Innovative value assessment for seasonal climate forecasting

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Outline

- Our basic premise
- Publications
- Objectives
- The present study
  - Sowing decisions in wet season rice cropping
  - Valuation method
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  - Discussion
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  - Conclusion

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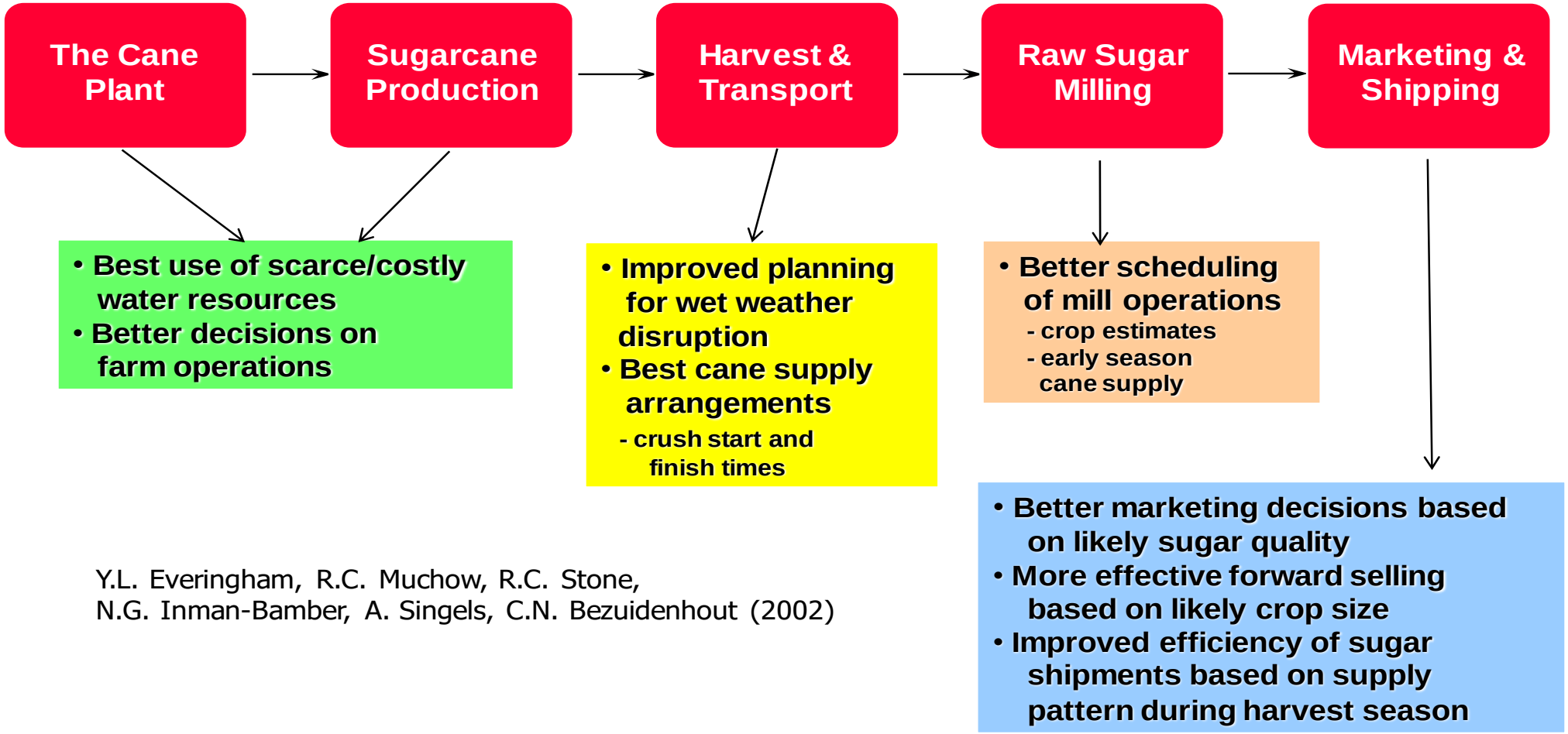
"Our basic premise: Seasonal climate forecasting has no value unless it changes a management decision"

A sugar industry example: need to understand decisions across the supply chain:



Y.L. Everingham, R.C. Muchow, R.C. Stone, N.G. Inman-Bamber, A. Singels, C.N. Bezuidenhout (2002)

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Publications

Climate Services
Volume 22, April 2021, 100234

A framework for assessing the value of seasonal climate forecasting in key agricultural decisions

Duc-Anh An-Vo [a], Ando Mariot Radanielson [b], Shahbaz Mushtaq [a], Kate Reardon-Smith [a], Chris Hewitt [a, c]

European Journal of Agronomy
Volume 104, March 2019, Pages 37-48

Value of seasonal forecasting for sugarcane farm irrigation planning

Duc-Anh An-Vo [a, b], Shahbaz Mushtaq [b], Kathryn Reardon-Smith [b], Louis Kouadio [b], Steve Attard [c], David Cobon [b], Roger Stone [b]

Value of seasonal climate forecasts in reducing economic losses for grazing enterprises: Charters Towers case study

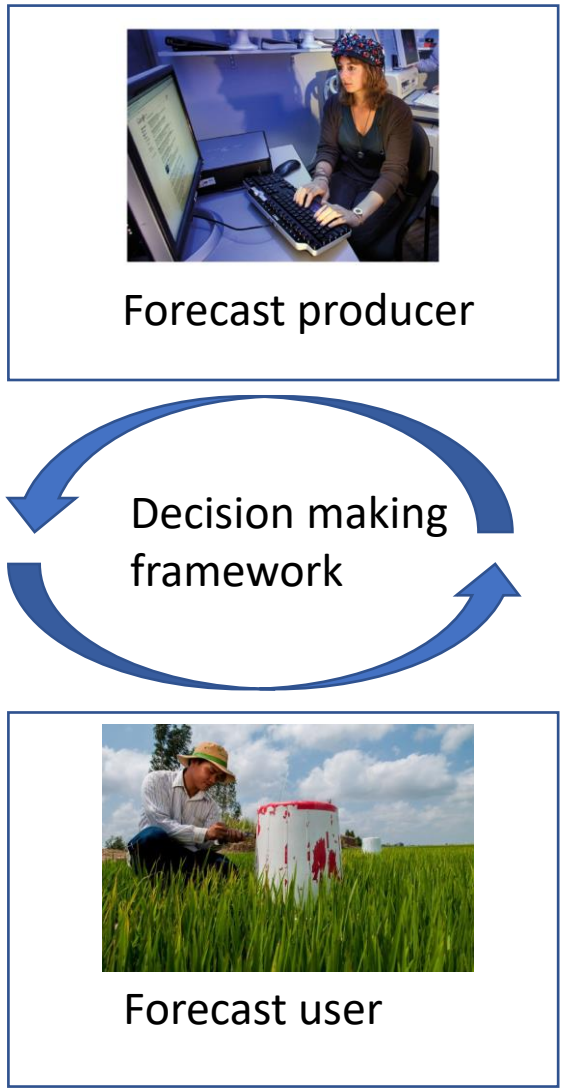
Duc-Anh An-Vo [A B C], Kate Reardon-Smith [A C D], Shahbaz Mushtaq [A C], David Cobon [A C], Shreevatsa Kodur [C] and Roger Stone [A C]

