Comparative Evaluation Between Soilless and Soil Greenhouses

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Abstract: The research aimed at evaluating of soilless greenhouse systems projects in comparison to traditional soil culture (TSC) greenhouse projects, for cucumber and strawberry. For cucumber the study examined soilless pots system (SPS) compared to (TSC) and strawberry by using pipes soilless system (PSS) compared to (TSC) also. Five evaluation criteria as discounted measures were used: 1) Internal rate of return (IRR), 2) Net present worth (NPW), 3) Benefit-cost (B/C) ratio, 4) Net benefit-investment (N/K) ratio, 5) Risk-exposure (RE) ratio, in addition to sensitivity analysis. For cucumber, the average of annual production of SPS exceeds the average of annual production of TSC by 25.3%. Cost per kilogram of cucumber in SPS and TSC were LE 1.42 and LE 2.11 respectively. For strawberry, the comparison criteria (IRR, NPW, N/K ratio and B/C ratio) for PSS were (235%, 208404, 8.15, 2.63) respectively, and these criteria achieved higher value than the same criteria for TSC. Sensitivity analysis indicated that; Price of the final product significantly changed NPW so producers must find ways to obtain high prices for their product. Decrease in discount rate enable projects best opportunity to achieve more income and more stability.

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1. Introduction:

Food availability for human beings is one of the problems of common interest to the whole world, especially in light of the scarcity of the production elements used in agricultural production, such as fertile land, water and the suitable climate for agriculture. Therefore, researchers and scientists in the field of agricultural production intended to find ways and means to maximize the use of rare production elements.

Greenhouses were one of the methods that lead to obtaining multiplication production of the land unit used in agriculture, in addition to the advantages, characteristics greenhouses like 1) Full control of the production process and provide a suitable climate for agriculture at any time of the year. 2) Reduce water used in agriculture. 3) Obtain high quality and symmetric output. 4) Energy saving. 5) Employment reduction. 6) Limiting negative environmental effects. All of these features contributed to spread greenhouses among farmers, especially in producing vegetables, fruits, and flowers along the world, and this happened after showing them the great benefits they will obtain from the adoption of this technology, among these benefits were the most important factor: obtaining high production and multiplied returns.

Recently, the modern technique of the greenhouse using soilless culture system (SCS) emerged. It is a modern technique that allows producers to grow plants in greenhouse without using traditional soil, they use many suitable alternatives, farming cultures, such as peat moss, zeoilte, perlite and sand, or using water as culture (hydroponics). Soilless culture can be defined as "any method of growing plants without the use of soil as a rooting medium, in which the inorganic nutrients absorbed by the roots are supplied via the irrigation water". The fertilizers containing the nutrients to be supplied to the crop are dissolved in the appropriate concentration in the irrigation water and the resultant solution is referred to as "nutrient solution" (FAO, 2013). Previous studies had confirmed that (SCS) gives higher yields than agriculture using traditional soil culture (TSC), in addition to its distinction in the other advantages of greenhouse technique, as stated by (Gruda, 2009) SCSs guarantee flexibility and intensification and provide high crop yield and high-quality products, even in areas with adverse growing conditions. Despite the considerable advantages of commercial soilless culture, there are disadvantages limiting its expansion in some cases: High installation costs and Technical skills requirements (FAO, 2013).

To make farmers adopt this (SCS) it is not sufficient hearing about it, but it requires a practical reality that provides them with reliable scientific evidence proving to them that (SCS) offers meaningful returns, especially when it's known that (SCS) needs high initial investment costs. Which was the motivation to do this study and the primary objective is financially evaluate (SCS) projects represented in

two methods: the first one soilless pots system (SPS) for growing cucumber and the second method is pipes soilless system (PSS) for growing strawberry. Then compare the result to the results of (TSC) evaluation for the same two crops as they are successful grow in greenhouses conditions. On the base of the study results producers will have reliable scientific evidence that may help them in taking right decisions with conviction toward adopting (SCS) methods.

