

EGU22-2330

<https://doi.org/10.5194/egusphere-egu22-2330>

EGU General Assembly 2022

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Spatiotemporal patterns of crop diversity reveal potential for diversification in Swedish agriculture

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Objective

Diverse cropping systems are associated with multiple ecosystem services and are suggested to alleviate the effects of drought and heat stress. The magnitude and frequency of extreme weather events are projected to increase in the future due to climate change, and diverse cropping systems might therefore become key for food security. However, there is still limited information on the spatiotemporal variation of crop species diversity and how it relates to differences in climate or soil type. We aimed at quantifying how crop diversity developed over time at the national and regional scale in Sweden between 1965 and 2019, and how crop species diversity is related to climatic factors and soil texture.

Methods

Sweden is an interesting case study due to the large range in latitude from north to south. The analyses were conducted using national databases containing historical records of crop production and climate data, as well information on soil texture. To quantify crop species diversity, species richness and a crop diversity index that reflects the area-weighted equivalent number of crops were used.

Results

Crop species richness and crop diversity index increased from north to south in Sweden, and our results showed a positive relationship between mean annual temperature and latitude to crop diversity at national level. The positive relationship shows how mean annual temperature and length of the vegetation period control crop diversity across the country. There were no significant relationships between crop diversity and mean annual precipitation and soil texture, respectively. Crop species richness did not change over time at national level while crop diversity index experienced a temporal decrease. At the county level, different temporal trends were observed among counties: in some counties an increase in crop diversity and species richness occurred, while other counties had no change or a temporal decrease.

Conclusions

The differences in the results between national and county level show the importance to include different scales in the examination of temporal developments of crop diversity. Although crop diversity index decreased over time at national level, the temporal increase observed in almost half of the counties suggest that it is possible to increase crop diversity in Sweden. The different temporal changes between counties imply that crop diversity is affected by an interplay between natural and socioeconomic factors. Natural factors constrain which crops can be grown, but to promote diversification of agricultural crops in the future, socioeconomic factors need to be considered.