+ Author Affiliations

The Rangeland Journal 41(3) 165-175 https://doi.org/10.1071/RJ18004
Submitted: 23 January 2018 Accepted: 29 May 2019 Published: 11 July 2019

Objectives

- Forecast use framework
- Handle forecast uncertainty
- Economic model for decision making
- Provide evidence of forecast potential values in Greater Mekong Region (GMR) agriculture



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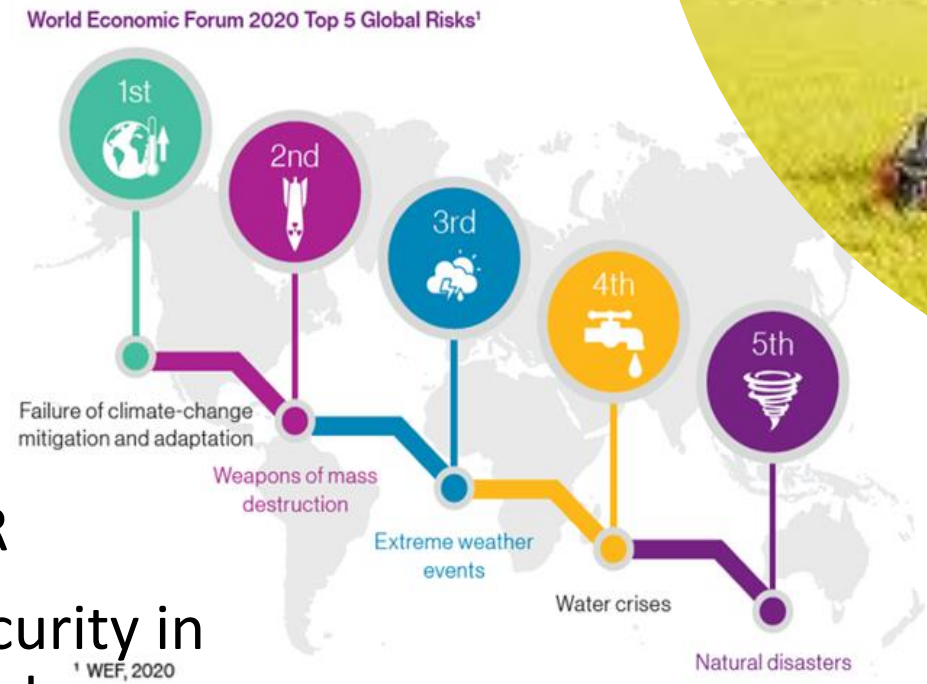
Introduction



- Climate risk in GMR
- Challenge: Food security in the face of climate change
- There is limited uptake of advances in seasonal climate forecasting

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Sowing decisions in wet season rice cropping

- **Climate:** 2 seasons – wet season (May to October) and dry seasor (November to April)
- **Wet season:**