2. Methodology:

The research relied on unpublished data obtained from Central Laboratory for Agricultural Climate. The experiments were conducted in 2017 greenhouse growing seasons for cucumber and strawberry without heating or cooling systems, at the same place in the laboratory, greenhouse area in Agricultural Research Center in Dokey, Giza governorate, Egypt. For each crop the study compared between two growing systems, one of them was the traditional soil culture greenhouse (TSC), and the ather system was the greenhouse Soilless Culture System (SCS); for cucumber the study examined soilless pots system (SPS), where pots containing beat moss mixed with sand were used as culture. Meanwhile, strawberry cultivated in greenhouse by using pipes soilless system (PSS), where110 mm pipes settled on hierarchical iron triangle (8 holders) were used. The different systems were compared in two round arch, single span type, and plastic greenhouses of 360 m^2.

The lifetime of each project was assumed as 15 years of pursuing the highest yield from the main investment capital component like greenhouse structure and irrigation system. As stated by (Grafiadellis, 2000) Economic life is the length of time over which an investment yields economic benefits.

The real discount rate was 18% (Central Bank of EGYPT, 2017), represents deposit interest rate used in the EGYPT financial market in that period, where the government followed International Monetary Fund (IMF) instructions by increases interest rate and floating the Egyptian pound. Costs and benefits were estimated at 2017 prices. The cost items of greenhouse crop production can be classified into; initial investment costs, variable costs, and fixed costs (Sait, 2009). One half of investment costs and fixed costs were used that's because the growers eventually grow two crops yearly in one greenhouse.

The currency unit is Egyptians pound (1 U.S dollar = 17.65 Egyptians pound LE) (Central Bank of Egypt, 2017).

When costs and benefits have been identified, priced, and valued, the analyst is ready to determine which among various projects to accept and which to reject. The analyst immediately confronts two problems. He must find some way to evaluate projects that will last several years and that have differently shaped future cost and benefit streams. He must also be able to evaluate projects of varying size. The usual method of addressing these two problems is through discounting. (Gittinger, 1982).

Five evaluation criteria were used: 1) Internal rate of return (IRR) (Gittinger, 1982), 2) Net present worth (NPW) (Gittinger,1982), 3) Benefit-cost (B/C) ratio 4) Net benefit-investment (N/K) ratio (Gittinger,1982), 5) Risk-exposure (RE) ratio (Gitman, 1977). In addition to that, sensitivity analysis were employed to investigate how much the project will affect due to negative changes in costs, returns and positive changes in the discount rate.

The principle of incremental cash flows, states that a project can be evaluated by considering all the incremental cash inflows and outflows induced by the investment. This implies that costs and benefits "with" and "without" the investment must be compared to determine which alternative solution yields a higher return (Grafiadellis 2000).

The internal rate of return is a very useful measure of project worth. It is the measure the World Bank uses for practically all its economic and financial analyses of projects and the measure used by most other international financing agencies (Gittinger,1982). The formal mathematical statement of internal rate of return can be defined by the following equation:

$$\sum_{i=1}^{t=n} \frac{B_t - C_t}{(1+i)^t} = 0$$

Internal rate of return (IRR) accept all independent projects with IRR equal to or greater than opportunity cost of capital, and may give incorrect ranking among independent projects and cannot be used directly; must discount differences between incremental net benefit flows of mutually exclusive alternative projects (Gittinger,1982).

The most straightforward discounted cash flow measure of project worth is the net present worth (NPW). This is simply the present worth of the incremental net benefit or incremental cash flow stream (Gittinger, 1982). can be defined by the following equation:

$$\sum_{i=1}^{t=n} \frac{B_t - C_t}{(1+i)^t}$$

Net present worth accept all independent projects with NPW of zero or greater when discounted at opportunity cost of capital, gives no ranking for order of implementation and accept alternative with largest NPW when discounted at opportunity cost of capital (NPW) is the preferred selection criterion for mutually.

