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دراسة اقتصادية للتراكيب المحصولية المتوقعة من استصلاح مليون ونصف فدان في مصر

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المستخلص

يعد الاستغلال الاقتصادي الأمثل للموارد الزارعية أحد الأهداف الرئيسية للسياسة الزارعية لتحقيق التنمية الزارعية المتواصلة وذلك من خلال زارعة توليفة المحاصيل التى تُحقق أهداف الدولة وأهداف المزارع معاً، بحيث تحقق أعلى صافي دخل زارعي ممكن على المستوى القومي وأعلى صافي دخل مزرعي للزارع مع الحفاظ على الموارد الطبيعية من أراضي ومياه وغيرها.

أن إجمالي صافي عائد المساحة المحصولية بالتركيب المحصولي القائم في عام 2020 قد بلغ نحو 142.06 مليار جنيه، وأن التوليفة المُثلى للزروع المنتجة طبقاً للسيناريو الثالث هي التي يبلغ عندها إجمالي صافي عائد المساحة المحصولية أكبر قيمة له والتي تبلغ نحو 157.119 مليار جنيه، مما يعني أن التركيب المحصولي طبقا للسيناريو الثالث يُحقق زيادة في إجمالي صافي عائد المساحة المحصولية تُقدر بنحو 10.60%، في حين بلغ إجمالي صافي عائد المساحة المحصولية بالتركيب المحصولي للسيناريو الثاني والأول نحو 152.153 و148.12 مليار جنيه لكل منهما على الترتيب.

وأن إجمالي الاحتياجات المائية للتركيب المحصولي القائم في عام 2020 قد بلغت نحو 41.86 مليار متر مكعب، وأن التوليفة المُثلى للزروع المنتجة طبقا للسيناريو الأول هي التي يصل عندها إجمالي الاحتياجات المائية للتركيب المحصولي إلى أدنى قيمة له والتي تبلغ نحو 42.71 مليار متر مكعب، في حين بلغ إجمالي الاحتياجات المائية للتركيب المحصولي للسيناريو الثاني والثالث نحو 44.277 و 45.756 مليار متر مكعب لكل منهما على الترتيب.

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An Economic Study on Expected Cropping systems of the reclamation of One and a half million Feddans in Egypt

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ABSTRACT

The optimal economic utilization of agricultural resources is one of the main objectives of the agricultural policy to achieve agricultural sustainable development that realizes the objectives of the macro economy and on the same time the objectives of farmers. So that a pattern most be selected for achieving the highest possible net agricultural income at the national level and the highest agricultural net income farmer level.

The total net yield of the cropped area with the existing cropping structure in 2020 amounted to about 142.06 billion pounds, and that the optimal combination of crops produced according to the third scenario is the one at which the total net yield of the cropped area reaches its largest value, according to the third scenario, achieves an increase in the total net yield of the cropped area estimated at 10.60%, while the total net yield of the cropped area with the cropping structure of the second and first scenarios is about 153.152 and 148.12 billion pounds each, respectively

And that the total water needs of the existing cropping structure in 2020 amounted to about 41.86 billion cubic meters, and that the optimal combination of crops produced according to the first scenario is when the total water needs of the cropping structure reach its lowest value, which amounts to about 42.71 billion cubic meters, while it reached the total water needs for crop composition for the second and third scenarios are about 44.277 and 45.756 billion.

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Introduction

Agricultural land is one of the most important non-renewable national productive resources, and its scarcity is increasing year after year. Hence, the horizontal agricultural expansion through the reclamation of new lands has become one of the most important pillars of the agricultural policy in Egypt. The problem of the study is that there is no balance between the horizontal expansion in reclaiming lands with the increase in population where the per capita average is 0.09 feddan which is 2.2 qirat It does not reflect the individual's needs in achieving food security from grain crops (wheat, maize), which affects the Egyptian food security.

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The success of the expansion is represented in the reclamation of new lands and the achievement of sustainable agricultural development depends on procuring the water resources needed for cultivation operations in addition to providing the necessary financing and institutional management for land reclamation operations. Therefore, the state is facing difficulties in providing water resources due to the stability of Egypt's share of the Nile River water and the decrease in the per capita share of water. Water, which affects the achievement of the goals of reclamation and cultivation of new lands.

