The Economic Feasibility of Aquaponics

A post-hoc Cost-Benefit Analysis of investing in a fish vegetable farm near Dumaguette, Philippines

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Until 2015 economic feasibility little studied

Aquaponics = producing fish and vegetables
- ✓ in a closed-loop water system,
- ✓ reduces fertilizer use and effluent discharge,
- ✓ fish effluents suppress fungal diseases and stimulated root growth in tomato.

=> promoted as a sustainable venture.

Economic feasibility poorly studied since 1999:

Chaves P.A, Sutherland RM & Laird LM, 1999. An economic and technical evaluation of integrating hydroponics in a recirculation fish production system. Aquac. Econ. & Management 3(1): 83-91

Love DC., Fry JP, Ximin Li, Hill ES, Genello L, Semmens K, Thompson RE, 2015. Commercial aquaponics production and profitability: Findings from an international survey. Aquaculture 435 (2015) 67–74.

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From home-garden

to farm-size.

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Methods

ACT group of 7 MSc students from various nationalities:
- Literature and grey literature
- Survey by phone and e-mail;
- System simulation => Post-hoc cost-benefit analysis,

Nutrients in effluent of fish component =>
- volume of fish tank : area vegetables 1:30 to 1:100 depends on used species of both.

=> farm size set by quantity marketable fresh vegetables.

Kaikanen et al., 2012: N-output of the fish component.

Mori et al., 2008: Tomato's N-demand (vegetative & fruit).

De Pinheiro Henriques & Marcelis, 2000: Lettuce N-demand.

ACT= Academic Consultancy Training = Interdisci--plinary Group Assignment on a real world question.

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Methods

- Discounted benefit-cost : $DBCR = [\sum_{t=0}^{n} B_t/(1+r)^t]/[\sum_{t=0}^{n} C_t/(1+r)^t]$
  Bt = benefit in yr t; Ct = cost in yr t; n = project length (yr);
  r =discount rate: 8%, similar projects between 6% and 10%.
- Cost prices for materials from local providers & survey.
- Operational cost : insurances not included.
  For taxes: two scenarios: without and with taxes.
  VAT = not paid when farmers sell directly to consumers & when total gross sales are below 1.919.500 PHP.
  Fingerling catfish 12 PHP/pcs ; seabass 24 PH/pcs
  Feed catfish 34 PHP kg^{-1}, seabass: 51 PHP kg^{-1}
- Revenues: wholesale prices, i.e. farm-gate price,
  - Tomato's: 18 PHP kg^{-1}; Lettuce: 55 PHP kg^{-1}.
  - Catfish: 79 PHP kg^{-1} ; Seabass: 300 PHP kg^{-1}.

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Operational cost (* 1,000 PHP)

Description	Amount
Seeds	27.6
Fertilizer	7.0
Fingerlings catfish	17.5
Fingerlings seabass	35
Feed catfish	22.6
Feed seabass	34
Treatment pests & diseases	5.5
Electricity	35.5
Transportation	3.9
Repairs	12.0
Labour	184.8
Total amount	**316.4**

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Investments:

Cost (*1,000 PHP) for the materials and the life.

- Depending the component and its material.

Material	Amount	Life span (yr)
Greenhouse	542.5	5,10,20*
Media beds	411.9	1,3,5,20*
Land	115.1	n.a.
Roof for fish tanks	40.7	10
Bio-filter	30.8	10
Fish tanks	27.0	10
Plumbing	27.0	10
Crates for vegetables	26.0	3
Well for fresh water	15.5	20
Air pump	5.9	10
Fishing gear	5.0	5
Water pump	4.9	5
Test toolkit	2.2	10
Clarifier	1.4	5
Trays for seedling	1.2	0.33 ; 1*
Fish transport container	0.7	5
Total amount	**1,259.8**	= USD31,500

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Cost Benefit Analysis for catfish

CBA over 20 year for aquaponics with catfish only (*1000 PHP)

Year	1	3	4	8	11	12	Total
Total Disc. Investment	1,683	16	42	11	83	8	2,079
Total Disc. Operational	301	271				136	3,339
Total Disc. Revenus	407	510				255	6,115
Undisc. Net Benefits	1,150	259				259	3,336
NPV = Disc. Net Ben.	1.150	222	178	151	48	111	1,131

Disc. Benefit / Cost = TD Revenus / (TD Inv.+ TD Oper.)

	No VAT Catfish		No VAT Seabass		Catfish / seabass No VAT		10% VAT	
r	10 yr	20 yr	10 yr	20 yr	10 yr	20 yr	10 yr	20 yr
4	1.16	1.31	1.61	1.81	1.38	1.61	1.21	1.42
8	1.10	1.23	1.53	1.70	1.29	1.52	1.14	1.32
16	0.99	1.07	1.42	1.54	1.17	1.33	1.02	1.13

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Discounted Benefit Cost Ratio

Insurance not in Operational cost =>

DBCR > 1.3

Paying insurance = benefit shareholder = loss farmers.
Capital investors want >12% benefit on their investment.

In LDCs: Interest rate < 8% are rare =>

- Aquaponics with catfish only too risky;
- Fish needs to focus on niche markets (expensive fish);
- Start with catfish for testing and learning but
- shift to seabass as soon as possible;
- When paying tax need to find better paying buyers.

Integration of fish - vegetables

Aquaponics

Financially sustainable if:

1. High end niche market for fish,
2. large market for fresh organic vegetables.

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Contribution of fish component to revenue, investments and operation

Netherland's farmers did not adopt aquaponics with tilapia:
- fish component asks relatively too much capital and effort.

- Accounting to the fish component:
  - 100% of the cost for fingerling,
  - 50% for feed and electricity, and
  - 20% for transportation, repairs and labour.
- The operation cost attributable to
  - catfish was estimated at 28%
  - seabass was estimated at 34%.
- In case of catfish only, revenues from fish =17% of total
- After the shift to seabass this contribution > 40% of total.