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Man vs. nature

Investigating factors affecting the winter wheat production in Tibetan area

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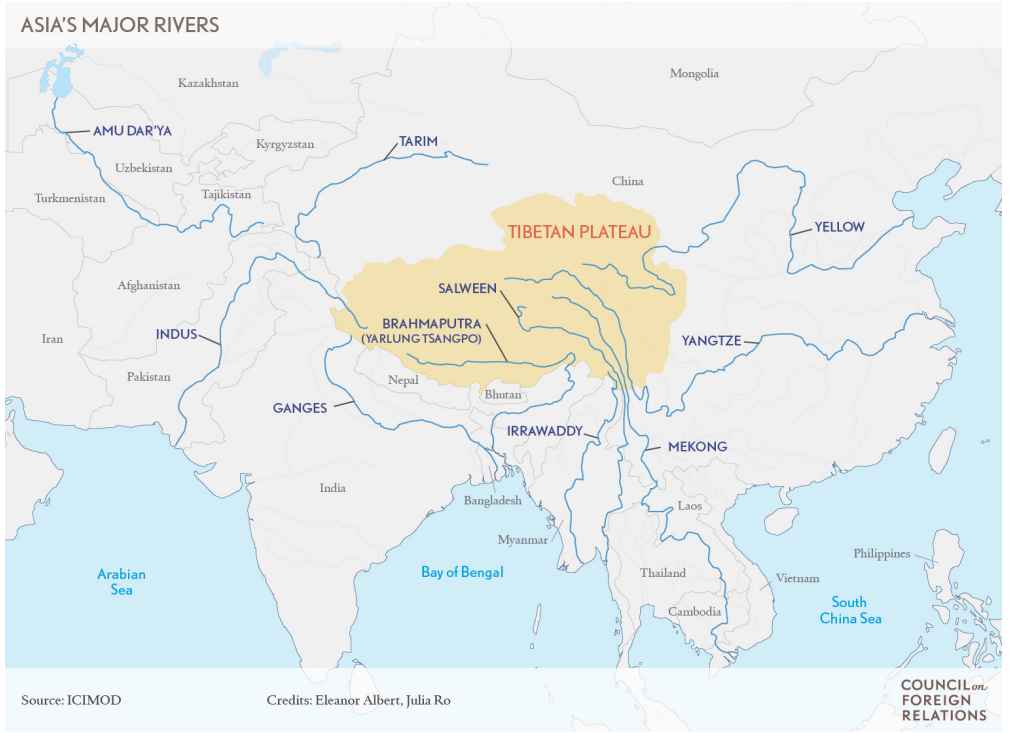
Content

Introduction

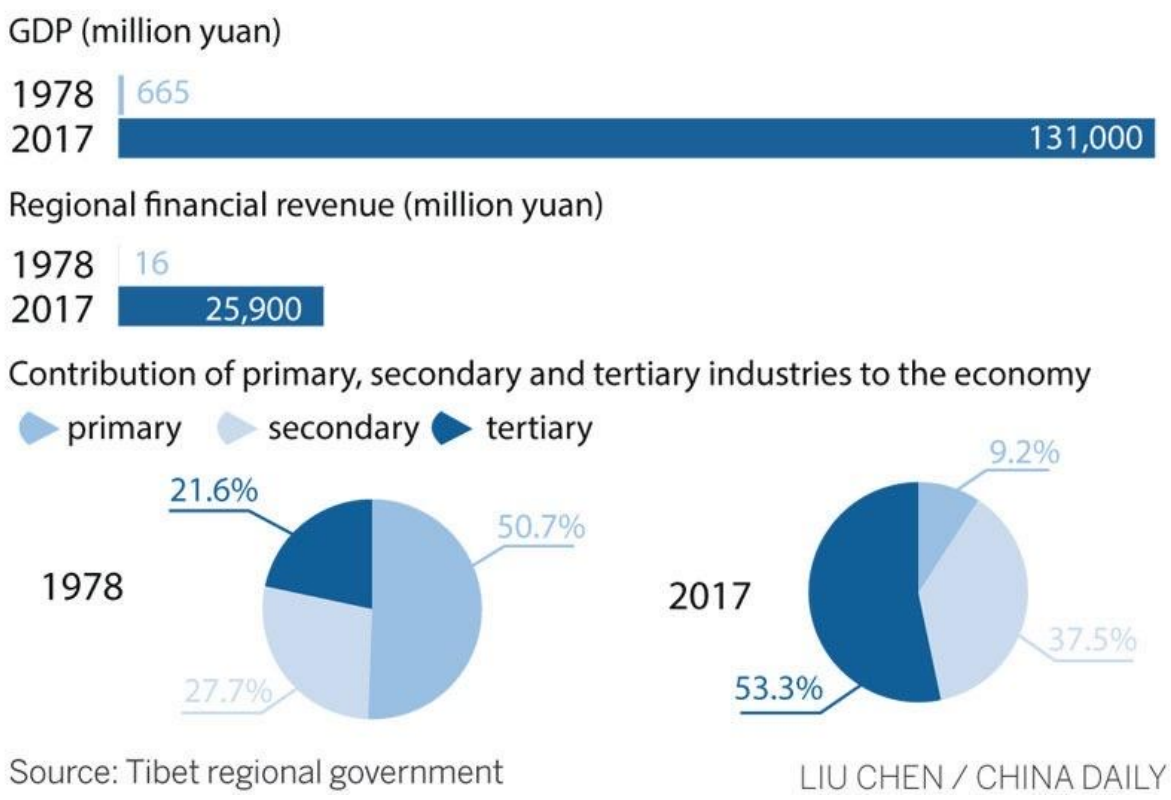
Why Tibetan Plateau?