Research problem

The problem of the study is focused on urban sprawl on agricultural lands, some desertification processes, soil salinization due to poor agricultural drainage, and the steady increase in the population, reaching a maximum of about 3.98 million people in 2020, while the total cultivated land amounted to 1.9 million feddans, representing 9.88% of the total cultivated area. This made the relationship between agricultural land and population increase uneven. Which affects the Egyptian food security, and to achieve this requires more land reclamation in order to increase the amount of agricultural production to provide Egyptian food security. also, the increase in the expansion of desert land reclamation requires large capitals in its reclamation and large quantities of water required for cultivation with low marginal productivity. at the beginning of its productive life, which may not cover the costs of reclamation for a long period of time, which raises the value of the internal debt of the state in light of the current situation.

During the contemporary local and international changes with the limited agricultural land and the limited irrigation water resources, especially during the problem of the Ethiopian Renaissance Dam, it is necessary to determine the appropriate crop composition that maximizes the net yield per acre of agricultural crops in addition to minimizing the use of available Egyptian water resources, and thus achieves the maximum possible return. From the savings in irrigation water that can be used in the reclamation and cultivation of new lands.

The aim of the research

The research aims to identify the best alternatives to the Egyptian cropping patterns through the increase in the areas of new lands, according to the expansionary measures taken by the state in agricultural lands, especially with regard to adding one and a half million feddans by analyzing the current and expected situation through multiple scenarios for the most appropriate cropping pattern that maximizes the net yield of crops. and minimizing the use of available water resources at the same time.

Research method and data sources

The research based on the method of descriptive and quantitative economic analysis, such as the use of multiple objectives programming by (Win QSB) program, in order to estimate the main economic criteria and indicators and achieve the research objectives. It should be noted that the data on which this research is based depends mainly on the data of the agricultural statistics bulletins issued by the Ministry of Agriculture and Land Reclamation, in addition to the data issued by the Central Agency for Public Mobilization and Statistics, in addition to some studies related to the subject of the research.

Description of the multi-objectives programming model for the cropping pattern under study:

1- The objective function: The objective function of the multi-objective programming models represented in the two objectives of maximization and minimization can be explained as follows:

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a) The objective function in the case of maximization: it includes maximizing the total net return for the current crop composition in 2020, and the model used in maximizing the objective function can be formulated as follows:

$$\text{Max G1}: \Pi_1 = \pi_1 X_1 + \pi_2 X_2 + \ldots.. + \pi_{21} X_{21}$$

b) The objective function in the case of a minimization: it includes minimizing in the total irrigation water resources used to irrigate the crops under study in the year 2020, and the model used in minimizing of the objective function can be formulated as follows:

$$\text{Min G2}: \Pi_2 = w_1 X_1 + w_2 X_2 + \ldots.. + w_{21} X_{21}$$

This is under the following restrictions:

Subject to:

$$C_1 = \sum_{j=1}^{n} \alpha_{1ij} X_j \le R_{1i}$$

$$C_2 = \sum_{j=1}^{n} \alpha_{2ij} X_j \le R_{2i}$$

$$\vdots \qquad \vdots \qquad \vdots$$

$$C_{27} = \sum_{j=1}^{n} \alpha_{27ij} X_j \le R_{27i}$$

$$X_j \ge 0 \qquad (j = 1,2,3,\ldots,21) \qquad (i = 1,2,3,\ldots,28)$$

:where

Π1: the total net yield of the cropping composition from the various agricultural productive activities "crops" (j), which includes about 21 crops.

Π2: the total irrigation water needs of the cropping pattern from the various agricultural production activities "crops" (j)

πi: net yield per feddan of agricultural productive activity "crop" (j)

wi: water standards per feddan of irrigation water for crop composition (for each crop)

Xj: the area cultivated with each agricultural production activity (j), as the number of agricultural production activities is 21 crops (j=1,2,...,21). To ensure the non-negativity of the activities, 0 ≤ Xj.

ai: the needs of one feddan for each agricultural productive activity "or crop" (j)

Ri: the total availability of restrictions imposed on agricultural production, as the number of restrictions is 28 (i=1,2,...,12)

2-Model constraints: It should be noted that the constraints included in the multi-linear goals programming model were divided into two main groups that include natural constraints and organizational constraints, as follows:

(1)**Natural restrictions**: It is a set of restrictions related to natural resources, such as the cultivated area of crops in each agricultural season, the total crop area, irrigation water, and nitrogen, phosphate and potassium fertilizers, where all the agricultural area and irrigation water are limited.they include four restrictions,the first is the crop area . The crops under study are in the winter season, the second is related to the area of the crops under study in the summer season, the third entry is related to the area of the crops being studied in the Nile season, and the last entry is related to the total crop area.

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(2)**Regulatory restrictions**: It refers to the set of restrictions related to the maximum restrictions of the cultivated area of the main agricultural crops under study.

