Co-funded by the European Union

german cooperation
DEUTSCHE ZUSAMMENARBEIT

nexus

WEF Nexus Farming:

Upscaling Solutions for Small and Medium-Scale Farms

Greenhouse Farming Business Models and Financial Viability

Prepared by: Mohamed Mounir Elbatran

Gebal جبال
SUSTAINABILITY . AGRICULTURE . LIVELIHOODS

مركز دندرة التنموي
Dandara Development Center

Implemented by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Synopsis

Upgrades in agricultural production are pursued for one or a combination of several upsides. These could be to increase productivity, enhance quality, reduce negative environmental externalities or reduce costs. Constructing a simple shading structure or a climate controlled greenhouse vary greatly in cost, but they also result in different upgrades. On the higher technical end, a climate controlled greenhouse that integrates solar power and an aquaculture pond gives the best upgrades in productivity, quality of output, resource preservation and environmental footprints. It is, however, a relatively capital intensive mode of production when compared to conventional open-field cropping, and it comes at a steep initial cost. This report develops several business models with financial projections that argue for the mid and long term viability of upgraded production units. Our models, however, are built on the assumption that the producers are supported, especially for small family farmers, in the post-harvest stages of packaging and marketing, and in delivering their products to consistent buyers. Such buyers are assumed to be high end domestic retailers with a customer base that finds utility in locally grown quality organic produce and is willing to pay a premium for it. On the other hand, this model could also be viable for wet market retail, but it will require a disintermediation of a longer chain of middle people and an increased effort of retail selling since venues are informally organized and do not have traceability systems in place that could ensure the differentiation of the better quality produce. Hence, we alternatively measure the profitability of these upgraded production units on farmgate wholesale prices and large wholesaling markets (Obour, sixth of October, etc.) where sales are made upstream to traders, given that this is the status quo for most small family farms.

1. The Status Quo

Open-field farms that produce cucumbers, one of our chosen model crops, have a productivity of roughly 15 or 16 tons a season, and they can only grow it once a year; for six months. The rest of the year they grow some other crop. This productivity is equivalent to a range of 3.75 to 4 kilograms of cucumber per square meter per season. The output is usually marketed at farmgate to a local trader who buys wholesale. On the one hand, this is a reliable and consistent buyer. On the other hand, the trader is a very low paying customer, who factors in the costs of several inefficiencies in the value chain they serve. Meaning: due to inadequate handling, storage, transportation and sorting, it is common for the chain to lose between 20% and 35% of the foods being moved; between when it's harvested and bought by end consumers. For highly perishable goods this could be worse. The cost of goods lost is shared between the most upstream and most downstream actors; the farmer and the end consumer respectively. From the farmer's side, they are rewarded very little also for the quality of their output, since products cannot be traced back to farmers once they leave their fields. Nevertheless, this is a functional system, and one that consistently delivers buyers to farmers. Yet

again, it does not provide incentive to produce better quality, since it won't be rewarded, and its inefficiencies' costs reflect in hindered farmgate prices[1].

We build here several scenarios for our upgraded models that use the farmgate or the trader as their main market channel to test for the profitability of farming inside our two greenhouse types. While farmgate prices (we prorate them as revenues per unit of output) remain the same for both of our greenhouse types outputs, the difference in profitability depends on two factors. These are as follows:

1- **Productivity** per square meter in each technical upgrade, relative to its initial cost of construction and yearly operational costs; to measure the Return on Investment (ROI)

[Revenues - (COGS + Expenses)] / [Initial Investment Cost] X100

2- **Type of Financing**; with debt being the most expensive source, followed by equity and then grants (at zero cost). For this we draw 11 scenarios for financing that either fully rely on one of the above three sources or combinations of two or a combination of three, and we consider different lending rates (to compare between borrowing costs of commercial loans and subsidized loans that are part of state or development initiatives).

To give an idea of what benchmark we're measuring our results against, open-field agriculture produces 4 kilograms of cucumbers per square meter of farmland that is at a quality normally priced at 4 pounds per kilo. This generates EGP 16 of revenues per square meter.

Although it requires a higher initial cost of construction, the simple entry level greenhouse (shaded structure model in El Heiz) produces roughly six times as much as it's open-field alternative, giving an output of 25 kilograms per square meter at a better quality and less bruised output (well protected from wind, animals, nearby spraying in fields and dust). Assuming it's sold at the low-end price of EGP 4 per kilo, it generates EGP 100 of revenues per square meter, yet we expect farmers to be able to bargain at a higher price range of EGP 5 to EGP 6 per kilo, which would bring up revenues per square meter to a range of EGP 125-150. But it would cost nearly EGP 300 per square meter to upgrade from the open-field to a shaded structure type of greenhouse. An Investment that would require an initial capital available to be invested immediately, and a payback period that could range anywhere between 2 and 10 years to recover the cost of money while accounting for inflation or debt interest rates, or both, depending on the financing source(s) used.

2. Proposed Changes

In the Dandara climate controlled greenhouse, operations are much different from open-fields. The new operating system integrates solar power (a decarbonized electric grid) and aquaculture (for water saving and better plant nutrition). Its productivity per square meter is estimated to average 39 kilograms per year, since its climate control system allows for more intense plantations and a prolonged season of 9 months instead of 6. It can allow for 2,500 plants a year with a productivity of 10 kilos per plant; totalling 25 tons from an area of 640 square meters.

Assuming that the open-field produces 4 kilos of another equally valuable crop in the second half of the year (off season), then yearly productivity per square meter in the open field is 8 kilograms, as

[1] If a kilo is worth EGP 10 and I buy 10 kilos, as a trader, knowing that 3 of them will go bad as I move them around, then I will try to only pay for the 7 kilos that will survive. So instead of paying the farmer EGP 100, I'll negotiate to pay only EGP 70, bringing down the price per kilo to EGP 7

opposed to 39 kilograms in a climate controlled greenhouse. Nevertheless, the 31 kilograms of increased output require an investment range of EGP 500-700 per square meter. In principle, this initial investment increases income per square meter by EGP 200 (a 40% year one ROI, with an interest-free 5 year payback period that does not factor in depreciation). Of course the cost of debt financing should be taken into account, which, along with depreciation, would consume the majority of profits realized in the first five years of operation. But, it is estimated here that on the sixth year income would rise by an equivalent of EGP150,000 at net present value (NPV); in addition to having yearly depreciation costs set aside in cash (EGP65,000/year), making the actual cash in hand EGP 215,000. The payback period could be extended to ten years, in which case the profits rise for the first ten years and on the eleventh they reach the full expected amount, all at NPV. Depending on the type of greenhouse, type of financing and the marketing channel, the net income in the first ten years (for a ten year payback period scenario) will range from EGP 10,000 to EGP 117,000, roughly. In year 11 this range rises to be approximately between EGP 23,000 and EGP 189,000. Section 5 of this report details the different net incomes from all the projected scenarios.

