

Effect of canopy cover level on solar radiation for conservation plant photosynthesis under the stand of cocoa plants

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Abstract. Land degradation, which is caused by erosion, is one of the causes of the decline in the quality of cocoa plants. Vegetative soil conservation technology is one of the solutions to soil conservation on land that already has plants. The obstacle to conservation plant cultivation is its existence under the stand of plants so that solar radiation is limited for photosynthesis. This study aims to determine the level of canopy cover that can pass solar radiation for photosynthesis in conservation plants under the stand of cocoa plants. Retrieval of canopy cover data obtained through direct measurement using photo images and processed using MATLAB Image Processing Toolbox with closure approach. Solar radiation measured using the NHGH09BU Photosynthetic Active Radiation (PAR) sensor. The sensor is connected to the Arduino UNO microcontroller module. The results showed that the smaller the canopy cover, the duration of radiation that can support photosynthesis is longer. Likewise, the total active radiation for photosynthesis is inversely proportional to the percentage of canopy closure, which is the effect of the duration of active radiation. Radiation above 300 Watt/m² occurs between 10.30 AM - 01.00 PM with the highest value 483 Watt/m² which occurs at 11.00 AM. Total solar energy is inversely proportional to the percentage of canopy closure and is a linear relationship with $R^2 > 0.9$.

1. Introduction

Erosion causes a decrease in soil quality, which in turn causes a decrease in the quality of the cocoa plants, this is due to the decrease in soil capacity to retain water due to rapid surface runoff and reduce soil organic matter [1]. Vegetative soil conservation technology is one of the solutions to soil conservation on land that already has plants. One of the most widely used plants for soil conservation is the vetiver plant which is recommended because it can increase soil fertility and reduce erosion [2]. At certain rainfall intensities, this plant has a good performance in terms of reducing surface runoff and soil erosion compared to using rice straw [3]. The application method is to plant vetiver plants as conservation plants under the stand of cocoa plants using a planting system that follows contour strips because, in addition to preventing soil erosion, it also reduces surface runoff and increases infiltration [4]. The constraint of cultivating such conservation plants is limited to solar radiation for photosynthesis, while the accumulation of the amount of solar radiation received by plants has a significant effect on the formation of plant biomass [5]. Thus it is necessary to conduct studies to

