World's largest database of weeds lets scientists peer into the past, and future, of global agriculture

January 23 2024

Credit: Pixabay/CC0 Public Domain

A new database of weeds that can help scientists understand how traditional agricultural systems were managed throughout history, could

provide insights into how global trends like the climate crisis could affect the resilience of our modern-day food systems.

The database is the culmination of 30 years of collaborative research from archaeologists and ecologists working at the Universities of Sheffield and Oxford. It catalogs nearly 1,000 species of weeds growing in traditional agricultural regimes in Europe, Western Asia and North Africa. The work has been published in *Vegetation History and Archaeobotany*.

The open access resource, created and published by academics continuing the research project through the Oxford University Research Archive, offers researchers worldwide the opportunity to compare archaeobotanical data with 'traditional' farming systems.

The database catalogs the functional traits of weeds growing among arable cereal and pulse crops for all 928 weed species. The aim of the project was to be able to compare past and present farming systems through the weeds that grow alongside arable crops.

Plant ecologist, John Hodgson, who worked at what is now the University of Sheffield's School of Biosciences, was involved in the research from the 1990s. He said, "The data gives archaeologists and plant ecologists a way to understand the past and predict the future together.

"In modern day agricultural environments, where crops are micromanaged and everything that is not wanted is removed, it can be difficult to monitor long term changes to environments and plant species. So by investigating historical weed populations, instead of the crops, the data offers researchers a unique way to see what has been lost and gained over the ages.

"Analysis of the data allows us to look at what kind of plants have the ability to adapt to, or may be vulnerable to changing conditions in their habitats. The robust data from this years-long research offers the potential for understanding the resilience of food systems in a time of climate change, drought and degradation of land, and the exploration of a narrative for issues the world is facing today in terms of global food production."

The data models contained in the new package look to understand how low input (extensive) farming and high input (intensive) arable agriculture compare, which offers a free resource for academics to understand the nature of crop cultivation at field research sites, including how much labor people were investing in agricultural practices at a given time and what this may say about the sites and their inhabitants.

Glynis Jones, Emeritus Professor of Archaeology at the University of Sheffield, commented that the data has uncovered new insights about the history of agriculture and changed our understanding of the development of farming globally. She said, "The aim of the project was to use relatively simple functional attributes of different plant species, that can be measured more quickly than expensive and time-consuming experiments, to give us some entirely new insights into historical sites.

"We tend to assume agriculture started off in a non-intensive fashion, and grew progressively more intensive over the ages. However we have found Neolithic and Bronze Age sites that challenge this belief, small patches of land that were farmed intensively, using practices such as fertilizing, watering and weeding crops like wheat or barley; places where there was a lot of human effort being put into the growing of crops.

"We also found that sites from the Iron Age and Roman period that encompassed more extensive areas were less intensively cultivated, so

more crops may be grown but they would not be farmed as intensively as before as they covered larger areas. Whereas modern agriculture is characterized by encompassing both intensive and extensive agricultural practices.

"Our research has revealed to us the trends in arable agriculture over time and how farming practices have varied in different environments."

Those involved with the database say it forms a key research resource for academics working in ecology and archaeobotany. It is the culmination of 30 years of research from current and previous academics at the University of Sheffield and those now at the University of Oxford, including Professor of Environmental Archaeology, Mike Charles and Professor of European Archaeology, Amy Bogaard who led the work to create the new R package "WeedEco" which is open access for all.

Elizabeth Stroud, from the University of Oxford, who led development of the new R package WeedEco, said, "The new publication for the first time makes these datasets and models accessible to anyone interested in comparative study of past and present arable farming. This means that anyone from developer-funded or university-based archaeology, or from the plant science and ecology side, can engage directly with this research and conduct their own analyses.

"The models we are releasing in the R package have featured prominently in recent farming-related research projects in the University of Oxford's School of Archaeology, such as FeedSax and AgricUrb. This work has shed new light on how a range of different societies through time produced their staple crops."

Amy Bogaard, from the University of Oxford and senior author on the latest study, noted, "The new R package and the newly published dataset

of functional traits for nearly 1,000 weed species is a testimony to the dedication of everyone involved, and above all to the vision and commitment of colleagues at the University of Sheffield, where the functional ecological approach, and the connection to archaeobotany, originated. This is very much a joint celebration with colleagues in Sheffield and the School of Archaeology in Oxford."

More information: Elizabeth Stroud et al, Seeing the fields through the weeds: introducing the WeedEco R package for comparing past and present arable farming systems using functional weed ecology, *Vegetation History and Archaeobotany* (2023). DOI: 10.1007/s00334-023-00964-8. link.springer.com/article/10.1 … 7/s00334-023-00964-8

Provided by University of Sheffield