

# Food safety, economics, and environmental impacts of aquaponics in Iowa

## Abstract:

Aquaponics offer promise as an alternative crop and protein production system for smaller farm operations. This project examined several aspects of aquaponic production: food safety, how UV treatments might mitigate food safety issues, what levels of profitability might be attained, and what the environmental impacts are for aquaponics operations.

## Investigators:

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*The PIs approached the question of whether aquaponics could be profitable in Iowa by building six research-scale aquaponics systems and evaluating the resource use and production yields from these systems. Using that production, the team modeled what a scaled-up system would look like and evaluated it for economic efficiencies through a techno-economic analysis (TEA) and life cycle assessment (LCA). The results indicated there is hope for profitability at a commercial scale.*

## What was done and why?

Aquaponics can be implemented using low-cost materials, which keeps capital overhead modest making it more attractive for small farm adoption. Also, the multiple crops produced in an aquaponics system (plants and fish) allow small-scale family farmers to diversify their incomes, which reduces risk of crop failure and increases revenue by providing products for multiple markets. There is tremendous potential to increase economic, social, and environmental sustainability of Iowa agriculture through aquaponics. However, little research has been done for aquaponics in Iowa.

This project assessed the potential for these systems to transmit bacterial contamination into fish and vegetative tissues, as well as the production economics of aquaponics systems, including capital equipment and facilities requirements, energy systems, water systems, and other operational expenses. These types of assessments are required because data regarding food safety, economies of scale, and facility/energy dynamics do not exist for aquaponics systems. Because the plants utilize fish effluent within a closed system, aquaponic food production should be more sustainable and environmentally friendly than many other livestock or agricultural production systems. But winters in the Midwest United States will require high energy consumption to maintain proper environmental conditions.

Objectives for the project were to:

- Determine food safety status and efficacy of UV sterilization as a food safety intervention for aquaponics in Iowa.
- Perform a techno-economic analysis for an aquaponics system in Iowa.
- Determine environmental impacts of an optimized aquaponics system in Iowa.

## What did we learn?

Presence and abundance of potential food pathogens were evaluated in the fish, plants, and water of the aquaponics systems. Three systems were run with ultraviolet (UV) irradiation and three without to assess the impacts of this intervention method on reducing potential pathogens. Results suggest that no human pathogens (*E. coli* or *Salmonella*) were present in the aquaponics systems and produce; however, some bacteria cultures were present and UV usage had no detectable effect in this system. Additionally, many potential pathogens were not evaluated, thus this should be continued.



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