Improving performance of index insurance using crop models and phenological monitoring

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Outline

1 Risk of extreme weather events

2 Weather index insurance

3 The goal of study

4 Methodology and case study

5 Results and next steps

Risk of extreme weather events

- Over the years climate risks are creating significant impacts on agriculture communities.
- Extreme events include adverse weather conditions such as global warming, heat waves, floods, etc.
- Risks need to be managed efficiently to reduce negative impact of extreme events.
- Farmers in communities need to understand & predict weather conditions to determine which management practices they should use in their geographical locations.

Index insurance

Index insurance is coverage based on an ‘index’ which is correlated with farmers’ losses
Index insurance pays out farmers based on an index, such as rainfall or temperature, rather than based on response of farmer’s crop yield to them (rainfall deficit).

Farmers get paid only if this index falls above or below a pre-defined threshold.
if the maximum temperature value rises above a pre-defined threshold, then the insurance pays out.

Index insurance is more accessible to smallholder farmers than traditional insurance.
Unlike traditional insurance schemes, the insurance company does not require to measure damages which makes this scheme to be less expensive.

Index insurance should accurately capture the damages and farmers’ loss on the ground.
The payment of index insurance highly depends on accuracy of index products and quality of the datasets used in them.

Vegetation levels (a ‘satellite-based’ index)

Growing season rainfall (a ‘weather-based’ index)

Average regional yield losses (an ‘area yield’ index)

The goal of study

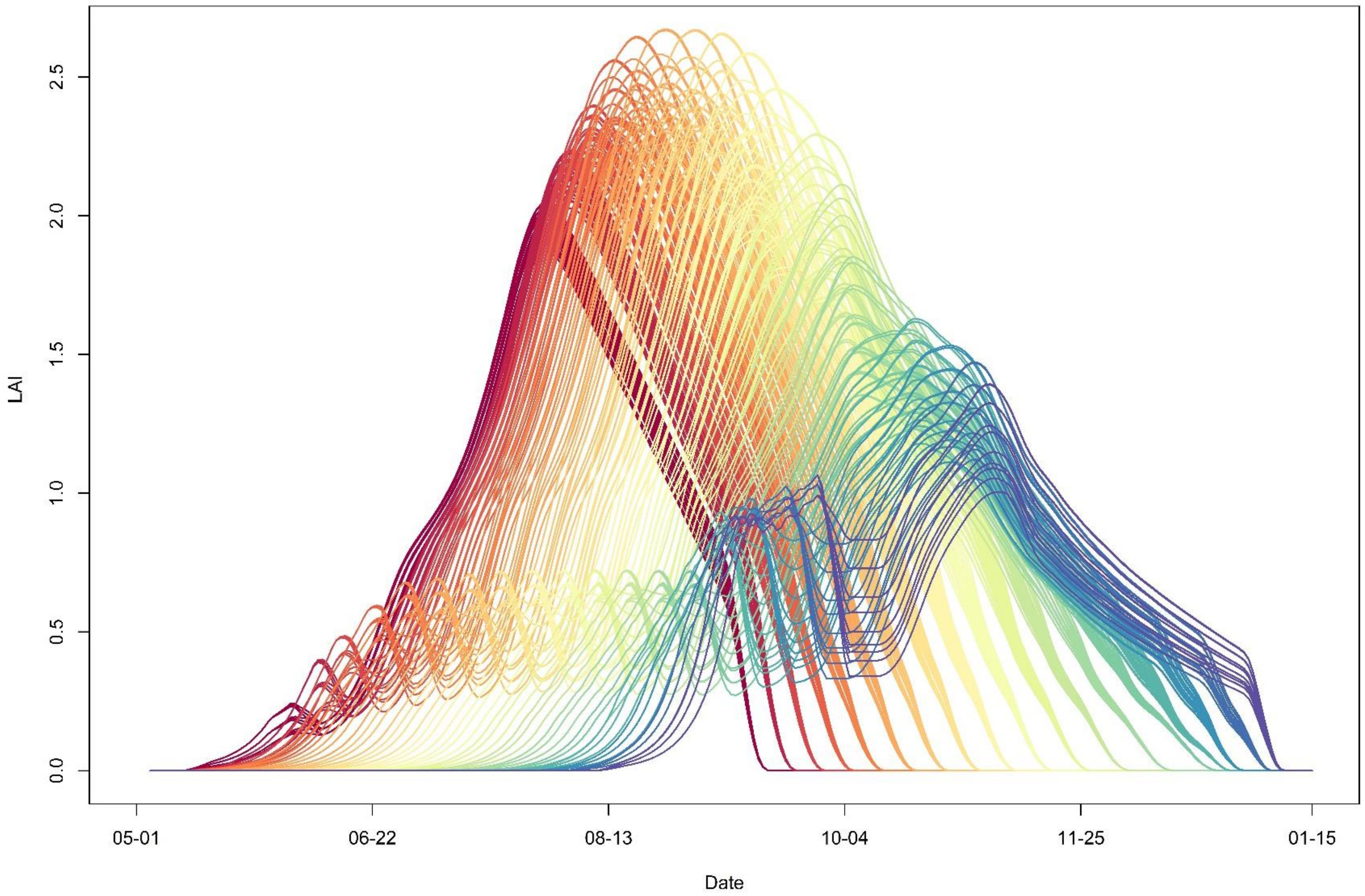
Existing weather index-based insurance contracts is that payouts are triggered based on weather indices defined over fixed calendar periods

