LEOPOLD CENTER
FOR SUSTAINABLE AGRICULTURE

Exploring the role of multifunctional agriculture on the future of agriculture and rural development

Abstract: The goal of this project was better understanding of the interplay between climate shifts and management practices as it affects soil organic matter (SOM) stocks in agricultural fields. Two advanced computer models were used to study this issue.

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How can we implement multifunctional agriculture (MFA) in an Intense Managed Landscape? Is it even realistic and feasible? Which are the barriers for implementing MFA? This project made progress in identifying the barriers.

What was done and why?

High levels of soil organic matter (SOM) are critical for sustaining healthy soils; however, the collective effects of rainfall/runoff- and tillage-induced erosion can trigger enhanced soil and SOM losses. This study coupled a physically based erosion model (i.e., the Water Erosion Prediction Project model, WEPP) and a biogeochemical/ SOM dynamics model (i.e., CENTURY) to help explain the relationships between management practices and rainfall/ runoff- and tillage-induced erosion under historical, current, and hypothetical management scenarios. Better knowledge of SOM dynamics is critical for sustaining agricultural soils and assessing the overall health of a watershed.

The specific objectives of this study were to:

1. Develop a methodological framework that couples WEPP and CENTURY to quantify better SOM losses due to rainfall/runoff- and tillage-induced erosion, as well as decomposition.
2. Calibrate and verify the coupled models with collected field data and reported literature values.
3. Determine the long-term effects of land management and climate on SOM stocks in the Clear Creek (Iowa) watershed.
4. Gauge the status quo of SOM under current management practices and climate to ultimately determine the state of soil quality in Clear Creek.
5. Perform a cost-benefit analysis for current and alternative management practices used in Clear Creek.

What did we learn?

In addition to providing accurate estimates of SOM under a variety of management practices, the coupled models could be used to assess additional services that agro-ecosystems provide. Multifunctional Agriculture (MFA) focuses on ecosystem services in addition to food production. These services include carbon sequestration, decreased CO_2 emissions, improved water quality, and biodiversity to promote environmental rehabilitation and landscape sustainability.

Many MFA concepts have been applied to minimal agricultural producing countries and developing nations, but to incorporate these concepts within intensively managed agricultural systems requires a solid modeling framework that offers reliable estimates of the services to stakeholders.