The benefit- cost (B/C) ratio is the present value of the benefits relative to the present value of the cost, accept all independent projects with a B/C ratio of 1 or greater when discounted at the opportunity cost of capital, may give incorrect ranking among independent projects and for mutually exclusive alternatives; cannot be used directly (Gittinger, 1982). Can be defined by the following equation:

$$\frac{\sum_{i=1}^{t=n} \frac{B_t}{(1+i)^t}}{\sum_{i=1}^{t=n} \frac{C_t}{(1+i)^t}}$$

Net benefit-investment (N/K) ratio. A suitable and very convenient criterion for ranking independent projects (that is, those which are not mutually exclusive) that is reliable in all but the most extreme cases is the net benefit-investment ratio (Gittinger,1982).

$$\frac{\sum_{i=1}^{t=n} \frac{N_t}{(1+i)^t}}{\sum_{i=1}^{t=n} \frac{K_t}{(1+i)^t}}$$

Accepts all independent projects with a N/K ratio of 1 or greater when discounted at opportunity cost of capital in order of ratio value until investment funds are exhausted.

In the four mathematical formulations,

B_t =benefit in each year.
C_t =cost in each year.
N_t = incremental net benefit in each year after stream has turned positive
K_t = incremental net benefit in initial years when stream is negative.
t =1,2,…..,n
n =number of years.
i =interest (discount) rate.

Gitman (1977) developed a new ratio, the risk exposure-ratio (RE-Ratio), which, instead of assessing variability or dispersion, measures the degree of risk exposure present in a given capital expenditure alternative. The RE Ratio can be interpreted as representing the reduction in annual cash inflows (expressed as percentage of the net investment) that could be experienced annually and allow the project to remain acceptable. This ratio actually represents a linear transformation of a benefit/cost ratio. The specific form of RE-Ratio is given below:

$$RE - Ratio = \left(B/C - 1\right) * \left(\frac{1}{F_{k,n}}\right)$$

Where B/C = benefit/cost ratio; and $F_{k,n}$ = the factor for the present value of an n-year annuity discounted at k percent or:

$$F_{k,n} = \frac{1}{(1+k)^1} + \frac{1}{(1+k)^2} \cdots\cdots \frac{1}{(1+k)^t}$$

The decision rule for RE-Ratio is to accept all projects that exhibit positive RE-Ratios and NPW. When alternative techniques (projects) are assessed, projects with higher RE-Ratios should be selected. Therefore, RE Ratio can be used to measure project worth, and allows estimations of the degree of project risk exposure to be made (Grafiadellis, 2000).

Soilless Pots System (SPS) could be defined as follows: One of the agriculture soilless systems, which uses plants that need more depth of root growth, they need to use pots, this system is suitable for growing cucumber and strawberry - tomatoes - eggplant - Chinese cabbage. Black plastic bags of different sizes are used and then fill the suitable culture for cultivation and grow seedlings. Holes are made from the bottom of the bags for the leakage of excess water and may collect this water or nutrient solution to feed it again. There are bags of planting about one meter long and 20 Centimeters wide usually have two cucumber plants or three tomato plants. These bags are placed on the ground along the farming line. These farms use special black plastic bags to suit root growth and white surface to reflect sunlight or black to absorb energy Photovoltaic in cold areas.

Pipes Soilless system (PSS): This system carries nutrient-laden water around plant roots in the form of a thin layer that does not cover more than one third of the plant root. The plants obtain their water, nutrient and oxygen needs in a balanced manner. PVC pipes are used for different purposes according to the nature of the crop It is designed to have iron supports in the form that is given the maximum intensification of agricultural, taking into account that each plant takes sufficient lighting, most notably the shape of the triangle, where the pipes are installed on the props and then plant plants in the pipes after adjusting irrigation lines and drainage, this system is suitable for plants that are characterized by small size vegetative such as strawberries - lettuce – cabbage - tomato. These systems also distinguish oneself by the possibility of increasing the number of cultivated plants in the unit area which increases the production obtained.

3. Results and Discussion

3.1. Cucumber:

Table (1) showed the average of annual production, gross revenue and costs of both SPS and TSC for cucumber.

Production and gross revenue: The average of annual production of SPS exceeds the average of

annual production of TSC by 25.3%. Meanwhile, the gross revenue average of SPS also exceeds TSC by 25.3%.

