2026 El Dia Video Proposal
Trevor Askins

Scientific Gap

Water costs and sensor costs are two of the primary areas that, if used in the most cost-effective ways, can allow local farmers to stay competitive in the evolving market. In this study, it is proposed that machine learning can be used to maximize cost savings in both areas. It has been shown that soil fluxes can be predicted, given the correct soil data (Clutter, 2016 and Groenendyke, 2025). By predicting soil flux, the efficiency of irrigation of crops can be maximized throughout a season. However, soil fluxes change by the day, and one must constantly update site data to manage irrigation practices. By using cost weighted machine learning it is possible to identify the cheapest sensor layout needed to obtain the data resolution necessary for optimal irrigation (Groenendyke, 2025). If the machine learning process is completed for various scenarios, ranging from general to specific, the factors most relevant to cost-efficient sensor layouts can be identified. Furthermore, schemes for cost efficient sensor layouts can be recommended without site specific analysis.

Social Value

As the human population grows the need for food security grows with it. However, land and water availability to produce crops is not increasing. In fact, farmland and water suitable for irrigation have declined in many parts of the world. One solution to this growing imbalance has been major efficiency efforts in the agricultural sector. Yuma county in Arizona has seen a 30% reduction in water use, but a 30% increase in crop yield per acre. This is possible by the wide array of advanced sensors used in the area to allow active and passive monitoring.

Unfortunately, the high-fidelity sensor arrays used on corporate farms are not available to the local farmer operating on a tight budget. More than anyone, the local farmer needs to maximize growth while cutting expenses everywhere that is feasible. If sensor layouts can be cost optimized and assigned without site specific analysis, local farmers will see financial benefit at both ends of the irrigation process (Figure 1).

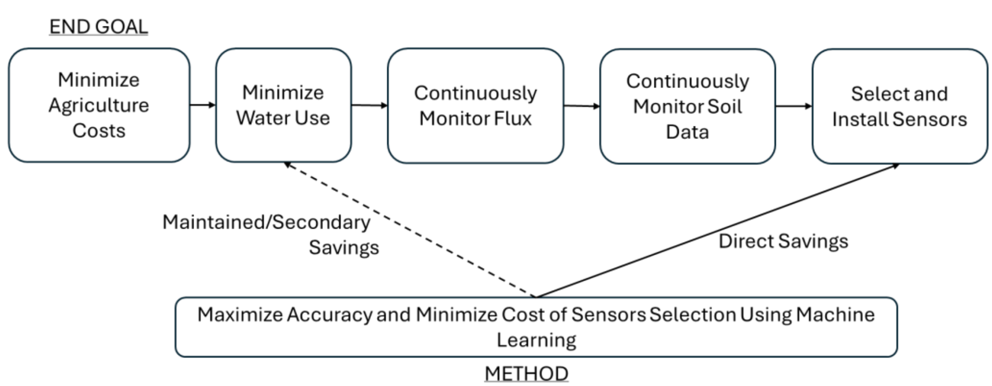

Figure 1: Proposed analysis linked to the current flow of irrigation efficiency. Machine learning can be used to create savings in one area of farm efficiency (sensor arrays) while maintaining, or even improving, previously realized saving in irrigation techniques.

Analysis Plan

Our goals will be achieved by use of high-fidelity data sets in HYDRUS-1D and open-source decision trees available from scikit-learn. The decision tree from scikit-learn will be modified to prioritize accuracy and cost. The cost modification will have multiple forms to test how sensitive results are to regional costs. HYDRUS-1D data sets will be used to train and test the decision trees.

The variables HYDRUS-1D has available for consideration will be altered to create different scenarios. Some scenarios will only fix the most basic variables while others will fix as many variables as possible (crop type, irrigation techniques, etc). By running multiple scenarios with changing restrictions, results and recommendations may be made for different regions.

Timeline and Milestones

31 March – Baseline decision tree created and tested, replicating previous work in the field

30 April – Refine decision tree for various cost weighting and produce new sensor choices

15 May – Consult with local farmers to identify appropriate variable manipulation in HYDRUS

31 May – Relax and constrain HYDRUS data to observe effect on decision tree

30 Jun – Draft Written

31 Jul – Presentation of findings