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Using geoarchaeological records and the adaptive cycle metaphor to understand processes within the social-ecological system agriculture

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Agriculture is a complex system, which consists of natural variables such as soil, climate, and vegetation. All these variables are influenced by society for example through tillage, carbon emissions, and selective breeding. Thus, the agricultural system combines the natural and the social system forming a complex social-ecological system (SES). This SES developed during the Neolithic transition and underwent challenges and changes throughout history. Analyzing these with the adaptive cycle metaphor as a tool contributes to our understanding of the complexity of the system. The analysis relies on archaeological, archaeopedological, and archaeobotanical research, which shows the importance of interdisciplinary work to understand past developments. This understanding is needed to learn from the past and avoid rigidity traps in the future.

According to Holling and Gunderson (2002), the adaptive cycle has four phases: the α-, r-, K-, and Ω- phase. The reorganization of a system (α-phase) is followed by the r-phase of exploitation, where a new system is established. The K-phase of conservation consolidates the system, which becomes vulnerable to shocks. Eventually, creative destruction (Ω-phase) occurs, which leads to a new phase of reorganization.

The SES agriculture underwent the four phases of the adaptive cycle from the Neolithic transition to the Industrial Revolution. It currently is in its second cycle. The SES agriculture has been a resilient system for thousands of years, despite facing challenges such as soil erosion, or changes such as the introduction of the plow. Both of these examples indicate the adaptive capacity of the system. By using the approach of the adaptive cycle, a comparison of past developments with the present progresses becomes possible.