In reality, the timing of crop's sensitivity to weather often varies significantly between individual plots or farmers due to their management practices (e.g., sowing date, cultivar)

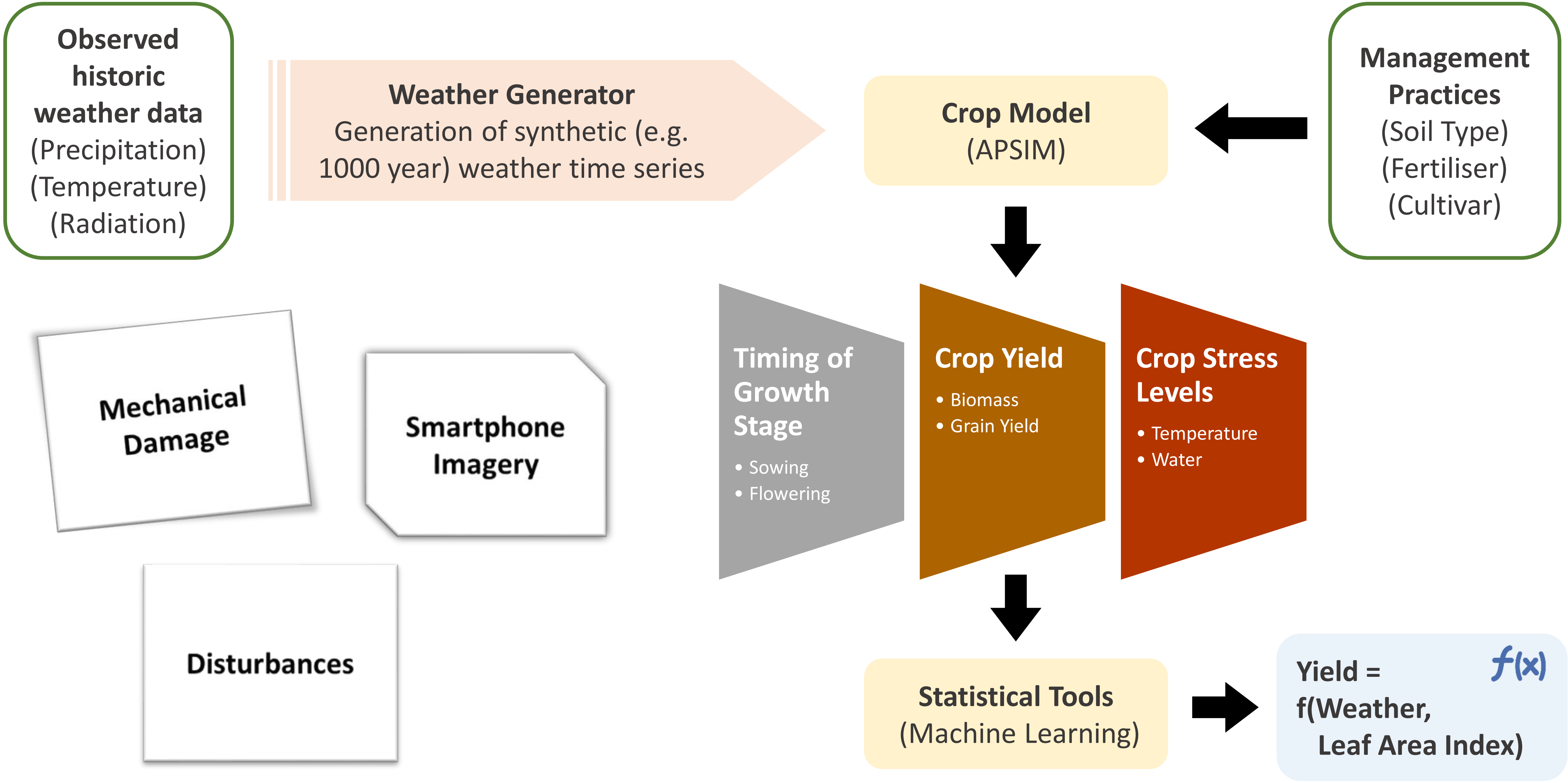
Failure to consider this heterogeneity is potentially a significant driver of basis risk.