The straight line method depreciation amount calculated for tax purposes as well as the larger amount needed, and reflecting depreciation adjusted for inflation, to cover the actual cost of replacement is an expense that the farming family is expected to set aside for the economic sustainability of their investment. Yet, this is also a resource they could tap into in the short term, whether to borrow from without accruing interest, or to use for investing in low risk and profitable endeavours as they see fit. This is why it is important to point out the cash they will have in hand, and classify the amounts in it that are disposable (Net Income) and those they need to preserve for long-term use (Depreciation money) but can utilize in the short term if they wish to.

Cash in Hand = Depreciation amount (which must be replenished) + Net Income (disposable)

Upgraded production units have varying costs, with the Dandara unit being the most costly amongst them, ranging between EGP 450,000 and 600,000. The least expensive unit was the shade house constructed in El Heiz, which cost EGP 40,000, on an area of 240 square meters; costing EGP 170 per square meter. The downside of a shaded structure, however, is that it does not allow for growing crops off season, since it is not climate controlled. Its upside is that it enhances quality and at a relatively low cost, and of course increases output per square meter of farmland. Alternatively we examine the combination of growing cucumbers and okra in El Heiz shaded farmland, and our financial projections show profitability. Not only that, but by also examining its return on investment (ROI), and with an estimated rise in productivity of almost 300%, the increased output value per square meter is likely to exceed EGP 150 a year. The even higher income increase in this range would be in the case of direct retail sales. This means that such an investment would result in an ROI ranging from 50% to 100% at the end of year one. This is an important finding, given how relatively affordable the upgrade in El Heiz is to a cash strained small-family-farm unit.

A midrange investment in a climate controlled greenhouse that drops one or both of the two add-on features of solar power and aquaculture is going to save greatly on the initial capital required for the climate controlled model. However, it forgoes two immensely important medium and long term rewards. One is a material reward, from solar power, where energy cost savings recover the cost of solar power installations many times over throughout the duration of the project (five times to be specific). It also reduces carbon emissions drastically, which is already an issue heavily discussed socio-politically at the moment, and will become an increasingly more important one in the coming few

years. As for the aquaculture system, the value proposition is intangible at first, since it generates no significant profit on its own, but has the potential to expand and retain a strong customer base for the food produced. The nitrogen fertilizer coming out of the fish pond and into irrigation water, not only saves on inputs, but enhances the quality (taste, texture, etc.) of the produce in a way that is appreciated once customers consume the product and differentiate it from the average produce available on the market. Of course, if this output is packed and labelled under one brand name, then this allows willing return customers to find your output again and spread the word to their networks. We consider the financially zero sum investment of aquaculture part of a free marketing strategy. Additionally, it saves on water consumption; which is another crucial geopolitical and economic resource that's increasing in scarcity.

- A Cost Benefit Analysis for each of the two add on features is available in our sheets and at the end of this report; in section 6.
- Each of the production unit types has a model reflecting its output per square meter, cost, projected revenues (from different revenue streams), and profitability prospects. The business models are adaptable to different marketing channels, since the greenhouses' organic produce could be sold to retailers or at farmgate to traders, and still generate profits.

3. Common Business Model Components for all Proposed Investments

Main Components

Value Proposition: Why would others want to buy and consume our output?

1- Enhanced Quality (Organic or All Natural)

2- Supports Local and Small Family Farms

Market segment: who are our prospect buyers and the price paid by potential customers?

1- Traders supplying major wholesale markets for domestic consumption

2- Domestic Retail Shops with Organic Produce Shelves

Value Chain: How many stops are there between us and the end consumers, and what are their value added activities?

1- Up to 4 in farmgate sales, they add very little value aside from distribution.

2- Direct to Retailers makes one stop at the store before reaching consumers and value is added at the village level, and they include fresh harvests, environmentally conscious type and method of packaging, brand oriented labeling and just in time deliveries.

Profit Creation and Costs - How much of the final price can we claim, and what does it take to produce the required quality and quantities, and to deliver them to paying buyers?

1- Farmgate, negotiations with buyers are part an ongoing process for wholesaling entire crop harvests and are reliant on strong interpersonal village relationships with a network of traders. Prices are regularly low, but buyers are consistent, and sometimes even provide deposits pre-season which substitutes for credit. For cucumbers, we project prices would be around 4k per ton, and no additional costs will be incurred by the farmers post-harvest.

2- Retail sales are a way that enables producers to capture a bigger share of a higher unit price. Our estimates are at an EGP15 per kilo price, based on ongoing retail prices for organic cucumbers, and after accounting for retailers' price share (25-30%), post-harvest losses and sales returns (15-20%), we build our revenue projections on EGP 9 per kilo. The additional cost incurred to deliver to retailers will be that of packaging, labeling, short term storage and deliveries. We account for an outflow of EGP2/kilo to cover such expenses.

Value Network: What kind of exposure and linkages are necessary

1- Farmgate: no additional networks are needed.

2- Retail: This marketing channel requires a more sophisticated network which will unlikely be built and sustained by an individual farmer or family. A more extensive and consistent exposure to retail offerings and customer preferences is necessary in this case. This network requires a collective and collaborative form of production on the side of the farming families, and the existence of village-level collection centers that are run by trained teams of locals who mediate between their farming families and the retailers. These mediators should be stakeholders who are constantly exposed to market places, informed by customers, and able to negotiate with retail buyers as well as understand and help deliver the required standards.

Strategy

This project will benefit greatly from collaborations with financing institutions as well as development offices and local governments. We recommend that participants put up part of the required capital from their own equity, to ensure high levels of involvement and commitment. A producers' consortium in the form of a for-profit association is essential to the success of a retail-oriented model. This entity is expected to handle the administrative and technical supervisory roles. It would carry on collective bargaining to whole buy inputs and secure direct to retailer selling contracts, which it also follows through on and executes. All growers under one association produce output under the same label, even if they supply different types of produce to fulfill a variety of orders to retailers.

Initial Investment's payback method and duration

All models amortize their initial investment on either 5 or 10 years, with different interest rates depending on the method of financing, or the combination of several financing methods. For example, if a greenhouse is fully financed by equity, then we amortize at an interest rate of 9% to account for Egypt's average inflation rate. In the case of debt financing, interest rates rise to a range of 12.5 to 15%. Grants are not amortized. While a combination of two of the above or all three, will amortize each amount financed from each source separately and add them to produce one yearly payback amount.

Source, method and cost of financing

Debt: 12.5-15% interest rate, Grants: zero cost and Equity: 9% inflation rate

Long term sustainability

Sustainability in this endeavor will require factoring in depreciation (to secure the cost of replacement for the productive capital) as well as achieving, sustaining and growing a sizable market share (for

retail sales, and possibly for farmgate sales with simpler packaging and labeling; like cucumbers in net bags).

Appeal

This remains a straightforward upgrade, given that producers will be growing crops they are familiar with, and will be selling to a channel that is not hard to understand (in the case of retail), while still having their main channels (farmgate) to fall back on.

Supporting financial projections

Financial Statements with estimated costs, revenues, profits, and business cycle durations → Income statement (P&L), Balance Sheet, and Cash Flow Statement. Included in the sheets attached to the report.

