ECONOMIC VIABILITY OF LOW-COST AQUAPONIC SYSTEM IN SOUTH AFRICA

Dr. MJ Thaela-Chimuka
ThaelaMJ@arc.agric.za
STATUS OF AQUAPONICS IN SOUTH AFRICA

ECONOMIC OF AQUAPONICS
Introduction

• Aquaponics has been documented to be economically feasible and sustainable, particularly in areas with limited land and water resources availability.

• Due to limited economic data and variability of the economic viability metrics applied in various studies, there have been no clear conclusions reached on the economic viability of aquaponics.
Introduction cont......

• The economic viability of an aquaponics system can be determined through the assessment of the following:
  ✓ Price trends,
  ✓ cost,
  ✓ revenue,
  ✓ return on investment (ROI),
  ✓ net present value (NPV),
  ✓ internal rate of return (IRR)
• Sequence of procedures to determine the economic feasibility of an aquaponics operation:
  ✓ Determine the system requirements by calculating the growth projections of the fish and plant species,
  ✓ Determine the capital cost of the system,
  ✓ The operational cost,
  ✓ Revenue projection, and
  ✓ Determination of financial feasibility by modelling the cost factors and revenue analyses into financials.
Economic factors to be considered in setting up an aquaponic system

Factors

Realistic market price estimates of the products based on price trend analysis

The total capital outlay required to setup the aquaponics (CAPEX)

The annual operating costs of the system (OPEX)
Entry level Aquaponics modular Revenue

- ARC-UKZN are using aquaponics as a climate Smart agriculture leap frog technology that will improve access to affordable and diverse food
- Entry modular system can be made of a simple 10 000l tank
- (fish) from a halved JOJO or equivalent IBC tank, barrel
- The plant culture system will comprise of four 10000L flowbins where six pots of lettuce, spinach, chilli and tomato and other seedlings in each container to be grown using gravel bed design system.
- The entry level is a unit for one household/school
Entry level Aquaponics modular Revenue

- The plant culture directly related to fish stocking density i.e. nutrient concentration aquaculture effluent.
- Plants that will do well in any aquaponics system are leafy plants house plants like herbs lettuce and leafy greens (chives, lettuce, basil) nutrient requirements is low to medium.
- Higher nutritional demands (Fruit yielding plants such as tomatoes, bell peppers, and cucumbers) and will only do well in a heavily stocked, well established aquaponics system.
## Economic viability of small-scale aquaponics operation

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Start-up Size</th>
<th>Costs</th>
<th>Infrastructure Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Stock</td>
<td></td>
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<tr>
<td>one household/school</td>
<td>1 modular aquaponics system + green house per famer</td>
<td>Plants</td>
<td>20</td>
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<td></td>
<td></td>
<td>Fish/ fingerlings</td>
<td>10 (includes transport)</td>
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<td></td>
<td></td>
<td>Total Cost for 1 system</td>
<td>R25 000</td>
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</table>
Elements of marketing

- **Product**
  - Functionality
  - Brand
  - Packaging
  - Services

- **Price**
  - List Price
  - Discounts
  - Bundling
  - Credit Terms

- **Promotion**
  - Advertising
  - Sales force
  - Publicity
  - Sales promotion

- **Place**
  - Channel
  - Inventory
  - Logistics
  - Distribution

**Target Market**
PRODUCTION Vs. DEMAND DRIVEN AGRICULTURE

• Economic theory is based on choice. The consumers make choices around the produce they want to buy and use. The producers make choices around how to produce their products, their quality, quantity etc. These choices made by producers and consumers, determine supply and demand for a product.
PRODUCTION Vs. DEMAND DRIVEN AGRICULTURE

Demand Driven

• Producing to meet the needs of customers, while making profit
• Marketing process includes market research, deciding on products and prices, advertising, promoting, distributing and selling.

