The key role of the labor market in assessing future climate impact on global agriculture

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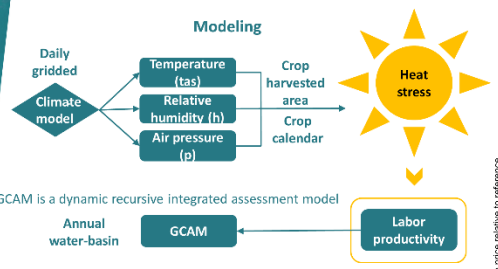
Motivations

- 25% of the global labor force is in agriculture (ILO, 2022).
- Heat stress hampers labor productivity (Kjellstrom et al., 2009; Dunne et al., 2013).
- Previous studies mainly focus on crop's response to climate impact, only a few studies incorporate human response to climate impacts in economic analyses. (de Lima et al., 2021; Matsumoto et al., 2021)
- Our study provides long-term detailed agriculture responses to heat stress

Objective

- Model climate impact on both labor productivity in the Global Change Analysis Model (GCAM) model.
- Evaluate long-term climate impact on the global agriculture market.
- Identify heat-stress vulnerable regions and sectors.

Modeling



Experiment design

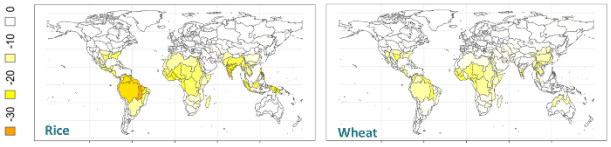
Experiment	Design	Scenario
Reference	No response to heat stress	SSP2
Human	Human response to heat stress	SSP2-RCP6.0 GFDL-ESM2M : Labor_eta*

SSP: Shared Socioeconomic Pathways; RCP: Representative Concentration Pathway; GFDL-ESM2M: a general circulation model
*Labor_eta defines climate impact on labor productivity, refer to Dunne et al. (2013)

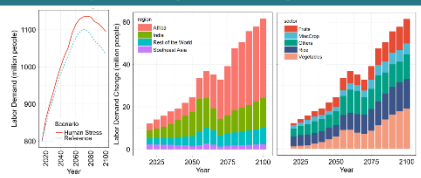
Discussions

- Heat stress reduces labor productivity in rice production by up to 30% in tropical areas by 2100.
- Over 100 million more people are needed for crop production by 2100 to compensate for the labor productivity loss with heat stress. Southeast Asia, India, and Africa are expected to experience large increases in agricultural labor demand due to heat stress.
- Heat stress increases crop prices by 10% at the median level. With heat stress, crop prices of warm season crops tend to increase more, and tropical areas tend to have higher crop price increases due to heat stress.
- Temperate zones tend to export more crops under heat stress while tropical areas tend to export less.

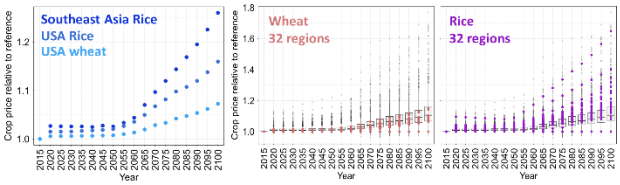
Labor productivity decreases in tropical area under heat stress



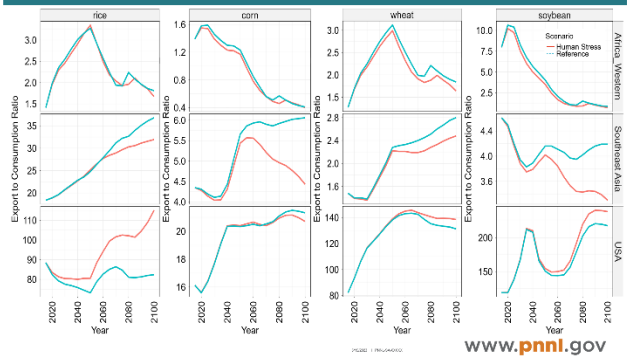
Tropical areas experience large increase in agricultural labor demand



Heat stress increases crop prices across regions and sectors



Heat stress affects crop exports across regions and sectors



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