

## **Governmental responses and smallholders' adaptations to climatic variability in southeastern Mexico**

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Maize agriculture comprises a third of the area under cultivation in Mexico (75 million hectares), with only a quarter of this crop irrigated artificially. With the great dependence of the country's dominant crop on natural rainfall, there is potential for major losses in maize production due to climatic events, such as irregular rainfalls, droughts, and hurricanes. In 2012, droughts alone caused losses of 16 billion Mexican pesos nationwide in the agricultural sector. Over the last decades, political and economic pressures in the agrarian sector have further stressed Mexican smallholder farmers, as they have to respond to a combination of economic and climatic factors. This interdisciplinary study first documents local climate changes and then explores smallholder farmers' adaptations and governmental policy responses to the variable and changing precipitation and temperature patterns across southeastern Mexico.

To assess local climate changes, we analyzed precipitation and temperature data from the land-based weather station network of CONAGUA for the 1973–2012 period. Precipitation anomalies were estimated to evaluate the annual and seasonal stability, deficit, or surplus; and linear regressions used to evaluate precipitation and temperature trends. Climatic analysis demonstrated, 1) a considerable increase in temperature across the study area; 2) a decline in precipitation across a sub-section; 3) increased drought frequency; and 4) an increase in negative anomalies in recent years.

We then combine findings from our previous research (Mardero et al. 2014 and Mardero et al. 2015), based on interviews with 150 swidden maize smallholders in 10 communities, to new data from in-depth interviews with managers of local and regional agricultural associations and with members of governmental institutions in charge of climate policy implementation (n=19). The new data allow us to explore governmental responses to climatic variability in the agricultural sector in direct relation to concurrent smallholder adaptive responses. The 150 smallholder surveys revealed several adaptation mechanisms to climatic variability, including adjustment of the agricultural calendar (e.g. delaying planting, combined with planting a greater number of maize varieties), water storage, and livelihood diversification both within and outside of agriculture. Interviews with representatives of government institutions indicated a lack of information on climate policy. Half of the public servants interviewed were unaware of any specific action for climate change adaptation made by their institution and didn't know about the existence of the State Plan of Climate Change Action (PEACC), the main tool of climatic policy at the state level in Mexico. Results also show weak linkage between the adaptation actions already made by smallholders and the state actions proposed through state programs.

Understanding and considering how resource- and climate-dependent swidden farmers respond to co-occurring climatic and economic changes is essential for effective adaptation policy design. Effective policy design must then be accompanied by increased capacity among public servants in charge of policy implementation in order to achieve more effective results.

**Keywords:** Yucatán Peninsula; climate variability; climate policy; agriculture; smallholders; adaptation.