Production Driven

• Producing for maximum volume/quantity (sometimes quality), without regard for market needs.
ADVANTAGES OF DEMAND-DRIVEN CROP PRODUCTION

- Satisfied customers/search
  - Demands met
  - Will buy again
  - Might pay higher prices

- Short turn around time
  - High quality produce from the soil to the table
    - High price
    - High profit margin

- Market

- Pack house
  - Short turn around time
  - High quality produce from the soil to the table
  - High price
  - High profit margin
  - No surplus produce
Economic viability of small-scale aquaponics operation

• The model in the University of KwaZulu Natal indicated that this small-scale aquaponic operation are not economically viable by adopting conventional aquaponics cultural practice (fish: plant revenue model 59 to 41 %) due to higher operating cost of producing a kg of fish (R55) vis-à-vis the market price, compared to plant production.

• A previous economic feasibility study conducted by (Lapere, 2010) on some small-scale aquaponic farms in South Africa showed that most of the aquaponic ventures were not viable due to factors such as design, setup and operational challenges.
Economic viability of small-scale aquaponics operation

- A revenue model of 42 to 58% fish to plant ratio was marginally feasible.
- A minimum revenue model of 30 to 70% fish to plant ratio by adopting optimized plant yield cultural techniques to attain economies of scale and viability, is suggested.
- This findings represented a model for promoting viable and sustainable unconventional food production system to attain food security and local economic development in South Africa.
Maximum Returns on Investment on vegetable production in aquaponics

- Numerous economic models run at the University of KwaZulu-Natal and other published work show that vegetables offer 90% of the profitability rather than fish.

- On this basis, the Agricultural Research Council is conducting a systematic literature review to analysis six years of average monthly prices of vegetables.

- This is informed by the fact that, because Vegetable pricing is not constant and is subject to market demands and fluctuations and to maximize profitability from vegetable sales, a historical trend analysis of pricing is needed.
## Entry level modular Revenue

<table>
<thead>
<tr>
<th>ITEM</th>
<th>INPUTS</th>
<th>INCOME</th>
<th>PROFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>throughput/Cycle</strong></td>
<td><strong>Cost/cycle</strong></td>
<td><strong>throughput/year</strong></td>
<td><strong>Cost/System/year</strong></td>
</tr>
<tr>
<td>3 Vegetable cycles sales per year</td>
<td>Lettuce Spinach Basil Pepper Tomatoes Other herb (total 15kg vegetables)</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; cycle is R40 000 2&lt;sup&gt;nd&lt;/sup&gt; and 3&lt;sup&gt;rd&lt;/sup&gt; R8 000</td>
<td>Lettuce Spinach Basil Pepper Tomatoes Other herbs (total 30kg vegetables)</td>
</tr>
<tr>
<td>2 Fish cycle Sale per year</td>
<td>1 000 fingerlings/cycle (total 270kg fish 10%mortality)</td>
<td>R10 000</td>
<td>2000 fingerlings/year (total 540 kg fish 10% mortality)</td>
</tr>
</tbody>
</table>
Maximum Returns on Investment on vegetable production in aquaponics

Trend analysis of pricing was then combined this data with a literature of vegetables grown in aquaponics systems planting times, as mechanism maximize returns on investment. ARC is basically carrying out study for mechanism vegetable producers to maximize their returns on investment in the production of vegetables.
Preliminary findings

• Preliminary findings underscored that the market price of vegetable crops may be influenced by the production volumes or other related costs.

• Meanwhile, other crops showed no correlation between market price and production volumes.

• The analysis also demonstrated that besides the market price and the growing periods of crops, other dynamic factors to consider in the efforts for the production of a particular crop involve yield and density of the plant.
Preliminary findings

• By combining knowledge of the relationship between planting times and prices, we may be able to improve predictability at the peak of profits.

• Producers may consider investing on the production of vegetable crops that are most valuable or those varieties of crops capacitated in meeting market demand.
Preliminary findings

• Some of the aspects involved in the valuation of crops include the unit value, production period, density, and yield.