Production Costs: the investment costs of SPS exceed the investment costs of TSC by 79.8%, that's because adopting SPS needs extra equipment like pots, peat moss and sand, irrigation system for SPS is more complicated to establish a recirculation system for the nutrient solution and so more costly. Contradictory, the fixed costs of SPS were less than fixed costs for TSC by 2.7%, due to the value of rent where TSC needs special characters of traditional soil, which resulted in higher rental value, but SPS did not need traditional soil at all (table 2). Variable costs of SPS were less than variable costs for TSC by 21% (table 1), one of the main reasons of this result is nutrient solution melted in irrigation water and goes into the recirculation system in SPS, which reduced the waste and the amounts of nutrient solution used in this system. On the other hand, fertilizers and manure used in TSC were more vulnerable to waste in the soil. The second reason of less variable cost for SPS is Pesticide/insecticides, where TSC needed more of Pesticides/insecticides than SPS.

Also, TSC needed more labor cost than SPS (table 2) as stated by (Resh, 2012) soil-grown produce is most often cited for having increased labor costs because of weeding, watering, and spraying of pesticides. All of the above factors contributed in making the total costs of SPS were less than the total costs of TSC by 15.5% and the high yield of SPS resulted in cost per kilogram of cucumber in SPS and TSC were LE 1.42 and LE 2.11 respectively, which mean cost per kilogram of cucumber of SPS were less than the cost per kilogram for TSC by 32.7% (table 1).

Financial analysis: as mentioned earlier, five discounted measures (IRR, NPW, N/K ratio, B/C ratio and RE ratio) were estimated to assess the economic efficiency of SPS vs. TSC. Therefore, monetary flows of the two systems were considered (table 2) and discounted at 18% within a period of 15 years (table 3) (Grafiadellis, 2000).

Table 1: Average annual production, gross revenue and costs for soilless pots system (SPS) vs. The traditional soil culture (TSC) for cucumber on 360 m^2 greenhouse.

System	SPS	TSC	Increase with SPS (%)
Production (Kg)	11900	9500	25.3
Gross revenue (L.E)	35700	28500	25.3
Costs (L.E)			
Investment	1875	1043	79.8
Fixed	286	294	-2.7
Variable	14750	18680	-21
Total	16911	20017	-15.5
Cost per Kilograme	1.42	2.11	-32.7

Source: summarized and calculated from table (2) data.

As shown in (table 3) each of comparison criteria (IRR, NPW, N/K ratio and B/C ratio) for SPS was achieved higher value than the same criteria for TSC. This means, adopting SPS technique for cucumber increased earned income. In spite of, the highest value of investment costs out flowed in SPS the project achieved a higher income than TSC method. In addition to that RE ratio of 15% for SPS indicated that the annual cash inflow may be reduced by 15% and the project can still maintain its positive NPW. Contradictory, TSC obtained RE ratio of 5%, which indicated the project is facing high exposure risk if the annual cash inflow decreased to less than 5%.

Sensitivity analysis: The process of re-evaluation of the project is defined under the assumptions of changing returns and costs due to the assumption that the circumstances change as sensitivity analysis of the project, means the extent of the project's response or sensitivity to the changes in factors affecting its profitability. Using sensitive analysis a firm can best estimate all revenues and costs involved in a project by calculating the project's NPW and then checking the sensitivity of the NPW to possible estimation errors of the gross revenues and various cost items (Grafiadellis, 2000).

In this research there are two essential factors investigated (table 3). The first one is the price, which represented in three cases: 1- increasing total costs by 10%. 2- Decreasing revenue by 10%. 3- Increasing total costs by 10% and decreasing revenue by 10%. In these three cases NPW of SPS decreased by 12.6%, 26.9% and 47.9% respectively. Meanwhile, NPW of TSC decreased by 45.5%, 70.3% and 264.7% for the three above cases respectively. That's mean NPW for TSC was more vulnerable to losses than NPW for SPS. The increases of input prices affect the producer income. But, the decreases in output prices affect producer income more crucially. In other words, the price of the final product significantly changes NPW so producers must find ways to obtain high prices for

their product like pursuing export their product, implementing advanced marketing strategy and well planed time of production.

