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Photovoltaic Solar Power Plant Integrated Over Fruit Trees: Erciyes AgriPV

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Abstract

In recent years, the increasing frequency of extreme weather events has severely impacted fruit producers. Events such as agricultural frost and hail pose significant risks, while global warming has led to fruit blemishes and leaf burns. Additionally, certain fruit cultivations require the use of shading nets. Agrivoltaic (AgriPV) systems offer a promising solution to these challenges.

This study presents the design details and light distribution analysis of an AgriPV system installed over apricot trees, developed under the sub-project titled "Solar Energy for Green Transformation in Agriculture" within the Sustainable Smart Agriculture Platform (S-ATP) project. The design utilizes custom-made photovoltaic panels with a sparse cell layout, mounted on a single-axis tracking system aligned in the east-west direction at a height of 4.5 meters. Beneath the panels, there are mature trees over 5 years old, as well as younger saplings approximately 2 years old. The system comprises 120 solar panels covering an area of around 330 m². An adjacent control plot of equal size hosts trees and saplings without panel coverage.

Over the course of two years, both agricultural productivity and energy generation will be monitored to assess the dual land-use efficiency and evaluate how agricultural yield is affected by environmental stressors. The Erciyes AgriPV system is the first implementation in Turkey to integrate specially designed sparse-cell PV panels with a sun-tracking system over fruit trees. Furthermore, in 2026, a custom-developed decision-support algorithm will be activated to control the panel positioning prioritizing crop productivity, and to optimize irrigation timing based on soil moisture and ambient conditions.

Keywords: Agrivoltaic System, Solar Energy, Apricot Trees, Custom-Designed Solar Panel

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