- “Third Pole”
- Multi-sphere interactions
- High climatic sensitivity

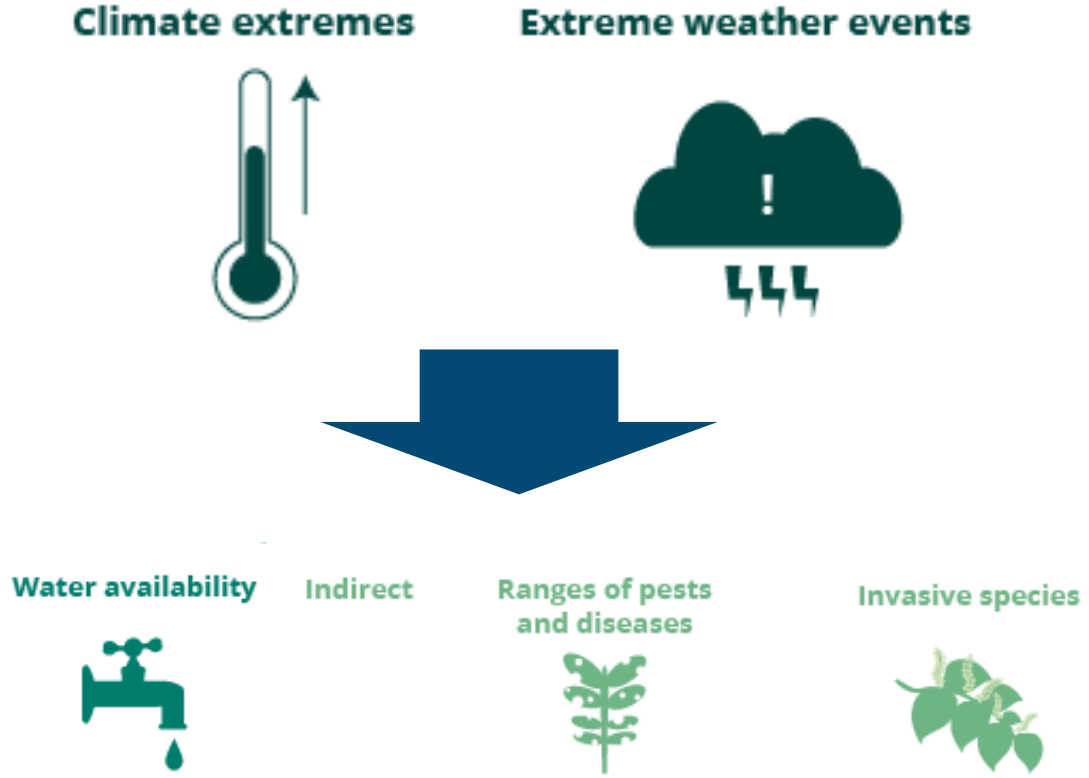
Yang *et al.* (2014) Global and Planetary Change



Why agriculture?



