accompanied by a team of students in the course of environmental engineering, where he obtained a list of the significant impacts resulting from the pilot project, in addition to researches carried out in national and international scientific studies with an emphasis on the subject under discussion. In this context, it was possible to identify positive impacts, such as the scope of research on the topic and the financial savings in energy costs, as well as negative impacts such as the use and occupation of the soil and the removal of vegetation for deployment of photovoltaic modules. However, the positive impacts presented greater prominence, given that, for this study, have become more expressive.

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INTRODUCTION

In its action plan for sustainable development, Agenda 2030, the organization of the Actions Nations stands in one of its objectives the need to produce and to give access to clean energy, which is highlighted in the goal number seven, that you should "ensure reliable access, sustainable, modern and affordable energy for all" (UN, 2015).

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According to the BP Statistical Review of World Energy (2017), there was a growth of 14.1% in the production of renewable energy in the world, the largest increase recorded in the last 10 years, driven mainly by the production of wind energy, although most significant investments have been employed in the production of solar energy (18% of total investment in renewable energies). With a huge solar potential, Brazil has in its territory more than 2,200 hours of sunshine, presenting an energy potential of 15 trillion MWh, which corresponds to 50 000 times the national consumption of electricity and MATAJS (Rodrigues, 2004).

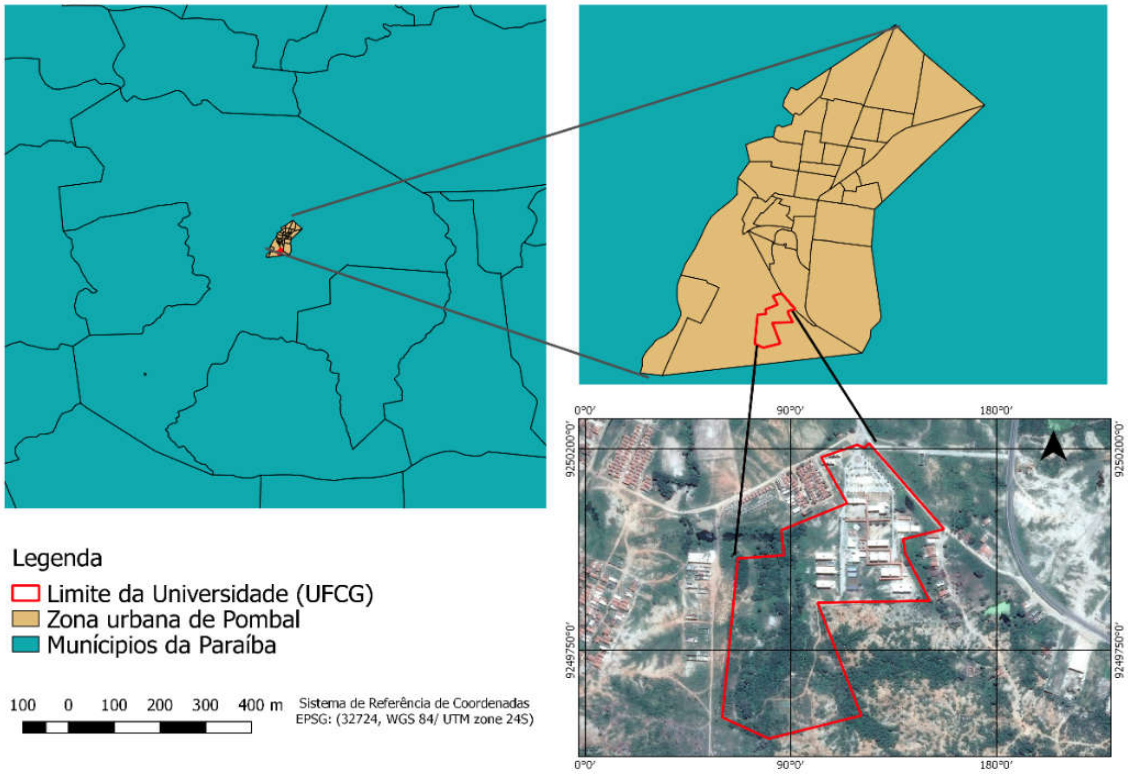

Figure 1. Location of study scenario

The states of the northeast, on a global scale, presented the highest values of solar radiation, reaching the highest average and lower annual variability, among all the geographical regions (PEREIRA *et al*., 2017). According to Ben (2017), Brazil, in the year 2016, reached 150,338 megawatts (MW) of the total installed capacity of electric power generation, obtaining an increase of 9,479 MW, where the hydroelectric turbines and solar were responsible for 26.3% of the increase of the national grid. However, new technologies bring environmental consequences. Thus, the environmental impacts occurring due to the installation of solar energy plants, be they positive or negative change, depending on its location, the physical characteristics and climate of the area to be deployed and ecosystems present there. However, when comparing the positive and negative impacts of these projects, the negatives are significantly reduced when taken into account the advantages of implantation of the photovoltaic system (TURNEY and FTHENAKIS, 2011; Barbosa *et al*., 2015).