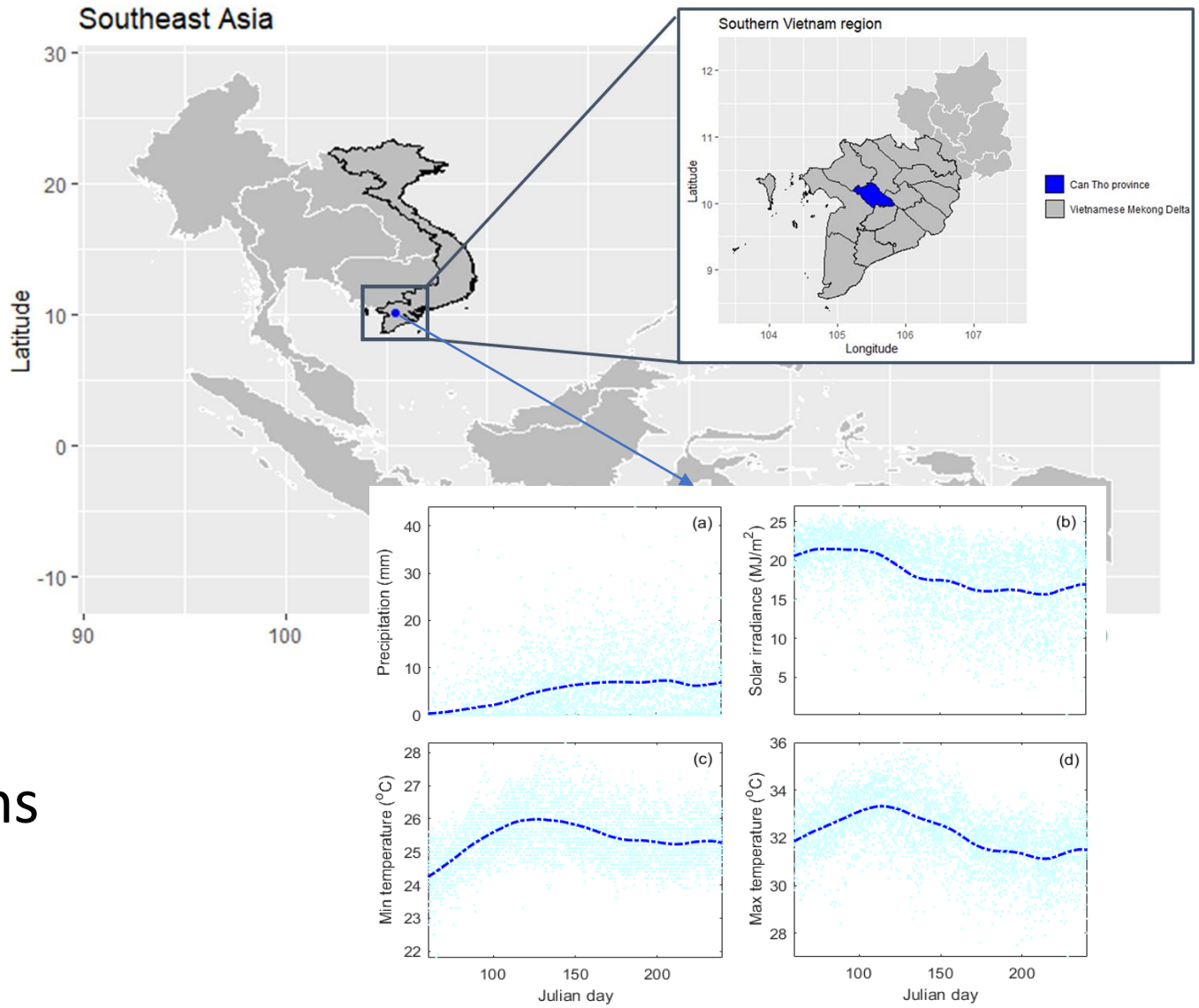
✓ 80% annual rainfall

✓ Significant seasonal variation

- **Wet season rice:**

✓March to August

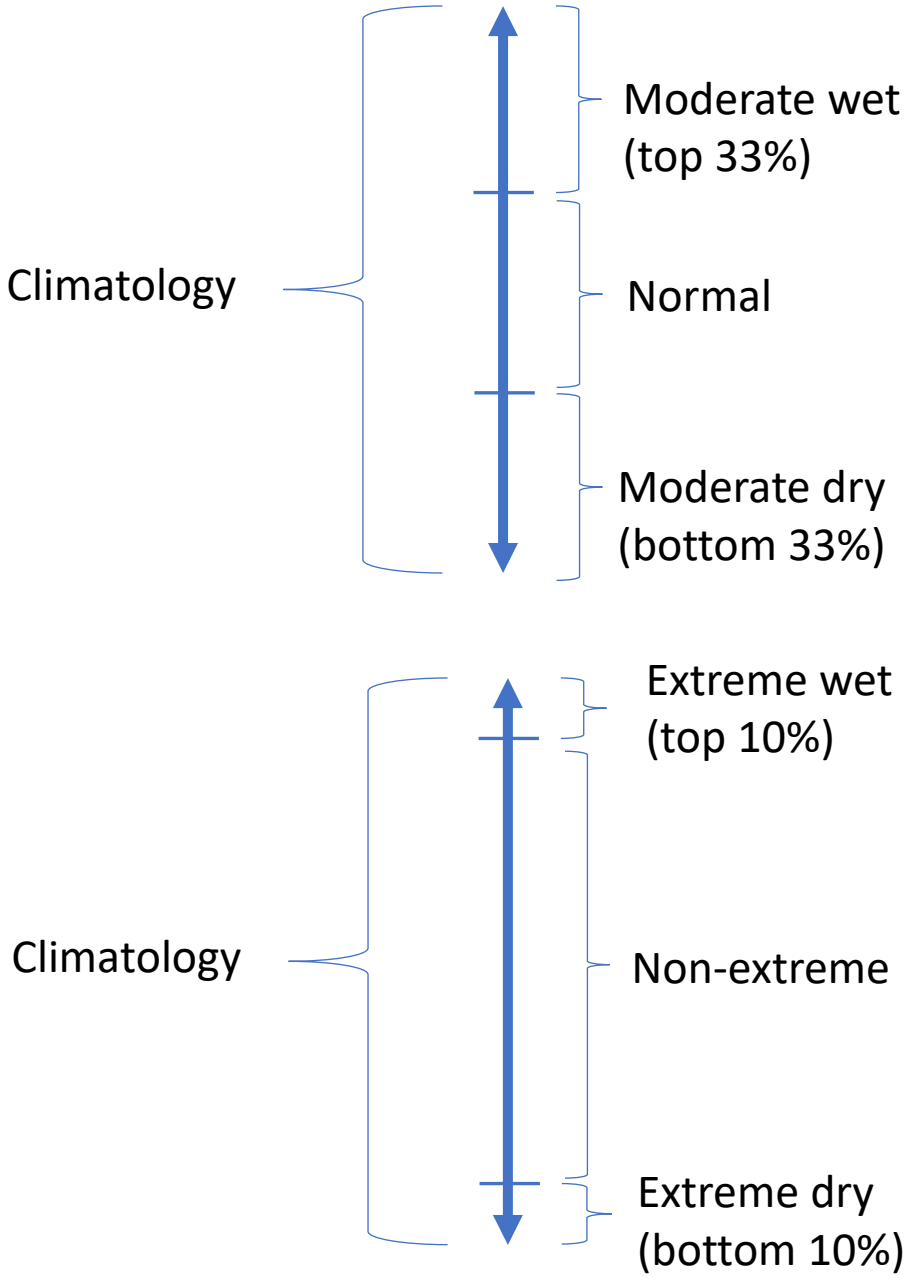
✓Optimal sowing date is determined by climatic conditions



Method: overview

- Growing season precipitation (GSP)
- For each potential sowing date:

- Simulated rice yields for each sowing date in the current sowing window (March to May) with daily climate data (1985 to 2016)
- Calibrated rice crop model ORYZA v3



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Method: Forecast quality parameterisation

Moderate forecast system

Forecast issuing date	Forecast	Outcome		
		W	N	D
I	W	$q_1(s)$	$\frac{2}{3}[1-q_1(s)]$	$\frac{1}{3}[1-q_1(s)]$
	N	$\frac{1}{2}[1-q_2(s)]$	$q_2(s)$	$\frac{1}{2}[1-q_2(s)]$
	D	$\frac{1}{3}[1-q_3(s)]$	$\frac{2}{3}[1-q_3(s)]$	$q_3(s)$

