



Full Length Research Paper

An Economic study for the Production of the Most Important Vegetables in Greenhouses in Egypt

Ashraf M. Eldalee¹; Ashraf E. M. Elemar² and Rehan M. Attia³

¹Professor Researcher, Agricultural Economics Research Institute, Agricultural Research Center – Egypt.

^{2,3}Senior Researcher, Agricultural Economics Research Institute Agricultural Research Center – Egypt.

ARTICLE INFORMATION

ABSTRACT

Corresponding Author:

Ashraf M. Eldalee

Article history:

Received: 06-02-2021

Accepted: 10-02-2021

Published: 18-02-2021

Key words:

Greenhouses; production; vegetables; Consumption; Prediction.

The research aimed to estimate the extent of the contribution of protected agriculture to the production of some vegetable crops in Egypt, especially in the new lands of the research sample in the Beheira Governorate, to determine the current situation for the production of study crops, as an indicator that can be inferred to estimate the economic effects of the implementation of the national greenhouse project, and the research relied on achieving its objectives on Both descriptive and quantitative analytical method, where percentages and arithmetic averages, some indicators of productivity and profitability, and time series analysis were used for the purpose of predicting the value of some study variables through the general trend. The results showed that the needs, numbers of greenhouses, and the amount of irrigation water needed to cover the same amount of production in open fields according to the 2019 data for tomato, cucumber, pepper, eggplant and green beans, which amounted to about 32.3, 2.3, 5.8, 10.1, 3.3 thousand feddans greenhouses for each of them. The arrangement, and the production amounted to 7969.5, 435.3, 745.7, 1471.2, 187.5 thousand tons, and the amount of irrigation water needed to cover the water needs of the crop was about 124.56, 8.03, 19.10, 31.56, 9.88 million cubic meters each, in the same order. It turned out that the total number of greenhouses needed to cover the needs of local consumption of vegetable crops, which were covered by the study in 2030, is estimated at about 62 thousand feddans greenhouses, and therefore the national project for greenhouses, which includes equipping 100 thousand feddans of greenhouses capable of covering the future needs of local consumption of the study crops. With the achievement of an export surplus that supports the competitiveness of Egyptian vegetable exports in the global market.

Introduction

Protected agriculture acquires special importance in countries whose climate is not compatible throughout the year with the production of sufficient vegetables, in addition to the rapid and the successive increase in the number of the population and the need to meet their food needs of vegetable crops, which are in increasing demand every day ⁽³⁾. Protected agriculture is considered one of the modern methods of agriculture that allows access to high-quality agricultural products, and many non-agricultural countries have turned to it as a way to solve the problem of non-fertile lands and not suitable for agriculture⁽⁴⁾. On the other hand, the success of protected cultivation of some important crops of vegetables in the new lands in large areas is what necessitated the state's adoption of these crops through its adoption of a national project for greenhouses that opens the door for major investments to be implemented in accordance with international standards and international experiences in this field. It has an effective role in achieving sustainable agricultural development to advance the Egyptian economy, by increasing self-sufficiency ratios, and reducing the burden on citizens by providing food at reasonable prices, preserving water wealth, and providing job opportunities for youth ⁽²⁾.

International Journal of Social Sciences Arts & Humanities

Despite the success of protected agriculture for some important vegetable crops in the new lands, the expansion of protected agriculture is still not to the extent commensurate with the requirements of Egyptian agriculture, as Egypt is one of the countries with scarcity in suppliers of agricultural land and irrigation water, in addition to the low efficiency of using all who are they. Greenhouses are one of the means to raise the efficiency of using these resources due to their agricultural intensification, increase in the productivity of the land unit, and the adoption of modern irrigation methods that consume less water compared to traditional open cultivation, which required the state to adopt a national greenhouse project aimed at establishing and cultivating 100 thousand high greenhouses Preparing to produce vegetables, to meet the increasing demand for these products.

The research aims to estimate the extent of the contribution of protected agriculture to the production of some vegetable crops in Egypt, especially in the new lands of the research sample in Beheira Governorate, to determine the current situation for the production of study crops, as an indicator that can be inferred to estimate the economic effects of implementing the national

greenhouse project by studying the following sub-objectives: First, Indicators of costs and revenues of vegetable crops in protected agriculture in the research sample in Buhaira Governorate. Second, The per-feddan needs of irrigation water for vegetable crops produced by protected cultivation by the research sample. Third: The national greenhouse project in Egypt and the economic implications of its implementation. Fourth, The current situation of local consumption and the future forecast of needs for greenhouses to cover domestic consumption by 2030.

Materials and Methodology

Research sample

By reviewing the relative importance of the study crops in protected agriculture in Buhaira Governorate for the 2018/2019 agricultural season, as shown in Table No. (1), it is evident that pepper production is ranked first in terms of the number of greenhouses, reaching about 688 greenhouses, with a total area of about 93 feddans and producing a pot of about 4829.8 tons, at a rate of about 38.4%, 44.5%, 44.8% of the total number of

greenhouses, the total greenhouse area and the total greenhouse production respectively. Whereas, the production of cucumbers came second in terms of the number of greenhouses, reaching about 580 greenhouses, with a total area of about 61 feddans, and production estimated at about 3410.4 tons, a rate of about 32.4%, 29.2% and 31.6% of the total of all of them, respectively. The production of green beans came in third place in terms of the number of greenhouses, reaching about 260 greenhouses, with a total area of about 27.3 feddans, and production estimated at about 349.44 tons, a rate of about 14.51%, 13.08%, 3.24% of the total of all of them, respectively, as well as eggplant production. It is ranked fourth in terms of greenhouse numbers, reaching about 142 greenhouses, with a total area of about 14.2 feddans, and production estimated at 795.2 tons, at a rate of about 7.92%, 6.80%, 7.38% of the total of each, respectively, while tomato production came last in number. It amounted to about 122 greenhouses, with a total area of about 13.4 feddans, and production estimated at about 1395.7 tons, at a rate of about 6.8%, 6.4%, and 13% of the total of each, respectively.

