Some Water Quality Impacts of Alternative Energy Crops

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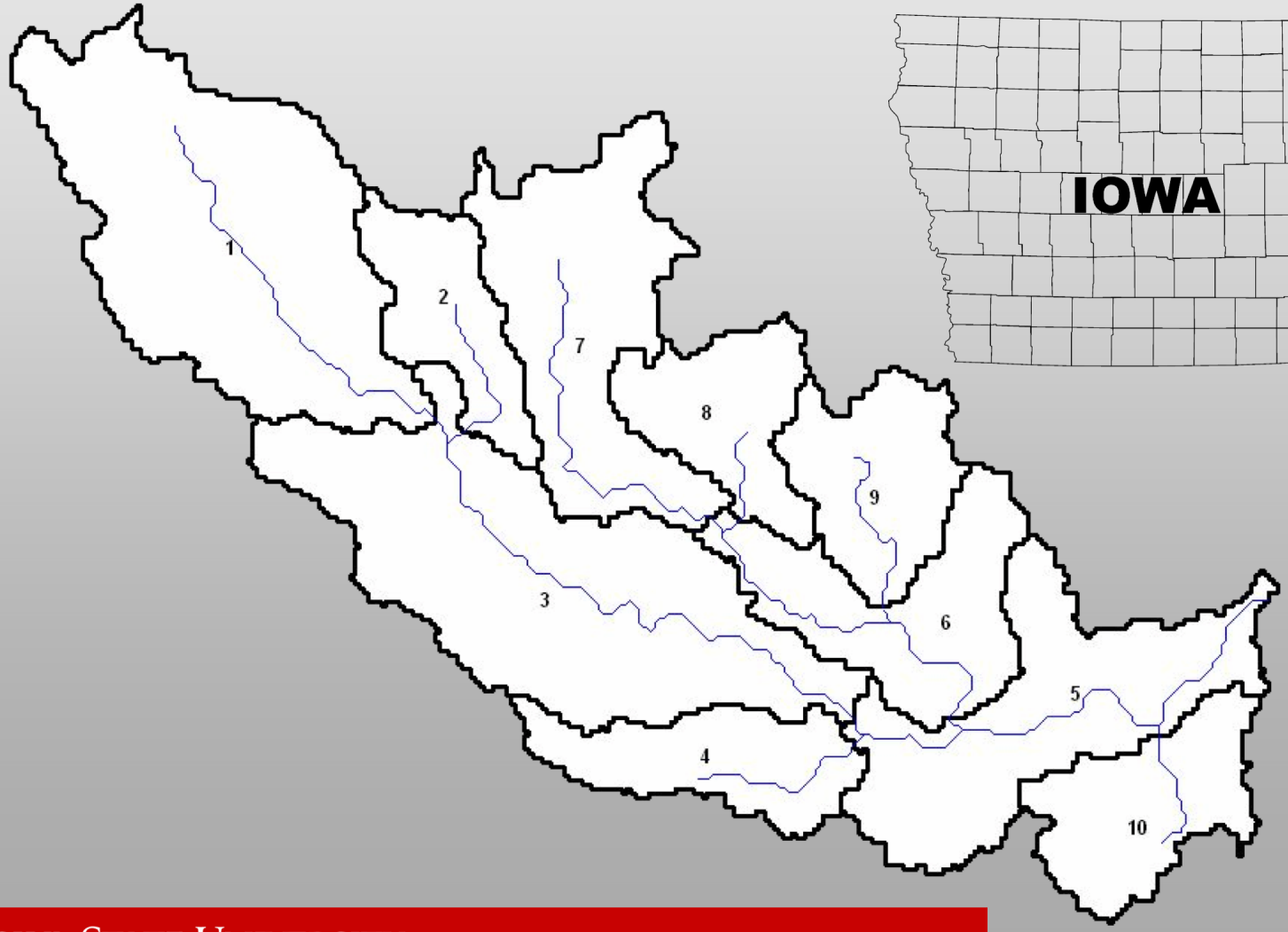
Biomass Energy Crops and the Environment

- Consider two sources of biomass:
  - Corn stover
  - Switchgrass
- Conventional wisdom
  - Reliance on stover increases environmental damage
  - Reliance on switchgrass will lower it

Investigate effects of these crops on water quality

- Three very stylized scenarios
- Single watershed in Iowa
- Much is unknown about how these crops would actually be grown and harvested
- Thus, findings reported here should be considered suggestive and preliminary

Maquoketa River Watershed



Maquoketa River Watershed

- Major contributor of sediments and nutrients to Mississippi River
- Dominant land uses
  - Cropland (corn and soybeans) 55%
  - Grassland (pasture) 32%
  - Forest 10%
  - Urban 3%

Model/Data

SWAT- Soil and Water Assessment Tool

- Predicts effect of land management practices on hydrology and water quality
- Watershed based
- Extensively used, over 250 peer reviewed publications

Model/Data

Key Data

- U.S. Geological Survey, Iowa Geological Survey Bureau: Flow, water quality data,
- National Resource Inventory: land use, cropping history, slope, etc.
- Weather, soils, etc.
- Model calibrated using flow, sediment, and nitrates

Scenarios

- Meant to illustrate extremes
- Three land use scenarios
  - Switchgrass: convert all potential cropland to switchgrass
  - Corn: convert all potential crop land to continuous corn, remove 50% biomass
  - Mixed strategy: switchgrass on HEL, continuous corn elsewhere

Scenarios

- **Compare each to Baseline**
  - **Baseline is current land use**
  - **Compare streamflow, sediment, nitrate, total N, and total P**

1. Switchgrass

- All potential cropland becomes switchgrass, includes current CRP
- No tillage of soil undertaken
- Spring fertilization: 110 lb/ac of nitrogen fertilizer, 60 lb/ac of phosphorous
- No fall fertilization

2. Corn

- All potential cropland becomes continuous corn
- Remove 50% biomass
- Mulch tillage operation
- Fertilization rates: 182 lb/ac of nitrogen, 54 lb/ac of phosphorous

3. Corn and Switchgrass

- Switchgrass on HEL, continuous corn elsewhere
- Highly Erodible Land = Erosion Index ≥ 8
- Switchgrass on HEL land, 53% of watershed
- Corn elsewhere, 47% of watershed

Summary Findings

Description	*Stream Flow (mm)*	*Sediment Yield (Tons)*	*Nitrate (Tons)*	*Total N (Tons)*	*Total P (Tons)*
Baseline	250	146,652	8,380	10,030	360
1. All Switch Grass	255	22,780	4,673	4,697	65
2. All Corn (remove 50% biomass)	257	180,054	20,738	25,067	857
3. Mixed (corn HEL<8)	254	119,135	12,382	13,201	206

Summary Thoughts

- Significant move towards continuous corn and biomass removal likely to worsen water quality
- Switchgrass relatively water quality friendly
- Targeting switch grass to highly erodible land can dampen water quality problems from continuous corn, but may still be problematic, particularly with respect to N
- Much better understanding of these sytems needed