Extreme forecast system

Forecast issuing date	Forecast	Outcome		
		EW	NE	ED
I	EW	$q_1(s)$	$\frac{8}{9}[1-q_1(s)]$	$\frac{1}{9}[1-q_1(s)]$
	NE	$\frac{1}{2}[1-q_2(s)]$	$q_2(s)$	$\frac{1}{2}[1-q_2(s)]$
	ED	$\frac{1}{9}[1-q_3(s)]$	$\frac{8}{9}[1-q_3(s)]$	$q_3(s)$

$$q = \frac{\text{correct forecasts}}{\text{all forecasts}}$$

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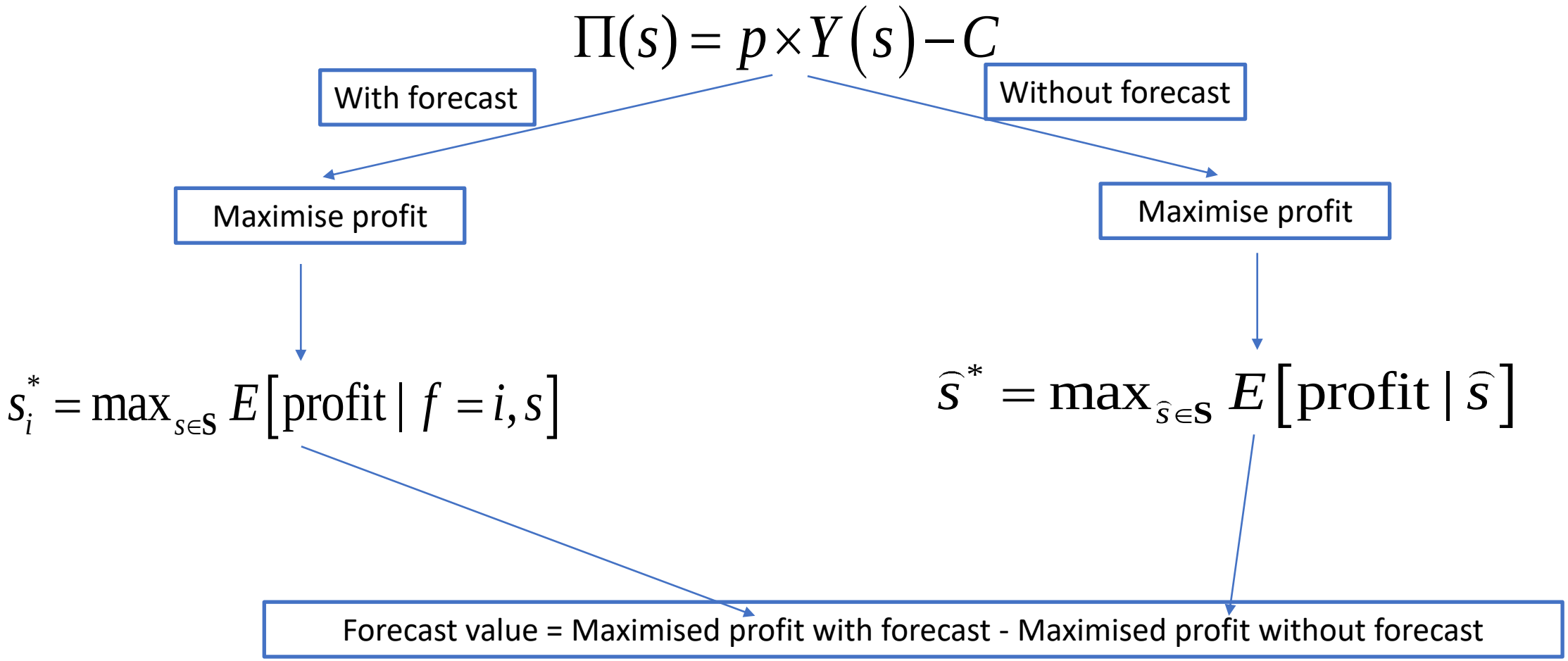
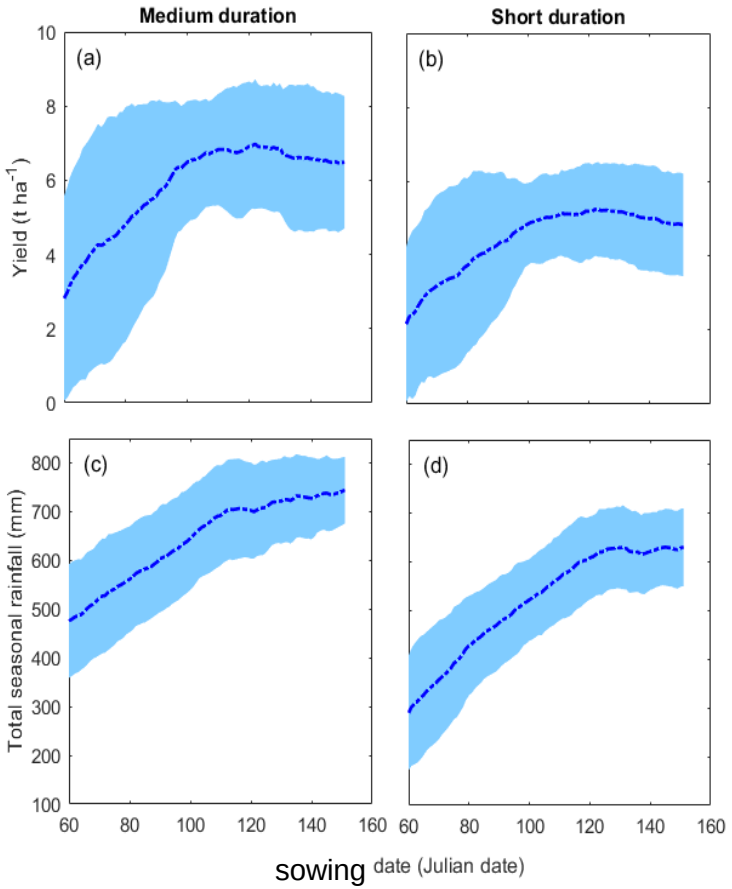
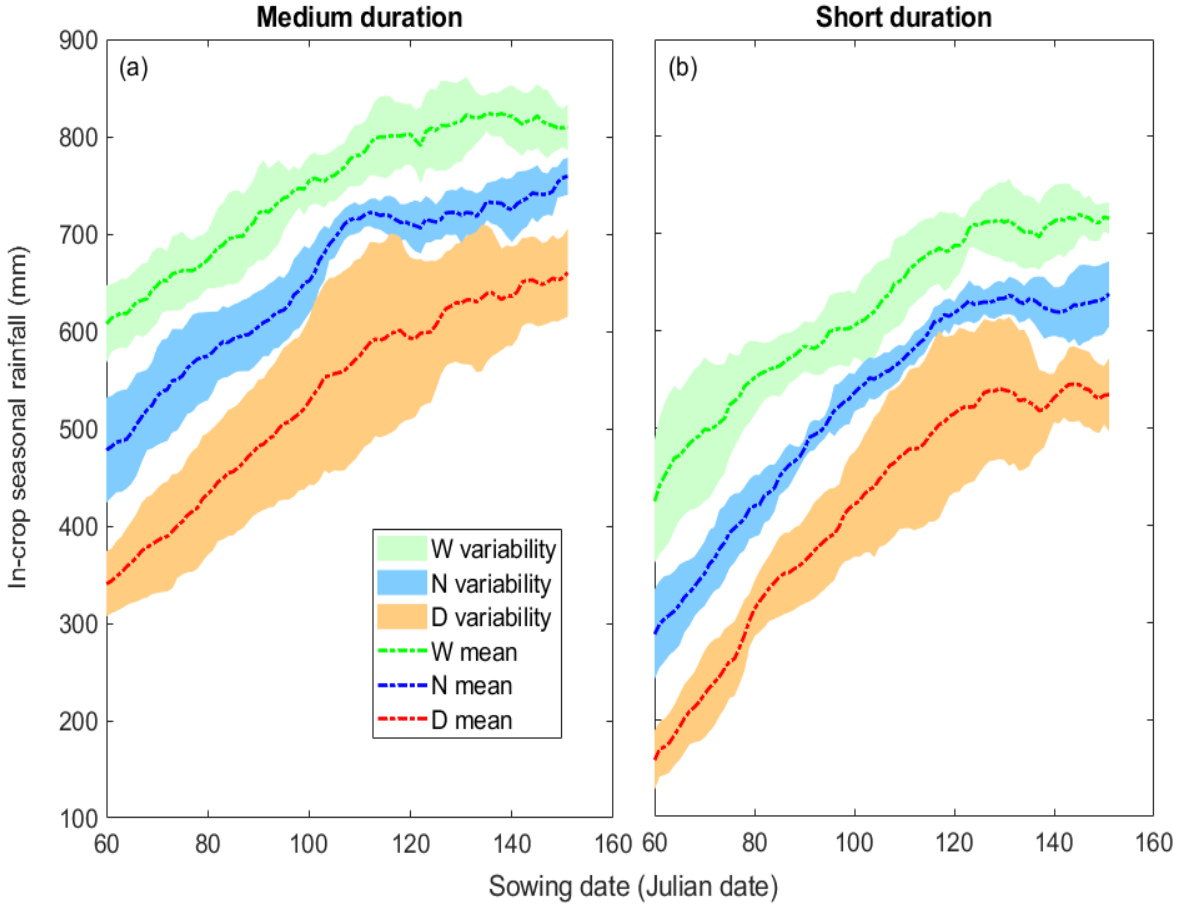
Method: Decision analytic and value assessment



