Agrivoltaics – a potential solution for sustainable energy use from a global perspective

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Agrivoltaics, the amalgamation of solar panels with farming methods, has been steadily gaining traction as an innovative remedy for managing the conflicting needs of land in both food cultivation and energy generation. This concept emerged in the 1980s and has since gained momentum as a viable solution to optimise land usage for sustainable agriculture and renewable energy production. This integrated production model seeks to synergize food, energy and water resources, offering a sustainable alternative to traditional land division practices. The co-location of solar panels with crops demonstrates promising results, indicating increased agricultural outputs and energy yields. While global leaders like Japan, France, Germany and China have embraced agrivoltaics, challenges in regulatory frameworks and societal acceptance persist, particularly in European nations. Economic feasibility studies, conducted through simulations, highlight promising electrical and agricultural benefits. Comparative assessments against conventional photovoltaic systems reveal potential advantages, including increased electric yield and positive impacts on crop yields. Integration of agrivoltaics into diverse farming practices, from aquaculture to horticulture, offers a holistic approach to sustainable land use, promising secondary income and enhanced crop yields. By addressing farmers' distress, agrivoltaics emerges as a unique solution, providing additional income sources and reducing reliance on traditional farming. As the world pivots towards sustainable agriculture, agrivoltaics presents a beacon of promise, poised to play a pivotal role in the world's transition towards integrated and resilient agriculture.

Keywords: Agrivoltaics, economic feasibility, global initiatives, integrated production, renewable energy, sustainable agriculture.

fuel for France's 40 million cars with biofuels would require land exceeding the country's existing cultivated area, regardless of the chosen production method. Additionally, widespread biofuel production might create competition between fuel markets in developed countries and food security in developing nations, potentially causing food shortages[2].

Since we rely on both fuel and food, sustainable land use strategy needs to consider both needs simultaneously. There are two approaches: (i) Production separation: This traditional approach splits the land, dedicating one part to food and the other to fuel crops, as is commonly done today[3]. (ii) Integrated production: This alternative approach combines food and fuel production on the same land unit. We will explore this option by focusing on the innovative concept of agrivoltaics, which co-locates solar panels with food crops[3]. Interestingly, this idea has not been explored further since its initial proposal. Combining crops for food with trees for fuel is another potential approach within this category, as explored by other researchers[2,4–6].

Agrivoltaics represents a synergy between agricultural practices and the development of photovoltaic (PV) systems, referred to as agri photovoltaics in Germany, solar sharing in India, and PV agriculture in China. This approach offers advantages for both sectors, contributing positively to the interconnected aspects of food, energy and water resources[7]. It is proposed as a solution to the increasing conflict over land use between agricultural needs and energy production[8]. The setup consists of PV panels supported by stilts, each measuring 0.8 m in width, elevated at a height of 4 m and inclined at a 25° angle[9]. Dupraz *et al.*[10] demonstrated that the agrivoltaic farm experiment yielded higher outputs than their respective monoculture equivalents. The land equivalent ratio (LER) methodology is ap-