Table-1 The relative importance of the numbers, areas and production of greenhouses on the new lands in Buhaira Governorate 2019

Crop	No. greenhouses greenhouse	%	area		production		
			M ²	feddan	ton	%	
Tomatoes	122	6.81	53680	13.42	6.43	1395.68	12.95
cucumbers	580	32.37	243600	60.9	29.18	3410.4	31.63
pepper	688	38.39	371520	92.88	44.5	4829.76	44.81
Eggplant	142	7.92	56800	14.2	6.804	795.2	7.38
bean	260	14.51	109200	27.3	13.08	349.44	3.24
Total	1792	100	834800	208.7	100	10780.48	100

Source: Ministry of Agriculture, Directorate of Agriculture in Beheira, Statistics Department, unpublished data.

The size of the research sample amounted to about 100 observations representing about 5.6% of the study population. It was selected in a simple random way from vegetable growers tomatoes, cucumbers, peppers, eggplant and peppers in greenhouses, by 20 observations per crop. The research form was collected from new lands in villages. The centers of Dilangat, Abu al-Matamir and Wadi al-Natrun in Buhaira governorate, through a personal interview during the winter season in 2019, and the estimated greenhouse area in the sample ranges between 9 * 40 square meters and 9 * 60 square meters, and the number of greenhouses per feddan ranges from 6-10 greenhouses.

Methodology

The research relied on achieving its objectives on both the descriptive and quantitative analytical method, through the use of percentages and arithmetic averages, some indicators of productivity and profitability, and time series analysis for the purpose of predicting the value of some study variables through the general trend using the growth function on the following form:

$$Y = e^{a+bt}$$

Where: Y: is the variable to be predicted

e: basis of the natural logarithm (e=2.71828)

a: constant function

b: growth rate T: element of time

The main reliance was on the published secondary data issued by the Central Administration of Agricultural Economy at the Ministry of Agriculture and Land Reclamation, in addition to the primary data through a questionnaire form that was

prepared to meet the purpose of the research and was collected from greenhouse farmers in Beheira Governorate for the 2018/2019 agricultural season.

Results and Discussion

Indicators of costs and revenues of vegetable crops in protected agriculture in the research sample in Buhaira Governorate

The relative importance of the construction cost items

It is evident from the average items of construction costs for a feddan of greenhouses cultivated with vegetable crops in the study sample shown in Table No. (2) that a feddan of greenhouses is divided into 10 greenhouses whose dimensions are 9 meters in width and 60 meters in length, and the greenhouse consists of iron structures, galvanized wire, plastic, climbing thread. Fell trays in addition to greenhouse installation costs, which amounted to tomatoes, cucumbers, peppers, eggplant and green beans about 319.56, 292.42, 298.31, 301.91, 272.54 thousand pounds, with a rate of about 81.09%, 80.77%, 81.85%, 82.40%, 81.76. % Of the total construction costs for each of them respectively, which represents the largest percentage of the construction costs of the greenhouse, while the irrigation network consists of pipes and hoses, ground motors and valves, pesticide spraying motors, and fiber tanks, which cost per acre towards about 31.47, 29.85, 28.62, 29.01 and 27.65 thousand pounds, at a rate of about 8.06%, 8.24%, 7.85%, 7.92% and 8.30% of the total construction costs for each of them, respectively.

The cost of establishing a living room for each of the study crops amounted to 14.1, 14.9, 15.15, 14.4 and 13.45 thousand pounds, with a percentage of the total construction costs

amounting to about 3.61%, 4.12%, 4.16%, 3.93%, 4.04% for each of them, respectively, as it reached The cost of establishing the store was about 19.85, 18.65, 17.25, 16.05 and 14.4 thousand pounds, at a rate of about 5.08%, 5.15%, 4.73%, 4.38% and 4.32% for each of them, respectively. Thus, the total construction costs of the greenhouse reached about 390.42, 362.04, 364.46, 366.38, and 333.33 thousand pounds for each of the study crops, in the same order, respectively.

The relative importance of the operating cost items

By reviewing the operational costs items for the production of study crops, tomatoes, cucumbers, peppers, eggplant and green beans in the greenhouse in the 2019 research sample contained in Table No. (3), it was found that the items for preparing and preparing the soil for cultivation included disposal of the previous crop, plowing the greenhouse, leveling and squaring the land, and washing the soil at a value Annually, it amounted to about 13.1, 13.3, 13.1, 13.4, 3.9 thousand pounds/year, at a rate of about 5.3%, 5.1%, 4%, 4.7% and 2.1% of the total operational costs of the study crops, respectively. As for fertilization, the total organic and chemical fertilization amounted to about 43.7, 29.3, 58.8, 57.2, 21.7 thousand pounds, at a rate of about 17.6%, 11.3%, 18.1%, 20.1% and 11.5% of the total operational costs of the study crops respectively, and it was found that Preparing seedlings