Table (2) Estimitaded costs and revenue (LE) of the soilless pots system (SPS) vs. The traditional soil culture (TSC) for cucumber on 360 m^2 greenhouse.

	Year 0		Year 1		Year 3		Year 6		Year 9		Year 12		Year 15	
	SPS	TSC	SPS	TSC	SPS	TSC	SPS	TSC	SPS	TSC	SPS	TSC	SPS	TSC
Investment costs														
Greenhouse structure	8000	8000	0	0	0	0	0	0	0	0	0	0	0	0
PE (covering material)	1125	1125	0	0	1125	1125	1125	1125	1125	1125	1125	1125	1125	1125
Pots	1125	---	0	---	0	---	0	---	0	---	1125	---	0	---
Beat moss	1575	---	0	---	0	---	1575	---	0	---	1575	---	0	---
Sand	240	---	0	---	0	---	240	---	0	---	240	---	0	---
Irrigation system	2800	1450	0	0	0	0	0	0	0	0	0	0	0	0
Total	14865	10575	0	0	1125	1125	2940	1125	1125	1125	4065	1125	1125	1125
Fixed costs														
Assembly and installation	1500	1500	0	0	0	0	0	0	0	0	0	0	0	0
Rent	175	200	175	200	175	200	175	200	175	200	175	200	175	200
Total	1675	1700	175	200	175	200	175	200	175	200	175	200	175	200
Variable costs														
Seedlings	0	0	1400	1280	1400	1280	1400	1280	1400	1280	1400	1280	1400	1280
Nutrient solution or Fertilizers and manure	0	0	5000	7000	5000	7000	5000	7000	5000	7000	5000	7000	5000	7000
Water	0	0	400	500	400	500	400	500	400	500	400	500	400	500
Pesticides/Insecticides	0	0	2000	3000	2000	3000	2000	3000	2000	3000	2000	3000	2000	3000
Electricity	0	0	150	100	150	100	150	100	150	100	150	100	150	100
Thread for winding	0	0	1100	1000	1100	1000	1100	1000	1100	1000	1100	1000	1100	1000
Labor	0	0	3500	5000	3500	5000	3500	5000	3500	5000	3500	5000	3500	5000
Wrapping and transport	0	0	1200	800	1200	800	1200	800	1200	800	1200	800	1200	800
Total	0	0	14750	18680	14750	18680	14750	18680	14750	18680	14750	18680	14750	18680
Total costs	16540	12275	14925	18880	16050	20005	17865	20005	16050	20005	18990	20005	16050	20005
Depreciation	0	0	0	0	25	0	75	50	25	0	75	50	620	530
Gross revenue	0	0	35700	28500	35725	28500	35775	28550	35725	28500	35775	28550	36320	29030
Net benefits	-16540	-12275	20775	9620	19675	8495	17910	8545	19675	8495	16785	8545	20270	9025

Source: Agriculture Research Center, Central Laboratory for Agricultural Climate, Egypt, unpublished data.

The second factor examined in sensitivity analysis was the discount rate. As mentioned earlier the real discount rate was 18%, which reflects deposit interest rate used in Egypt's financial market in the study period, before that the real discount rate was 10%, a decrease in discount rate assumed to be 10%, this decrease in discount rate increased NPW for SPS by 36.8% and 39.8% for TSC (table 3). So the research argued that a decrease in discount rate enables the project best opportunity to achieve more income and more stability.

Table (3) The financial comparison of soilless pots system (SPS) and Traditional Soil Culture (TSC) for cucumber production on 360 m^2 greenhouse.