Brief on Key Operational Tasks

Marketing and Post-harvest processes

All upgraded methods of production will incur incremental costs on operations in addition to the required initial costs of the new capital installed. A reliance on conventional wholesaling at farmgate is projected to cover the costs of high quality output, and achieve profitability. However, retail marketing has the potential to double such profits. In such case, traceability systems must be in place to enable individual producers to claim the premiums their enhanced output should demand, and a medium term plan must be in place to build a customer base for a brand that has the appropriate labels and is recognizable by consumers.

Operational Time Commitment

The frequency of tasks in a greenhouse is higher than conventional farming, but it still requires less than four hours a day according to technical experts. The commitment will be daily, and a well sustained routine will show in productivity as well as output quality; which are both essential for our pricing strategy. On the bright side, daily tasks are straightforward and could be shared between family members, but one or two individuals must take on the responsibility of keeping track of operations and variations in output.

Operational Costs

There will be necessary costs, such as monthly technical visits and changing of spare parts. Also things like buying higher quality seeds and fertilizer or compost. These will be slightly different from open-field inputs, in quality and price, and are important for an improved output.

Financial discipline

Discipline in taking out financing and depreciation costs from cash inflows, and a timely spending on maintenance and quality inputs is absolutely necessary for the sustainability of this upgraded unit.

To understand the viability of this capital intensive form of farming, it's important to examine what its revenue model is like.

A revenue model tells us how this new method of operation is going to generate income. This income is expected to primarily come from the sales of the greenhouse's products, but could also potentially come from the positive externalities it creates; like saving water and diesel consumption and being financially rewarded for it by the government or NGOs.

At this stage our focus is going to be on the main income stream, which comes from selling high quality food in a climate controlled greenhouse, in and off season. To calculate that, we need to state the value that this product is going to provide, and then put a price on this value which allows for it to be sold to a group of people consistently who demand such value at the given price.

Once we reach this point, we deduct the cost of producing these goods (COGS), add it to initial capital investments as well as overhead costs, to find out how profitable, or not, this endeavor will be. If it is profitable, we then compare its profitability with other conventionally produced farm output as well as bond-like interest from bank savings deposits to help the producer decide which route suits them best.

Product value proposition

Organic, environmentally friendly, available off season, supports small and local family farms which is an all-gender inclusive production unit, nutrient rich (naturally fertilized), freshly harvested, low carbon emissions from saved storage time and less miles traveled (if sent directly to retailers' shelves or online sellers fulfillment centers – just in time), known source, traceable, and more affordable (also an import substitute).

The greenhouse can produce a wide variety of products at different quality levels. This could range from seedlings for other farmers to ornamental plants, and to ready to consume edible vegetables and fruits. The process could also greatly benefit from an integrated aquaculture system that supports the plants with vital nitrogen fertilizers as well as protein-rich fish for either personal consumption or market sale.

We will use bell peppers, okra and cucumbers to build our model here, and examine it with a climate controlled facility, then again with a solar powered energy source and an integrated aquaculture pond; both as cost saving, climate and water conscious add ons to our model.

Price and paying customers

Greenhouses are generally six to eight times more productive in terms of output units than conventional open field agriculture. This productivity, however, comes at a very steep initial cost, and requires a much more continuous monitoring process with harvesting and seeding happening a lot more frequently than with open field seasonal work requirements. A market for this output, with consistent demand along with an ability and willingness to pay a premium price for the increased quality and output amounts, makes producing large amounts of a high quality food more worthwhile.

The good news is that there is a market for high quality organic and environmentally friendly produce. The better news is that part of this market is from domestic demand. The challenge will be to secure medium term contracts with retailers with consistent traffic of paying customers who demand this product. This requires production consistency on several fronts. First, quality control points must ensure that all output complies with particular quality attributes and with very limited variations or

discrepancies. Second, supply quantities must be consistent and timely to form a reliant interdependence between producers and the retailers, and build consumer confidence in the product. Think Heinz Ketchup, Juhayna Milk, Saudi packed dates, and SEKEM herbal teas.

The high end retail channel offers the highest price points for the prospect of high quality output a climate controlled greenhouse with an integrated aquaculture could produce. The second major selling channel, farmgate-traders, is at a much lower end price point, rewards quality poorly, and does not allow for a customer base to form, simply because it lacks a traceability mechanism and goes through several distributive and storage points that mix produce, loses on average a third of it, and deteriorates quality attributes in the process. It is a functional channel, however, and has a consistent buyer who is represented in the farmgate village trader. Yet, the price they offer is inconsistent and depends on several short-term and unpredictable outside factors that can hardly be controlled by any producer; especially of a smaller scale. The traders themselves, however, are consistent in their presence. Which makes this a functional, but not a highly rewarding channel.

Price ranges are per one kilo unit of packed food for direct to retail sales, and per ton for farmgate trader sales.

- Retail: Cucumbers (EGP 15 - 4 [fee] = EGP11 per kilo), this price falls to EGP 9 when accounting for post-harvest losses and price variations between in season and off season output.
- Farmgate: Cucumbers (4K per ton), EGP4/kilo.

Business cycle length: 9 months (1.25 cycles a year)

Expected productivity: 24.96 tons per 640 Sq.meter climate controlled greenhouse space. This is equivalent to 39 kilos per square meter, or ten kilos per cucumber plant (of which we have 2,500 planted and harvested throughout the year).

4. Greenhouse types and initial capital requirements

A- Dandara (640 square meters)

- Base Climate Controlled, without solar power or aquaculture systems.
- Fully Integrated

B- El Heiz

- Small 240 square meters, without an aquaculture system (40k)
- Small 240 square meters, with an aquaculture system (70k)
- Large 1,440 square meters, with an aquaculture system (154k)

5. Financial viability

5.1. Financing Scenarios and Expected Net Incomes during Payback Years

A- Dandara Model

i. Dandara Farmgate Sales

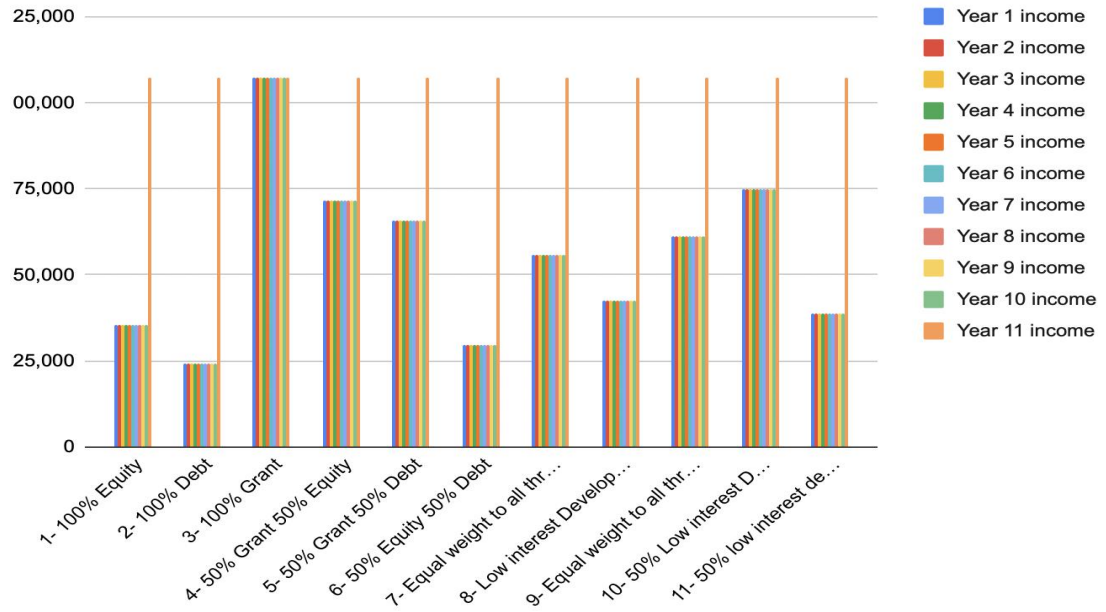
The least preferred financing method here would be the second row, 100% debt. It generates a disposable net income for farmers of EGP24k in the first ten years. At year 11, it is expected to rise to over 107k (at NPV), and more importantly they would have paid off the entire loan, and kept the depreciation money aside for capital replacement purposes. The cash in hand, however, would include the depreciation costs (30k). Cash in hand = (24k+30k) = 54k.

