Aquaponics

HORT 4601

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# Understanding Cost and Revenue Parameters to Construct a Profitability Model for Aquaponic-raised walleye (*Sander vitreus*) in the Upper Midwest

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## Introduction

- Walleye (*Sander vitreus*) is one of the most desired food fish species in the Upper Midwest (Venturelli, 2014).
- Historically, production methods for walleye have mainly been limited to wild catch with most commercial production originating from Canada.
- Declining wild stocks and the high market demand for this food fish have prompted interest in farming this species.

## Issue and Importance

- Naturally occurring walleye populations are declining in some areas prompting a shift toward alternative, controlled methods of production.
- Aquaponic walleye cultures must accommodate issues such as population density, feed source, water quality, light cycling, and facility management.
- It is important to compose an analysis calculator of operation methods which can determine if accommodating walleye species is economically significant.
- Female walleye and male sauger can breed to produce saugeye (Figure 1) a very similar tasting and appearing fish to walleye. This hybrid could in part aid the walleye shortage.

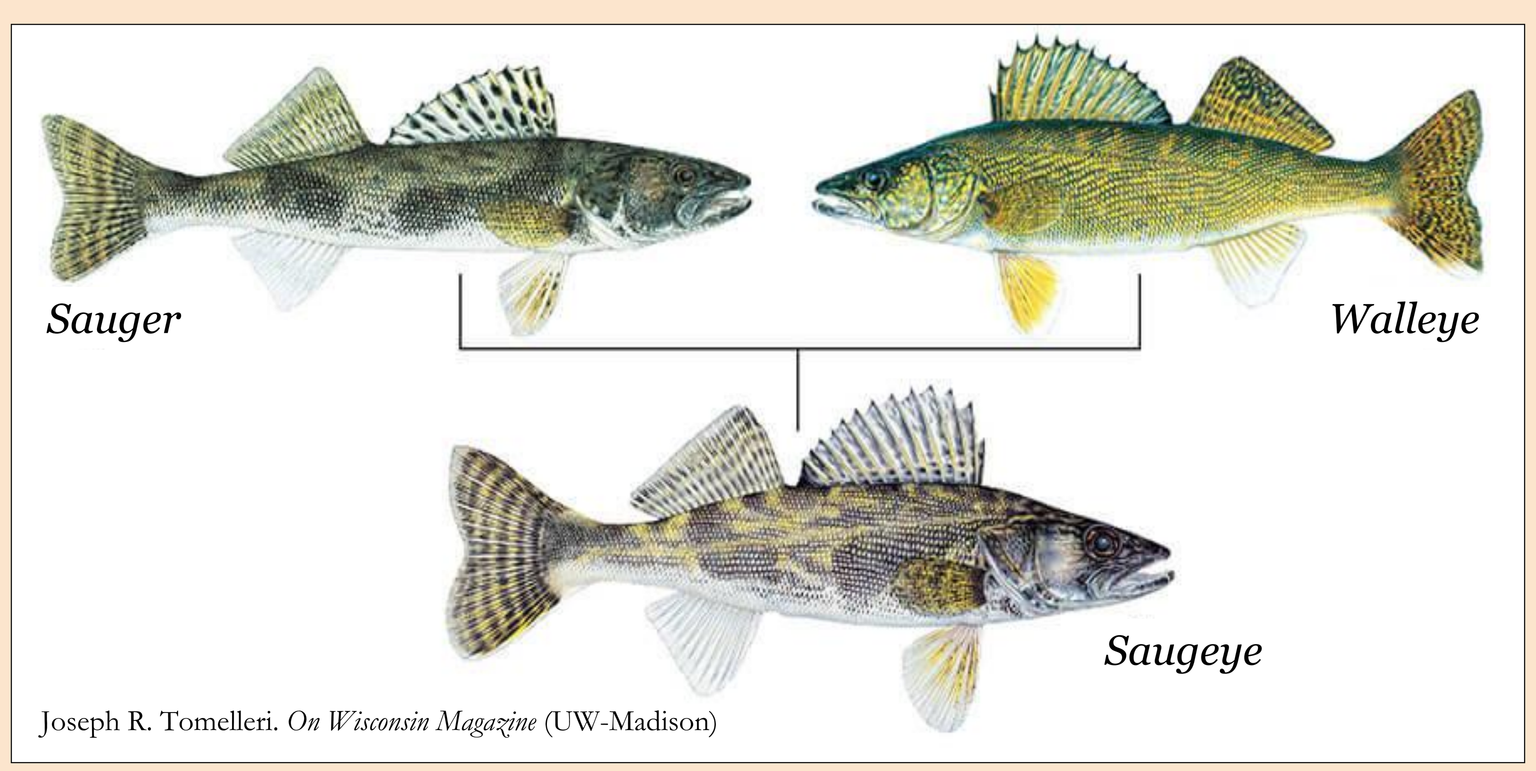


**Figure 1**. Image displaying physical differences between Walleye, Sauger, and Saugeye

## Objectives

This experiment is to test which parameters of raising walleye in aquaponics will minimize overall costs while maximizing profit through constructing the Walleye Cost Calculator (WCC). Values will reflect:

- Records related to startup, maintenance, distribution, and costs.
- Identification of seasonal walleye markets (wild caught in summer vs. farmed in winter).
- If hybrid walleye (saugeye; *Sander canadensis*) offers greater profitability over purebred regarding taste profile, growth rate, and marketability.
- Reduced costs by studying feed options (opposed to the desired, live pinhead minnow, fishmeal diet vs. diet without fishmeal).

