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Opinion

Climate Change Effects on Watershed Processes and Resilience

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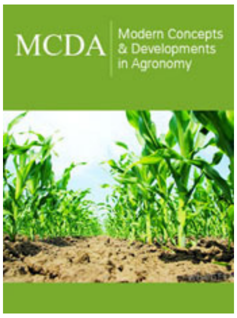

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Opinion

Adaptive watershed planning provides resilience to mitigate potential losses from agro-ecosystems due to climate change. Climate change is a global problem, but the earliest and most extreme consequences could be experienced in areas that are most exposed to its severity. Global greenhouse gas concentrations and surface temperatures are continuously increasing since atleast last four decades mostly caused by human activities. Globally some regions observed heavy precipitation, while other areas are observing deficit precipitation and drought [1]. Such variation in the global temperature and precipitation pattern increases the risk of environmental hazards like flooding, storm surge, landslides, soil erosion, drought, and other environmental damage [2].

While mitigating the future impacts of climate change will require a global effort, resilient adaptation of watershed practices should be taken on the regional and local levels. Future climate change assessment is a major part of watershed management programs that would allow adapting climate resilient practices to protect agro-ecosystems. Climatic variables (e.g., precipitation, temperature, carbon-dioxide concentration) can be analyzed and utilized in the bio-physical models to quantify their impact on hydrology, water quality and crop yields.

Watershed specific future time-series data of the climate variables can be generated using stochastic weather generators. Climate change assessment is performed based on the climate change scenario data obtained from different sources. The main sources of these data are from General Circulations Models (GCMs). The GCMs have been developed for the generation of future climate data for any parts of the globe. Although they are available for any parts of the world, the data may not be used directly at study areas because of their coarse spatial resolution. The regional scale coarse resolution of the GCM data must be downscaled to finer resolution before applying them in the watershed level study using biophysical models [3-5]. In addition to the generation of climate time-series data, downscaling models also performs statistical tests by comparing probability distribution of observed and synthetic climate data showing calculated statistical values (e.g., mean, standard deviations, chi-square test, t-test, F-test).

More research is needed to assess how climate change could influence the global agriculture. In the U.S. average change in the length of growing season has increased by more than fourteen days since the beginning of the 20th century with steady increase over the last 30 years [6]. Rising temperatures impact on agriculture as warmer summers and temperatures lead to reduced crop yields. Current climate change studies and recommendations are generally focused on the observed and predicted effects of climate change as well as adaptation strategies. Several studies showed that streamflow, and water quality loads (e.g., sediment, nutrients) were varied significantly under future climate change scenarios and human activities [7,8]. Climate resilient adaptive watershed management practices are more important to have in place to reduce the climate change impacts. Adaptation of climate resilient practices based on projected future climate scenarios simulation would be very useful for watershed management and reducing the potential adverse impact to the U.S. agriculture, rangelands, and forestry.

Recommendations to deal with future climate change globally or in the U.S. may include but not limited to: identify gaps between current literature and needs of the agricultural stakeholders; develop methods or tools to implement educational and outreach activities with the objective of enhancing agricultural productivity; focus on climate smart agriculture and livestock programs by adapting climate-resilient crop production, crop diversification, livestock breeds, and marketing strategies; develop emergency response systems; sequester carbon, improve water management and irrigation; strengthen current capacity related to innovative research, extension, and outreach approaches; develop and disseminate information by mapping climate-smart agricultural practices; integrate traditional practices with new climate-smart agriculture practices for wider acceptance of related crop and livestock production systems; and implement climate-smart practices at field as well as watershed scales [4,9,10].

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