Second Generation Bioenergy Potential

in the Upper Missouri River Basin

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Read the full study in the Journal of Global Change Biology Bioenergy: https://onlinelibrary.wiley.com/doi/full/10.1111/gcbb.12686

RESEARCH OBJECTIVES: Growing plants for energy production – bioenergy – can minimize our reliance on fossil fuels and create more opportunities for producers. Bioenergy crops are often grown in place of the crops used in food systems. This can make food more expensive and have other unintended consequences. We studied how much bioenergy could grow in areas of the Upper Missouri River Basin that are not used to grow crops and that are not identified as critical conservation areas to avoid such conflicts.

RESEARCH FINDINGS

1. Second generation bioenergy can be grown on large areas of the Upper Missouri River Basin

Between 37 million acres with large areas of land maintained for conservation and grazing **to 82 million acres i**f a more aggressive land conversion scenario is used.

2. Second generation bioenergy in the Upper Missouri River Basin can yield a large amount of power.

Between 8,000-28,000 megawatts of energy can be produced on lands that are not currently used to grow crops and are not critical conservation priorities. **During unproductive years this value might drop to 1900 megawatts**, which is less than the power produced, for example, by the Colstrip power plant in Montana.

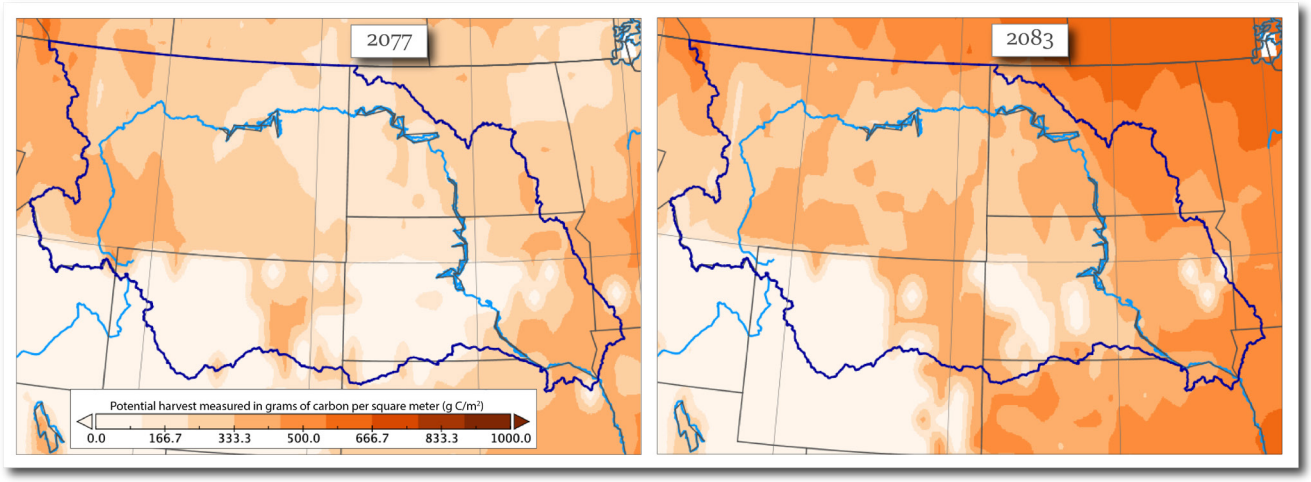
SECOND GENERATION *Bioenergy* IS

Second generation bioenergy is energy produced from crops that does not take the place of food production.

The Upper Missouri *River Basin*

The Upper Missouri River Basin is a large watershed encompassing most of Montana and South Dakota, portions of Wyoming and North Dakota, as well as corners of Nebraska, Minnesota, and Iowa.

MODELED SWITCHGRASS POTENTIAL HARVEST IN THE UPPER MISSOURI RIVER BASIN



We predicted switchgrass harvest potential using a dynamic vegetation model (LPJml) coupled with historic and future climate and land cover change projections. The above figure highlights the spatial and temporal variations in above ground biomass potential, assumes a high warming future climate scenario. While spatial patterns of potential harvest in the above maps are determined by both climate and soil variability, changes between years are a result of inter annual variability of climate.

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3. Transportation of the harvest and the ability of power plants to use this resource remains an issue.

Our simulations assumed that all of the harvest is used for energy production and that crops can easily reach power plants, which is not the case. To fully realize the benefits of bioenergy, **transportation and power plant infrastructure would need to be built.**

4. Yields of switchgrass as a bioenergy crop are likely to decrease as the region becomes warmer in the future.

Elevated atmospheric **carbon dioxide will have minimal impacts on switchgrass growth**, because this warm-season (C_4) grass already concentrates carbon dioxide within the leaf for photosynthesis.

5. The amount of carbon lost by soils when planting crops was about the same as the amount of carbon emitted by all of the power plants in the Upper Missouri River Basin.

Plowing can cause large carbon losses from soil, which may offset any advantages from replacing fossil fuels with bioenergy.

6. Opportunities for second generation bioenergy production in the Upper Missouri River Basin need to be weighed against soil carbon losses and infrastructural constraints.

REFERENCE: Dolan KA, Stoy PC, Poulter B (2020) Land management and climate change determine second-generation bioenergy potential of the U.S. Northern Great Plains. Global Change Biology Bioenergy. DOI: 10.1111/gcbb.12686.

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