According to CONAMA Resolution 001 of 23 January 1986, environmental impact is any change, held by man, in the physical, chemical and/or biological that modify a natural environmental condition or current, directly or indirectly, affecting the health and well-being of the population, beyond the quality of environmental resources and other activities (BRAZIL, 1986). Another definition used in literature is given by the NBR ISO 14,001: 2004, which deals with environmental impact as "any modification of the environment, whether adverse or beneficial, resulting, in whole or in part, elements of the activities or products or services of an organization" (ABNT, 2004). The identification of these impacts is performed by the Environmental Impact Assessment (EIA), the purpose of which is to consider the identified impacts, prevent damage, enable and select best alternatives of projects, plans and/or environmental programs (SÁNCHEZ, 2008).

Because of this, the objective of this work was to raise the main environmental impacts arising from the installation of the UFV UFCG Pombal (solar photovoltaic power plant), identifying the most significant impacts on the physical, biotic, and socioeconomic status of the area of influence.

MATERIALS AND METHODS

Study area: The photovoltaic power plant, UFV UFCG Pombal, popularly known as mini power plant of the CCTA, is located in the center of Science and Food Technology (CCTA) at the Federal University of Campina Grande (UFCG) on munícipio of Pombal, Paraíba. For a better interpretation of the scenario of this study, we elaborated a thematic map with the aid of the *software* of georeferencing, QGIS version 2.14.22, obtaining more precise information on the scenario of the study.

Survey of environmental impacts: The environmental impacts were raised by means of a simple listing, performed with a team of three students of the environmental engineering of the campus of Pombal, in the period of 10 and 11 September 2018. The team of students, for better identification of impacts, was present at the place to which it is installed the mini solar photovoltaic power plant. With this, each member of the team should list the major goals ali identified and, subsequently, to discuss the reason by which listed the impact quoted. However, it should be noted that each of the three students, was responsible for identifying the impacts regarding the classification of their environment, which are: physical, biotic environment and socioeconomic environment.

Literature Review

For this study, we carried out a review of the literature, in the period from August to November of the year of 2018,

employing the data base Portal de Periódicos CAPES/MEC (http://www.periodicos.capes.gov.br/), Scielo (http://www.scielo.org) and Google Scholar (https://scholar.google.com.br/). Throughout the research literature were used key words such as "renewable energy", "solar energy", "photovoltaic", "environmental impact", "Impact sociaambiental", in addition to some of their counterparts in English, such as: "renewable energy", "solar energy", "photovoltaic" and "environmental impact". The selection of the articles was made by reading the titles and their summaries, respectively, for all the results that have emerged, however we sought to prioritize work carried out in the last six years. To facilitate the inclusion of references chosen to integrate the revision of work, jobs that were selected, the key words cited above were present in the title or in their resumes. After the selection of articles, and a brief reading of them, they were directed to the software Mendeley Desktop to be better organised, facilitating the systematization of important information such as author (s), year of publication, location of the survey and the means used for their publications. Jobs that are not reported content with the purpose of the research, were excluded in order to better achieve the final selection of literary review. For the survey, it was considered that specific technical and scientific journals, national and international, prioritizing the most current, but we have also opted to include less recent articles that had relevance to the search. Thus, for the following study, sought to diversify the original research articles, reports, notes, bibliographic review, etc.).

RESULTS AND DISCUSSION

Impacts on the physical environment: Few are the potential environmental impacts on the physical environment raised due to the installation of the unit of microgeneration of photovoltaic solar energy in the campus of Pombal, given that the purpose of the investment of the mini plant on campus it is as main interest to perform searches on the characteristics of the area which was installed. A potential impact on the physical environment resulting from the deployment of solar photovoltaic power plant is the occupation of large tracts of land for their installation, once it is necessary an extensive area and relatively flat, which ends up causing, many times, the removal of components of the local vegetation (FEAM, 2016). Because of this, what stands out is the occupation and use of the soil as impact on the physical environment, since they were used 180 m² total area (Figure 2) ground of center of Science and Food Technology (CCTA), this area is to be covered by 114 photovoltaic module.

