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Metaheuristic Algorithms for Smart Agriculture Optimization in Potato Farming and Water Management Systems

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Abstract:

Smart agriculture systems increasingly rely on intelligent algorithms to enhance productivity and sustainability, particularly in water-intensive crops such as potatoes. This research proposes a metaheuristic optimization framework for improving resource utilization and crop yield in smart potato farming. The system incorporates real-time data from IoT sensors monitoring soil moisture, temperature, humidity, and nutrient levels. Metaheuristic algorithms—including Genetic Algorithms (GA), Particle Swarm Optimization (PSO), and Ant Colony Optimization (ACO)—are employed to optimize irrigation schedules, fertilization strategies, and planting decisions. The integration of these algorithms enables adaptive decision-making under dynamic environmental conditions, significantly improving water efficiency and crop performance. Experimental validation on smart farm datasets demonstrates the effectiveness of the proposed approach in minimizing resource waste and maximizing agricultural output, contributing to the broader goals of precision agriculture and environmental conservation.

Keywords:

Smart agriculture, metaheuristic algorithms, potato farming, water management, IoT, crop optimization.

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