Forecasting the Future: A Predictive Modeling Approach to Deciphering Climate Change’s Impact on US County-Level Soybean Yields

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Given climate change's widespread impact on weather, it is vital to determine its effects on soybeans, a versatile crop, through yield predictions, to help tackle America’s food insecurity problem. This study aimed to compare weather and fertilizer factors against US soybean yields to determine if and which factors contributed to higher soybean yields, and to create a predictive model to forecast county-level yields. This study separated NOAA weather and USDA fertilizer data into 7 variable categories and grouped those variables into high, midrange, and low yield scenarios to compare against each other through ANOVA tests. The statistically significant variables (p-value<0.05), which included all temperature and fertilizer variables, were constructed into a multiple linear regression analysis comparing against 50-year historical county-level NASS soybean yields. Then, a new model was created with the variables that contributed statistically significantly to the yield's variance, which included days over 32.22 degrees Celsius, potash usage, and phosphate usage, along with the past year's yields. This model yielded an R-squared value of 0.651, with a correlation of 0.782 against actual yields on a testing set, when predicting county-level yields, and 0.946 for yearly overall yields. Using the model, an easy-to-use website was created for instant soybean yield predictions. With this, the government and farmers can cheaply predict crop yields for better preparation. Overall, with rising temperatures from climate change, this study highlighted how an increasing number of days greater than 32.22 degrees Celcius will be detrimental to soybean yields.

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