Results

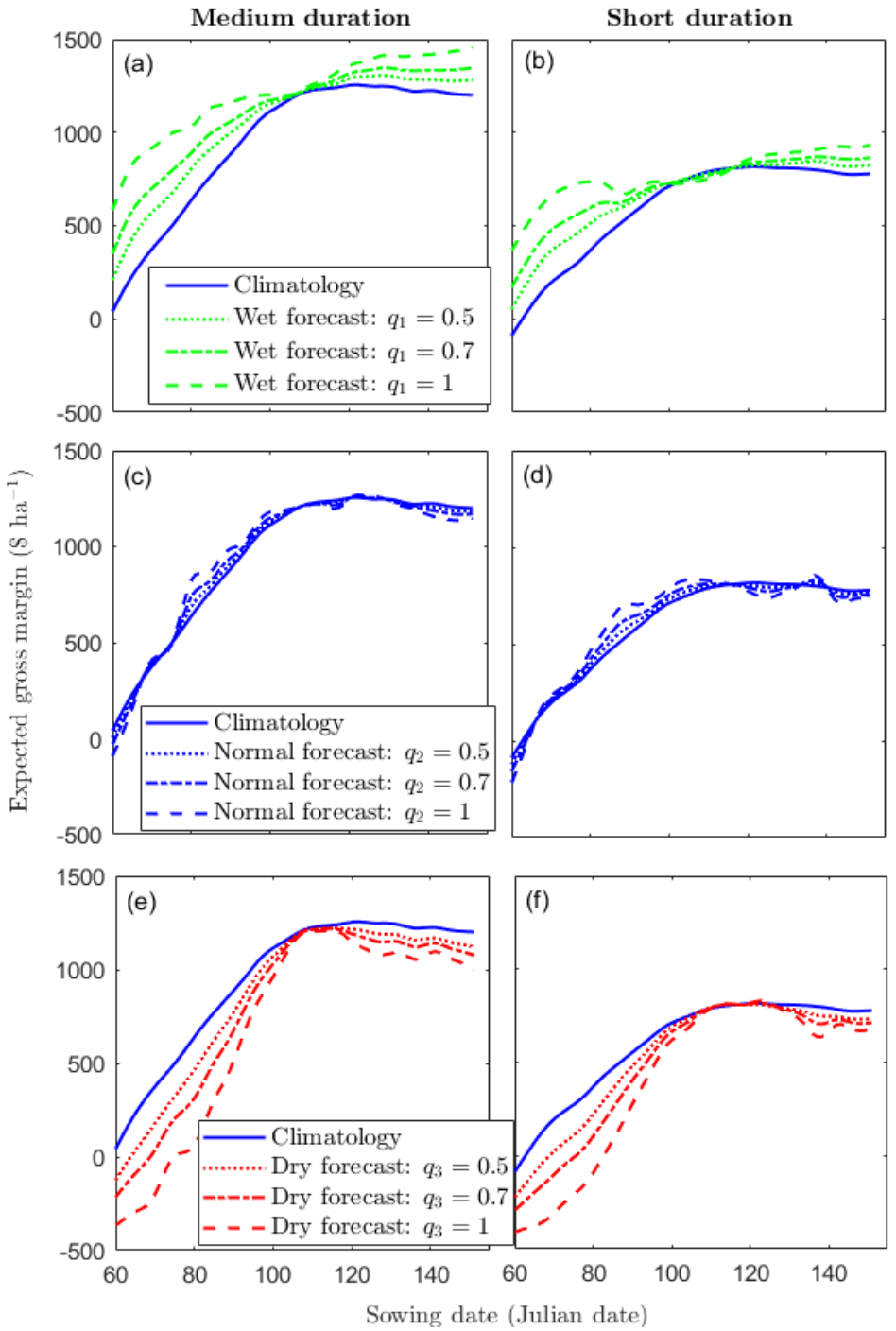
Variety	Extreme wet	Moderate wet	Climatological condition	Moderate dry	Extreme dry
Jasmine	0.51*	0.97*	0.95*	0.92*	0.79*
OM 5451	0.49*	0.92*	0.95*	0.93*	0.92*