amounted to about 20.1, 43.5, 64, 44.3, 1.3 thousand pounds/year, at a rate of 8.1%, 16.8%, 19.7%, 15.5% and 0.7% of the total operational costs for each of them respectively, while the cost of planting that included On planting seedlings, fertilization, irrigation, pesticides, collecting the crop, packages about 44.4, 48.6, 47.3, 46.5, 41.9 thousand pounds/year, at a rate of about 17.9%, 18.7%, 14.6%, 16.3%, 22.2% of the total operational costs for each Among them, respectively, the total agricultural costs amounted to 121.2, 134.8, 183.2, 161.4, 68.8 thousand pounds/year, at a rate of about 48.8%, 52%, 56.4%, 56.6%, and 36.5% of the total operating costs for each of them, respectively. Electricity and water costs amounted to about 7.8, 6.6, 9.4, 9.1, 9 thousand pounds, at a rate of about 3.1%, 2.5%, 2.9%, 3.2% and 4.8% of the total operating costs for each of them, respectively, while labor costs amounted to about 108.3 and 107.4. 122.1, 105.3, 102.2 thousand pounds/year, at a rate of about 43.6%, 41.5%, 37.6%, 36.9%, 54.2% of the total operating costs for each of them respectively, and the feddan rent amounted to about 10, 9.5, 9.2, 8.7 and 8.4. One thousand pounds/year, at a rate of about 4%, 3.6%, 2.8%, 3.1%, 4.4% of the total operating costs for each of them respectively, and therefore the total annual variable costs for each of the study crops amounted to about 248.17, 259.07, 324.63, 285.22. , 188.37 thousand pounds each, respectively.

Table -2 Average construction costs items per feddan greenhouse of vegetable crops in the study sample in Buhaira Governorate in 2019

		<i>Value: thousand pounds</i>									
Item	Tomatoes		cucumbers		pepper		Eggplant		bean		
	Value	%	Value	%	Value	%	Value	%	Value	%	
Greenhouse area		60*9									
No. greenhouses per feddan	10		10		10		10		10		
Greenhouse components	Metal structure	236.19	60.5	215.99	59.66	213.09	58.47	219.88	60.01	201.18	60.35
	Galvanized wire	4.17	1.07	3.79	1.05	4.44	1.22	4.27	1.17	4.01	1.2
	Plastic	72.69	18.62	66.04	18.24	74.22	20.36	71.06	19.4	61.5	18.45
	Climbing thread	2.87	0.74	2.75	0.76	2.95	0.81	2.89	0.79	2.79	0.84
	Installation costs	3.43	0.88	3.55	0.98	3.38	0.93	3.55	0.97	3.06	0.92
	Cork trays	0.21	0.05	0.3	0.08	0.23	0.06	0.26	0.07	0	0
	Total	319.56	81.85	292.42	80.77	298.31	81.85	301.91	82.4	272.54	81.76
Irrigation network	Pipes and hoses	12.44	3.19	13.93	3.85	11.89	3.26	12.51	3.41	12.17	3.65
	Ground motors and cocks	11.9	3.05	10.47	2.89	10.3	2.83	10.2	2.78	9.4	2.82
	Pesticide spraying motors	7.13	1.83	5.45	1.51	6.43	1.76	6.3	1.72	6.08	1.82
	Fiber tanks	4.29	1.1	4.99	1.38	3.84	1.05	3.56	0.97	3.19	0.96
	Total	31.47	8.06	29.85	8.24	28.62	7.85	29.01	7.92	27.65	8.3
Establish a living room	14.1	3.61	14.9	4.12	15.15	4.16	14.4	3.93	13.45	4.04	
Store	19.85	5.08	18.65	5.15	17.25	4.73	16.05	4.38	14.4	4.32	
Other	1.15	0.29	1.23	0.34	1.29	0.35	1.45	0.4	2.1	0.63	
Total fixed costs	390.42	100	362.04	100	364.46	100	366.38	100	333.33	100	
Year's share of fixed costs	39.042		36.204		36.446		36.64		33.33		

Source: Calculated from the research sample data

Annual revenue and cost indicators

The indicators of annual revenues and costs for producing vegetable crops from greenhouses in the research sample, as shown in Table 4, indicate that the cultivation of vegetable crops in the study takes place in two production cycles throughout the year, and the average production per square meter in the greenhouse was about 34.35, 22.31, 17.99 and 9.30 , 7.8 kg/m², while the average greenhouse yield in the session was 12.37, 8.03, 6.48, 25.90 and 2.81 tons/greenhouse for tomatoes, cucumbers, peppers, eggplant and green beans respectively. The average production per feddan in the session was about 123.65, 80.33, 64.75, 93.20, 28.07 tons/feddan for the session, with a total annual production value per feddan of about 698, 590.8, 1013, 717.8, 399.9 thousand pounds for each

of tomatoes, cucumbers, peppers, eggplant and green beans, Respectively. While the average price of study crops throughout the year was about 2.83, 3.68, 7.84, 3.84, and 7.34 pounds/kg. The annual costs per feddan were about 287.17, 295.3, 361.1, 321.8, 221.7 thousand pounds, with an average annual profit per feddan of about 410.8, 295.5, 651.9, 395.9, 178.2 thousand pounds for each of tomatoes, cucumbers, peppers, eggplant and green beans respectively. The highest return on the invested pound was achieved towards the production of pepper, reaching about 1.83 pounds, followed by each of the tomatoes and eggplants at a value of about 1.46 and 1.25 pounds each, respectively. Finally, it came towards cucumbers, then green beans at a value of about 1.01 and 0.79 pounds each respectively.

Table 3 - Average operating costs items per feddan of greenhouses producing vegetable crops in the research sample in Buhaira Governorate in 2019.

