INTRODUCTION

This study examines the implications of climate change on farming practices in Minnesota. Climate models predict high variability in global temperatures and precipitation levels in upcoming years. Increasing climate instability leads to uncertainties in the agricultural sector. A historical analysis of climate conditions and agricultural reactions has the potential to forecast future changes in Minnesota by addressing the following questions: how have farmers adapted to changing climate conditions in the past, which of these alterations have been successful, and what will be viable modifications for the future? Varying climate circumstances have influenced previous farming behaviors. Better understanding climate and agricultural patterns enables more accurate predictions of climate and crop models. On a local level, Minnesota agriculture will most likely see an overall increase in temperature and moisture levels due to climate change. However, this will require proper farm management in an ever-changing climate.

METHODS

An agricultural and historical climate history for the state of Minnesota over the past century was established through means of analyzing statistical data from the U.S. Department of Agriculture and the National Climatic Data Center. Three marker crops (corn, wheat, and soybeans) were selected as a representative sample of an agricultural history for the state. Data showing production, yields, and acres harvested/planted was plotted in an attempt to visualize obvious trends. These graphs were compared to a constructed climate graph depicting what are referred to as “water years”. Water year values consider both ground water and precipitation levels over a twelve month period making it an accurate representation of climate conditions that may affect crop production. Correlations amongst the climate and agriculture graphs were noted and further analyzed for historic importance. Any similarities in the graphs attributed to non-climate related conditions were disregarded. The remaining trends were reviewed through further historical and literary analyses of primary sources as means of obtaining firsthand accounts of agricultural changes to identify specific adaptations. The findings of this study were used to create projections for the future of farming in Minnesota and suggest viable modifications to be considered by farmers.

RESULTS

Historic Climate Trends: (see Figures 1 and 2)

- 1919: First commercial PTO (power take-off) is developed.
- 1920: Ten City “40” Farm Tractor developed by Minneapolis Steel and Machine Co.
- 1925: Farmers rotate crops, use contour plowing, and plant trees to protect against wind damage.
- 1930: Great Depression ruins many farm families.
- 1935: Six years of drought has ruined crops and exhausted the land.
- 1939: World War II brings demand for agricultural products.
- 1940: Farmers rotate crops, use contour plowing, and plant trees to protect against wind damage.
- 1949: Minnesota’s agriculture sector plays significant role in renewable energy development.
- 1999: Manufacturers develop cleaner burning engines and advanced computer technology.
- 2000: Use of “Precision Agriculture” technology becomes widespread, increasing farm efficiencies, decreasing labor costs, improving yields and minimizing the environmental impact of farming.

CONCLUSION

The current ongoing climate regime will present a whole new set of challenges for farmers to overcome. Table 1 outlines key projections for the future of Minnesota farmers based off IPCC reports, assessments by local climatologist Mark Seeley, and an analysis of numerous historical documents and climate-crop related literature. In comparison to past modifications, this current period of climate anomalies will require more innovative and sustainable means of adaptation. Much research is still necessary to better understand climate and crop models. On a local level, Minnesota agriculture will most likely see an overall productive gain as a result of climate change. However, this will require proper farm management in an ever-changing climate. Minnesotans have adapted to bizarre weather conditions in the past; there is no reason to believe they cannot do the same in the future.

Table 1. Future predictions for the state of Minnesota based on historical trends and published reports.

**Historic Agricultural Trends:** (see Figures 1 and 2)

- **Early 20th Century:** increased dependency and development of machinery (later shifts into a reliance on chemical and biological inputs), adaptive methods such as crop rotation and contour plowing established as means to counter extended periods of drought
- **Late 20th Century:** increased government price supports and advancements in agricultural science to decrease inputs and increase outputs in production to meet increasing demand