The most profitable financing method would be 100% grant, as cost of capital would be zero.

The recommended financing method is row 9, with a third of each, and the debt being from a low interest development loan (at a 5% interest rate). The net disposable income here in the first ten years would be 61k, and cash in hand would be nearly 92k. At year 11, net disposable income for all scenarios is projected to be 107k at NPV.

Dandara Farmgate

Type of Financing	Type of Financing	Year 1 income	Year 2 income	Year 3 income	Year 4 income	Year 5 income	Year 6 income	Year 7 income	Year 8 income	Year 9 income	Year 10 income	Year 11 income
1	1- 100% Equity	35,537	35,537	35,537	35,537	35,537	35,537	35,537	35,537	35,537	35,537	107,370
2	2- 100% Debt	24,104	24,104	24,104	24,104	24,104	24,104	24,104	24,104	24,104	24,104	107,370
3	3- 100% Grant	107,370	107,370	107,370	107,370	107,370	107,370	107,370	107,370	107,370	107,370	107,370
4	4- 50% Grant 50% Equity	71,454	71,454	71,454	71,454	71,454	71,454	71,454	71,454	71,454	71,454	107,370
5	5- 50% Grant 50% Debt	65,737	65,737	65,737	65,737	65,737	65,737	65,737	65,737	65,737	65,737	107,370
6	6- 50% Equity 50% Debt	29,821	29,821	29,821	29,821	29,821	29,821	29,821	29,821	29,821	29,821	107,370
7	7- Equal weight to all three; 33%, Grant, Equity and Debt	55,670	55,670	55,670	55,670	55,670	55,670	55,670	55,670	55,670	55,670	107,370
8	8- Low interest Development Debt Financing (5% i-rate) 100% Debt	42,370	42,370	42,370	42,370	42,370	42,370	42,370	42,370	42,370	42,370	107,370
9	9- Equal weight to all three; 33%, Grant, Equity and Debt (i-rate 5%)	61,370	61,370	61,370	61,370	61,370	61,370	61,370	61,370	61,370	61,370	107,370
10	10- 50% Low interest Debt and 50% Grant	74,870	74,870	74,870	74,870	74,870	74,870	74,870	74,870	74,870	74,870	107,370
11	11- 50% low interest debt and 50% Equity	38,954	38,954	38,954	38,954	38,954	38,954	38,954	38,954	38,954	38,954	107,370



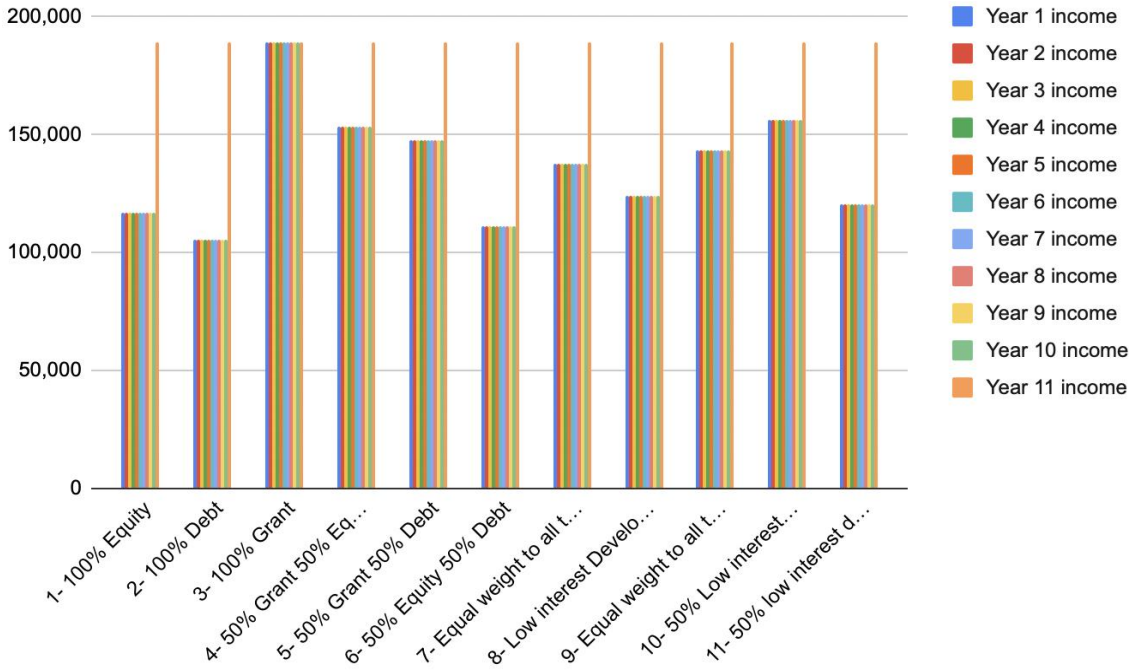
	Type of Financing	Debt Amortization	Yearly Cost of Equity based on a 9% inflation rate	Payback Period	**Realized Profit during first ten years (At NPV)**	**Year 11 Owards: Realized Profit after initial capital costs are covered (At NPV)**
1	**100% Equity**	0	71,833	10 Years	35,537	107,370
2	**100% Debt**	83266	0	10 Years	24,104	107,370
3	**100% Grant**	0	0	0	107,370	107,370
4	**50% Grant 50% Equity**	0	35916.5	10 Years	71,454	107,370
5	**50% Grant 50% Debt**	41633	0	10 Years	65,737	107,370
6	**50% Equity 50% Debt**	41,633	35,917	10 Years	29,821	107,370
7	**Equal weight to all three; 33%, Grant, Equity and Debt**	27755.33333	23944.33333	10 Years	55670.33333	107,370
	Low interest Development Debt Financing (5% i-rate) ↓			10 Years		
8	**100% Debt**	65000	0	10 Years	42370	107,370
9	**Equal weight to all three; 33%, Grant, Equity and Debt**	22000	24,000	10 Years	61,370	107,370
10	**50% Low interest Debt and 50% Grant**	32,500	0	10 Years	74,870	107,370
11	**50% low interest debt and 50% Equity**	32,500	35916.5	10 Years	38,954	107,370

ii. Dandara Retail Sales

- Least preferred financing scenario:
  - First ten years net disposable income: **105k/year**
  - Year eleven disposable income: **189k at NPV**
  - Cash in Hand during the first ten years = **135k/year**
- The most profitable financing method would be 100% grant, as cost of capital would be zero.
- The recommended financing method is row 9, with a third of each, and the debt being from a low interest development loan (at a 5% interest rate).
  - First ten years net disposable income: **143k/year**
  - Year eleven disposable income: **189k at NPV**
  - Cash in Hand = **173k/year** (during the first ten years)