		<i>Unit: greenhouse feddan</i>														
Items		tomatoes			cucumbers			Pepper			Eggplant			Green Beans		
		Cycle	Year	%	Cycle	Year	%	Cycle	Year	%	Cycle	Year	%	Cycle	Year	%
Land preparation for planting	Get rid of a previous crop	1.3	2.6	1	1.4	2.8	1.1	1.4	2.7	0.8	1.4	2.7	1	0	0	0
	Greenhouse plowing	1.9	3.9	1.6	1.9	3.7	1.4	2	4.1	1.3	2.2	4.3	1.5	2	3.9	2.1
	Squaring land	1.7	3.5	1.4	1.8	3.6	1.4	1.7	3.4	1.1	1.8	3.6	1.2	0	0	0
	Soil washing	1.6	3.2	1.3	1.6	3.2	1.2	1.5	2.9	0.9	1.4	2.8	1	0	0	0
	Total	6.5	13.1	5.3	6.7	13.3	5.1	6.6	13.1	4	6.7	13.4	4.7	2	3.9	2.1
Fertilization	organic	4.1	8.1	3.3	3.4	6.8	2.6	3.6	7.2	2.2	3.5	7.1	2.5	2.6	5.3	2.8
	Chemically	17.8	35.6	14.3	11.3	22.5	8.7	25.8	51.6	15.9	25.1	50.2	18	8.2	16.4	8.7
	Total	21.9	43.7	17.6	14.7	29.3	11.3	29.4	58.8	18.1	28.6	57.2	20	10.9	21.7	11.5
Farming	Seeds and seedling preparation	10	20.1	8.1	21.8	43.5	16.8	32	64	19.7	22.2	44.3	16	0.7	1.3	0.7
	Growing seedlings	2.1	4.2	1.7	2.2	4.4	1.7	1.4	2.8	0.9	1.4	2.8	1	1.4	2.8	1.5
	Fertilization	3.1	6.3	2.5	5.8	11.7	4.5	2.4	4.8	1.5	2.4	4.8	1.7	2.4	4.8	2.6
	Irrigation	2	4	1.6	1.6	3.2	1.3	1.6	3.3	1	1.6	3.2	1.1	1.6	3.2	1.7
	Pesticides	3.6	7.3	2.9	4.1	8.2	3.2	5.8	11.5	3.5	5.2	10.4	3.6	5	10	5.3
	Collect the crop	3.7	7.4	3	4.1	8.2	3.1	4.2	8.5	2.6	4.1	8.3	2.9	4.1	8.3	4.4
	The packages	7.6	15.2	6.1	6.4	12.9	5	8.2	16.4	5.1	8.5	17	6	6.4	12.8	6.8
	Total	22.2	44.4	17.9	24.3	48.6	18.7	23.6	47.3	14.6	23.2	46.5	16	20.9	41.9	22.2
Total planting costs		60.6	121.2	48.8	67.4	134.8	52	91.6	183.2	56.4	80.7	161	57	34.4	68.8	36.5
Incidental expenses		0.9		0.4	0.9		0.3	0.8		0.2	0.7		0.3	0		0
Electricity and water costs		7.8		3.1	6.6		2.5	9.4		2.9	9.1		3.2	9		4.8
Employment		108.3		43.6	107.4		41.5	122.1		37.6	105.3		37	102.2		54.2
Rent		10		4	9.5		3.6	9.2		2.8	8.7		3.1	8.4		4.4
Total annual variable costs		248.17		100	259.07		100	324.63		100	285.22		100	188.37		100

Source: collected and calculated from the research sample data.

Table 4- Indicators of annual revenues and costs for producing an acre of vegetable crops from protected agriculture in the research sample in Buhaira Governorate 2019

Item	Unit	tomatoes	cucumber	Pepper	Eggplant	Green Beans
Number of times planting in a year	Cycle	2	2	2	2	2
Number of plants	Plant	900.25	970.2	840	871.5	5312.5
Average plant yield	Kg/m ²	13.75	8.28	7.7	10.7	0.52
Average production per m ² greenhouse	Kg/m ²	34.35	22.31	17.99	9.3	7.8
Average greenhouse yield per cycle	Tons	12.37	8.03	6.48	25.9	2.81
Average production per feddan per session	Tons	123.65	80.33	64.75	93.2	28.07
Average price throughout the year	Pounds/kg	2.83	3.68	7.84	3.84	7.34
Greenhouse production value	Thousand pounds	34.9	29.54	50.65	35.7	20
Annual greenhouse production value	Thousand pounds	69.8	59.08	101.3	71.4	39.99
The annual production value per feddan	Thousand pounds	698.02	590.76	1013	717.8	399.93
The year's share of fixed costs feddan	Thousand pounds	39.04	36.2	36.45	36.64	33.33
feddan operating costs for a year	Thousand pounds	248.13	259.08	324.64	285.2	188.36
Total annual costs per feddan	Thousand pounds	287.17	295.28	361.09	321.84	221.69
Annual net profit per feddan	Thousand pounds	410.85	295.48	651.95	395.97	178.23
Return on the invested pound	pounds	1.46	1.01	1.83	1.25	0.79

Source: collected and calculated from the research sample data.