Item	**SPS**		**TSC**	
IRR	**124%**		**77%**	
NPW	**85814**		**35180**	
N/K ratio	**3.08**		**2.11**	
B/C ratio	**1.89**		**1.32**	
RE-ratio	**15%**		**5%**	
Sensitivity analysis	**NPW**	**(NPW) Change rate %**	**NPW**	**(NPW) Change rate %**
10% of cost increasing	**76200**	**-12.6**	**24173**	**-45.5**
10% of revenue decreasing	**67619**	**-26.9**	**20655**	**-70.3**
10% of cost increasing & 10% of revenue decreasing	**58005**	**-47.9**	**9647**	**264.7**
Discount rate of 10%	**135871**	**36.8**	**58438**	**39.8**

Source: summarized and calculated from table (2) data.

3.2 Strawberry:

Consumption of strawberries has been asserted to have many health promoting bioactive compounds including antioxidants (Chenin T, 2015). As mentioned earlier, the study compared between two growing systems, one of them was the traditional soil culture greenhouse (TSC), and another system was the greenhouse soilless culture technique, in this technique Strawberry cultivated in greenhouse by using pipes soilless system (PSS), where110 mm pipes settled on hierarchical iron triangle (8 holders) were used.

Production and gross revenue*:* The average of annual production of PSS exceeds the average of annual production of TSC by 60%. Meanwhile, the gross revenue average of PSS also exceeds TSC by 80.9% (table 4).

Production Costs: the investment costs of PSS exceed the investment costs of TSC by 53%, that's because adopting PSS needs extra equipment like pipes 110mm, hierarchical iron triangles, and irrigation system for PSS is more complicated to establish a recirculation system for the nutrient solution and so more costly.

Contradictory, the fixed costs of PSS were less than fixed costs for TSC by 8.5%, due to the value of rent where TSC needs special characters of traditional soil, which resulted in higher rental value, but PSS did not need traditional soil at all (table 5). Variable costs of PSS were more than variable costs for TSC by 18.9% (table 4), one of the main reasons of this result is intensification in PSS needed seedlings equal 3 times TSC needed, accordingly, plants in this system consumed more costs for water, electricity, thread for winding and wrapping and transport. In addition to that PSS needed extra equipments than TSC like culture and plastic bags for planting (table 5) all of these reasons contributed in making variable costs in PSS exceeds variable costs for TSC. All of the above factors contributed in making total costs of PSS were more than the total costs of TSC by 205%. The high yield of PSS resulted in cost per kilogram of strawberry equal to 1.62 L.E and for TSC was 2.15 L.E, which mean cost per kilogram of strawberry for PSS were less than the cost per kilogram for TSC by 24.7% (table 4).

Table 4: Average annual production, gross revenue and costs for pipes soilless system (pss) vs. The traditional soil culture (TSC) for Strawberry on 360 m^2 greenhouse.

System	PSS	TSC	Increase with SPS (%)
Production (Kg)	13200	8250	60
Gross revenue (LE)	61961	38728	80.9
Costs (LE)			
Investment	1597	1044	53
Fixed	269	294	-8.5
Variable	19486	16387	18.9
Total	21352	17725	20.5
Cost per Kilograme (LE)	1.62	2.15	-24.7

Source: summarized and calculated from table (5) data.

Table (6) The financial comparison of pipes soilless system (PSS) and Traditional Soil Culture (TSC) for Strawberry production on 360 m^2 greenhouse.

Item	PSS		TSC	
IRR	235%		191%	
NPW	208404		106200	
N/K ratio	8,15		6,36	
B/C ratio	2,63		2,02	
RE-ratio	27%		17%	
Sensitivity analysis	NPW	(NPW) Change rate %	NPW	(NPW) Change rate %
10% of cost increasing	195623	-6.5	95803	-10.9
10% of revenue decreasing	174782	-19.2	85183	-24.7
10% of cost increasing & 10% of revenue decreasing	162001	-28.6	74786	-42
Discount rate of 10%	320408	35	164527	55.8

Source: summarized and calculated from table (5) data.