Dandara Retail

Type of Financing	Type of Financing	Year 1 income	Year 2 income	Year 3 income	Year 4 income	Year 5 income	Year 6 income	Year 7 income	Year 8 income	Year 9 income	Year 10 income	Year 11 income
1	1- 100% Equity	117,037	117,037	117,037	117,037	117,037	117,037	117,037	117,037	117,037	117,037	188,870
2	2- 100% Debt	105,604	105,604	105,604	105,604	105,604	105,604	105,604	105,604	105,604	105,604	188,870
3	3- 100% Grant	188,870	188,870	188,870	188,870	188,870	188,870	188,870	188,870	188,870	188,870	188,870
4	4- 50% Grant 50% Equity	152,954	152,954	152,954	152,954	152,954	152,954	152,954	152,954	152,954	152,954	188,870
5	5- 50% Grant 50% Debt	147,237	147,237	147,237	147,237	147,237	147,237	147,237	147,237	147,237	147,237	188,870
6	6- 50% Equity 50% Debt	111,321	111,321	111,321	111,321	111,321	111,321	111,321	111,321	111,321	111,321	188,870
7	7- Equal weight to all three; 33%, Grant, Equity and Debt	137,170	137,170	137,170	137,170	137,170	137,170	137,170	137,170	137,170	137,170	188,870
8	8- Low interest Development Debt Financing (5% i-rate) 100% Debt	123,870	123,870	123,870	123,870	123,870	123,870	123,870	123,870	123,870	123,870	188,870
9	9- Equal weight to all three; 33%, Grant, Equity and Debt	143,259	143,259	143,259	143,259	143,259	143,259	143,259	143,259	143,259	143,259	188,870
10	10- 50% Low interest Debt and 50% Grant	156,370	156,370	156,370	156,370	156,370	156,370	156,370	156,370	156,370	156,370	188,870
11	11- 50% low interest debt and 50% Equity	120,454	120,454	120,454	120,454	120,454	120,454	120,454	120,454	120,454	120,454	188,870



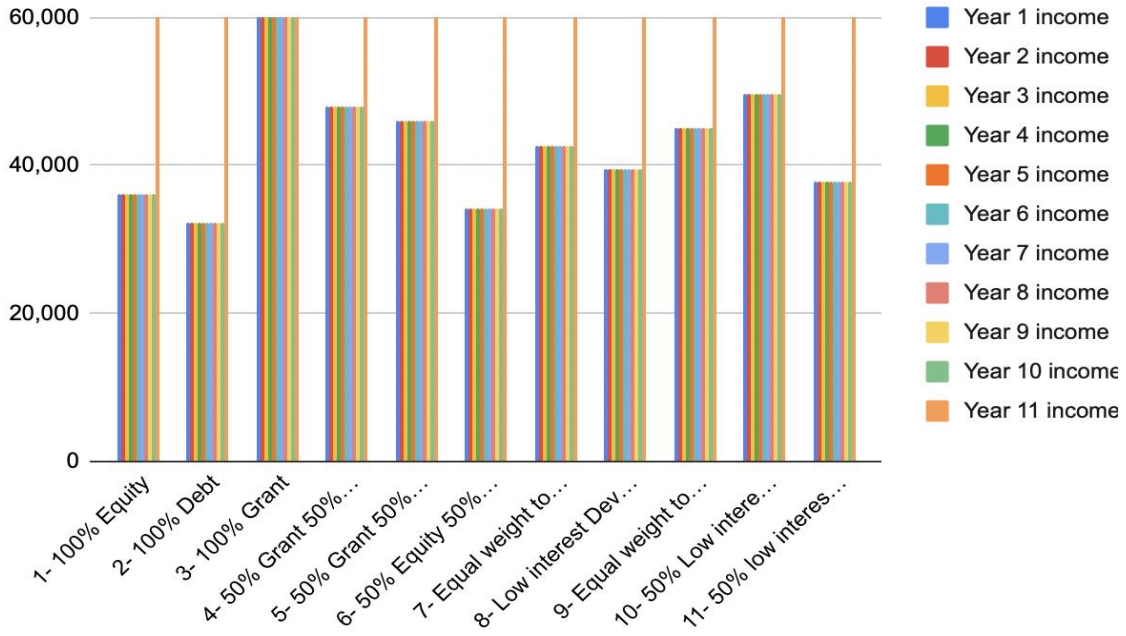
Type of Financing	Debt Amortization	Yearly Cost of Equity based on a 9% inflation rate	Payback Period	**Realized Profit during first ten years (At NPV)**	**Year 11 Owards: Realized Profit after initial capital costs are covered (At NPV) EGP 153,000**
100% Equity	0	71,833	10 Years	117,037	188,870
100% Debt	83266	0	10 Years	105,604	188,870
100% Grant	0	0	0	188,870	188,870
50% Grant 50% Equity	0	35916.5	10 Years	152,954	188,870
50% Grant 50% Debt	41633	0	10 Years	147,237	188,870
50% Equity 50% Debt	41,633	35,917	10 Years	111,321	188,870
Equal weight to all three; 33%, Grant, Equity and Debt	27755.33333	23944.33333	10 Years	137,170	188,870
Low interest Development Debt Financing (5% i-rate) ↓			10 Years		0
100% Debt	65000	0	10 Years	123,870	188,870
Equal weight to all three; 33%, Grant, Equity and Debt	21666.66667	23,944	10 Years	143,259	188,870
50% Low interest Debt and 50% Grant	32,500	0	10 Years	156,370	188,870
50% low interest debt and 50% Equity	32,500	35916.5	10 Years	120,454	188,870

B- El Heiz Model (4 joint-greenhouses (1,440 m^2) run simultaneously)

i. El Heiz Farmgate Sales

- Least preferred financing scenario: 100% Debt
  - First ten years net disposable income: **32k/year**
  - Year eleven disposable income: **59k at NPV**
  - Cash in Hand during the first ten years = **44.5k/year**
- The most profitable financing method would be 100% grant, as cost of capital would be zero.
- The recommended financing method is row 9, with a third of each, and the debt being from a low interest development loan (at a 5% interest rate).
  - First ten years net disposable income: **45k/year**
  - Year eleven disposable income: **59k at NPV**
  - Cash in Hand during the first ten years = **57.5k/year**