Feddan needs of irrigation water for vegetable crops produced by protected cultivation of the research sample

By reviewing the per-feddan needs of irrigation water for vegetable crops produced by protected cultivation in the research sample in Buhaira Governorate as shown in Table No. (5), it is evident that the water requirements of the crop vary during the period of its growth stages as it increases with the increase in growth in the last months of the crop's life than at the beginning of cultivation, and that The water requirements of the tomato crop are the highest among the study crops, reaching about 193 cubic meters for one greenhouse, followed by the water requirements for the cucumber crop and then the

pepper in an amount of about 172 and 166 cubic meters for one greenhouse for each, respectively, in the eggplant and bean crop register, the lowest water need for the study crops. With an amount of about 156, 148 cubic meters for one greenhouse. Accordingly, the per acre needs of irrigation water for the study crops amounted to about 1920, 1720, 1660, 1560 and 1480 cubic meters / acre for the study crops in the same order. The average water requirement for one greenhouse was about 167 cubic meters, and the average water requirement for a greenhouse feddan was about 1670 cubic meters for the study sample.

Table 5 -Per feddan needs of irrigation water for vegetable crops produced with protected agriculture in the research sample in Buhaira Governorate in 2019

Crop	Average monthly water requirement for a greenhouse						Total greenhouse	Average amount of irrigation water (m3/feddan)
	first	Second	Third	Fourth	Fifth	Sixth		
Tomatoes	15	24	30	36	40	48	193	1930
cucumber	12	20	30	30	36	44	172	1720
pepper	12	18	30	30	36	40	166	1660
Eggplant	10	20	24	30	36	36	156	1560
Beans	10	18	24	30	33	33	148	1480
Average	11.8	20	27.6	31.2	36.2	40.2	167	1670

Source: collected and calculated from the research sample data.

The national greenhouse project in Egypt and the economic implications of its implementation

Established in December 2016 in order to contribute to bridging the gap of food local agricultural production and the provision of vegetable varieties with high quality and favorable prices and employment opportunities for young graduates farming with training, employment and raise the efficiency to create a cadre of high efficiency to deal with modern technology in the field of agriculture protected . The project aims to establish integrated agricultural development communities in the new reclamation areas within the 1.5 million feddans project, and the project consists of about 100 thousand greenhouses distributed geographically over the following areas ⁽¹⁾:

- West Minya region: aims to establish 20 thousand greenhouses, to grow tomatoes, peppers, cucumbers, cantaloupe, eggplant, green onions, zucchini and red cabbage.
- West-West Minya and Moghra regions: It aims to establish 10 thousand greenhouses each to grow tomato, cucumber, eggplant, cantaloupe, pepper, watermelon, zucchini and cut flowers crops.
- Sinai region: aims to establish 20,000 greenhouses to grow tomatoes, eggplant, cantaloupe, pepper, lettuce and cut flowers.
- Al-Marashda 1, Al-Marashda 2 area aims to establish 30,000 greenhouses to grow tomatoes, peppers, beans, cantaloupe and cucumbers.
- Halayeb and Shalateen area aims to establish 10 thousand greenhouses to grow tomatoes, cucumbers, eggplant, cantaloupe, pepper, zucchini and cut flowers.
- Muhammad Najib base area in Al-Hammam city, Matrouh governorate, aims to construct 1,300 greenhouses on an area of 10,000 feddans to grow tomatoes, cucumbers, eggplant, cantaloupe, pepper and zucchini.

In order to determine the expected economic effects of this national project based on the results obtained from the research sample, taking into account the difference between the high technological level of the greenhouses implemented in the framework of this project, and the traditional greenhouses in the research sample, it is necessary to shed light on the following points.

The current status of vegetable crops production by studying open fields in 2019

It is evident from the data in Table No. (6) that the study crops are grown in three cycles: winter, summer and nili, with a total area of about 761 thousand feddans, representing about 58.5% of the total area of vegetable crops in Egyptian agriculture, which is about 1.3 million feddans. The tomato crop, which amounted to about 457 thousand feddans, followed by the eggplant and pepper with an area of about 118, 96 thousand feddans each, respectively, then the cucumber crop with an area of about 47 thousand feddans, and finally the green bean crop with an area of about 44 thousand feddans. Feddan yields reached the highest for tomato crops at an amount of 17.7 tons/feddan, followed by eggplant crops with an amount of about 12.8 tons/feddan, then crops of cucumbers, peppers and green beans with an amount of about 9.4, 7.8, 4.6 tons/feddan each, respectively. As for the total production, it reached a maximum of about 7.97 million tons of tomatoes, then the eggplant crop with a quantity of 1.47 million tons, then each of the peppers, cucumbers and green beans with an amount of about 746, 435 and 188 thousand tons each, respectively.

Table - 6 Area, productivity and production of vegetable crops studied in open fields in Egypt in 2019

Crop	Winter season			Summer and nili season			Total		
	Area Thousand feddan	Production Thousand tons	Productivity ton/fed	Area Thousand feddan	Production Thousand tons	Productivity ton/fed	Area Thousand feddan	Production Thousand tons	Average Productivity ton/fed
tomatoes	167.7	3076.5	18.35	288.8	4893	16.94	456.5	7969.5	17.65
cucumber	12	114.3	9.49	34.4	321	9.32	46.5	435.3	9.41
Pepper	37.2	291.3	7.84	59.2	454.4	7.68	96.3	745.7	7.76
Eggplant	45.6	653.2	14.32	72.4	818	11.3	118	1471.2	12.81
Green beans	31.2	122.3	3.92	12.3	65.2	5.29	43.5	187.5	4.61
Total study crops	293.7	4257.5		467.2	6551.6		760.8	10809.1	
Total without potatoes	580			720.8			1300.8		
%	50.6			64.8			58.5		

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, **Bulletin of Agricultural Statistics 2019**.

