Policy, market, and climate change impacts on maize production in Mexico

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Research Overview and Questions

- Project examines agricultural transitions, their drivers, and potential climate change impacts across maize systems in Mexico (Fig. 1).
- Will identify whether current agricultural transitions are adaptive or maladaptive under future climate.
- Will use a combination of remote sensing, field surveys, causal econometric models, and crop models.

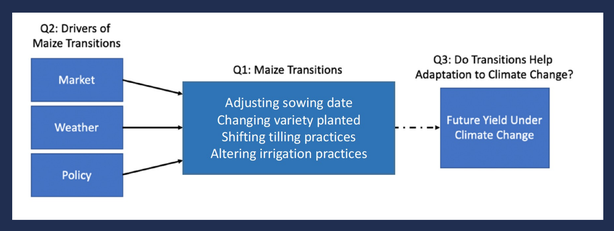

Figure 1. Diagram of overall research questions. Remote sensing products that will be developed are highlighted in the middle box.

Field survey

- Conducted a field survey in June-August 2022 with 708 farmers across a gradient of maize production systems in Mexico (e.g., large vs small landholdings, rainfed vs irrigated; Figs. 2 and 3).
- Interviewed farmers about maize management practices, perceptions of climate change, and whether they are adapting their crop management practices.
- Georeferenced plot boundaries for each farmer's main maize plot and collected management information to train/validate remote sensing algorithms.

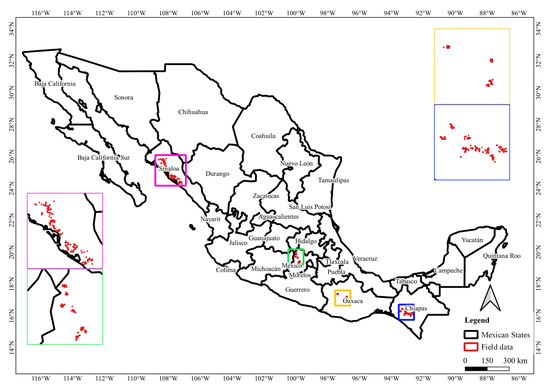

Figure 2. Surveyed farms across Mexico.

Figure 3. Photo of field team and some farmers who were interviewed.

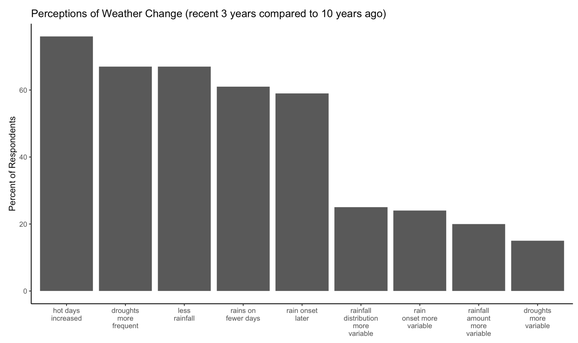

Figure 4. Farmers' perceptions of changes in weather.

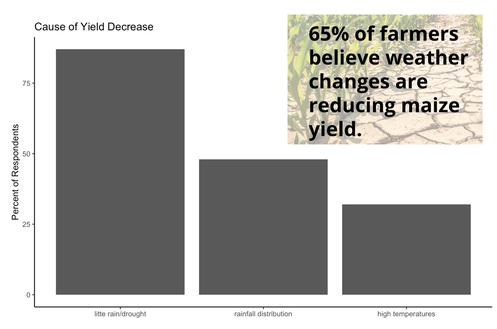

Figure 5. Farmers' perceptions of weather change impacts on maize yield.

