Public Abstract
First Name:Loise
Middle Name:Njambi
Last Name:Wambuguh
Adviser's First Name:Bruce
Adviser's Last Name:Cutter
Co-Adviser's First Name:
Co-Adviser's Last Name:
Graduation Term:SP 2010
Department:Forestry
Degree:PhD
Title:THE POTENTIAL OF PRODUCING BIOENERGY CROPS ON CONSERVATION RESERVE PROGRAM LAND IN MISSOURI, IOWA, NEBRASKA, AND KANSAS (MINK REGION) TO MITIGATE CARBON DIOXIDE EMISSIONS: AN INTEGRATED ECONOMICS AND BIOLOGICAL MODELING APPROACH

Global warming has become one of the most challenging environmental issues facing world leaders in the twenty-first century. Policymakers in the U.S. and elsewhere continue to debate on cost-effective and efficient ways to reduce CO2 emissions, a key greenhouse gas emitted through human activities particularly burning of fossil fuels and changes in land use. One option is to grow large-scale bioenergy crops dedicated to providing biomass feedstock for energy generation and sequester carbon in soil. Studies have suggested that putting marginal and set aside lands such as the U.S. Conservation Reserve Program (CRP) land under bioenergy crop production could potentially reduce competition with traditional food crops. Using such land to mitigate CO2 emissions could also provide other environmental co-benefits including soil and water quality improvement as well as economic benefits such as providing alternative source of farm income and reducing government expenditure on CRP. The objectives of this study were to evaluate the environmental and economic effects of converting CRP land into bioenergy and traditional food crop production. This study used the APEX model to evaluate field-level environmental effects over a 20-year simulation period in MINK region and an econometric model to evaluate the economic impacts on farm-level income, U.S. commodity prices, and federal expenditure on CRP. Switchgrass and hybrid poplar were selected as bioenergy crops. Seven locations - Missouri, Central Iowa, Northeastern Iowa, South Iowa, West Iowa, Nebraska, and Kansas - were selected to provide representative soils and climate inputs for APEX. Results within each study location indicate that uncoppiced poplar has the potential to produce significant biomass relative to coppiced poplar or switchgrass. Across the study locations, areas with lower rainfall showed correspondingly lower biomass yields. Soils in Central Iowa sequestered the highest amount of soil C while and the greatest losses occurred in South Iowa. Producing bioenergy crops on CRP land significantly reduced sediment, nitrogen, and phosphorus loading into water bodies relative to traditional crop production under conventional and conservation tillage. However, depending on soil type and climatic condition, converting CRP land to traditional food crop production while adopting no-till and buffer conservation methods reduced sediment and nutrient loadings as much as or better than under bioenergy crop production. Results from economic impacts show that about 80% of CRP land would revert to traditional food crop production, if the CRP were terminated. The study also shows that the federal government could save nearly $ 1.7 billion annually on CRP expenditures. Additionally, planting buffers on some of the cropland has insignificant impact on prices of major commodities.
Large-scale bioenergy crop production on CRP land coupled with adoption of land management conservation methods has the capacity to produce significant biomass feedstock, sequester soil carbon, improve soil and water quality, and provide an alternative source of farm income. Quantitative information on predictions of potential environmental and economic effects of producing large-scale bioenergy crops to mitigate CO2 will greatly benefit policymakers as they decide on sustainable and balanced environmental, agricultural, and energy policies.