

Utilization of Smart Irrigation Systems to Refine Water Management for Guam's Farmers



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Abstract

With use of a virtual decision-support tool and irrigation technology, determination of optimal irrigation and nutrient management for vegetable crops helps save costs of water and its conservation.

Introduction

Water is a vital natural resource and is one of the most important factors in agricultural production. With concerns of water scarcity due to an increase of population, urbanization, and pollution, it is critical to improve water management for the protection and preservation of this precious natural resource. This project utilizes CropManage and irrigation technology to build Guam's irrigation scheduling database for vegetable crops. Data collected will also be applied to a greater project, in collaboration with the University of Hawaii at Manoa, to broaden CropManage's parameters to the tropical regions soil and climate type.

What is CropManage?



It is a free, web-based tool developed by UC Cooperative Extension to assist farmers with accurate determination of water and nitrogen fertilizer application on a field-by-field basis within a farm. The system works, in conjunction with a water meter and weather station, to measure rainfall, humidity, wind speed, and temperature (Fig. 1, 2). With that data, CropManage will also consider climate, soil type, crop characteristics, and other factors when providing recommendations for ideal irrigation scheduling.



Figure 1: Set-up of weather station at Ija Research Experiment Station



Figure 2: Water meter used to measure amount of water in control & CropManage plots



Figure 3: Transplant of Galine eggplants at Farm to Table-Guam, Mangilao

Objectives

1. Carry out field trials for vegetable crops to develop an accessible online database for an irrigation schedule, exclusively for Guam farmers
2. Determine the benefits and limitations in using the system
3. Conduct outreach to increase awareness of water and fertilizer management to farmers and agriculturalists

Methods

As this project has been ongoing since 2019, some farms and crops were already identified. This is a continuation of crop trials to collect more data for the publicly accessible website (<https://cropmanage.ucanr.edu/>). There are three plots established in the Northern, Central, and Southern parts of Guam, which each have distinctly different soil compositions.

Phase 1: Data collection

Identification of partnered farmers, soil, weather, and crop data was determined in this phase. Importantly, soil profiles were analyzed to set-up the CropManage system to correlate with it's weather data from the weather stations installed at each farm. Within the 3 years of the project, these data collected helped formulate the crop coefficient (Kc) and crop evapotranspiration to calculate the irrigating schedule. This was then used for CropManage to suggest a real-time irrigating schedule (Fig 4).

Equation used by CropManage to generate recommended irrigation amount:

$$\text{Recommended Irrigation Amount} = \frac{\text{Total Crop Evapotranspiration}}{(1 - \text{Leaching Requirement})} - \text{Total Precipitation}$$

Phase 2: Compilation of data and outreach

More crop trials done will be to improve and test irrigating suggestions. The data will be used to compare to the beginning trials, as this is now in the refining process of field documentation and interpretation.

