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Assessment of the impact of utility-scale photovoltaics on the surrounding environment in the Iberian Peninsula. Alternatives for the coexistence with agriculture

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ABSTRACT

The rapid growth of photovoltaic solar energy, to achieve decarbonization, has been accompanied by increasing land occupation and the subsequent concern in the agroforestry sector. The increase in land area occupied has been of 20% in recent years, boosting solar electricity production to 5.9% of the total in Europe. This fact raises the question of the impact on vegetation greenness and moisture in the rural environment, something that has not always been considered.

Image analysis is presented as one of the most effective tools to estimate the variation of vegetation greenness and moisture. For this, terrestrial images, like those from unmanned aerial vehicles, can be used; however, this limits the amount of information available and/or increases the cost. The use of satellite images in different bands is a relatively new tool that can be exploited for the analysis of solar plants impact. This work presents a new way to use Sentinel imagery to analyse the impact of utility-scale solar plants on vegetation and moisture of the surrounding areas. According to our results, a moderate decrease in weighted index for both moisture (5%) and vegetation (3%) occurred after solar plant installation. It is expected that these results can be of help for the design of new PV and agrivoltaic plants, originating the Ground-Integrated Photovoltaics (GIPV).

1. Introduction

The growth of photovoltaic solar energy has been unstoppable in the last decades, and more accelerated yet in recent years. The electric energy demand, together with the decarbonization strategy of most countries, is causing the demand of photovoltaic solar energy to skyrocket [1]. According to the International Energy Agency, electricity demand is forecasted to grow at an annual rate of 3 % over the next three years compared to 2022 [2,3], with one-third of the global consumption located in China. Besides, more than one-third of the world's electricity consumption will come from renewables in 2025 [3]. Such contribution entails that CO_2 emissions are still growing, but more slowly than in former years, making renewable energies the way to reach the net-zero emissions goal.

Global electricity consumption grew from about 11,000 TWh in 1990 to more than 26,000 TWh in 2022. Even the global energetic crisis caused by the war in Ukraine made global electricity demand growth slow-down only slightly in 2022. Renewable energies as a whole are the main growing energy source, with around 400 TWh of increase in the period from 2019 to 2022. Even the initial forecast for the growth in 2023 has been overpassed and renewable energies had grown more than 1000 TWh at mid-2023.

Photovoltaics (PV) is among the cheapest ways to produce electricity, due to the descent in the price of the main element: the solar panel. Nonetheless, the success of PV has also brought criticism [4], not always based on scientific evidence and often pushed by spurious interests. Regardless of the reasons behind criticism, the occupation of the land by ground-mounted PV plants is a fact to be considered. The best scenario for the installation of photovoltaic plants would be the use of unproductive land. Nonetheless, in a context of ever-growing world population and the subsequent food demand, there is the possibility of coexistence or land sharing between PV and agriculture, recently coined

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