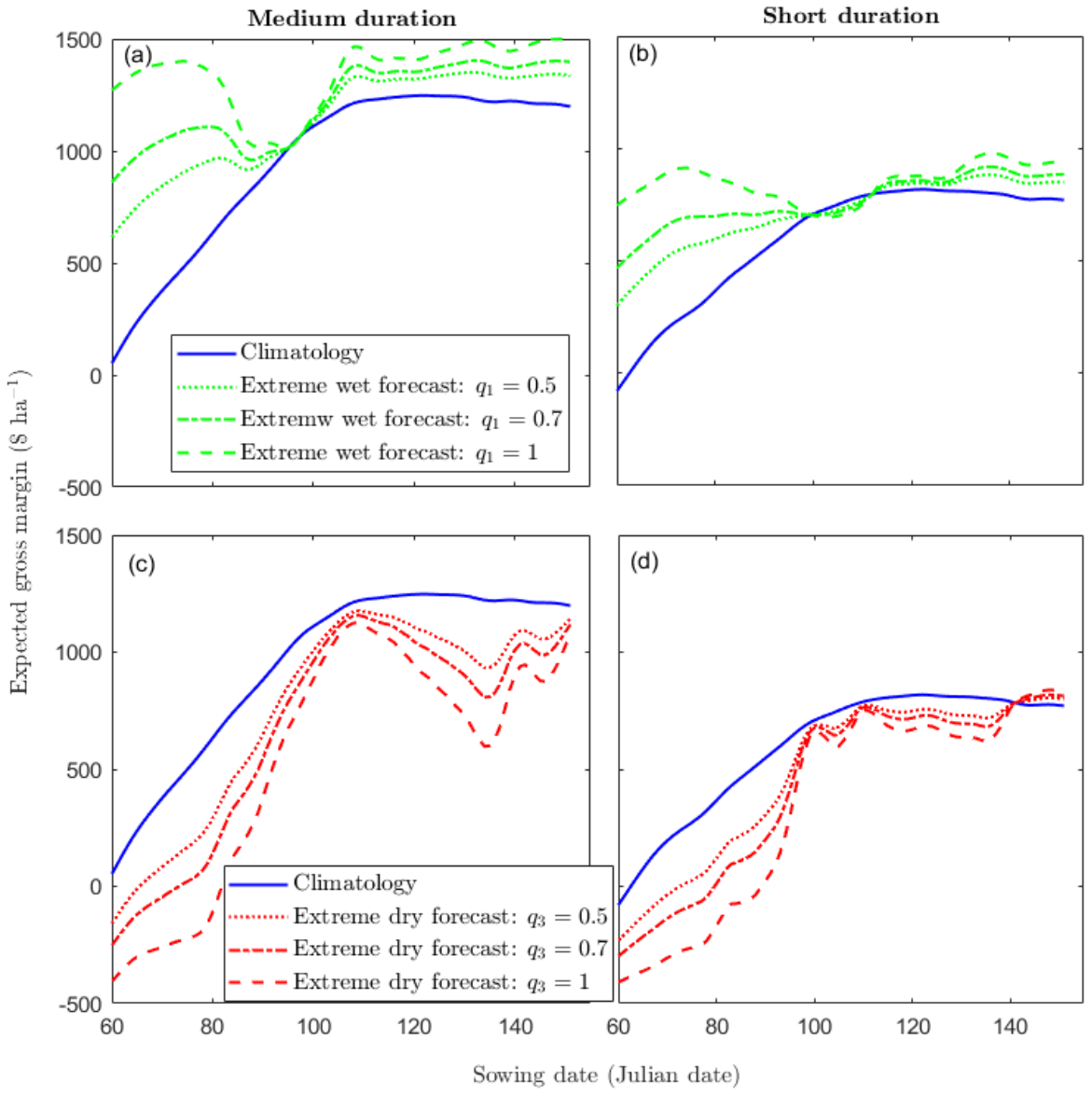
Results: Moderate forecasts

- Sowing date has remarkable impacts on economic outcomes
- Optimal sowing date varies with forecasts and forecast quality



Results: And more with extreme forecasts

- Sowing date has remarkable impacts on economic outcomes
- Optimal sowing date varies with forecasts and forecast quality



