

## **Abstract for Ag Econ Workshop**

### **Economic and Climatic Determinants of Farmer Suicide in the United States**

Farming has an elevated rate of suicide in the United States and elsewhere. The suicide rates among working-age (aged 16-64 years) male farmers, ranchers, and other agricultural managers were the highest of any occupational group in 2012 and the fourth highest in 2015 in the U.S. (Peterson et al., 2018). A CDC report highlights higher rates of suicide and a significant rate increase in areas with lower levels of urbanization and demonstrates a growing disparity between rates in less urban and more urban areas of the United States (Kegler, Stone, & Holland, 2017). These facts draw attention to the mental well-being of agricultural workers, especially farmers. Yet people have almost no understanding of the factors that cause farmers to commit suicide in the U.S. Farm operators and farm workers are significantly under-studied in the area of violent workplace fatalities, but studies consistently show that farmers are at increased risk for violent death, in particular for suicide (Ringgenbert et al., 2018).

Possible factors impacting the high farmer suicide rate include steadily declining farm income since 2013 (USDA, 2019). Agricultural producers usually have little market power relative to their downstream trading partners. Farmers may feel powerless to improve their livelihoods in these cases. In addition, the variability of agricultural incomes, risks associated with farming, and exposure to toxic chemicals are possible explanatory factors for the increased risk for violent death for farmers. Climate change is potentially an additional factor influencing the suicide rate among farmers. Recently published studies suggest that climate change may be related to suicides among the general population (Burke et al., 2018; Carleton 2017), but no evidence exists for farmers, who are a population group most likely to be impacted adversely by climate change. For example, weather or climate-induced crop failures would depress farm income, deepen farmers' debt burden, and diminish hope for future improvements, potentially causing suicide in extreme instances. These and other exogenous factors beyond farmers' control make stress an inherent component of a career in farming.

Therefore, the weather effect is more than just a trigger to farmer suicide. It is an underlying cause of reductions and increased volatility in farm incomes. The temperature effect on suicide is heterogeneous across different occupational groups. Yet the existing literature rarely recognizes such heterogeneity effects and treats the effects as homogenous for the general population. This paper will address the heterogeneity effect of weather/climate for farmers and explore the underlying mechanism of temperature on farmers' propensity to commit suicide.

The primary objective of this study is to explore the causal effects of climate change (e.g., extreme temperatures, variable precipitation) and economic factors on agricultural workers' suicide, especially on farmer suicide. Although a decision to commit suicide can be based on many other factors, the goal is to determine the extent to which these factors play a causal role in farmer suicides.

We construct a theoretical economic model describing farmers' production, profit, and utility to construct hypotheses regarding farmer suicide. Under a farmer's utility maximization framework given the input constraints in both static and dynamic settings, a bad weather shock or bad

economic shock can lead to a “snowballing” effect that reduces farm income and also reduces a farmer’s utility through the work-leisure trade-off. Thus, it is possible to identify settings when severe adverse weather outcomes can so diminish a farmer’s utility that it causes a decision to commit suicide. Under a dynamic framework, as a farmer experiences bad weather shocks for some successive years, her perception of the probability of having bad weather increases, diminishing hope for a successful future. The theoretical model proposes the following three hypotheses: (i) the marginal effect of harmful weather (temperature and precipitation) on farmer suicide is positive and (ii) the marginal effect of poor economic conditions (declining crop/animal prices) on farmer suicide is positive.

We have obtained access to the CDC nonpublic vital statistics database. We combine these data with PRISM daily weather data and USDA NASS economic statistics to test the aforementioned hypotheses. The data structure is a county-year panel including 3037 counties spanning 19 years from 1999 to 2017. We analyze the relationship between the annual farmer suicide count for each U.S. county as a function of economic conditions impacting farm income in both levels and variability and cumulative exposure to beneficial/harmful temperature and rainfall during the crop growing season using a fixed-effect Poisson regression model that accounts for time-invariant differences across Agricultural districts in unobservable determinants of the suicide decision.

Results show that harmful weather is positively associated with farmer suicide. For example, as high level degree days (cumulative days with temperature above 10°C during crop growing season) increase, farmer suicide increases. Low level of degree days has little impact on farmer suicide. Being consistent with literature of rainy days causing depression, precipitation has a positive effect on farmer suicide in general. Such effect is not statistically significant in non-irrigated counties. A single year of low agriculture prices is not statistically associated with farmer suicide at the same year. Two and three years prolonged low prices are positively associated with farmer suicide. Chronic, not idiosyncratic, poor economic conditions motivated farmer suicide. Results are robust to model variations.

Climate change and its impacts are one of the most important topics confronting society. Mental wellness has gained ever-growing attention and importance. Yet analyses focusing on farmer suicide in the U.S. are rare in the existing literature despite the high rates of farmer suicide. This paper provides insights into the relationship between climate change and the health of the agricultural economy and farmer suicide.

This work will enhance our understanding of the factors contributing to farmer suicides and contribute to improving the effectiveness of suicide prevention. It could also enrich our understanding of the foreseeable impacts of future climatic change. Further discussion will be stimulated regarding farmer suicide forecasts and corresponding suicide-prevention policies.

## References

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