The amount of irrigation water consumed to produce vegetable crops in open lands in 2019

It is evident from the data of the water rationing of vegetable crops in the different agricultural areas and under the different irrigation systems in the open fields in 2019 included in Table No. (7), that the water needs of each crop differ according to the agricultural area, the irrigation system used, as well as according to the agricultural season, a feddan planted is considered vegetables in a region Upper Egypt consumes the highest water consumption with an average amount of irrigation water amounting to about 4780 m³/feddan in the case of flood irrigation, about 3824 m³/feddan in the case of the drip irrigation system, and about 3374 m³/feddan in the case of the sprinkler irrigation system, followed by a feddan of vegetables in the Middle Egypt region With an average amount of irrigation water amounting to about 3728, 2961, 2632 m³/feddan according to the three irrigation systems

respectively, then vegetables feddans in the North Delta region with an average amount of irrigation water amounting to about 2922, 2337, and 2062 m³/feddan according to the three irrigation systems in the same order. With the irrigation system, it is evident that flood irrigation is the highest consumption of irrigation water, followed by sprinkler irrigation, then drip irrigation, where the average water requirements per feddan of vegetables are about 3810, 3041, and 2689 m³/feddan for the three irrigation systems respectively. It is also noted that the average needs are The hydropower per feddan of vegetables increases in the summer season than in the winter season, as it reached about 4,646 m³/feddan in the case of flood irrigation, about 3,717 m³/feddan in the case of sprinkler irrigation, about 3,280 in the case of drip irrigation, it decreases in the winter season to about 2974, 2364, 2099 m³/feddan according to the three irrigation systems respectively.

Table - 7 the water ration of vegetable crops by studying under different irrigation systems in Egypt in 2019

Crop	Irrigation system	North Delta			Middle Egypt			Upper Egypt			Season average		overall average
		winter	Summery	Average	winter	Summery	Average	winter	Summery	Average	winter	Summery	
tomatoes	Immersion	2349	4216	3283	3140	5243	4192	4120	6477	5299	3203	5312	4258
	Spraying	1879	3373	2626	2512	4194	3353	3296	5182	4239	2562	4250	3406
	Drip	1658	2976	2317	2216	3701	2959	2908	4572	3740	2261	3750	3005
cucumber	Immersion	2200	3489	2845	2912	4357	3635	3799	5610	4705	2970	4485	3728
	Spraying	1760	2791	2276	2330	3486	2908	3039	4488	3764	2376	3588	2982
	Drip	1553	2463	2008	2056	3075	2566	2682	3960	3321	2097	3166	2632
Pepper	Immersion	2290	4111	3201	3061	5111	4086	4017	6315	5166	3123	5179	4151
	Spraying	1832	3288	2560	2229	4089	3159	3213	5052	4133	2425	4143	3284
	Drip	1617	2902	2260	2161	3608	2885	2835	4458	3647	2204	3656	2930
Eggplant	Immersion	2349	4216	3283	3140	5243	4192	3980	6477	5229	3156	5312	4234
	Spraying	1879	3373	2626	2512	4194	3353	3184	5182	4183	2525	4250	3387
	Drip	1658	2976	2317	2216	3701	2959	2809	4572	3691	2228	3750	2989
Green beans	Immersion	1843	2152	1998	2370	2704	2537	3034	3975	3505	2416	2944	2680
	Spraying	1474	1721	1598	1896	2163	2030	2427	3180	2804	1932	2355	2144
	Drip	1301	1519	1410	1673	1909	1791	2141	2806	2474	1705	2078	1892
Average irrigation system	Immersion	2206	3637	2922	2925	4532	3728	3790	5771	4780	2974	4646	3810
	Spraying	1765	2909	2337	2296	3625	2961	3032	4617	3824	2364	3717	3041
	Drip	1557	2567	2062	2064	3199	2632	2675	4074	3374	2099	3280	2689

Source: Compiled and calculated from: Agricultural Research Center, Institute for Land, Water and Environmental Research, *Water Regulation of Crops in Egypt under Different Irrigation Systems, 2019.*

Estimating the economic impacts of implementing the national greenhouse project

By reviewing the data contained in Table No. (8), which shows the amount of production from the study crops in open lands,

the number of greenhouses needed to cover it, and the needs for irrigation water according to the 2019 data, the following was found:

Table-8 Estimation of the economic impacts of implementing the national greenhouse project according to 2019 data

	Item	Unit	tomatoes	cucumber	Pepper	Eggplant	Green Beans	Total
Open cultivation	Production	Thousand tons	7969.5	435.3	745.7	1471.2	187.5	
	Area	thousand feddans	456.5	466.5	96.3	118	43.5	1180.8
	Productivity	Tons/feddan	17.65	9.41	7.76	12.81	4.61	
	Irrigation water	Million m3	1623.4	1452.6	332.7	417.3	97.4	3923.4
	Water unit productivity	Kg/m3	4.9	0.3	2.24	3.53	1.93	
Protected cultivation	Area	thousand feddans	64.54	4.7	11.5	20.2	6.7	107.6
	Number of greenhouses	A thousand greenhouses	32.3	2.3	5.8	10.1	3.3	53.8
	Productivity	Tons/feddan	123.5	92.6	64.8	72.8	27.9	
	Irrigation water	Million m3	124.56	8.08	19.1	31.51	9.78	193
	Water unit productivit	Kg/m3	63.9	53.9	39	46.7	19.2	
Savings achieved	Area	thousand feddans	392	462	85	98	37	1073.2
	Irrigation water	Million m3	1498.8	1443.8	313.6	385.5	87.6	3729.3

(1) Estimated on the weighted average basis of the different open lands irrigation systems.