The goal of this study is to improve the quality of index insurance by designing phenology-specific insurance contracts.

Variation of LAI profile for different transplanting dates



Methodology



Study area & management practices

Management Practices for Rice

Sowing dates *5 day interval*

Seedling ages *(20-50 days)*

Fertilizer at transplanting *50-150 kg/ha*

Irrigation *No- partially- full-irrigation*

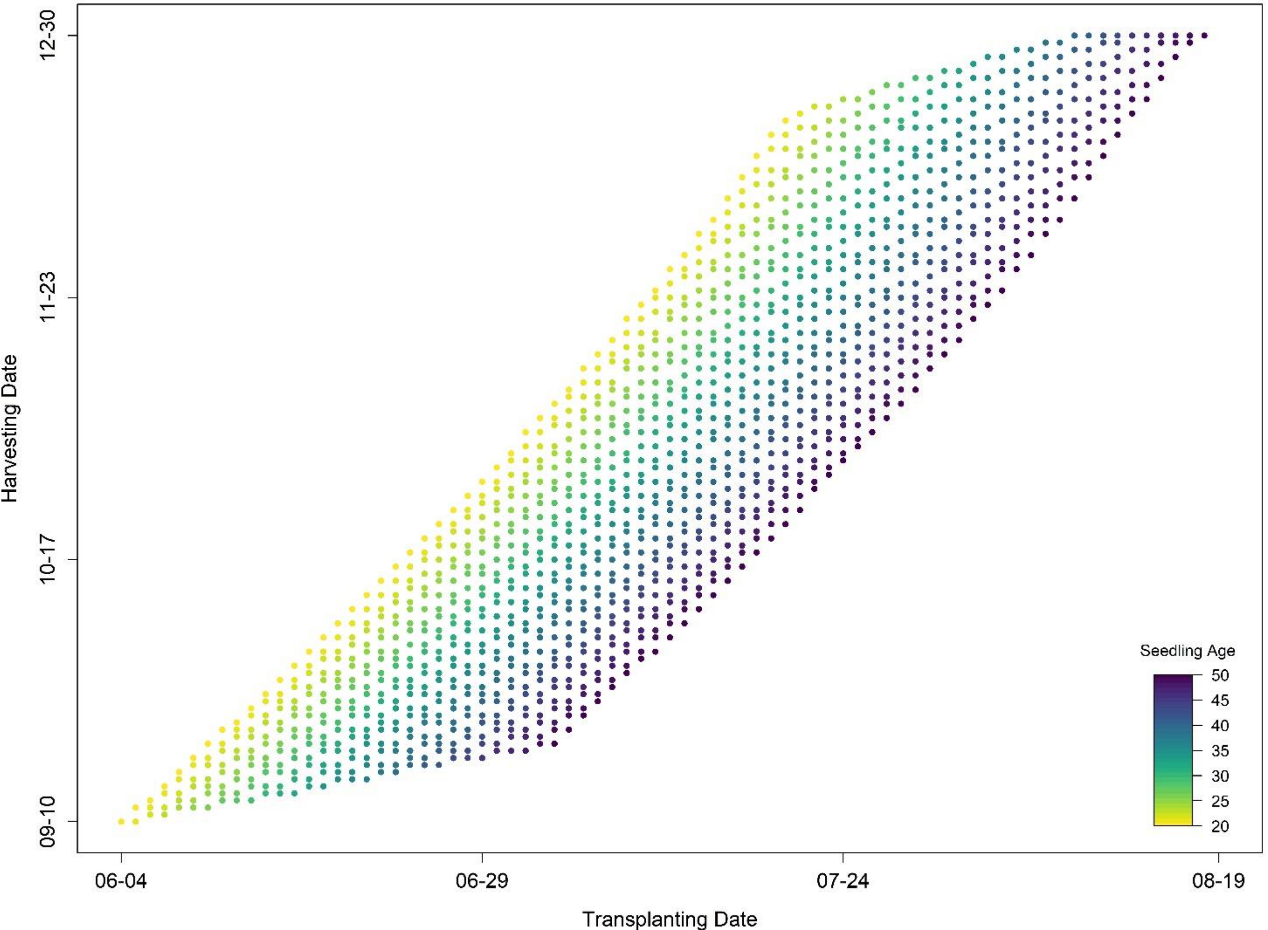
Plants density *100-200 plants/m2*

Other factors:

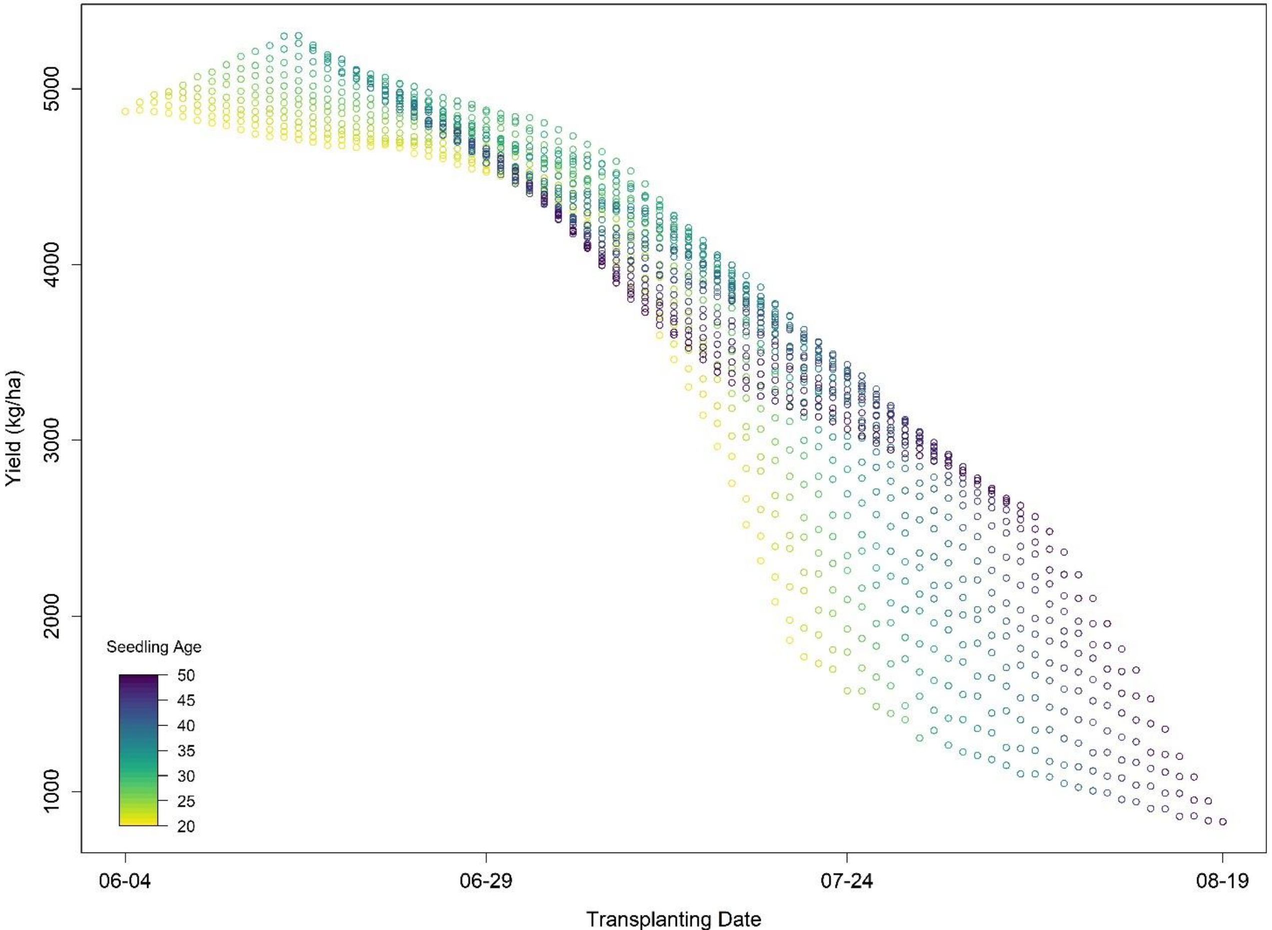
- *Cultivar*
- *Initial soil fertility*
- *Soil type*

