SUSTAINABILITY OF BIO-ENERGY PRODUCTION

Pierre-André Jacinthe
Department of Earth Sciences
Center for Earth and Environmental Sciences (CEES)

Spring Forum, Lugar Center for Renewable Energy

May 15, 2017
CONTEXT

Corn production in the US Midwest - role in the US government’s strategy to boost biofuel production.

conversion of corn stover into ethanol as biofuel.

Impact:

- More fertilizer and agro-chemicals in corn production; thus, increased risk to water quality and emission of greenhouse gases.

- Land surface is less protected; thus greater risk of soil erosion, and export of phosphorus to waterways.
ALTERNATIVES

Corn Stover → Energy extraction (pyrolysis) → Biochar

Land addition → residual

IUPUI
What is Biochar

Black solid material derived from thermal decomposition (carbonization) of biomass (slow pyrolysis under low O₂).

- The type and character of the biochar depends on: pyrolysis process, the feedstock (C/O/H ratio, lignin content)
Environmental Impacts

Biochar addition can improve soil functions.

Thus, can be a potential strategy for climate change mitigation and food production.

Impact on climate:
- is a stabilized form of carbon (CO$_2$ emission avoidance)
- Biochar is porous; thus increases soil aeration and consequently less emission of N$_2$O and CH$_4$ (methane)
Environmental Impacts

**Impact on water quality:**
- Sorption of agrochemicals onto biochar (similar to activated charcoal)

- Nutrients such as N and P are more efficiently used when applied with biochar (thus less nutrients available for leaching)

- Due to its high CEC, biochar contributes to nutrients retention in soil

High C/N ratio of biochar, thus its application promotes N retention in the tissue of soil microbes.
Environmental Impacts

Agronomic benefits:
- Improved water-holding capacity of soils (macropores); thus greater resilience to drought.
- Change in soil moisture dynamic (water retention and release)
- Improved crop yield (thus greater amount of crop residue return to soil → more organic matter).

Current knowledge on biochar is largely from pot/plot experiments. Large scale experiments are sorely needed.