Type of Financing	Year 1 income	Year 2 income	Year 3 income	Year 4 income	Year 5 income	Year 6 income	Year 7 income	Year 8 income	Year 9 income	Year 10 income	Year 11 income
1- 100% Equity	35,982	35,982	35,982	35,982	35,982	35,982	35,982	35,982	35,982	35,982	59,978
2- 100% Debt	32,162	32,162	32,162	32,162	32,162	32,162	32,162	32,162	32,162	32,162	59,978
3- 100% Grant	59,978	59,978	59,978	59,978	59,978	59,978	59,978	59,978	59,978	59,978	59,978
4- 50% Grant 50% Equity	47,980	47,980	47,980	47,980	47,980	47,980	47,980	47,980	47,980	47,980	59,978
5- 50% Grant 50% Debt	46,070	46,070	46,070	46,070	46,070	46,070	46,070	46,070	46,070	46,070	59,978
6- 50% Equity 50% Debt	34,072	34,072	34,072	34,072	34,072	34,072	34,072	34,072	34,072	34,072	59,978
7- Equal weight to all three; 33%, Grant, Equity and Debt	42,707	42,707	42,707	42,707	42,707	42,707	42,707	42,707	42,707	42,707	59,978
8- Low interest Development Debt Financing (5% i-rate) 100% Debt	39,478	39,478	39,478	39,478	39,478	39,478	39,478	39,478	39,478	39,478	59,978
9- Equal weight to all three; 33%, Grant, Equity and Debt	45,146	45,146	45,146	45,146	45,146	45,146	45,146	45,146	45,146	45,146	59,978
10- 50% Low interest Debt and 50% Grant	49,728	49,728	49,728	49,728	49,728	49,728	49,728	49,728	49,728	49,728	59,978
11- 50% low interest debt and 50% Equity	37,730	37,730	37,730	37,730	37,730	37,730	37,730	37,730	37,730	37,730	59,978



Type of Financing	Debt Amortization	Yearly Cost of Equity based on a 9% inflation rate	Payback Period	**Realized Profit during first ten years (At NPV)**	**Year 11 Owards: Realized Profit after initial capital costs are covered (At NPV) EGP 153,000**
100% Equity	0	23,996	10 Years	35,982	59,978
100% Debt	27,816	0	10 Years	32,162	59,978
100% Grant	0	0	0	59,978	59,978
50% Grant 50% Equity	0	11998	10 Years	47,980	59,978
50% Grant 50% Debt	13908	0	10 Years	46,070	59,978
50% Equity 50% Debt	13,908	11,998	10 Years	34,072	59,978
Equal weight to all three; 33%, Grant, Equity and Debt	9272	7998.666667	10 Years	42,707	59,978
Low interest Development Debt Financing (5% i-rate) ↓			10 Years		0
100% Debt	20,500	0	10 Years	39,478	59,978
Equal weight to all three; 33%, Grant, Equity and Debt	6833.333333	7,999	10 Years	45,146	59,978
50% Low interest Debt and 50% Grant	10,250	0	10 Years	49,728	59,978
50% low interest debt and 50% Equity	10,250	11998	10 Years	37,730	59,978

ii. El Heiz Retail Sales

- Least preferred financing scenario: 100% Debt
  - First ten years net disposable income: **128.5k/year**
  - Year eleven disposable income: **156k at NPV**
  - Cash in Hand during the first ten years = **141k/year**
- The most profitable financing method would be 100% grant, as cost of capital would be zero.
- The recommended financing method is row 9, with a third of each, and the debt being from a low interest development loan (at a 5% interest rate).
  - First ten years net disposable income: **141k/year**
  - Year eleven disposable income: **156k at NPV**
  - Cash in Hand during the first ten years = **153k/year**