Financial analysis: As showed in (table 6) the comparison criteria (IRR, NPW, N/K ratio and B/C ratio) for PSS were (235%, 208404, 8.15, 2.63) respectively, and these criteria achieved higher value than the same criteria for TSC, which indicate, adopting PSS technique for strawberry increased earned income for producers. In spite of, the highest value of investment costs out flowed in PSS technique the project achieved a higher income than TSC method. In addition to that RE ratio of 27% for PSS indicated that the annual cash inflow may be reduced by 27% and the project can still maintain its positive NPW. Contradictory, TSC obtained RE ratio of 17%.

Sensitivity analysis: as same as cucumber there are two essential factors investigated for sensitivity analysis in strawberry (table 6). The first one is the price, which represented in three cases: 1- increasing total costs by 10%. 2- Decreasing revenue by 10%. 3- Increasing total costs by 10% and decreasing revenue by 10%. In these three cases NPW of PSS decreased by 6.5%, 19.2% and 28.6% respectively. Meanwhile, NPW of TSC decreased by 10.9%, 24.7% and 42% for the three above cases respectively. That's mean NPW for TSC was more vulnerable to losses than NPW for PSS. The increases of input prices affect the producer income. But, the decreases in output prices affect producer income more crucially. In other words the price of the final product significantly changed NPW so producers must find ways to obtain high prices for their product like pursuing export their product, implementing advanced marketing strategy, well planed time of production and better packaging.

Table (5) Estimitaded costs and revenue (LE) of pipes soilless system (PSS) vs. The traditional soil culture (TSC) for Strawberry on 360 m^2 greenhouse.

	Year 0		Year 1		Year 3		Year 6		Year 9		Year 12		Year 15	
	SPS	TSC	SPS	TSC	SPS	TSC	SPS	TSC	SPS	TSC	SPS	TSC	SPS	TSC
Investment costs														
Greenhouse structure	8000	8000	0	0	0	0	0	0	0	0	0	0	0	0
PE (covering material)	1125	1125	0	0	1125	1125	1125	1125	1125	1125	1125	1125	1125	1125
Hierarchical iron triangle (8 holders)	3000	---	0	---	0	---	0	---	0	---	0	---	0	---
Pipes 110mm	2500	---	0	---	0	---	0	---	0	---	0	---	0	---
Irrigation system	2800	1450	0	0	0	0	0	0	0	0	0	0	0	0
Total	17425	10575	0	0	1125	1125	1125	1125	1125	1125	1125	1125	1125	1125
Fixed costs														
Assembly and installation	1500	1500	0	0	0	0	0	0	0	0	0	0	0	0
Rent	175	175	175	200	175	200	175	200	175	200	175	200	175	200
Total	1675	1675	175	200	175	200	175	200	175	200	175	200	175	200
Variable costs														
Seedlings	0	0	3360	1280	3360	1280	3360	1280	3360	1280	3360	1280	3360	1280
Culture	0	---	975	---	975	---	975	---	975	---	975	---	975	---
Plastic bags	0	---	300	---	300	---	300	---	300	---	300	---	300	---
Nutrient solution or Fertilizers and manure	0	0	5000	6000	5000	6000	5000	6000	5000	6000	5000	6000	5000	6000
Water	0	0	800	600	800	600	800	600	800	600	800	600	800	600
Pesticides/Insecticides	0	0	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
Electricity	0	0	150	100	150	100	150	100	150	100	150	100	150	100
Thread for winding	0	0	1500	1000	1500	1000	1500	1000	1500	1000	1500	1000	1500	1000
Labor	0	0	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Wrapping and transport	0	0	1200	1000	1200	1000	1200	1000	1200	1000	1200	1000	1200	1000
Total	0	0	20785	17480	20785	17480	20785	17480	20785	17480	20785	17480	20785	17480
Total costs	19100	12275	20960	17680	22085	18805	22085	18805	22085	18805	22085	18805	22085	18805
Depreciation	0	0	0	0	0	0	50	50	0	0	50	50	895	530
Gross revenue	0	0	66000	41250	66000	41250	66050	41300	66000	41250	66050	41300	66895	41780
Net benefits	-19100	-12275	45040	23570	43915	22445	43965	22495	43915	22445	43965	22495	44810	22975

Source: Agriculture Research Center, Central Laboratory for Agricultural Climate, Egypt, unpublished data.