Impacts of climate change (CC) on agriculture

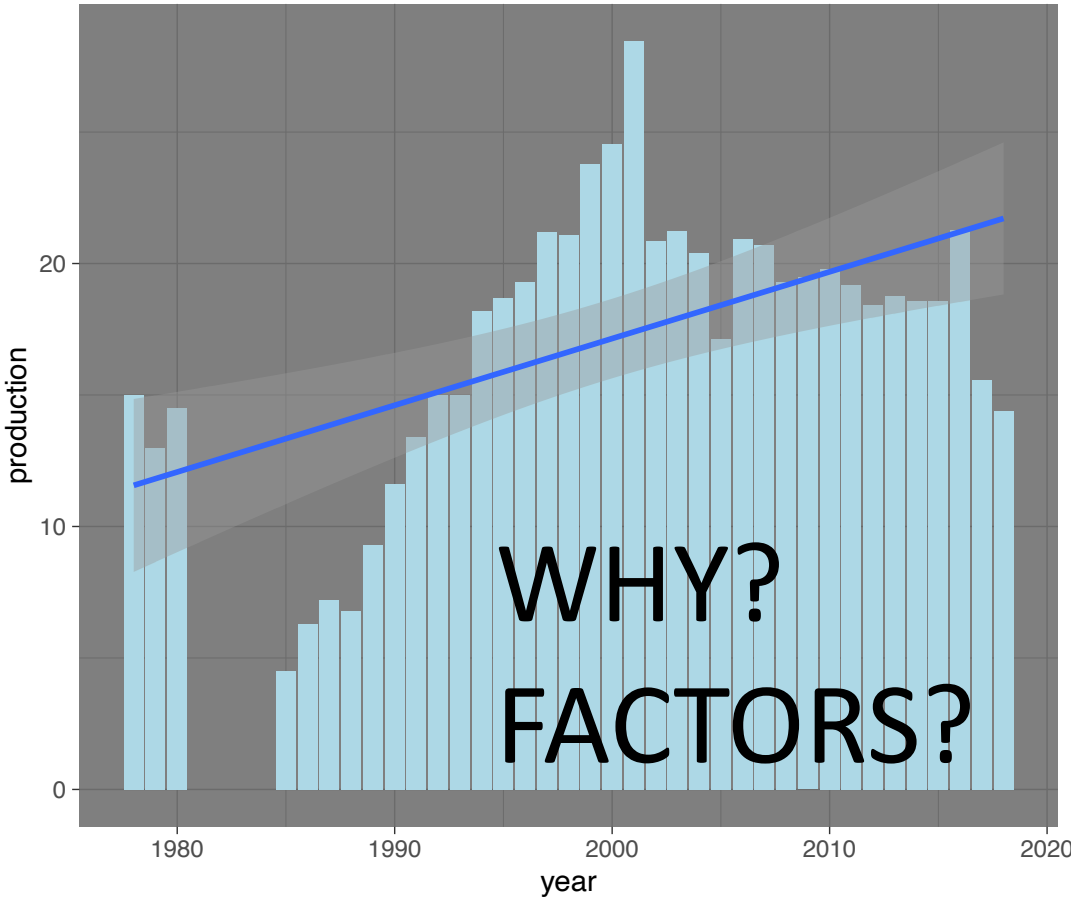


EPA. (2022)

Why winter wheat?

- 70% of the agriculture area
- Main source of flour

Yield increasing under the CC?