**Table 1**. A cost calculator for a single crop in an aquaponic greenhouse (Mann, 2015)

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Friendly Aquaponics Financial Proforma for single 35 X 96 greenhouse | | | | | | Key Color: | What Is It? | | | | | | | |
| Projections for a SINGLE species (lettuce, OR bok choi, OR green onions etc) | | | | | | | Places you MUST input your local numbers for an accurate projection | | | | | | | |
| | | | | | | | "Plants Per Square Foot" is the average density in your system | | | | | | | |
| | | | | | | | Cycle Time is how long the plants are in the rafts, not counting sprouting table time | | | | | | | |
| | | | | | | | Plant Weight is averaged; but is fantasy without a test grow to define it for your location and greenhouse | | | | | | | |
| | Width | Length | Square Feet of GH Area | | | | Accurate numbers; don't mess with them unless you're sure | | | | | | | |
| Modified High Tunnel | 35 | 96 | 3360 | | | | VERY accurate numbers, don't mess with them unless you're REALLY sure | | | | | | | |
| Climate Design | Moderate | | | | | | Formulas: if you know how to mess with these, you don't need us | | | | | | | |
| | | | | | | | White boxes are your results, DON'T MESS WITH THEM AT ALL! | | | | | | | |
| Weeks of Production | Pack Percenta | Raft Area sf | Plants Per Square Foot Of Raft | Plant Weight | Cycle Time | | | | | | | | | |
| 52 | 0.950 | 2,100 | 6.45 | 0.12 | 5 | | | | | | | | | |
| | | | Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Heads Per Year | Pounds/yr | $/unit | Product | | | | | | | | | | | |
| 133,825 | 16,059 | 8.20 | Leafy Greens per pound | *, *** | 131,683 | 135,634 | 139,703 | 143,894 | 148,211 | 152,657 | 157,237 | 161,954 | 166,813 | 171,817 |
| | 450 | 2.50 | Fish (Whole) | **, *** | 1,125 | 1,159 | 1,194 | 1,229 | 1,266 | 1,304 | 1,343 | 1,384 | 1,425 | 1,468 |
| | | 1.10 | Leafy Greens per head | | 147,207 | 151,623 | 156,172 | 160,857 | 165,683 | 170,653 | 175,773 | 181,046 | 186,477 | 192,072 |
| | | | Gross Income By The Pound | | 132,808 | 136,793 | 140,896 | 145,123 | 149,477 | 153,961 | 158,580 | 163,338 | 168,238 | 173,285 |
| | | | Gross Income By The Head | | 148,332 | 152,782 | 157,365 | 162,086 | 166,949 | 171,958 | 177,116 | 182,430 | 187,903 | 193,540 |
| | | | | | | | | | | | | | | |
| | | | Price Inflation Per Year | 1.03 | | | | | | | | | | |
| | | | | Lbs./wk. | | | | | | | | | | |
| | | Pounds of Vegetable Production per week | | 309 | | | | | | | | | | |
| Expense Development Costs | | $/ft | Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Greenhouse Area (sf) | 3,360 | $ 5.95 | Land | 0 | | | | | | | | | | |
| Trough (lf) | 525 | $ 7.00 | Greenhouse Cost + Installation | 20,000 | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Sprouting Table (lf) | 45 | $ 20.00 | Sprouting Tables | 900 | | | | | | | | | | |
| | | | 1 - Fish Tanks (2,057/gal ea.) | 1,100 | | | | | | | | | | |
| | | | Trough Liner, Lumber & Stakes | 3,675 | | | | | | | | | | |
| Water Storage gal | 2,057 | | Pumps | 750 | | | | | | | | | | |
| | | | Piping | 1,000 | | | | | | | | | | |
| | | | Fish Tank Heater and Pump | 1,200 | | | | | | | | | | |
| | | | Lighting, wiring, and receptacles | 450 | | | | | | | | | | |
| | | | 2" Blue Board (.98/sf) | 2,058 | | | | | | | | | | |
| | | | Other Equipment (Backup Solar) | 5,000 | | | | | | | | | | |
| Capital Cost/sf | $4.53 | | Total Capital Costs | $36,133 | | | | | | | | | | |

## Methods and Study Design

Constructing the WCC to understand profitability for aquaponic walleye ventures will consist of many input variables that can be tailored to each producer's needs. Variables will be based on reviewed articles from university and private extension services in collaboration with industry partners. Categories of costs will include: fish production components, produce production components, maintenance costs, operation costs, and labor. Revenue streams will include: sale of fish, sale of produce, and potentially sale of services in the forms of consultation and farm tours. These categories will be divided further to represent geographical and sourcing influence, which directly affects market value and capital costs. An example of a basic calculator is shown above (Table 1).

