

Joseph Lance Casila<sup>1</sup>, Maegan Marie Delfin<sup>1</sup>, Ferdinand P. Galsim<sup>1</sup>, Mohammad H. Golabi<sup>1</sup>, and Sayed Bateni<sup>2</sup>  
<sup>1</sup>University of Guam, Mangilao, Guam <sup>2</sup>University of Hawaii, Manoa, Honolulu, Hawaii

## INTRODUCTION

As Guam pushes towards having a more sustainable economy, agriculture has the potential of becoming one of Guam's main sources of sustenance, besides federal funds and tourism. The high costs of irrigation, however, is a deterrent in profitability.

	Guam	Utah	Central California	Arizona
Cost per 1K gal	\$4.66	\$0.82	\$0.0061378	\$0.0011662

Table 1. Guam's irrigation rate compared to other publicly available rates in other places in the U.S.

Guam has the benefit of receiving more rainfall than some areas on the United States. However, rainfall in the Pacific is comparably more unpredictable which presents water-use issues:

- |  |   |
|--|---|
| 1. <u>Overwatering</u>                                     | 2. <u>Under-watering</u>                |
| • Disease susceptibility                                   | • Stress in plants                      |
| • Leaching of fertilizers                                  | • Low quality produce                   |
| • Limited oxygen supply roots                              | • Reduced yield and profits             |
| • Unnecessary increase in cost of water and pumping energy | • <u>Limited water capacity in soil</u> |
|  | • Reduced water availability            |

The decision of when, how much, and how long to water crops is innately subjective to a local farmer, and this can be a large source of suboptimal and costly irrigation schedules.

### CropManage: Web-based irrigation scheduling tool

CropManage is a tool that can help farmers with irrigation decisions. The tool uses information specific to individual farms like soil type, crop type, water chemistry, and atmospheric data in order to generate optimal irrigation times and amounts that are appropriate to a crop's growth stage.

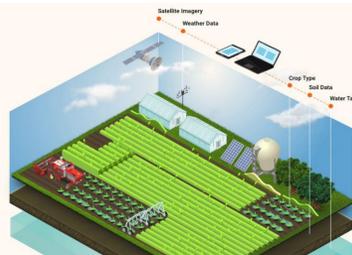


Figure 1. Diagram of CropManage.

Plants lose about 97% of their water through transpiration, while water for root uptake is lost through evaporation. Rain, however, is the process that replenishes this source of water. These two water loss and gain processes are what the recommendations are mainly based on.

### Why implement a water scheduling system?

- Lowers farmers' cost of water and labor
- Reduces fertilizer costs by minimizing leaching
- Minimize stress on crops
- Increase crop quality and yield, thereby increasing crop profit

## PROJECT OBJECTIVES

- Perform community outreach and implement a CropManage irrigation schedule customized for each local farm on Guam
- Assess effectiveness of CropManage through crop yield and amount of water saved

## METHODS

### RESEARCH FIELD AND EXPERIMENTAL DESIGN

At the University of Guam Yigo Research Station, 88 eggplants were planted in a 0.0768 acre plot with a Guam cobbly loam (3-7% slopes) soil type. Drip lines were laid out as seen in **Figure 2**, dividing the plot into 8 rows with alternating designations between CropManage and Control irrigation. Each row had 11 eggplants, totaling 44 for each irrigation schedule. To measure the difference in the amount of water applied for both schedules, two water meters were installed after the junction that divides the main water line. CropManage sections were irrigated with CropManage's recommended irrigation times while Control sections were irrigated constantly 2 hours per day. Application of fertilizer, pest and weed control were uniform throughout the whole plot. Eggplants produced by each of the 88 plants were harvested weekly and weighed.