Zhao *et al.* (2010) Journal of Triticeae Crops

Method

Environmental factors

- Annual mean winter temperature (degree Celsius)
- Annual mean winter precipitation (mm/month)

Data from KNMI Climate Explorer

VS

- Annual winter wheat planting area (1,000 hectares)
- Annual sum of agricultural machinery power (megawatt)
- Annual fertilizer usage (10,000 tons)
- Annual pesticide usage (10,000 tons)
- Annual farmer population (10,000 people)

Data from the China National Bureau of Statistics

Anthropogenic factors

Winter wheat production over the TP from 1978 to 2018

Method

Response variable

Winter wheat production

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Explanatory variables

Environmental factors & Anthropogenic factors

ALL

VIF

Simple linear regression model

Mode1

ANOVA

Mode2

Results

```
> anova(m1, m2)
Analysis of Variance Table

Model 1: production ~ scale(year) + scale(area) + scale(fertilizer) +
    scale(machine) + scale(pesticide) + scale(farmer) + scale(prep) +
    scale(temp)
Model 2: production ~ scale(area) + scale(machine) + scale(pesticide) +
    scale(farmer) + scale(prep) + scale(temp)
  Res.Df    RSS Df Sum of Sq     F  Pr(>F)
1     32 332.80
2     34 495.22 -2   -162.43 7.809 0.00173 **
---
Signif. cod    0 ‘***’ 0.001 ‘**’ 0.    ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

ANOVA

Significant differences between m1 & m2

Results

Coefficient	Estimate ± SE	t-value	p-value
Intercept	17.06 ± 0.50	33.88	< 0.01
z-standardized year	-0.52 ± 2.71	-0.19	0.85
