The Impacts of Land Use and Land Cover Change on Water Quality in the Big Sioux River: 2007 – 2016

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The increasing demands for ethanol and rises in the price of corn led to increase of corn acreage in South Dakota. Other driving forces such as crop insurance subsidies and disaster payments encouraged farmers to (1) convert pasture, fallow, and grassland to corn acreage, and (2) shift from other crops such as wheat to corn. Land use changes are associated with soil erosion and diminished water quality. The impact is greater when the change is because of conversion of grassland to corn cropland. Corn requires a large quantity of N fertilizer which farmers supply using industrial fertilizers. The industrial fertilizers, when supplied in excess, results in the nutrient-rich soils. Leaching of nutrients rich soils during rainfall or irrigation leads to degradation of downstream water quality. High concentrations of nitrates (>10 ppm) are associated with human health issues and are regulated by the United States Environmental Protection Agency. The research uses the National Agricultural Statistic Service-Cropland Data Layer to characterize and determine the rates of Land Use and Land Cover Change change, and the Mann-Kendall test to analyze the temporal and spatial trends of nitrogen levels in the Big Sioux River (BSR) watershed. The results show that the corn/soybean cropland increased from 2007-2016 by 1.9 million acres which was obtained from grassland and other crops. The initial Man Kendall test shows that the percentage of corn/soybean cropland had a upward trend with a tau value of 0.228 (2-sided) and the p-value of 1.8835e-05. Additionally, 6 out of 10 gauging stations showed an upward trend, 2 showed a downward trend, and 2 showed a neutral trend, for the nitrogen trend analysis. Finally, the linear model of the Sen's slopes of nitrates versus the Sen's slopes of percentage corn/soybean and other classes was carried out which gives lower R^2 values and p-values.

Keywords: the Big Sioux River basin, water quality, Mann-Kendall test, Sen Slope estimator, NASS CDL dataset, land use/land cover, East Dakota Water Development District (EDWDD)