• Based on this aspects, Lettuce is suggested to be a better crop to incorporate in aquaponics production to attain maximum returns, followed by tomato (although has longer growth period), with basil and spinach as comparatively good alternative options.
Large-scale/commercial aquaponics
Large-scale/commercial aquaponics
Large-scale/commercial aquaponics
## STRENGTHS AND WEAKNESSES OF AQUAPONICS

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>Economical production of either family food production fish or cash crops in many locations.</td>
<td>Unsustainable fish food</td>
<td>Natural feed for fish grow algae and worms to supplement or replace ingredients that are costly for</td>
</tr>
<tr>
<td>Construction materials and information base are widely available.</td>
<td>For commercialisation initial cost to set up higher initial cost than other production methods, such as home gardens. It will depend on the size of the system and its technological level. Consider that pumps and plumbing items are required.</td>
<td>One can always start small</td>
</tr>
<tr>
<td>Higher yields than soil culture by using same land for production agriculture and fishes. Land Conservation; Produces 2-6 times as it allows use of multiple platforms on top of each other. cultivate different crops in same area</td>
<td>Reduced management choices compared with stand-alone aquaculture or hydroponic systems.</td>
<td>(This could also be a positive) Operation needs to be according to guidelines.</td>
</tr>
<tr>
<td>Higher control on production leading to lower losses.</td>
<td>Mistakes or accidents can cause catastrophic collapse of system.</td>
<td>Training and extension in initial phases very important.</td>
</tr>
<tr>
<td>Higher level of biosecurity and lower risks from outer contaminants.</td>
<td>Daily management is mandatory.</td>
<td>Since it is a ‘home’ system, daily management is possible.</td>
</tr>
</tbody>
</table>
CHARACTERISTICS OF AQUAPONICS IN SOUTH AFRICA

The observed increase in starting aquaponics practitioners can be explained by the recent drought, food safety concerns, land reform, urban poverty, limited resources and increasing population size in South Africa, because these have been the main challenges facing South Africa in recent years (Faber et al., 2011; Mabhaudhi et al., 2013;
DISTRIBUTION AQUAPONICS S. A

Legend
- Commercial
- Subsistence
- Hobby
Most SA farmers raise leafy vegetables (green salad, lettuce and herbs) than fruity veggies that have high economic value and return.

- Low nutrients requirement and grow faster and raised in high density than fruity (8 plants m²).
high SA farmers are fish-only focusing enterprises, as they started as aquaculture farms and evolved as aquaponics. Having better fish than vegetable market crop production dominance in growth medium bed is cos no need of biofilters removing excess nutrients as it acts a biofilter itself. It is also readily and easily available than others.
In terms of harvest, most farmers (47%) harvested fish in 6 months, with 39% of farmers harvesting after one year- and 7% harvesting every week to every month (Fig. 7A). In terms of yield, most farmers (62%) harvested a yearly yield of 1–10 kg, followed by 10–20 kg (18%),
STATUS OF AQUAPONICS IN SOUTH AFRICA - FISH CHOICE

![Fish Types Raised Graph]

- **Tilapia**: 82%
- **Barbel**: 18%
- **Trout**: 30%
- **Ornamental**: 16%
- **Bass**: 2%
- **Bluegill**: 2%

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Plant of Choice and Method of Crop Production

![Bar chart A](chart_A.png)

- Salad greens: 75%
- Lettuce: 55%
- Basil: 50%
- Herbs: 46%
- Peppers: 32%
- Cucumbers: 25%
- Ornamental: 18%
- Beans & Peas: 16%
- Tomatoes: 16%
- Carrots: 9%
- Cut flowers: 7%

![Bar chart B](chart_B.png)

- GMB: 96%
- NFT: 16%
- DWC: 14%
MAIN AQUAPONICS CONSTRAINTS SA cont.

Many SA farmers are fish-only focusing enterprises, as they started as aquaculture farms and evolved as aquaponics and have better fish than vegetable market.

Further more aquaponics are regulated neither by Department of Environment, Forestry and Fisheries (DEFF) nor by Department of Rural Development and Land Reform (DRDLR) policies (personal communication Neale Strauss).

There is therefore a need for research studies supporting the policy-making process and also helping the aquaponics farmers to source funding, and credit, Hence, this project will developing model “A one-house one-aquaponics and one-school one-aquaponics systems” program to address that challenge.
THANK YOU