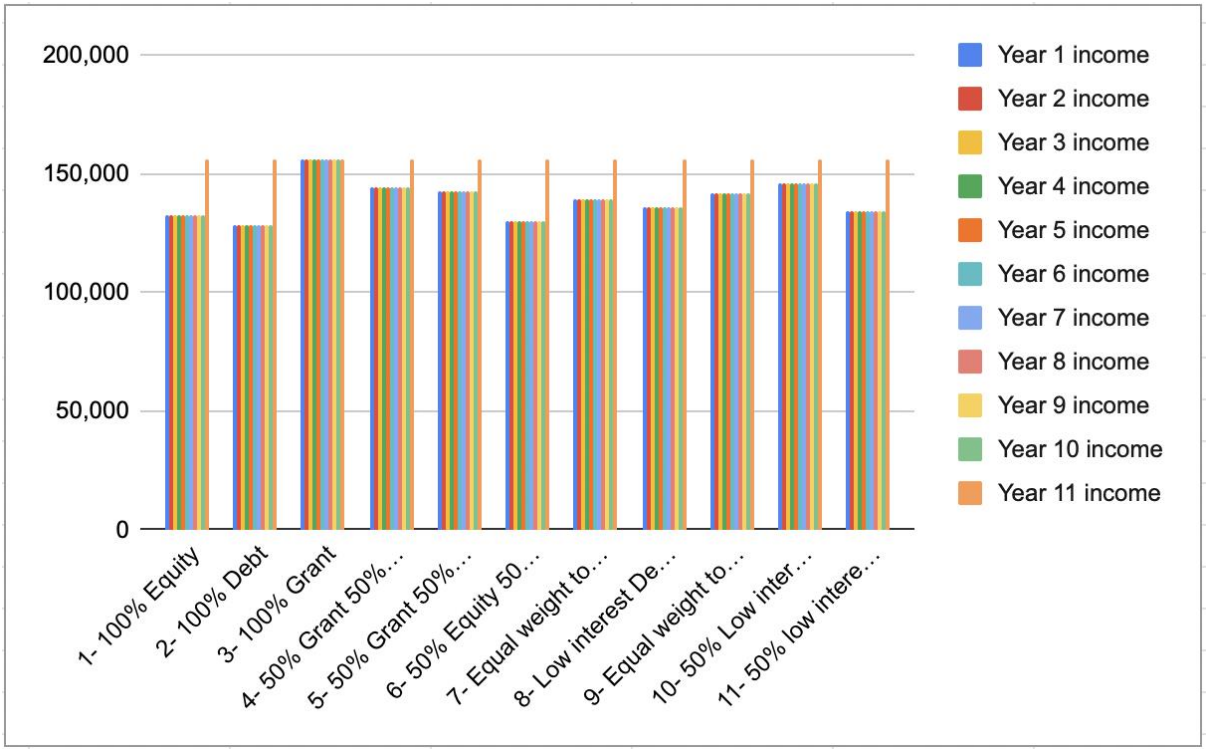
Co-funded by the European Union

german cooperation
DEUTSCHE ZUSAMMENARBEIT

nexus

Elheiz Retail

Type of Financing	Type of Financing	Year 1 income	Year 2 income	Year 3 income	Year 4 income	Year 5 income	Year 6 income	Year 7 income	Year 8 income	Year 9 income	Year 10 income	Year 11 income
1	1- 100% Equity	132,232	132,232	132,232	132,232	132,232	132,232	132,232	132,232	132,232	132,232	156,228
2	2- 100% Debt	128,412	128,412	128,412	128,412	128,412	128,412	128,412	128,412	128,412	128,412	156,228
3	3- 100% Grant	156,228	156,228	156,228	156,228	156,228	156,228	156,228	156,228	156,228	156,228	156,228
4	4- 50% Grant 50% Equity	144,230	144,230	144,230	144,230	144,230	144,230	144,230	144,230	144,230	144,230	156,228
5	5- 50% Grant 50% Debt	142,320	142,320	142,320	142,320	142,320	142,320	142,320	142,320	142,320	142,320	156,228
6	6- 50% Equity 50% Debt	130,322	130,322	130,322	130,322	130,322	130,322	130,322	130,322	130,322	130,322	156,228
7	7- Equal weight to all three; 33%, Grant, Equity and Debt	138,957	138,957	138,957	138,957	138,957	138,957	138,957	138,957	138,957	138,957	156,228
8	8- Low interest Development Debt Financing (5% i-rate) 100% Debt	135,728	135,728	135,728	135,728	135,728	135,728	135,728	135,728	135,728	135,728	156,228
9	9- Equal weight to all three; 33%, Grant, Equity and Debt	141,396	141,396	141,396	141,396	141,396	141,396	141,396	141,396	141,396	141,396	156,228
10	10- 50% Low interest Debt and 50% Grant	145,978	145,978	145,978	145,978	145,978	145,978	145,978	145,978	145,978	145,978	156,228
11	11- 50% low interest debt and 50% Equity	133,980	133,980	133,980	133,980	133,980	133,980	133,980	133,980	133,980	133,980	156,228



Gebal جبال
SUSTAINABILITY . AGRICULTURE . LIVELIHOODS

مركز دندرة التنموي
Dandara Development Center

Implemented by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

	Type of Financing	Debt Amortization	Yearly Cost of Equity based on a 9% inflation rate	Payback Period	**Realized Profit during first ten years (At NPV)**	**Year 11 Owards: Realized Profit after initial capital costs are covered (At NPV) EGP 153,000**
1	**100% Equity**	0	23,996	10 Years	132,232	156,228
2	**100% Debt**	27,816	0	10 Years	128,412	156,228
3	**100% Grant**	0	0	0	156,228	156,228
4	**50% Grant 50% Equity**	0	11998	10 Years	144,230	156,228
5	**50% Grant 50% Debt**	13908	0	10 Years	142,320	156,228
6	**50% Equity 50% Debt**	13,908	11,998	10 Years	130,322	156,228
7	**Equal weight to all three; 33%, Grant, Equity and Debt**	9272	7998.666667	10 Years	138,957	156,228
	Low interest Development Debt Financing (5% i-rate) ↓			10 Years		0
8	**100% Debt**	20,500	0	10 Years	135,728	156,228
9	**Equal weight to all three; 33%, Grant, Equity and Debt**	6833.333333	7,999	10 Years	141,396	156,228
10	**50% Low interest Debt and 50% Grant**	10,250	0	10 Years	145,978	156,228
11	**50% low interest debt and 50% Equity**	10,250	11998	10 Years	133,980	156,228

C- El Heiz Single Greenhouse Model (2740 m^2) / Farmgate Sales

- Least preferred financing scenario: 100% Debt (row 2)
  - First ten years net disposable income: **10k/year**
  - Year eleven disposable income: **23k at NPV**
  - Cash in Hand during the first ten years = **12.5k/year**
- The most profitable financing method would be 100% grant, as cost of capital would be zero.
- The recommended financing method is row 9, with a third of each, and the debt being from a low interest development loan (at a 5% interest rate).
  - First ten years net disposable income: **16k/year**
  - Year eleven disposable income: **23k at NPV**
  - Cash in Hand during the first ten years = **19k/year**