Results – management practices (rice)

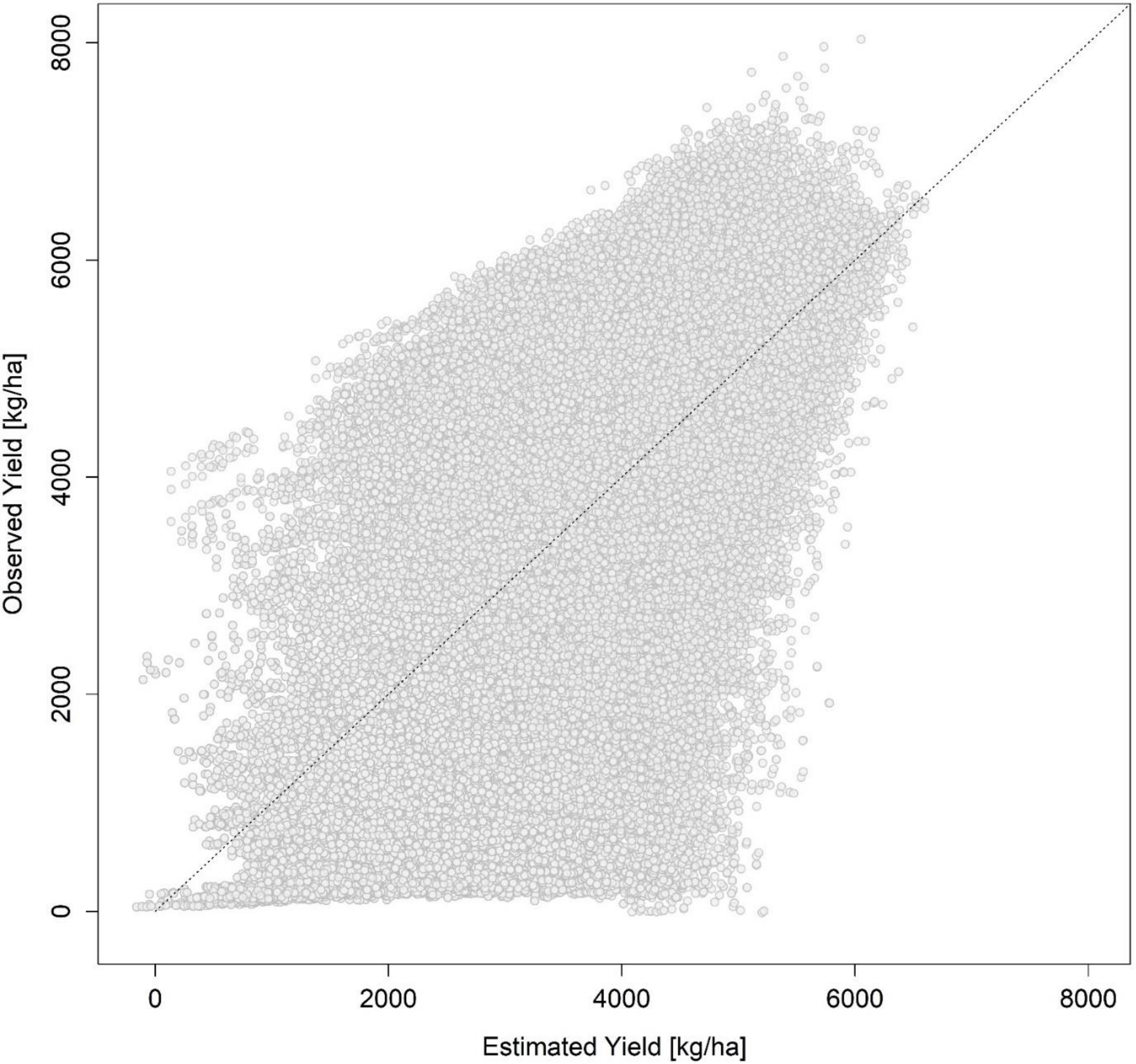
Impact of transplanting date and seedling age on harvesting date