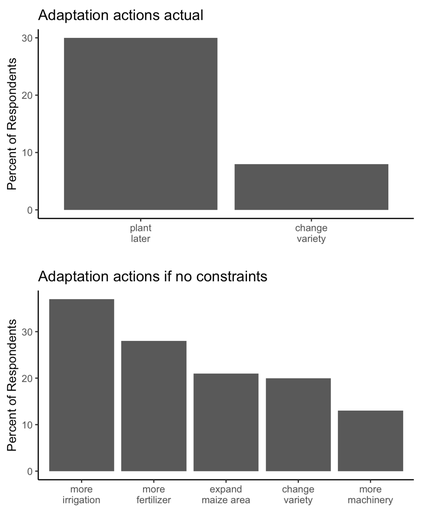

Figure 6. Farmers' actual adaptation actions and preferred adaptation actions if there were no constraints.

- Majority of farmers believe it is getting hotter and drier (Fig. 4).
- Majority of farmers believe this is negatively impacting yield, especially low rainfall and drought (Fig. 5).
- Farmers are adapting in a limited way – 30% of farmers shift sow date and 9% change variety (Fig. 6).
- Most farmers would adapt using a wide range of strategies if there were no constraints (Fig. 6).

Weather impacts on yields

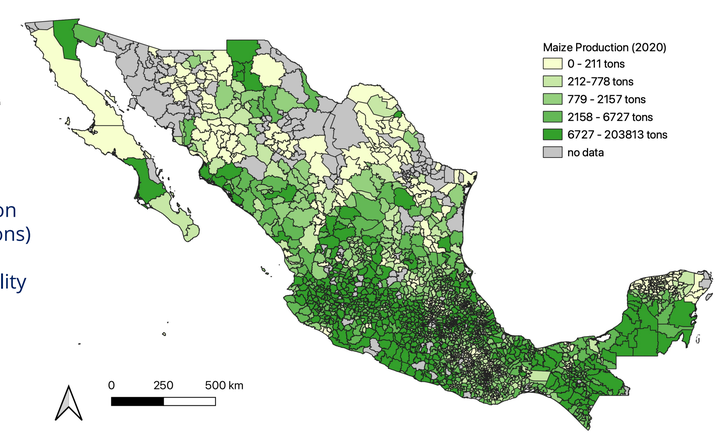

Figure 7. Maize production values (tons) for each Municipality in 2020.

- Downloaded and processed annual maize production statistics at the Municipality level across Mexico from 2003 to 2020 (Fig. 7).
- Census data contain information on maize area sown, area harvested, production, and irrigation status.
- Currently linking these census data with weather data using similar variables as those reported as important by farmers in our survey (Figs. 4 and 5).
- Will also estimate mean sowing date and variety length (adaptation actions, Fig. 6) for each municipality using MODIS and Landsat satellite data.
- Will use panel fixed effects regressions to causally identify the impact of inter-annual weather shocks on maize yields, and what the impact of adaptation strategies are on mitigating yield losses.

Remote sensing analyses

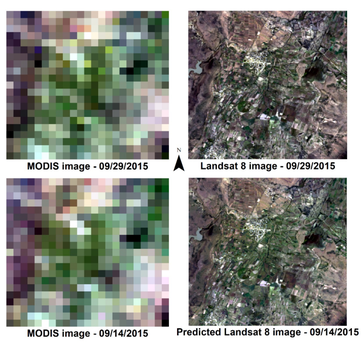

Figure 8. Application of STARFM in Python using starfm4py.

- Will use STARFM to fuse MODIS and Landsat satellite data (Fig. 8) to develop a high spatial and temporal resolution product.
- Will map maize sowing date and variety length (the two main adaptation strategies) by using methods that we have developed for and applied to the rice-wheat cropping system in northern India (Fig. 9).
- Will map maize area in 2000, 2005, 2010, 2015, and 2020 using field survey data, data from CIMMYT, and census statistics – methods are currently in development.

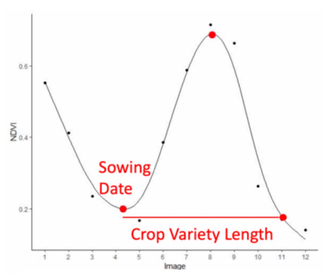

Figure 9. Method uses spline smoothing and the identification of inflection points to detect sow date and growing season length.

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