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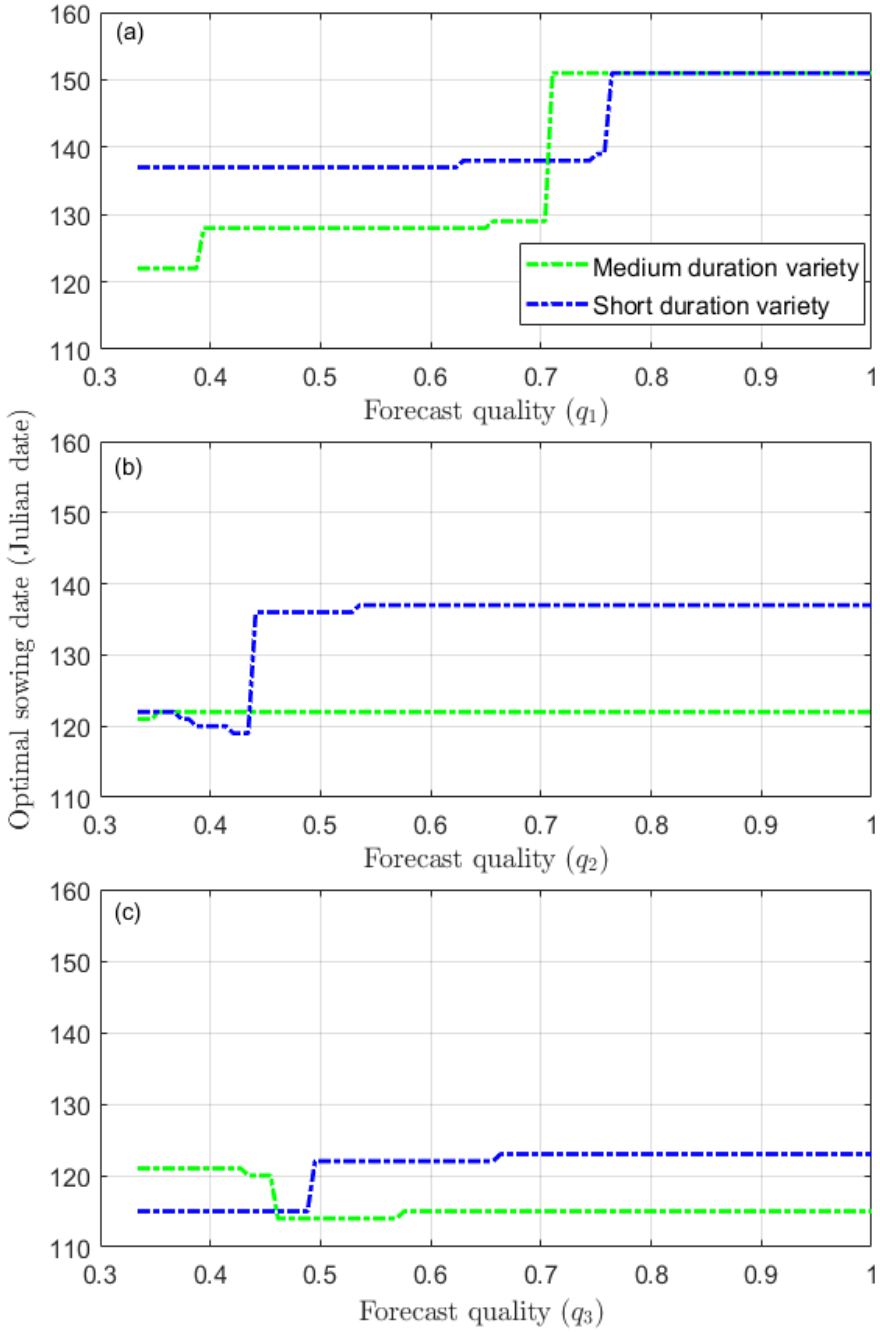
Results: Optimal sowing date

Trend in optimal sowing date:
(a) Later sowing with wet forecasts
(b) Large difference in optimal sowing dates between varieties
(c) Earlier sowing with dry forcasts

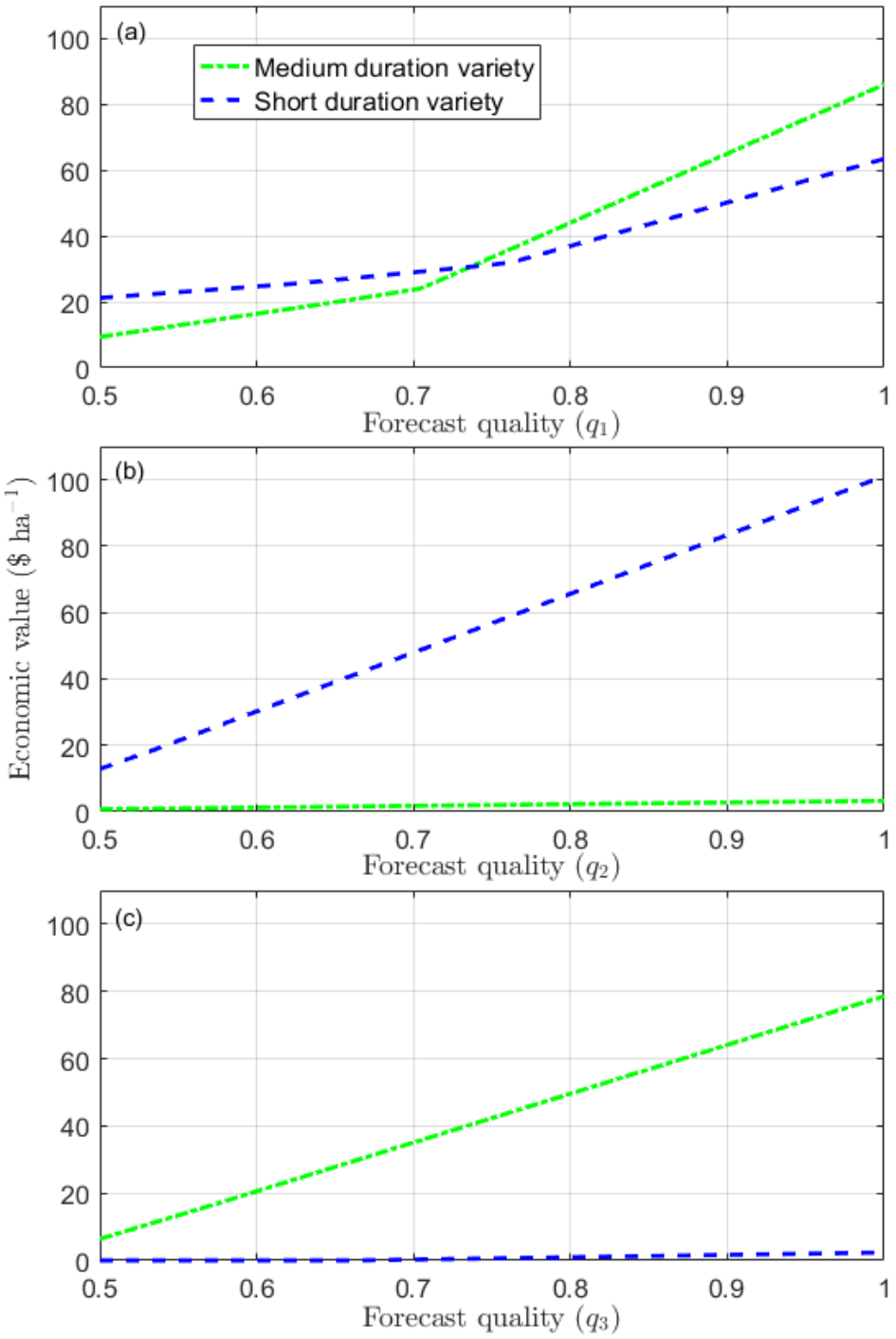
Optimal sowing varies at certain forecast quality levels and among crop varieties