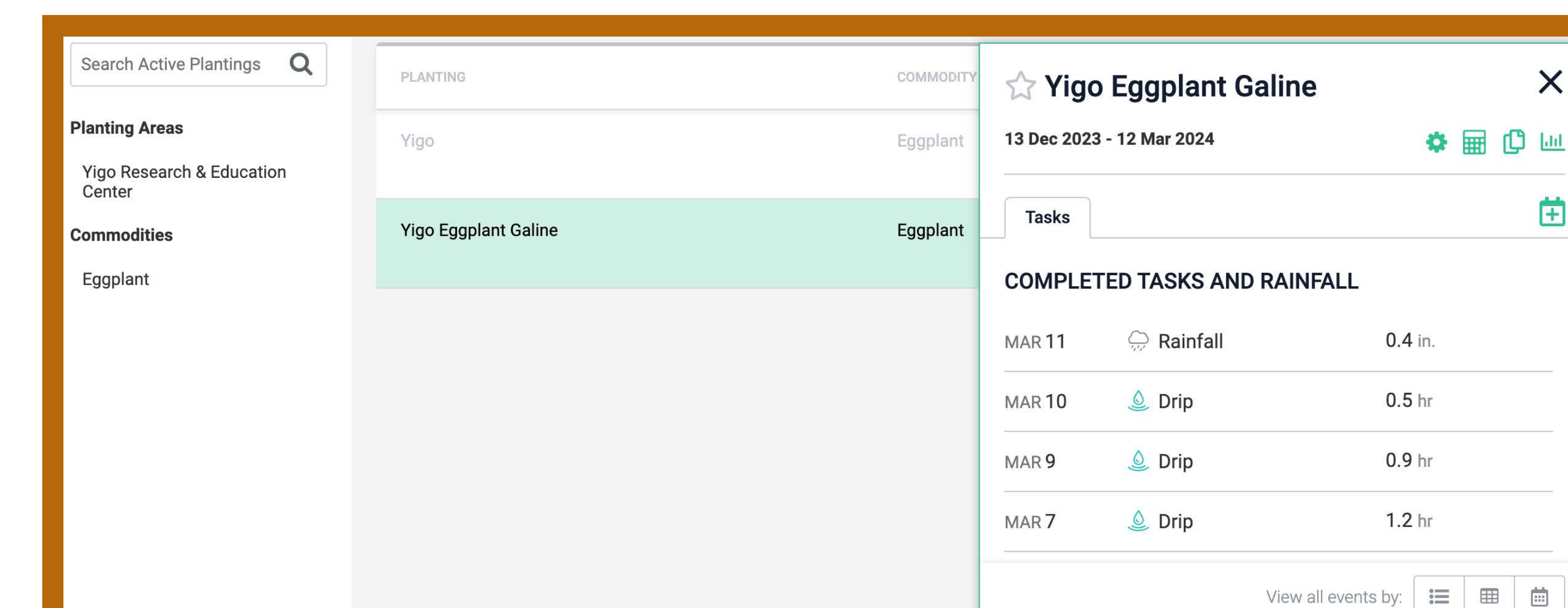


Figure 4: A screenshot of Yigo Research and Education Center database on CropManage website for Galine Eggplant. It also displays the current log of rainfall.

Results

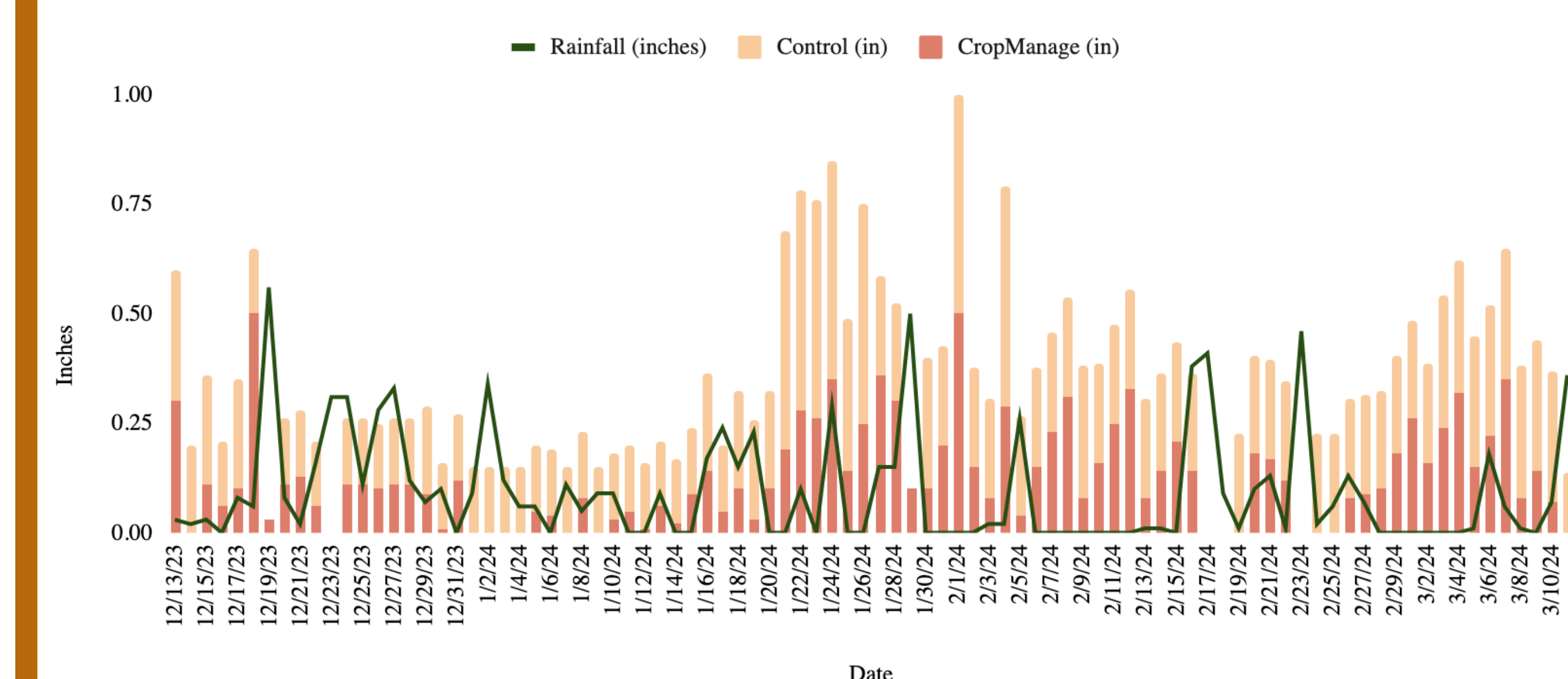


Figure 5: Rainfall vs. Irrigation

A comparison of actual rainfall (in.) from Dec 2023-Mar 2024 to the irrigation amount (in.) of a farmer and CropManage suggested plots. Figure 5 reflects the Galine Eggplant field located in the UOG Yigo Research Station.

Discussion/Conclusion

According to the graph, it is evident that a farmer's typical irrigation is significantly more than what CropManage suggests based on the weather data. Farmer's usually irrigate based on visual appearance of environment and plant status but with this web-based tool it will provide more accurate and sustainable insight into overall farm management. Furthermore, this data can help save costs of water and energy for the farmer and the island.

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