

STOOL TO FUEL

Locating Anaerobic Digesters in the Western Lake Erie Basin

Introduction

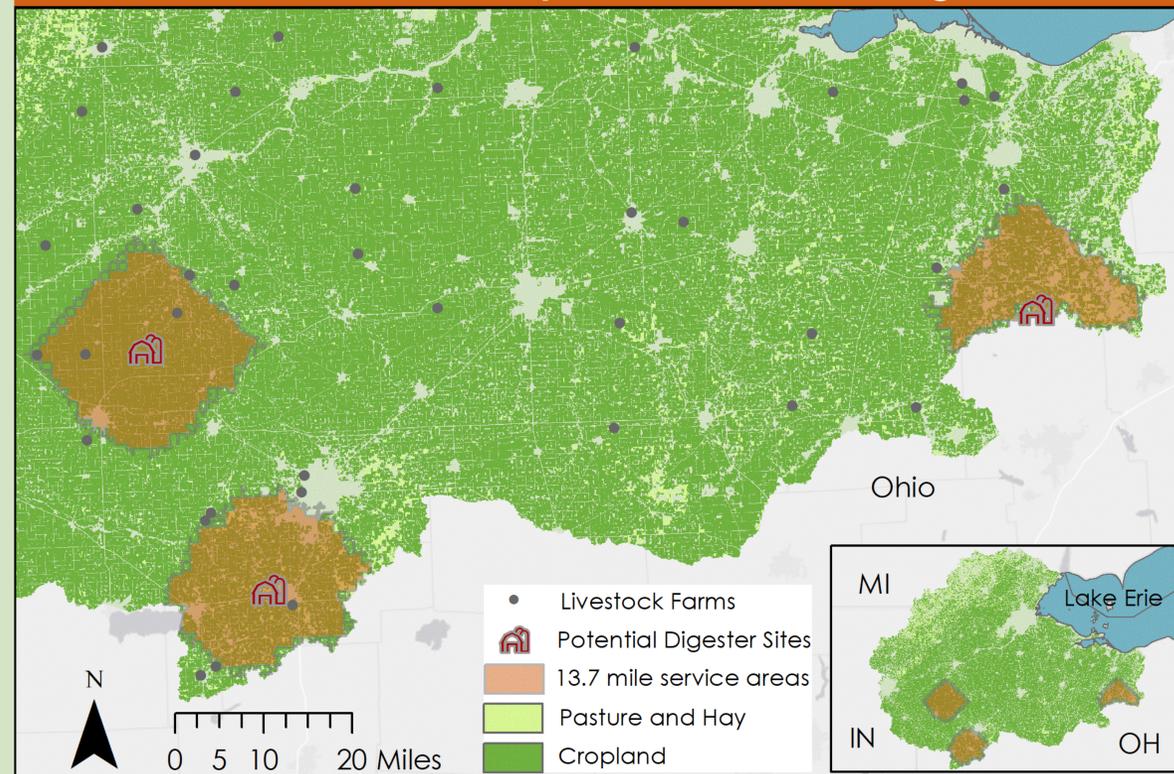
On-farm anaerobic digesters use microorganisms to facilitate the decomposition of organic materials including animal manure, food scraps, and food processing byproducts. Anaerobic digesters produce biogas and digestate. Biogas is primarily composed of methane and can be used to power engines, vehicles, or added to the natural gas pipeline. Digestate, a nutrient rich substance, can be used as crop fertilizer.

The Western Lake Erie Basin (WLEB) is dominated by farms, with 70% of its land base in agriculture. The basin is also densely populated and supports industrial activities which contribute to energy demand. In addition to producing renewable biogas energy, anaerobic digestion may help livestock farmers manage nutrients from animal manure. Western Lake Erie is severely degraded from nutrient pollution and, as a result, the lake experiences harmful algal blooms in the late summer months. By capturing a portion of animal manure in anaerobic digesters, farmers may be able to more easily manage nutrients and reduce the use of synthetic fertilizers.

Spatial Questions

- 1) Which farms within the Western Lake Erie Basin are most suitable for locating an anaerobic digester?
- 2) What is the area of agricultural land and total number of farms served by potential anaerobic digesters in Ohio?

Service Areas for Proposed Anaerobic Digesters



Results

The results of this model show that 5 farms in Indiana and Ohio are suitable for locating anaerobic digesters. All potential anaerobic digester sites are in the southern part of the basin, where many counties had high nutrient loading from animal manure.

Ohio accounts for 72% of the total land area in the Western Lake Erie Basin. Of the 75 livestock farms in the Basin, 53 are located in Ohio and three of the proposed anaerobic digester sites also fall within the state.

Network analysis indicates that 9 farms fall within a 13.7 mile drive of one of the proposed anaerobic digester sites.

Agricultural Land and Farms within Service Areas

| | Within Service Areas | Percent Served, within Ohio ¹ |
|----------------------------|----------------------|------------------------------------------|
| Agricultural Land | 608 thousand acres | 14 |
| <i>Pasture and Hay</i> | 20 thousand acres | 12 |
| <i>Cultivated Cropland</i> | 588 thousand acres | 14 |
| Farms | 9 farms | 14 |

¹ Percent is calculated as: "area within service" / "area within Ohio portion of Western Lake Erie Basin"

Methods

A fuzzy suitability analysis was used to locate suitable areas for anaerobic digesters. Areas were preferred for anaerobic digester facilities if they satisfied the following conditions:

1. Slope less than 14 degrees
2. Higher than the regional mean value for nitrogen and phosphorus loading from animal manure
3. Further than 1,000 meters from urban areas
4. Further than 500 meters from waterbodies

Of these areas, only those located on barren ground, shrub or scrub, grassland or herbaceous, and pasture or hay land were used in the final analysis and results. Existing livestock farms that fell within 50 meters of suitable land were selected as potential sites for locating anaerobic digesters.

Network analysis enabled estimation of the total land area and number of farms that could be served by potential anaerobic digesters in Ohio. The Ohio road network was used to delineate areas within a 13.7 mile drive of potential digester sites.

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All maps UTM Zone 16N projection

Data sources:

National Land Cover Database. US Geological Survey. 2011.
 National Hydrography Dataset. US Geological Survey. 2016.
 U.S. Businesses Database. NAICS Code 1121. Reference USA. 2017.
 National Elevation Dataset. US Geological Survey. 2017.
 TIGER/Line Shapefiles. County Boundaries. US Census Bureau. 2012.
 Road Inventory. Ohio Department of Transportation. 2017.
 County-Level Estimates of Nitrogen and Phosphorus from Animal Manure for the Conterminous United States. US Geological Survey. 2012.



Conclusions

This analysis indicates that there is potential to build anaerobic digesters in the Western Lake Erie Basin. While the proposed sites serve only 14 percent of the agricultural land base in the Ohio WLEB, anaerobic digesters in the region have promising potential for renewable energy and nutrient management.

This analysis could be strengthened through additional spatial and non-spatial exploration. In order to efficiently use the byproducts of anaerobic digestions, biogas needs to be converted to electrical energy or injected into the natural gas pipeline. Therefore, proximity to power grids is an important consideration. To effectively use digestate as fertilizer, presence of cultivated cropland is essential. The current analysis does not indicate how much digestate would be produced nor how much land area could be fertilized with the product. Further analysis could explore the potential of agricultural cropland in the Western Lake Erie Basin to assimilate digestate from anaerobic digesters. In addition to these considerations, farmer participation and economic factors are crucial to assess the potential for successful anaerobic digester facilities in the region.

Suitable Areas for Anaerobic Digesters