(2) The greenhouse area is a feddan and it is planted two sessions per year.

Source: It was compiled and calculated from tables (4), (5), (6), (7).

Impact on resource use of agricultural land

The project can absorb the total production of study crops in the open lands of the three winter, summer and indigo seasons which is about 7969.5, 435.3, 745.7, 1471.2, 187.5 thousand tons each of tomatoes, cucumbers, peppers, eggplant and green beans respectively, in a number of greenhouses estimated at about 32.3, 2.3, 5.8, 10.1, 3.3 thousand greenhouses for each crop in the same order, with a total area of about 53.8 thousand feddans of agricultural greenhouses equivalent to about 4.56% of the open agricultural land allocated for the production of these crops, which amounted to about 1180.8 thousand feddans, so the shift from open agriculture For protected cultivation of study crops alone, it provides about 1.07 million feddans that can be used in the production of strategic field crops, especially the wheat crop in the winter, and the maize crop in the summer, which are crops that local production cannot cover the local demand for, and the quantity and value of its imports increases from year to year.

The previous savings are due to the increase in the productivity of the land unit of the study crops to about 123.5, 92.6, 64.8, 72.8, 27.9 tons/feddan for each of tomatoes, cucumbers, peppers, eggplant and green beans, respectively, with an increase of about 600%, 884%, 735%. 468%, 505% of the open land productivity of the study crops in the same order, which is about 17.65, 9.41, 7.76, 12.81, 4.61 tons/feddan for each of them in the same order.

Impact on the use of the irrigation water resource

The use of greenhouses in agricultural production is characterized by rationalizing the use of irrigation water in general. The amount of irrigation water needed to achieve the same level of productivity of the study crops was estimated at about 124.56, 8.03, 19.10, 31.56, 9.88 million cubic meters for each of tomatoes, cucumbers, peppers, eggplant and green beans in the same order, with a total amount of about 193.1 million cubic meters annually, equivalent to about 4.91% of

the amount of irrigation water allocated to the production of these crops in open lands, which amounts to about 3930 million cubic meters, so the shift from open cultivation to protected cultivation for study crops only saves about 3.74 billion cubic meters annually It can be used in horizontal agricultural expansion projects and reclamation of more agricultural lands, especially since the abundance of irrigation water is the main determinant of these projects.

The previous savings are due to the increase in the productivity of the irrigation water unit for the study crops to about 63.9, 53.9, 39.0, 46.7, 19.2 kg / m³ for each of the tomatoes, cucumbers, peppers, eggplant and green beans, respectively, with an increase of about 1204%, 17866% and 1641%. 1223%, 895% of the productivity of the water unit in open lands for the study crops in the same order, which is about 4.9, 0.30, 2.24, 3.53, 1.93 kg / m³ for each of them in the same order.

The current state of consumption of vegetable crops and the future forecast of needs for greenhouses to cover domestic consumption by 2030

The current state of consumption of study vegetables according to consumption data in 2019

By reviewing the current status of the consumed quantities of the study vegetable crops according to the consumption data in 2019 to estimate the number of greenhouses needed to cover both production and consumption needs, it is clear from the data contained in Table No. as shown in Table No. (9). It appears that the number of greenhouses required to cover the domestic consumption of tomato crops It amounted to about 27.07 thousand feddans of greenhouses, and the difference between the number of greenhouses required to cover the production and the number of greenhouses required to cover consumption was about 5.23 thousand feddans greenhouses, which confirms that the production of tomatoes covers local consumption and there is a surplus directed to export and food industries.

Table-9 Domestic consumption, average per capita share, and the number of greenhouses required to cover consumption of vegetable crops in the study according to 2019 data

Crop	Consumption	Average per capita	Number of greenhouses to cover production	Productivity feddan greenhouse	Number of greenhouses to cover consumption	difference between production and consumption
	Thousand tons	Kg / year	Feddan greenhouse	Tons	Feddan greenhouse	Feddan greenhouse
Tomatoes	6686	67.9	32.3	123.48	27.07	5.23
Cucumber	488	4.96	2.3	72.72	3.36	-1.06
Pepper	811	8.24	5.8	64.8	6.26	-0.46
Eggplant	1151	11.69	10.1	93.24	6.17	3.93
Green beans	144	1.46	3.3	28.08	2.56	0.74
Total	9280	94.25	53.8	382.32	45.42	8.38

(1) Collected and calculated from the data of Table No. (8).

Source: Ministry of Agriculture, Economic Affairs Sector, Central Administration for Agricultural Economy, **Food Balance Bulletin**, Cairo, 2019.

The number of greenhouses required to cover the local consumption of the cucumber crop reached about 3.36 thousand feddans greenhouses, and the difference between the number of greenhouses required to cover production and the

number of greenhouses required to cover consumption was about 1.06 thousand feddans towards the benefit of the consumed quantity, which confirms that the consumed quantities of cucumbers do not depend on production From the

open fields, but there is a great dependence on the cucumber crop produced from protected agriculture, which is one of the most important crops commonly produced in greenhouses.

The number of greenhouses required to cover the consumed quantities of the pepper crop was estimated at about 6.26 thousand feddans greenhouses, and the difference between the number of greenhouses required to cover production and the number of greenhouses required to cover consumption was about 460 thousand feddans towards the benefit of the consumed quantity, which confirms that the consumed quantities of pepper do not depend on production. From the open fields, there is even a great dependence on the pepper crop produced from protected agriculture, which is one of the most important crops commonly produced in greenhouses.