z-standardized planting area	2.25 ± 0.54	4.17	< 0.01
z-standardized annual fertilizer usage	7.19 ± 2.32	3.10	< 0.01
z-standardized annual machine power	-3.43 ± 1.71	-2.01	0.053
z-standardized annual pesticide usage	-0.56 ± 0.73	-0.78	0.43
z-standardized annual farmer population	0.31 ± 0.86	0.36	0.72
z-standardized annual DJF precipitation	-1.97 ± 0.63	-3.15	< 0.01
z-standardized annual DJF temperature	-1.24 ± 0.93	-1.33	0.19

Model 1 with all the explanatory variables

Results

Compared to environmental factors, human factors matter more for winter wheat production over the TP

Discussion

Current results

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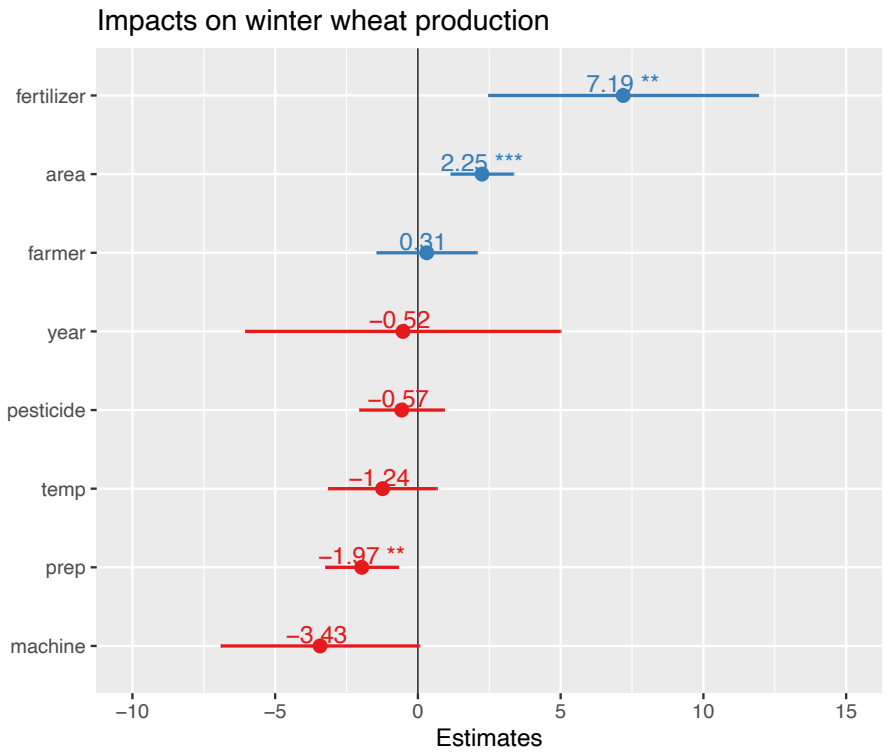
Historical findings



Agricultural management practices

- Improved irrigation infrastructures
- Elevated chemicals application

Xiao, Zhou & Zhang (2015) Ecosphere

Other practices for yield improvement

Agricultural management practices

- Improved irrigation infrastructures
- Elevated chemicals application

+

- Plantations of higher-yield wheat type
- Precise nitrogen application
- Early sowing

Kothari *et al.* (2019) Agricultural Water Management

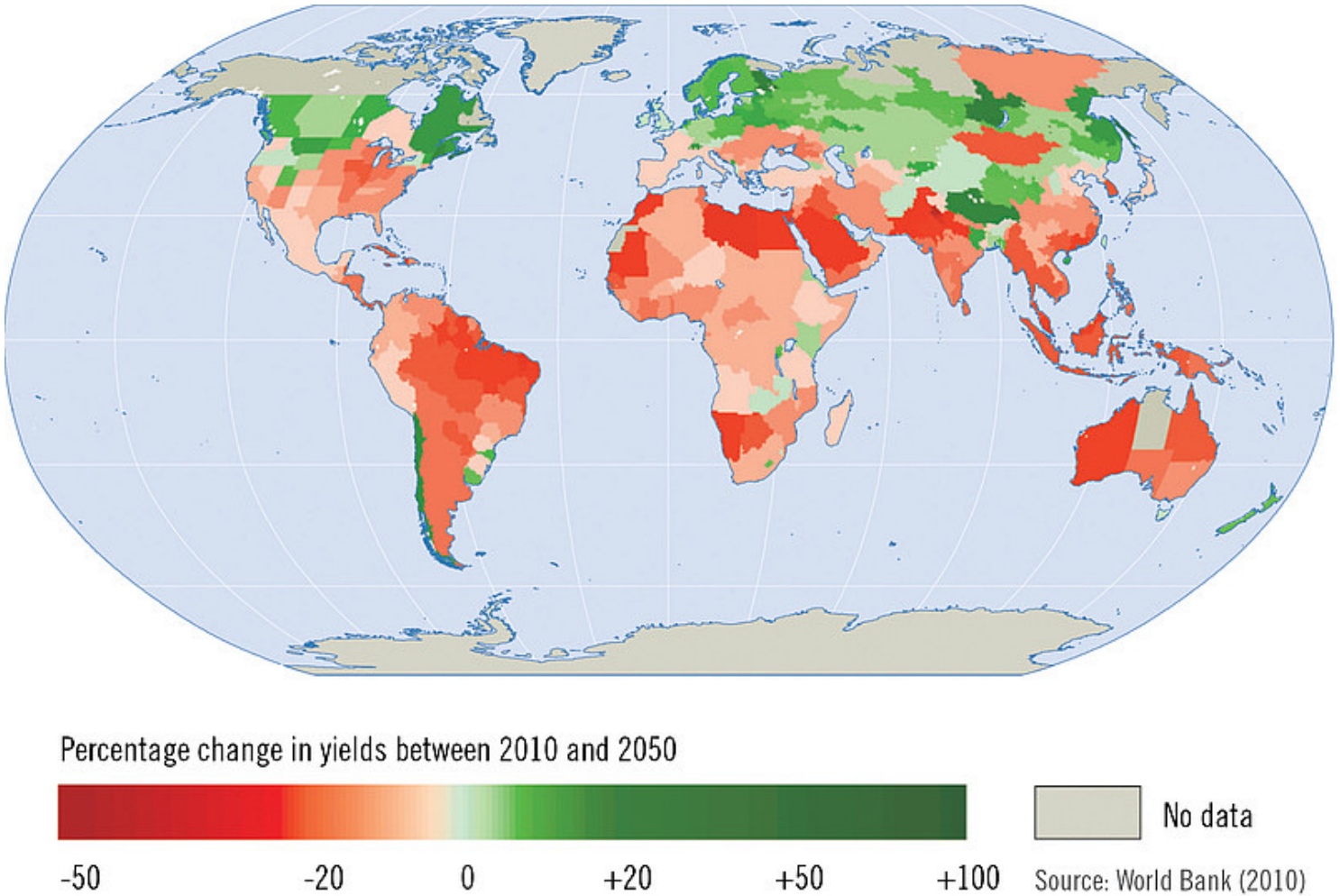
Zhang *et al.* (2022) Nature Communications

Limitations

- Relatively small data size
- NAs
- Neglection of variances between different planting locations

Robustness?

Future directions



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Thank you.

Please ask any question you have!