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# Agricultural operations planning for diverse farming systems: a resource constrained scheduling and routing problem

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Agricultural operations planning remains inherently challenging. The production of crops requires a sequence of operations over a growing season, such as soil preparation, seeding, irrigation, and harvesting. Agricultural companies must therefore schedule diverse tasks across multiple fields and route the related heterogeneous resources while accounting for skill compatibility, time windows, precedence, resource synchronisation, and unavailability of the fields. Problems that combine scheduling and routing, as in this case, have been studied in analogous contexts, such as home healthcare, and technician maintenance, where optimisation models have proven effective in supporting operational decisions. Although some work has begun to address agricultural operations, it does not fully account for the combination of features that characterise this context.

In this study, we address this gap by modelling this problem as a Resource Constrained Scheduling and Routing problem (RC-SRP) to gain insights into how agricultural operations can be scheduled efficiently. We develop and compare two solution methods, using Mixed Integer Linear Programming and Constraint Programming alongside a fast construction heuristic. Additionally, we design agronomically feasible instances, which we use to evaluate the effect of more diverse agricultural practices in operational costs and efficiency. Our results show that more diverse agricultural practices have the potential to lower operational costs significantly, compared to monoculture, mainly since it allows to avoid peaks in demand for critical resources that have to be otherwise outsourced. We discuss these results and their managerial implications for agricultural practice.