The results also showed that the number of greenhouses required to cover the consumed quantities of the eggplant crop amounted to about 6.17 thousand feddans greenhouses, and the difference between the number of greenhouses required to cover production and the number of greenhouses required to cover consumption was about 3.93 thousand feddans of greenhouses, which confirms that the production of eggplant covers local consumption. There is a surplus for export. The

number of greenhouses required to cover the consumed quantities of green beans reached about 2.56 thousand feddans greenhouses, and the difference between the number of greenhouses required to cover production and the number of greenhouses required to cover consumption was about 470 feddans greenhouses, which confirms that the production of beans covers domestic consumption and there is a surplus directed to export. And food industries.

Forecasting domestic consumption and the number of greenhouses required to cover vegetable crops in the study until 2030

It is evident from the study of forecasting the consumed quantities and the number of greenhouses needed to cover the consumption of vegetable crops in the study up to the year 2030 assuming that the average per capita share is fixed at its level in 2019, as shown in Tables No. (10) and (11) as it is expected that the population in 2030 will reach about 133.3. It is expected that the consumed quantities of tomatoes in 2030 will reach about 9052.1 thousand tons. Covering this quantity requires a number of greenhouses estimated at about 36.7 thousand feddans greenhouses.

Table - 10 Forecasting the population and local consumption of study vegetable crops until 2030

Year	population	Domestic consumption				
	Million	Thousand tons				
	people	tomatoes	cucumber	Pepper	Eggplant	Green Beans
2019	101.12	6866.08	501.56	833.23	1182.1	147.64
2020	104.05	7064.8	516.07	857.35	1216.31	151.91
2021	106.97	7263.53	530.59	881.47	1250.53	156.18
2022	109.90	7462.26	545.11	905.58	1284.74	160.46
2023	112.83	7660.99	559.62	929.70	1318.95	164.73
2024	115.75	7859.71	574.14	953.81	1353.17	169.00
2025	118.68	8058.44	588.66	977.93	1387.38	173.27
2026	121.61	8257.17	603.17	1002.05	1421.59	177.55
2027	124.53	8455.89	617.69	1026.16	1455.81	181.82
2028	127.46	8654.62	632.21	1050.28	1490.02	186.09
2029	130.39	8853.35	646.72	1074.4	1524.24	190.37
2030	133.31	9052.07	661.24	1098.51	1558.45	194.64

Source: Results of statistical analysis using E-views software For Food Balance Bulletin data during the period (2000: 2019).

Table – 11 Forecasting the number of greenhouses needed to cover the local consumption of vegetable crops by the study until 2030

Year	Number of greenhouses					
	thousand feddans greenhouses					
	tomatoes	cucumber	Pepper	Eggplant	Green Beans	Total
2019	27.8	3.4	6.4	6.3	2.6	46.6
2020	28.6	3.5	6.6	6.5	2.7	48
2021	29.4	3.6	6.8	6.7	2.8	49.3
2022	30.2	3.7	7	6.9	2.9	50.7
2023	31	3.8	7.2	7.1	2.9	52
2024	31.8	3.9	7.4	7.3	3	53.4
2025	32.6	4	7.5	7.4	3.1	54.7
2026	33.4	4.1	7.7	7.6	3.2	56.1
2027	34.2	4.2	7.9	7.8	3.2	57.4
2028	35	4.3	8.1	8	3.3	58.8
2029	35.8	4.4	8.3	8.2	3.4	60.1
2030	36.7	4.5	8.5	8.4	3.5	61.5

Source: Calculated based on the data provided in Tables (9), (10).

It is expected that the needs of the consumed quantities of cucumbers in 2030 will reach about 661.24 thousand tons, and covering this quantity requires a number of greenhouses estimated at about 4.5 thousand feddans greenhouses. It also

found that the needs of consumed quantities of pepper in 2030 are expected to reach about 1098.5 thousand tons, and covering this quantity requires a number of greenhouses estimated at about 8.5 thousand feddans of greenhouses. The study

indicated that it is expected that the needs of consumed quantities of eggplant in 2030 will reach about 1558.45 thousand tons, and covering this quantity requires a number of greenhouses estimated at about 8.4 thousand feddans greenhouses. It is expected that the needs of consumed quantities of green beans in 2030 will reach about 194.64 thousand tons, and covering this quantity requires a number of greenhouses estimated at about 3.5 thousand feddans greenhouses.

From the foregoing it is evident that the total number of greenhouses needed to cover the needs of local consumption of vegetable crops that were included in the study in 2030 is estimated at about 62 thousand feddans greenhouses. Therefore, the national greenhouse project, which includes equipping 100 thousand feddans, agricultural greenhouses capable of covering the future needs of local consumption of crops. Studying with an export surplus that supports the competitiveness of Egyptian vegetable exports in the global market.

Conclusion

Based on the results obtained, the study recommends that the production of the vegetable crops included in it be restricted to greenhouses, and to provide their areas with open cultivation to produce strategic crops that local production cannot meet the increasing demand for, to raise the self-sufficiency ratios of those crops and limit their imports, which Reflected on reducing the agricultural trade balance deficit. In the winter season, the areas allocated to tomato, cucumber, pepper, eggplant and green beans, which amount to about 293.7

thousand feddans in the 2019 season, can be replaced by wheat or Broad beans, and in the summer and nili season, the area allocated to these crops, amounting to about 467.1 thousand acres, can be replaced by crops of maize and soybeans.

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