Appendix 7 – Cost-benefit analysis for small-scale aquaponic units

Tables A7.1–A7.4 describe the costs and benefits of a small-scale aquaponic unit. The information in the tables is meant to provide the reader an understanding of the expenses necessary to build and run an aquaponic unit, as well as the expected production and incomes in the first year. Table A7.1 summarizes the total cost of materials for the initial installation (capital investment) for a small-scale media bed unit (the full list of materials and costs for this unit can be found in Appendix 8 of this publication). Table A7.2 details all the yearly running costs involved. The details of the running cost calculations can be found in the notes section of the table. Table A7.3 details the expected production of vegetables and fish in one year. Table A7.4 brings together the costs and revenues from Tables A7.1–A7.3 and shows the total profit on the initial investment and the payback period.

It should be noted that the figures given in the tables are only intended as guidelines for new users. It is difficult to provide accurate figures, particularly regarding production yields and their values, as many production and financial factors may influence them: temperatures, seasons, fish type, fish feed quality and percentage protein, markets prices, etc.

CALCULATION ASSUMPTIONS

- All calculations are based on a small-scale media bed unit (described throughout the main text of this publication) with 3 m^2 of growing space and 1 000 litres of fish tank space (as shown in Appendix 8 of this publication).
- The unit is meant for domestic food consumption only and not for small-scale income-generating production. The financial benefits can vary and might be larger than the figures shown in Table A7.4 if farmers select more profitable crops to grow. As the focus is on small-scale aquaponics for domestic food consumption, two crops have been considered in the calculations as these better reflect the production patterns of users growing food for consumption only: one leafy green (lettuce) and one fruiting vegetable (tomato).
- Yield data are obtained from a continuous production of 12 months, feeding the fish with good-quality 32 percent protein feed daily in unit water temperatures of 23–26 °C throughout the year.
- The units have a constant standing fish biomass of 10–20 kg.
- The fish cultured are tilapias. They are fed on a feeding ratio of 50 g per square metre of growing space, equivalent to a total feed consumption of 150 g per day (50 g × 3 m^2). The stocking weight of juvenile fish is 50 g; the expected harvest weight is 500 g per fish in 6–8 months.
- The average yields for amateur growers have been considered in the calculations: 20 heads of lettuce per square metre per month, and 3 kg of tomatoes per square metre per month.

TABLE A7.1
Total capital costs for a media bed unit (1 000 litre fish tank and 3 m² growing space)

Item description	Price (USD)
IBC tanks*	200
Electrical equipment: water pump, air pump and connections	120
Media bed support: concrete blocks and wood planks	80
Volcanic gravel (biofiltration medium)	120
Miscellaneous items: fish net, plumber's tape (Teflon), shading material, etc.	100
Plumbing: pipe, pipe fittings and connections	80
Total	**700**

Notes: All items in this table are discussed, at length, in Appendix 8 of this publication.
* The life span of IBC tanks will increase if protected from the sun light with a paint coating or other material.

TABLE A7.2
Total monthly operating cost for running a small-scale aquaponic unit

System inputs	Unit	Units per month	Price per unit (USD)*	Total cost (USD)
Plants	Seedling	35	0.10	3.50
Fish	Fingerling	5	1.00	5.00
Electricity	kWh	25	0.10	2.50
Water	litre	450	0.0027	1.20
Fish feed	kg	4.5	2.50	11.25
Miscellaneous	–	1	3.00	3.00
Total costs/month				**26.45**

Notes:
* The figures in this column are estimated prices for each input in Israel. Simply replace these figures with locally available prices to calculate the total operating costs in another location.

Seedlings: 35 seedlings is the average reseeding rate per month for 3 m² of growing space while growing 50 % leafy greens (20 plants/m²) and 50 % fruiting vegetables (5 plants/m²).

Fingerlings: The maximum yearly production is 30 kg, which equates to 60 fish of 500 g per year. Therefore, the unit needs 60 fish per year, or about 5 fish per month.

Electricity: 30 W (water pump) + 5 W (air pump) × 24 hours × 30 days ÷ 1 000 = 25 kWh per month.

Water: On average, the water replenishment volume for a unit growing leafy greens and fruiting vegetables is about 1 % of the total water volume in the unit (1 500 litres) per day; 15 litre × 30 days = 450 litres per month.

Fish feed: 50 g (fish feed) × 3 (media beds) × 30 days = 4.5 kg per month.

Miscellaneous: The total figure of USD3 per month is an estimated price for the use of acid or base, water test kits and liquid fertilizer, if necessary.

TABLE A7.3
Expected yearly production of vegetables and fish from a small-scale aquaponic unit, including estimated yearly revenues

Output	Production (quantity)	Unit	Unit market value* (USD)	Total (USD)
Lettuce	360	head	1.20	432.00
Tomatoes	54	kg	1.60	86.40
Fish	30	kg	8.00	240.00
Total				**758.40**

Notes:
* Unit market values: The prices are taken from an Israeli market price comparison website (www.zap.co.il) and that of the Israeli Plants Production and Marketing Board (www.plants.org.il). Both websites accessed on 17 September 2013.

Average lettuce heads per year: 1.5 m² (50 % of growing space) × 20 heads/m² per month (1.5 x 20) = 30 heads per month. Production per year: 30 × 12 = 360 lettuce heads.

Average tomato yield per year: 1.5 m² (50 % of growing space) × 3 kg/m² of tomatoes per month (1.5 x 3) = 4.5 kg per month. Per year: 4.5 × 12 = 54 kg.

Average fish yield per year: Fingerlings stocked at 50 g of body weight. Adults harvested at 500 g after 6–8 months. Average fish stock density between 10–20 kg/m³ in the 1 000 litre fish tank. Average harvest of 5 fish per month equivalent to 2.5 kg/month, 30 kg/year.

Important: The calculations are based on a staggered production of fish in an established aquaponic system. The expected production is lower from a newly established system stocked only with juvenile fish of the same age. For new systems, it is thus suggested that fingerlings be stocked in greater numbers in order to supply enough nutrients to plants. In this case, harvesting of the first fish can start from the third or fourth month onward (with fish at 150–250 g) in order to maintain a steady biomass.

TABLE A7.4
Annual cost–benefit analysis of a media bed unit

Total costs per year	Total per year (USD)
Initial construction costs (Table A7.1)	700.00
Yearly operating costs (Table A7.2)	317.40
Yearly revenues (Table A7.3)	758.40
Yearly net profit	441.00
Payback of initial construction costs (months)	19

Taking the final figures from yearly operating costs and yearly revenues (Tables A7.2 and A7.3), the total profit is USD441 (Table A7.4). This suggests that in general, once a unit is set up, USD1.38 net profit is earned for every USD1 invested in growing food using a small-scale aquaponics unit for domestic consumption. The payback period for the initial investment is 19 months.

Reducing the capital costs (e.g. using recycled tanks) or running costs (e.g. supplementing fish feed), or increasing the revenue (e.g. specialty markets), will considerably decrease the payback period.