Land, labor, and energy efficiency of alternative biofuel feedstock crops at three farm scales.

ANTHONY SILVERNAIL,* MICHAEL BOMFORD, MICHAEL WARD and JON CAMBRON
Community Research Service, Kentucky State University, 400 East Main St., Frankfort, KY 40601.
Corn and Ethanol Production

- Ethanol: Billion gallons
- Corn Production: Billion bushels

28% increase from 2001 to 2008
Sweet potato

Food

Fuel

2009

Bio-intensive
3.4m x 6m

Small Farm
38m x 22m

Market Garden
7m x 18m

Sweet

potato

Corn

Sorghum

Soybean
Sweet potato
Food Fuel

Corn
Food Fuel

Sweet potato
Food Fuel

Soybean
Food Fuel

Sweet Sorghum
Food Fuel

Crop Rotation

2009

Bio-intensive
3.4m x 6m

Small Farm
38m x 22m

Market Garden
7m x 18m

2009

Small Farm
38m x 22m

Market Garden
7m x 18m

Crop Rotation

Corn
follows

Soybean
follows

Sweet potato
follows

Sweet Sorghum
follows
Biointensive

- 20m²
- Hand Labor
  - Tillage
  - Maintenance
  - Harvest

Jeavons, J. *How to Grow More Vegetables...* Ten Speed Press, Berkeley, CA 2002
Market Garden

- Small Equipment and Hand Labor
  - BCS (12hp and 7hp)
  - Earthway Seeder
  - Hand Tools
Small Farm

- Conventional Management
  - 836 m²
  - Four Wheel Tractors (30-40hp)
  - Two Wheeled Tractors (BCS 12hp)
  - Hand Labor
Methods

- **Plots**
  - Plots were evenly divided into four strips
  - Corn, Soybean, Sweet Sorghum, Sw. Potato

- **Energy and Labor**
  - Metabolic Equivalent of Task (MET)
    - 2.5, 4.0, 8.0 (convert 5kJ per MET minute)
  - Fossil Energy
    - 32MJ L\(^{-1}\) for gasoline and 36MJ L\(^{-1}\) for diesel
  - Ethanol Yield (Potential)
    - 350 L Mg\(^{-1}\) of corn, 58 L Mg\(^{-1}\) sorghum, 167 L Mg\(^{-1}\) sweet po.
Results

- Biointensive used the most labor per unit area


Results

- Energy use was not significantly different between farm scales in 2008.
- In 2009, the small farm had the greatest energy use per unit area, followed by market garden, then biointensive.
Results

![Bar chart showing energy use (MJ m$^{-2}$) for Biointensive, Market Garden, and Small Farm in 2008 and 2009. The chart indicates that the energy use is lower in 2009 compared to 2008 for all categories.]