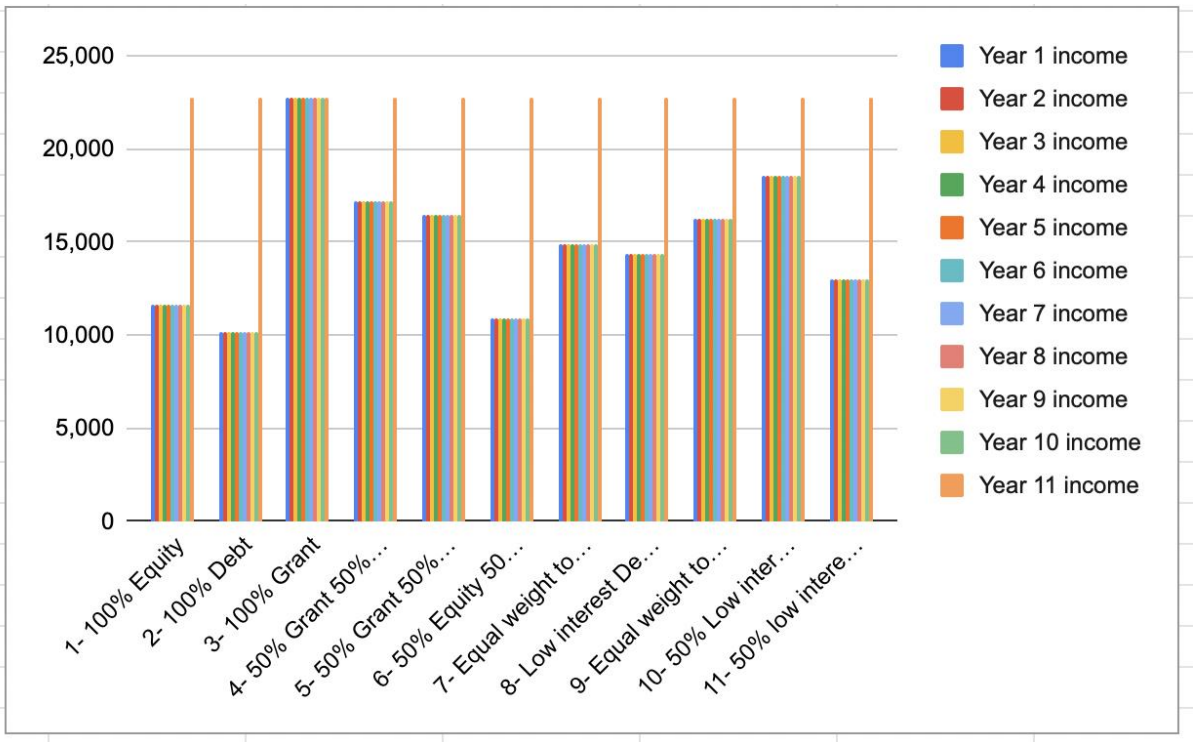
Co-funded by the European Union

german cooperation
DEUTSCHE ZUSAMMENARBEIT

nexus

Elheiz Farmgate 240 Sq. m

Type of Financing	Type of Financing	Year 1 income	Year 2 income	Year 3 income	Year 4 income	Year 5 income	Year 6 income	Year 7 income	Year 8 income	Year 9 income	Year 10 income	Year 11 income
1	1- 100% Equity	11,592	11,592	11,592	11,592	11,592	11,592	11,592	11,592	11,592	11,592	22,792
2	2- 100% Debt	10,192	10,192	10,192	10,192	10,192	10,192	10,192	10,192	10,192	10,192	22,792
3	3- 100% Grant	22,792	22,792	22,792	22,792	22,792	22,792	22,792	22,792	22,792	22,792	22,792
4	4- 50% Grant 50% Equity	17,192	17,192	17,192	17,192	17,192	17,192	17,192	17,192	17,192	17,192	22,792
5	5- 50% Grant 50% Debt	16,492	16,492	16,492	16,492	16,492	16,492	16,492	16,492	16,492	16,492	22,792
6	6- 50% Equity 50% Debt	10,892	10,892	10,892	10,892	10,892	10,892	10,892	10,892	10,892	10,892	22,792
7	7- Equal weight to all three; 33%, Grant, Equity and Debt	14,859	14,859	14,859	14,859	14,859	14,859	14,859	14,859	14,859	14,859	22,792
8	8- Low interest Development Debt Financing (5% i-rate) 100% Debt	14,392	14,392	14,392	14,392	14,392	14,392	14,392	14,392	14,392	14,392	22,792
9	9- Equal weight to all three; 33%, Grant, Equity and Debt	16,259	16,259	16,259	16,259	16,259	16,259	16,259	16,259	16,259	16,259	22,792
10	10- 50% Low interest Debt and 50% Grant	18,592	18,592	18,592	18,592	18,592	18,592	18,592	18,592	18,592	18,592	22,792
11	11- 50% low interest debt and 50% Equity	12,992	12,992	12,992	12,992	12,992	12,992	12,992	12,992	12,992	12,992	22,792



Gebal جبال
SUSTAINABILITY . AGRICULTURE . LIVELIHOODS

مركز دندرة التنموي
Dandara Development Center

Implemented by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

	Type of Financing	Debt Amortization	Yearly Cost of Equity based on a 9% inflation rate	Payback Period	**Realized Profit during first ten years (At NPV)**	**Year 11 Owards: Realized Profit after initial capital costs are covered (At NPV) EGP 153,000**
1	**100% Equity**	0	11,200	10 Years	11,592	22,792
2	**100% Debt**	12,600	0	10 Years	10,192	22,792
3	**100% Grant**	0	0	0	22,792	22,792
4	**50% Grant 50% Equity**	0	5600	10 Years	17,192	22,792
5	**50% Grant 50% Debt**	6300	0	10 Years	16,492	22,792
6	**50% Equity 50% Debt**	6,300	5,600	10 Years	10,892	22,792
7	**Equal weight to all three; 33%, Grant, Equity and Debt**	4200	3733.333333	10 Years	14,859	22,792
	Low interest Development Debt Financing (5% i-rate) ↓			10 Years		0
8	**100% Debt**	8,400	0	10 Years	14,392	22,792
9	**Equal weight to all three; 33%, Grant, Equity and Debt**	2800	3,733	10 Years	16,259	22,792
10	**50% Low interest Debt and 50% Grant**	4,200	0	10 Years	18,592	22,792
11	**50% low interest debt and 50% Equity**	4,200	5600	10 Years	12,992	22,792

5.2. Return of Investment (ROI)

A shaded field will enhance quality, and is expected to increase productivity by 300%. This brings up the productivity per square meter from 3.5 kilograms in an openfield to almost 4 kilograms under a shaded structure (like the one in El Heiz). The enhanced quality, however, can allow for contracting with retailers directly. This upgrade requires an investment of EGP 170 per square meter, and would enable a producer to sell for EGP8/kilo and increase output per sq.m to 16 kilos. This increases revenues from EGP 17.5 per square meter in an openfield to EGP128 per square meter, realizing an increase of EGP110.5 per square meter. This is a return on the EGP 170 investment of roughly 75%. If the price remains at EGP4/kilo, then revenues per square meter will be at EGP64, realizing a still high ROI of 37.5%.

In the Dandara model the initial investment goes up to EGP 900 per square meter. Productivity jumps from 3.5 kilograms per square meter to 25 kilograms per square meter. So instead of generating EGP 17.5 of revenues per square meter at farmgate wholesale, you sell for EGP200 per square meter directly to retailers (after accounting for their price cut, losses, and costs of packaging and delivery). This results in an ROI of roughly 22% [(200/900)x100], yearly. Selling at farmgate for EGP4/kilo generates EGP100/sq.m of revenues and an 11% ROI.

The costly initial investment of the Dandara model makes it less appealing from a ROI standpoint, in spite of its higher output and potentially better quality. Hence, Dandara remains to be better suited in the case of having retail contractual agreements and a village based growers' association.

6. Solar Power and Aquaculture ponds as Add-On Features

Fish Pond - Aquaculture System

	Fish Pond Aquaculture System							
			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Cost of Capital								
Cost Benefit Analysis								
1	Total Cost of Capital Purchases & Installation		14,000.00	0.00	0.00	0.00	0.00	0
2	Operational Costs		10,000.00	10,000.00	10,000.00	10,000.00	10,000.00	10,000
	Depreciation		2,200	2,200	2,200	2,200	2,200	2,200
3	Resulting Cost Savings		1,500	1,500	1,500	1,500	1,500	1,500
4	Sales Revenue		14,000	14,000	14,000	14,000	14,000	14,000
Return on Investment Analysis								Net yearly income: 3,300
5	Total Return on Investment		-$10,700	-7,400.00	-4,100.00	-800.00	2,500.00	5,800.00
6	Payback Period (years)		Paid Upfront	Payback Period is the time required to recover the investment costs of the project.				
7	Breakeven Fiscal Year		Quarter 4 of Year 5	Fiscal Year during which the project's investment costs are recovered.				
	Once the initial investment is fully recovered (early in year 5), the aquaculture system adds a yearly net benefit of EGP 3,300							

Solar Power System for Dandara

	Solar Power System for Dandara							
			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Cost of Capital								
Cost Benefit Analysis								
1	Total Cost of Capital Purchases & Installation		180,000.00	0.00	0.00	0.00	0.00	0
2	Operational Costs		0.00	0.00	0.00	0.00	0.00	0
3	Depreciation Cost		30,000	30,000	30,000	30,000	30,000	30,000
4	Resulting Cost Savings		72,000	72,000	72,000	72,000	72,000	72,000
5	Sales Revenue		0.00	0.00	0.00	0.00	0.00	0
Return on Investment Analysis								
6	Return on Investment		-138,000.00	-96,000.00	-54,000.00	-12,000.00	30,000.00	42,000
7	Payback Period (years)		Paid Upfront	Payback Period is the time required to recover the investment costs of the project.				
8	Breakeven Fiscal Year		Quarter 3 of Year 5	Fiscal Year during which the project's investment costs are recovered.				
	Once the initial investment is fully recovered (by the end of year 5), the solar power system saves every year EGP 72,000 of costs and depreciates by EGP 30,000, adding a yearly net benefit of EGP 42,000.							