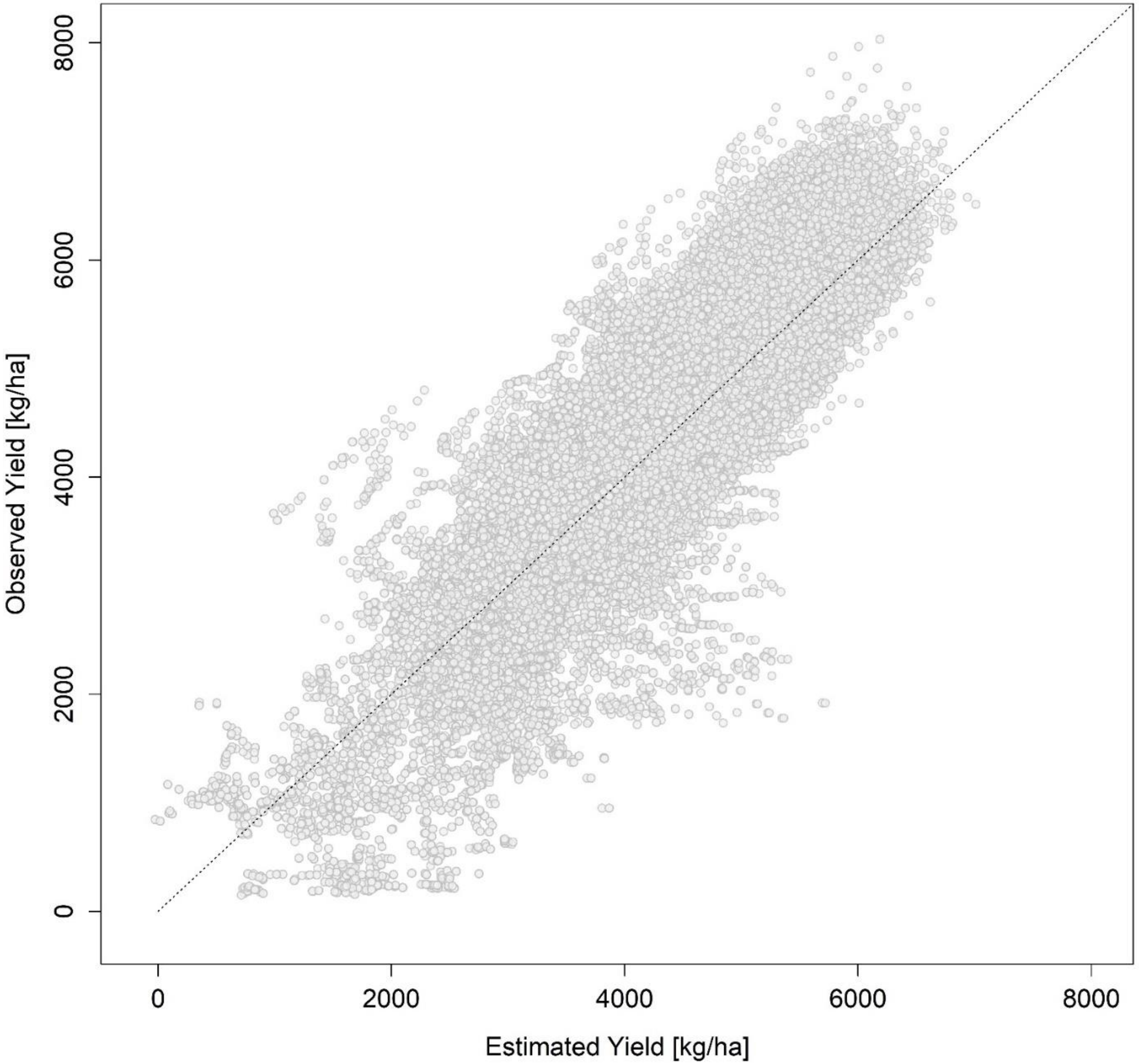
Impact of transplanting date and seedling age on crop yield



