Perennial Riparian Buffers for Bioenergy: A Flood-Resilient Climate Adaptation for Agricultural Landscapes

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Background/Objectives. The frequency and magnitude of flooding are projected to increase in the future under a warming climate. Agricultural landscapes are some of the most affected areas by flooding with potential implications for the sustainability of agriculture-based economies. To cope with the climate change impact on agricultural landscapes, it is crucial to develop adaptation and resilience strategies in flood-prone areas. In this study, we focus on the integration of perennials into the agricultural landscapes as partially harvested riparian buffers replacing annual crops (e.g., corn and soy). The proposed buffers could offer multiple benefits, including flood resilience, economic resilience, and ecosystem services.

Approach/Activities. The study uses ensemble streamflow projections from the Variable Infiltration Capacity (VIC)-ÂRouting Application for Parallel computation of Discharge (RAPID) hydrologic model forced with dynamically downscaled and bias-corrected climate models from the Climate Model Intercomparison Project Phase 6 (CMIP6). We extract annual and seasonal maxima for both baseline (1980-2019) and future (2020-2059) periods. In this proof-of-concept demonstration, we perform a flood frequency analysis for every stream reach in the Shenandoah basin in the US estimating different return period floods for each member of the ensemble streamflow projections. We use these estimates to conduct inundation mapping by using the Height Above Nearest Drainage (HAND) model using a 3-m DEM to produce flood inundation depth and extent for both baseline and future periods. We overlay the flood inundation maps with the perennial buffers to estimate the frequency of flooding at every perennial buffer pixel. Furthermore, the projected change in the extent of flooding of riparian buffers under future climate conditions is evaluated.

Results/Lessons Learned. We quantify the avoided crop insurance cost resulting from planting perennial instead of annual crops in flood-prone areas. The framework implemented in this study demonstrates the potential cost savings to farmers and society from planting partially harvested riparian buffers for flood and economic resilience under climate change and it is extensible to other similar basins in the US.