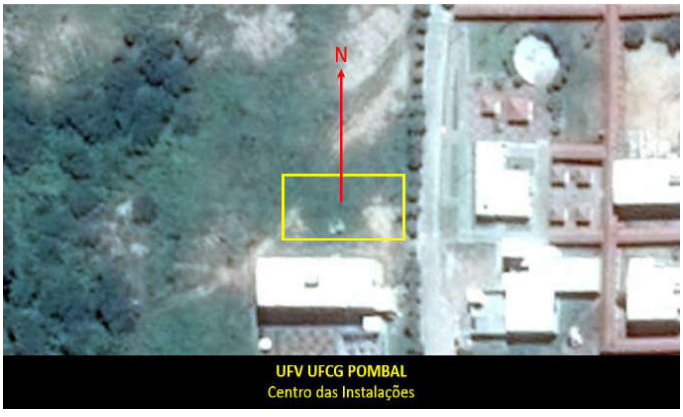

Figure 2. Location of the UFV UFCG Pombal

With the installation of the mini mill, another impact that deserves to be highlighted is the degradation of the landscape, which will eventually suffer variations according to the extension of the project to be developed, in addition to the alterations of the site to which it is built. In case of expansion of the plant, with the purpose to meet the entire demand, there will be a need for monitoring and mitigation of the area, i.e., control measures will be applied due to possible deterioration and/or degradation of the landscape.

Impacts on the biotic environment: In the case of impacts on the biotic environment, the most significant impacts observed are related to the loss of vegetation cover in the area provided and risks of accidents with animals or even caused by them. Many authors highlight the importance of vegetation cover for soil protection, conservation of local climatic conditions and preservation of resources, highlighting the human activities as the main cause for their degradation, causing suppression of natural ecosystems, (TUCCI and Clarke (1997), Menezes (2008), *apud* COELHO *et al*. (2015); Sá *et al*. (2015)). Thus, with the withdrawal of vegetation (Figure 3) to the insertion of the eucalyptus bases for support of photovoltaic modules (Figure 4), the area of deployment of the plant is vulnerable to the occurrence of erosive processes, which may cause soil movement by landslides.

Figure 3. Structure of the installation of photovoltaic modules

Figure 4. Base with eucalyptus for support of photovoltaic modules

The presence of plant cover is of utmost importance to allow the soil protection against impact, such as the soil compaction, in addition to increasing its stability. Another impact observed are the potential risks of accidents with animals, once the enterprise generates electrical discharges, which may cause accidents caused by insects, whether they are mosquitoes, bees, ants, given that their natural habitat suffered some fragmentations.

Impact on the socioeconomic environment: For the socioeconomic environment, it is possible to observe more significant impacts, ranging from the local community expectation generated in the production of new research in the academic field, such as research, study, performed here.

Social: With the installation of photovoltaic plates on the campus of The Ccta, the expectation of the Community in receiving this new technology as an alternative of renewable energy amounts, since it is expected that the project will awaken and encourage, in a certain way, greater awareness of sustainable practices in the academic center. You might say, too, that the increase of academic research generated in the academic community are being truly a significant positive impact to the campus. The researches carried out by teachers and students of higher education institution in the area of renewable energy pluralizou in the second half of the year 2018, showing the interest of ourselves for this new sphere of study.

Economical: There are still, who knows the most significant impact to the users and managers of the campus, the positive expectation with the improvement in the electrical system in place, consequently reducing costs with energy bills of the university, in the case of an autonomous system. Since, with the UFV UFCG Pombal Square, the Center of Science and Food Technology (CCTA) save, initially, a total of R$ 18,000.00 (eighteen thousand reais) per year with energy bills, having as an initial investment of R$ 160,000.00 (one hundred and sixty thousand Brazilian reais) in the pilot project. Consequently, the use of a source of clean and renewable energy, this type of project, is also seen as impact, in consequence of the high availability of solar radiation during the day in the city of Pombal. Availability this, that second CRESESB (2018), the city of Pombal offers a daily solar irradiation monthly average of 6.03 kWh/m².day, which indicates a solar potential significant for the municipality and satisfactory for projects with an emphasis on solar photovoltaic energy.

Conclusion

The global scenario has been investing heavily in the energy sector, where large countries with high development potential are adopting new renewable energy in its energy matrix. This fact happens because of the concern with the environment, primarily with the preservation and conservation of natural resources. By virtue of this fact and the progressive need to conserve and preserve natural resources for future generations, the UFV UFCG Pombal stimulates best studies to sustainable practices, consequently, better future results for the energy sector of the institution. In this way, it is important to highlight an important factor of this investment, which is the study of the environmental impacts, even if the positive impacts are predominant to negative, which allows you to celebrate, in a certain way, that projects such as this are viable from an environmental point of view. However, the environmental impact study for an autonomous system of energy at the Federal University of Campina Grande, reveals that the investment of the pilot project addressed is significantly positive for the environmental issues of socioeconomic environment.

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