Calendar based rice yield estimates
Statistical model (nonlinear) estimates versus
APSIM simulations



Phenological based rice yield estimates
Statistical model (nonlinear) estimates versus
APSIM simulations



Results – rice yield estimation

Independent Variables: Temperature, Precipitation, Leaf Area Index

May2Dec: Get independent variables between May and December as a single observation

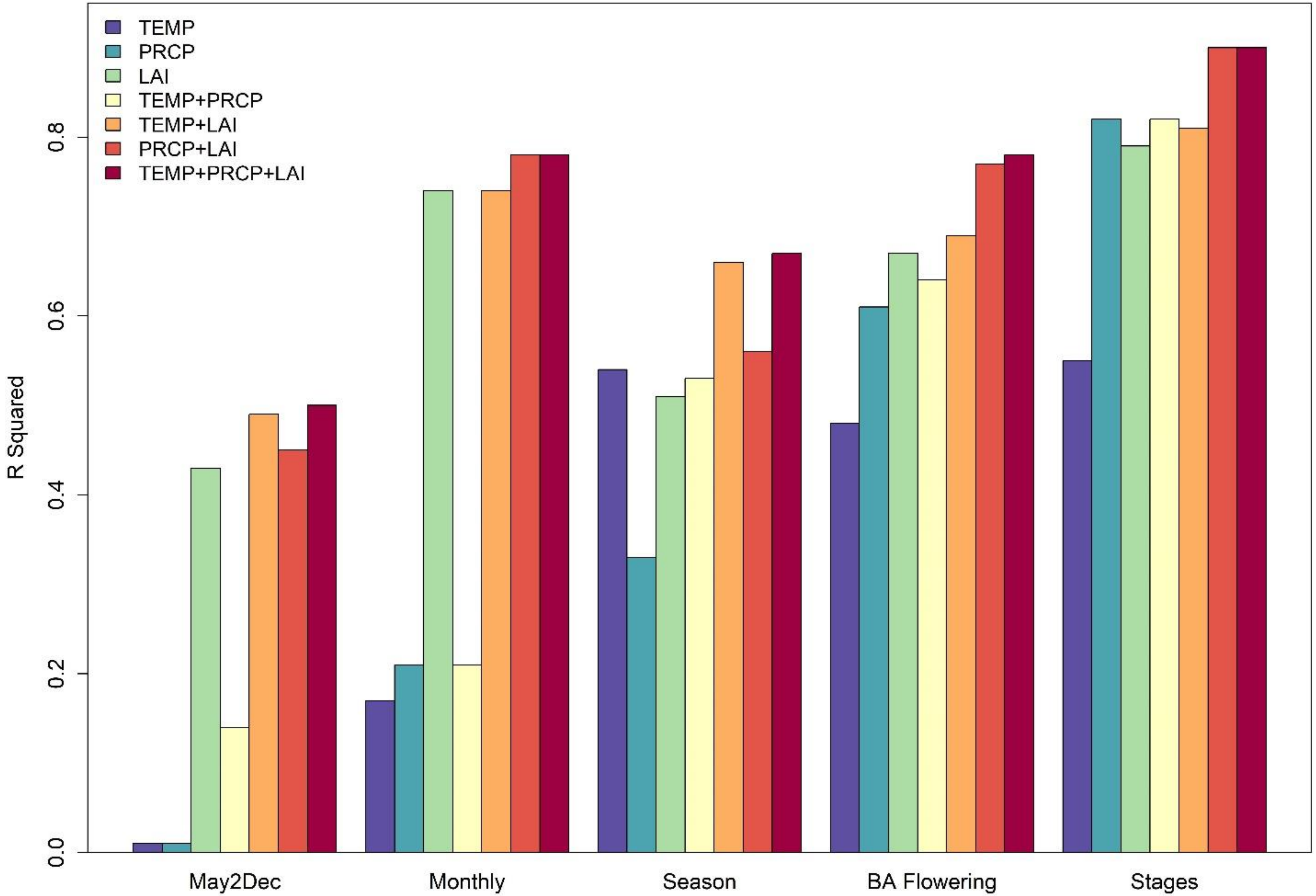
Monthly: Independent variables are obtained on each month separately

Season: Independent variables are obtained over season (time varying) as a single observation

BA Flowering: Independent variables are obtained over two periods of before and after flowering (time varying)

Stages: Independent variables are obtained over each stage separately.