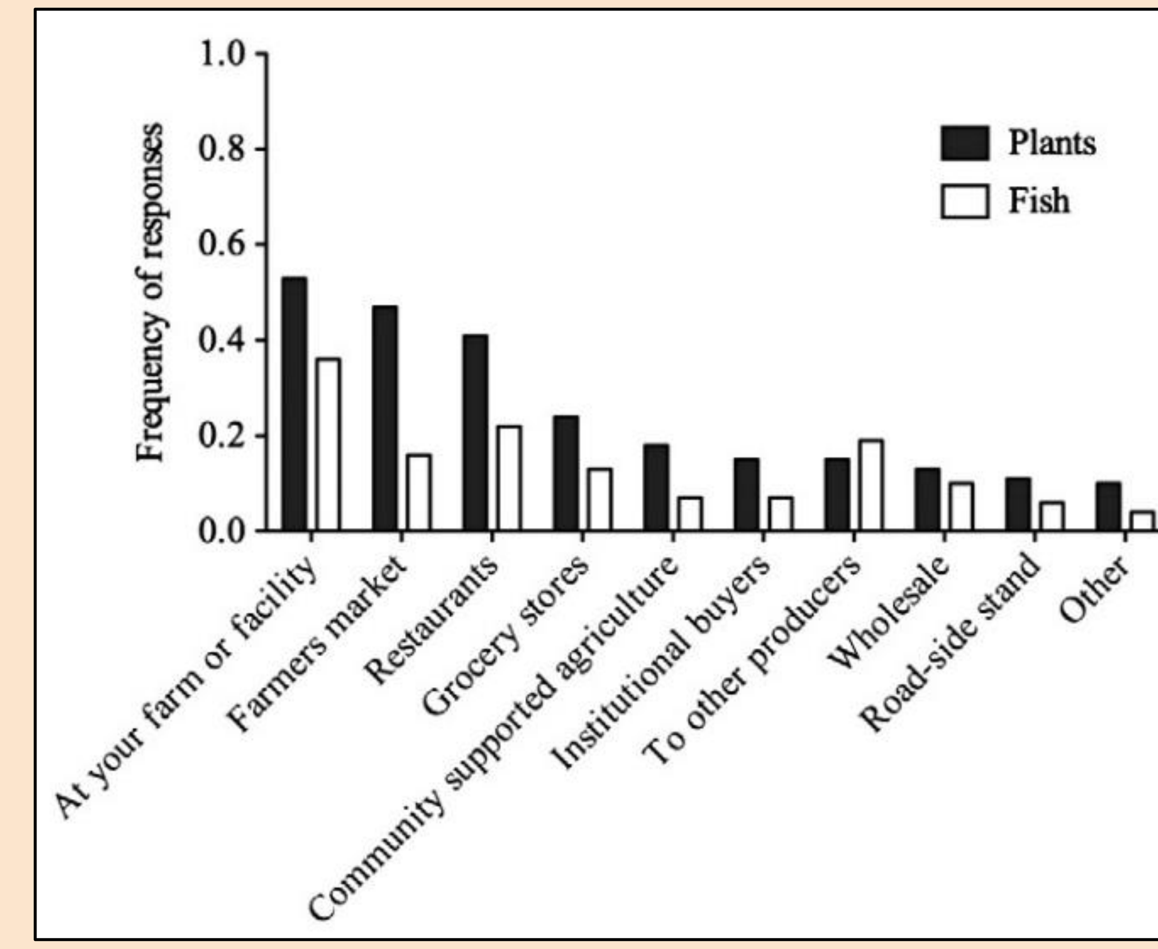


**Figure 2**. The distribution of aquaponic markets (where owners choose to sell their goods) (Love et al., 2015).

## Anticipated Results

The researchers expect that market price of walleye will be the largest determining factor in the economic feasibility of producing walleye in an aquaponic system. Different markets will offer varying returns on goods, understanding this relationship will be important. A distribution of selected markets for aquaponics operators is shown above (Fig. 2). If the WCC determines that it will not be profitable to rear aquaponic raised walleye it will allow the user to see why. The WCC will ultimately allow prospective producers to make a more informed decision about whether or not to enter the market. Greater transparency of market potential will lead to greater walleye availability and demonstrate a positive effect on local economies in the Upper Midwest.

## Potential Problems

A potential issue of the Walleye Cost Calculator is its ability to remain relevant and accurate to current markets and production costs; this is important in creating a reliable tool. When new price standards present themselves or production costs deviate from the research used to create the WCC, users will have to update cost and revenue values. These values must be credible and sourced to current markets; involvement from industry partners should remain unbiased and reflect authentic trends.

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