The second factor examined in sensitivity analysis was the discount rate. A decrease in discount rate assumed to be 10%, this decrease in discount rate increased NPW for PSS by 35% and 55.8% for TSC. So the research confirms that a decrease in discount rate enables the project best opportunity to achieve more income and more stable.

Conclusion

Using modern techniques in agriculture is often expensive, but it generates higher profits than traditional methods. This is confirmed by the current research. Where pointed out that, despite the increase in investment costs of greenhouse cultivation used

Soilless Pots System SPS by 79.8% more than the investment costs of greenhouse cultivation used Traditional Soil Culture TSC for cucumber, SPS has achieved an annual increase of revenues amounted to about 25.3% more than TSC.

Financial analysis results for the projects indicated that SPS is more profitable than TSC. SPS has achieved a net present worth (NPW) of about LE 85,814 for cucumber over the lifetime of the project (15 years). The TSC has achieved (NPW) of about LE 35180 for the same crop over the same period. In terms of project risk exposure (RE-ratio), it was found that the project using SPS was less exposed to risk than the project using TSC.

Another comparison was made between the two projects; one depended on soilless farming by using Pipes Soilless System PSS, and another one used Traditional Soil Culture TSC for strawberry growing. The same previous results were confirmed, but PSS required higher investment costs than TSC for strawberry as well as the SPS for cucumber. However, PSS achieved more intensification rates than other methods, resulted in a higher net yield than achieved by other methods. Risk exposure was also lower in strawberry cultivation PSS than TSC, as well as the SPS for cucumber.

The sensitivity analysis indicated that both input and output prices have a significant impact on the NPW of the project, and when the final product price is improved, even by a small percentage, the project income increased much more. Therefore, attention should be given to factors that ensure that the producer obtains a higher price for its production, such as: high quality of the crop, a good marketing strategy, and contractual agriculture. The sensitivity analysis also indicated that the lower discount rate (the deposit interest rate), the greater chances of achieving projected for high profitability, and thus the incentive to expand the establishment of small projects, which generate high returns and create more job opportunities. The research confirmed that the use of modern technologies in agriculture increases the production amount of agricultural crops, thus providing more food available globally, meanwhile the technique of soilless planting needs further research on assurance of consumer access to safe and healthy food.

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References:

1. Central bank of Egypt. 2017, Monthly Statistical Bulletin.
2. Central Laboratory for Agricultural Climate. 2017, Agricultural Research Center, Ministry of Agriculture and Land reclamation, Egypt.
3. Chenin T and Stanley O. 2015. Comparison between hydroponic and soil systems for growing strawberries in a greenhouse. Int. J. Agr. Ext. 03 [3], Pp 195-200.
4. Food and Agriculture Organization of the United Nations. 2013. Good Agricultural Practices for greenhouse vegetable crops- Principles for Mediterranean climate areas, Pp 303-304. FAO, Rome.
5. Gitman, L.J. 1977. Capturing risk exposure in the evaluation of capital budgeting projects. Eng. Economist.
6. Gittinger, J.P. 1982. Economic analysis of agricultural projects. 2nd Ed. Intl. The Johns Hopkins University Press, Baltimore and London.
7. Grafiadellis I, Mattas K, Maloupa E, Tzouramani I and Galanopoulos K. 2000. An Economic Analysis of Soilles Culture in Gerbera Production. Hort Science, Vol. 35(2), April, Pp 300-303.
8. Gruda N. 2009. Do soilless culture systems have an influence on product quality of vegetables? Journal of Applied Botany and Food Quality. V. 82, Pp 141 – 147.
9. Resh, H. M., & Howard, M. (2012). Hydroponics Food Production: A Definitive Guidebook for the Advanced Home Gardener and the Commercial Hydroponic Grower. In Santa Bárbara, California, EUA (Sixth).
10. Sait E, Ayse G. 2009. Economic Analysis of Soil-Based Greenhouse Cucumber Production in Turkey. Sci. Agric. (Piracicaba, Braz.), v.66, n.5, Pp.606-614.

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