Comparison of different heterogeneity levels on rice yield estimation



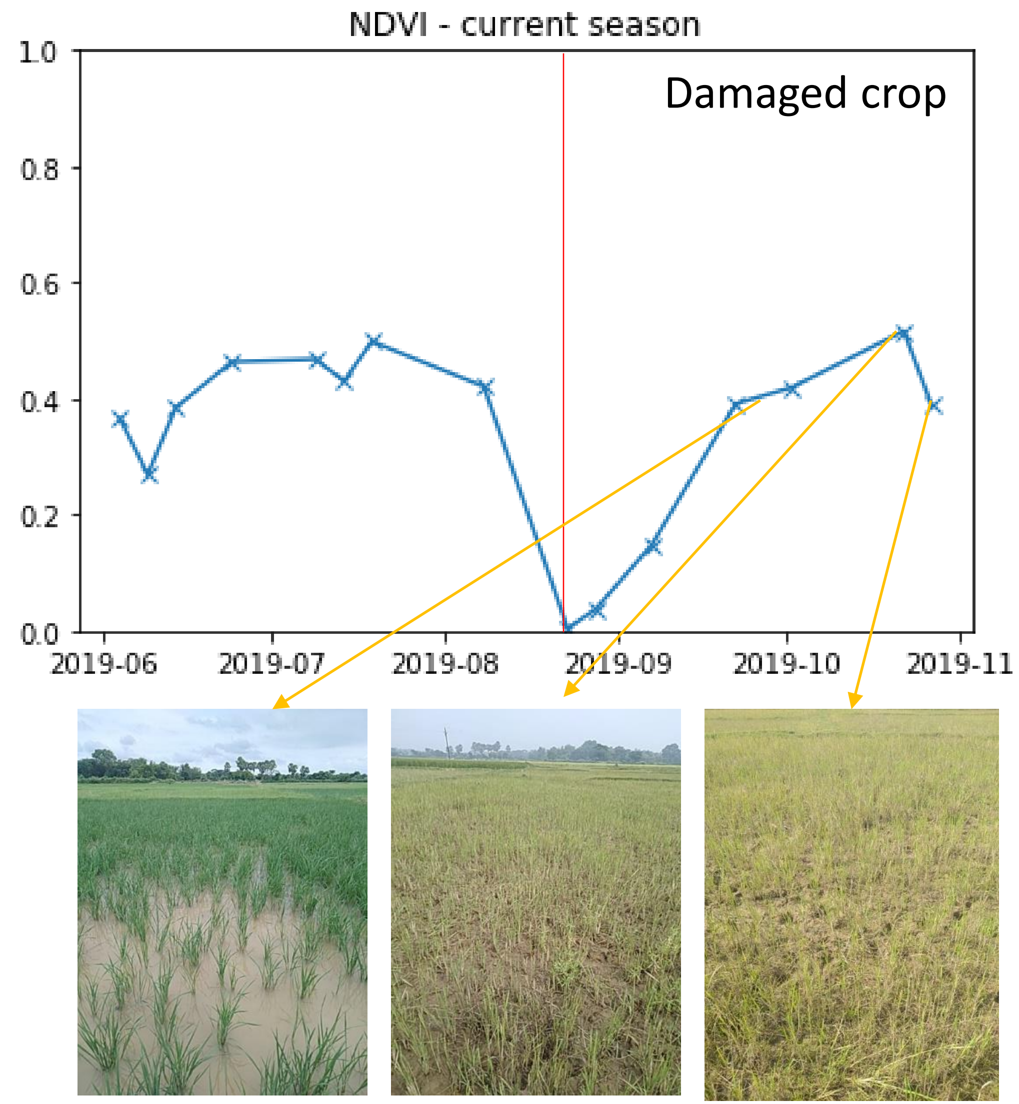
Concluding remarks

Statistical models can estimate APSIM simulated yields with good accuracy.

crop phenological based approaches perform better than fixed calendar dates approaches.

Leaf area index is the main driver of yield estimations in statistical models

Adding information about leaf area index helps statistical model both in fixed calendar- and phenological-based approaches.



Next steps

Apply developed statistical models in order to estimate observed yields.

Assessment of the impact of observed damages through remote sensing and smart phone imagery on residuals of estimated yields by statistical models.