**Risk-based evaluations of competing agronomic climate adaptation strategies: The case of rice planting strategies in the Indo Gangetic Plains**

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# Abstract

CONTEXT: Adjusting crop planting dates and variety durations is emerging as a crucial climate change adaptation strategy for many cereal systems. Such strategies include harmonizing crop planting with the onset of the rainy season or planting at specific recommended calendar dates. Evaluations of these strategies mostly consider yield and yield variability, but focus less on financial risks associated with different planting strategies. However, choosing recommendations amongst competing levels of yield and yield stability is not straightforward and need to cater to farmers that are risk averse – especially financially.

OBJECTIVE: Here, we present a novel framework that uses a computational spatial ex-ante approach using golden section search algorithm and second order stochastic dominance for risk-based evaluations of agronomic adaptation options. This framework allows development of climatic risk proof recommendations such that even risk averse farmers would find it profitable to adopt that strategy

METHODS: We use a second order stochastic dominance approach that is paired with computational optimization—Golden section search algorithm. To demonstrate our approach, we compare the yield risks and economic risks associated with readily available gridded crop simulation outputs for various rice planting strategies across the Indo-Gangetic Plains – a major region experiencing food insecurity and climate impacts.

RESULTS AND CONCLUSIONS: Our findings provide quantitative evidence about the riskiness of previously recommended rice planting date strategies. Our risk-based assessment corroborates the recommendation for planting long-duration varieties at the monsoon onset in the Eastern IGP, and at state-recommended planting dates in most of the Western and Middle IGP. Importantly, our risk-based assessment shows where the results are not as clear cut and which strategy is the least risky. This is especially important in the Middle IGP where farmers appear to have more flexibility to achieve comparable outcomes with several planting strategies.

SIGNIFICANCE: In conclusion, our approach provides a useful and novel tool for comparing different agronomic climate adaptation strategies from an economic risk perspective in a spatial framework.