Results: Forecast value

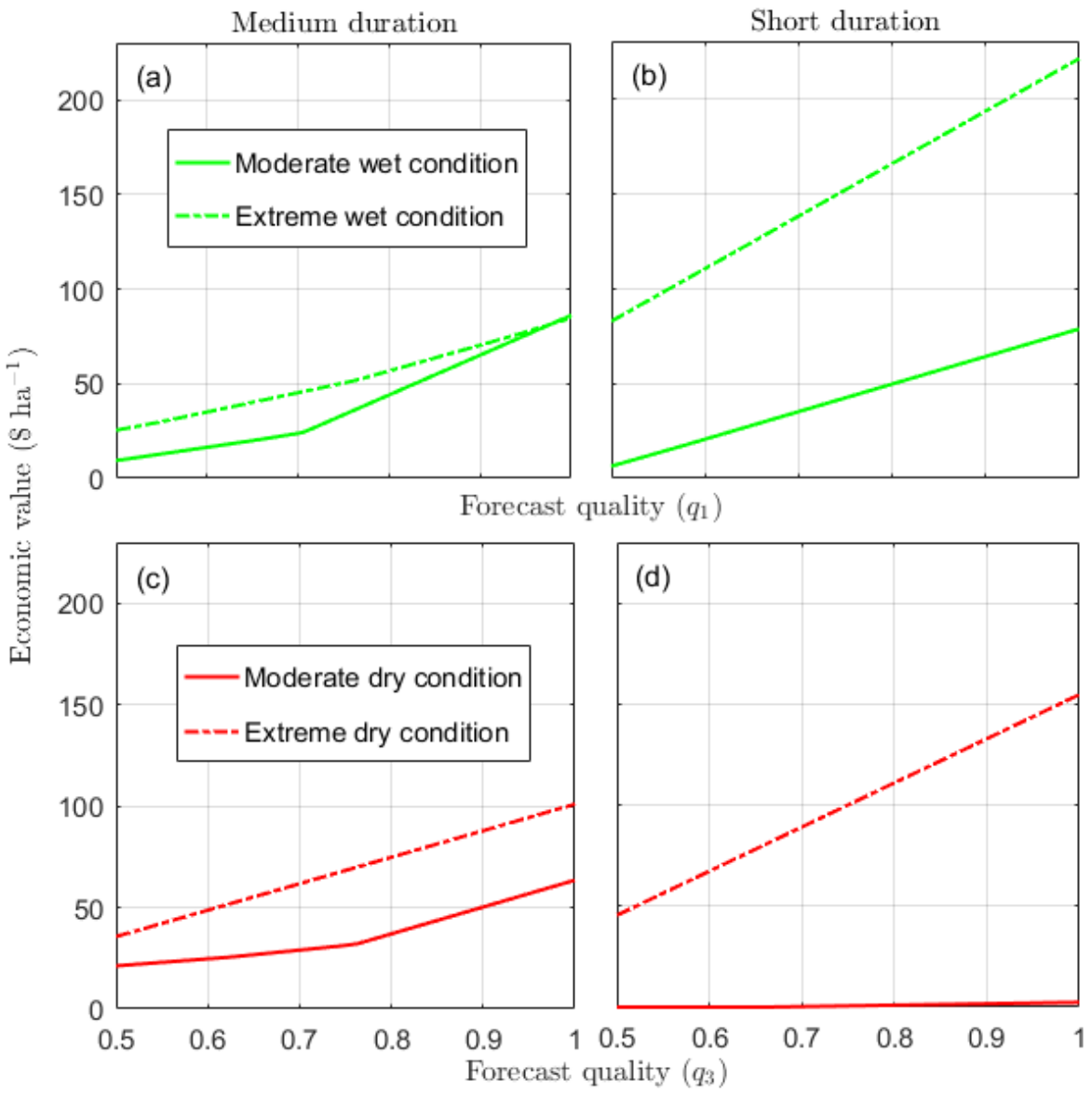
Moderate forecasts:

High quality forecasts can produce up to $100/ha



Results: Forecast value

More forecast values with extreme forecasts



Discussion

- Seasonal forecasts are useful in informing better rice cropping decisions
- Forecast uncertainty should not limit the use of forecasts
- Baseline for climate services valuation
- Improved climate information for upscaling

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Limitation

- The presented optimal sowing dates based on forecasts were achieved in an expected economic sense rather event-based.
- Presented results may be sensitive to differences in locations, soil type and pricing structure.
- Farming involves multiple decisions, all influence yield and profitability. We should explore forecast value in a more integrated decision-making context.
- Application of the framework at farm level must be cautious due to uncertainties associated to the source of data used to inform the model, the ability of the model to account for spatial variability, as well as the spatial resolution of the forecasts.

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Conclusion

- Economic valuation of climate services provides an improved tool to communicate and translate climate knowledge
- An end-to-end (integrated) seasonal forecasting framework was developed here for rice production but is general
- Seasonal rainfall variability was found to have large impacts in rice production (up to 3 t/ha) and profit (up to $1000/ha)
- Value of seasonal precipitation forecasts when making sowing decisions may be up to $220/ha
- This work has potential to improve the value and adoption of climate services for rainfed rice growing areas globally and agricultural production systems more broadly.

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Questions