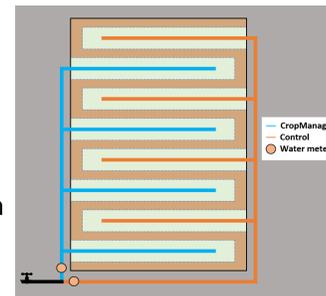


Figure 2. Irrigation setup of test plot

### HOBO RX3000 REMOTE MONITORING STATION:

Weather station was used to log the following in 1-hour intervals everyday:

- Rainfall
- Temperature
- Wind Speed
- Gust Speed
- Relative Humidity
- Dew Point
- Solar Radiation

### GENERATING DAILY CROPMANAGE IRRIGATION TIMES

1. Atmospheric data is collected from the field site by the weather station and then uploaded to the online HOBOLink server
2. CropManage then accesses the HOBOLink server to import the daily atmospheric data. Evapotranspiration is then calculated.
3. Once CropManage acquires field data, local farmers will be able to go online and generate an irrigation recommendation for the day



Figure 3. Flow chart that describes how atmospheric data is to make optimal irrigation times

### CANOPY% MEASUREMENT AND ANALYSIS

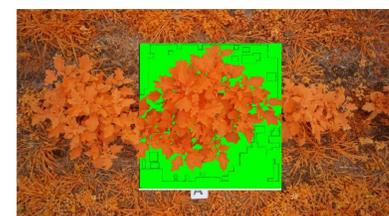


Figure 4. Near-infrared photograph of eggplants. Green and orange areas represent soil and canopy respectively.

To assess crop growth, near-infrared photos of 10 randomly chosen eggplants from both CropManage and Control schedules were taken at a height of 14.5ft using a Sony multi-spectral digital camera. Photos were cropped within a 5 ft<sup>2</sup> quadrat and analyzed using a segmentation algorithm in PixelWrench2.

## RESULTS

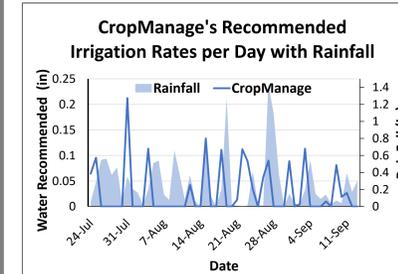


Figure 5. CropManage increases irrigation rates after low-rainfall days.

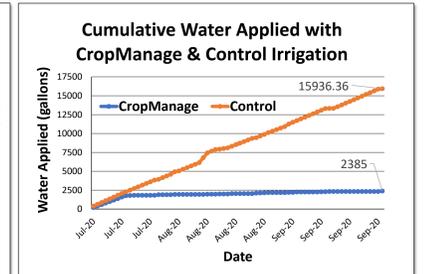


Figure 6. CropManage applies 2,385 (gal) Control applies 15,936 (gal)

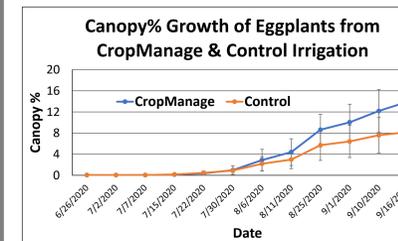


Figure 7. Crops irrigated with CropManage had higher growth in canopy% than Control

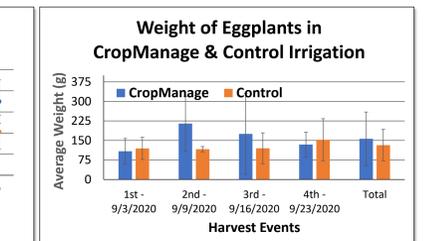


Figure 8 Crops irrigated with CropManage had greater weight than Control

## DISCUSSION

In a 0.0383 acre plot for eggplants, CropManage saved about 13,551.36 gallons of water, an 85% decrease.

Future studies will incorporate these different variables:

- Crops
- soil types
- Seasons
- actual farmer's watering schedule

### Projected Cost of Irrigation per acre in Several U.S. Locations

	Guam	Washington	Utah	Arizona	Central California	South California	Central Valley, California
0.0384 acres	\$ 71.71	\$ 142.32	\$ 13.07	\$ 0.02	\$ 0.10	\$ 0.98	\$ 1.96
0.5 acres	\$ 933.77	\$ 1,853.12	\$ 170.15	\$ 0.24	\$ 1.27	\$ 12.74	\$ 25.47
1.0 acres	\$ 1,867.54	\$ 3,706.23	\$ 340.31	\$ 0.48	\$ 2.55	\$ 25.47	\$ 50.94
2.0 acres	\$ 3,735.08	\$ 7,412.47	\$ 680.62	\$ 0.97	\$ 5.09	\$ 50.94	\$ 101.89

Table 2. Comparing irrigation costs between several locations highlights Guam's costs

## ACKNOWLEDGEMENTS

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