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## Sustainable Agricultural Intensification through Crop Water and Nutrient Management Optimization

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# Sustainable Agricultural Intensification through Crop Water and Nutrient Management Optimization

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**Abstract:** To meet the needs of the Earth's growing population, three key challenges need to be addressed in the 21st century; namely food, energy, and water security. The demands of the growing population require that each of these sectors increase their output. However, given the interconnected nature of these sectors, sustainability is required to insure that the global demands for all three are still met while preserving the environment. In this study, optimization was used to determine when irrigation and fertilizer should be applied to maximize crop yield while minimizing environmental impacts at the farm level. To do this a multi-objective optimization technique, Non-dominated Sorting Genetic Algorithm-III (NSGA-III) and crop model, Decision Support System for Agrotechnology Transfer (DSSAT), were utilized to identify optimal solutions that represented the tradeoffs between crop yield and environmental impact. Identifying a set of possible solutions allows producers and decision makers to select the solution that best fits their situation. For this study, this technique was implemented and successfully identified irrigation schemes that reduced the water use by 50%. Given this success, the next step is to develop a web-based decision support tool that allows for the wide-spread use of the technique developed in this study by both policy makers and producers. Allowing them to perform optimizations with multiple conflicting objectives while taking into account a variety of soil, crop, and climate types.

**Keywords:** Crop Modeling; Optimization; Water and Nutrient Management; DSSAT; NSGA-III.