These restrictions and the maximum limits for each restriction can be described as follows:

C1 = area of winter crops, provided that the total area of winter crops does not exceed (6.76) million feddans.

C2 = area of summer crops, provided that the total area of summer crops does not exceed (4.13) million feddans.

C3 = The area of the Nile crops, provided that the total area of the Nile crops does not exceed (175,141) thousand feddans.

C4 = Recording the total cropped area, provided that the total cropped area does not exceed (16.286) million feddans.

C5 = the feddan needs of nitrogen fertilizer, provided that the total availability of nitrogen fertilizer does not exceed (21.317) billion kilograms.

C6 = the feddan needs of phosphate fertilizers, provided that the total availability of phosphate fertilizers does not exceed (8.242) billion kilograms.

C7 = Needs per feddan of potassium fertilizer, provided that the total availability of potassium fertilizer does not exceed (14.548) billion kilograms.

C8 = Water needs for winter crops, provided that the available irrigation water in the winter season does not exceed (244.786) billion cubic meters.

C9 = water needs for summer crops, provided that the available irrigation water in the summer season does not exceed (214.967) billion cubic meters.

C10 = Water needs for Nile crops, provided that the availability of irrigation water in the Nile season does not exceed (1.051) billion cubic meters.

C11 = The cultivated area of wheat, provided that the area does not exceed (3.453) million feddans.

C12 = The cultivated area of barley, provided that the area does not exceed (168,715) thousand feddans.

C13 = The cultivated area of beets, provided that the area does not exceed (517,947) thousand feddans.

C14 = The cultivated area of perennial alfalfa, provided that the area does not exceed (1.300) million feddans.

C15 = The cultivated area of winter potatoes, provided that the area does not exceed (357,939) thousand feddans.

C16 = The cultivated area of winter tomatoes, provided that the area does not exceed (192,782) thousand feddans.

C17 = The cultivated area of maize, provided that the area does not exceed (1.506) thousand feddans.

C18 = The cultivated area of sorghum, provided that the area does not exceed (412,319) thousand feddans.

C19 = The area cultivated with cotton, provided that the area does not exceed (500,000) thousand feddans.

C20 = The cultivated area of summer potatoes, provided that the area does not exceed (152,000) thousand feddans.

C21 = The cultivated area of summer tomatoes, provided that the area does not exceed (171,583) thousand feddans.

C22 = The cultivated area of winter onions, provided that the area does not exceed (211,141) thousand acres.

C23 = The cultivated area of garlic, provided that the area does not exceed (38.975) thousand feddans.

C24 = The cultivated area of peanuts, provided that the area does not exceed (157,483) thousand feddans.

C25 = The cultivated area of sesame, provided that the area does not exceed (102.368) thousand feddans.

C26 = The cultivated area of soybeans, provided that the area does not exceed (29,946) thousand feddans.

C27 = The area cultivated with sunflowers, provided that the area does not exceed (17,819) thousand acres.

C28 = The cultivated area of fruits, provided that the area does not exceed (1.633) million acres.

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Table (1): The results of the current best cropping pattern in the Egyptian agricultural land, using the goal programming

S	the goal	Yield		Solution	profit or unit cost	Total
		Variable		The value is in thousand	thousand	Million
1	G1	Wheat	X1	3452.65	3.25	11207.29
2	G1	Barley	X2	0	2.72	0
3	G1	Sugar beet	X3	517.95	4.28	2217.33
4	G1	Clover Tahreesh	X4	690.62	2.76	1905.43
5	G1	Clover Crop	X5	1300	8.86	11519.3
6	G1	Tomato	X6	192.78	44.04	8489.54
7	G1	Potatoes	X7	357.94	3.4	1218.07
8	G1	Summer maize	X8	1506.36	3.29	4948.39
9	G1	Summer sorghum	X9	412.32	1.41	579.31
10	G1	Cotton	X10	500	7.94	3972
11	G1	summer tomato	X11	171.58	20.45	3508.87
12	G1	summer potatoes	X12	152	7.86	1195.33
13	G1	nili maize	X13	0	2.88	0
14	G1	nili tomato	X14	175.14	10.49	1837.93
15	G1	nili potatoes	X15	0	1.55	0
16	G1	Onions	X16	211.14	24.08	5084.7
17	G1	the Garlic	X17	38.98	15.77	614.67
18	G1	Summer Peanuts	X18	157.48	3.67	577.49
19	G1	Summer sesame	X19	102.37	7.07	723.95
20	G1	summer soybeans	X20	29.95	3.96	118.65
21	G1	summer sunflower	X21	17.82	1.07	19.08
22	G1	the fruits	X22	1632.65	50.42	82320.45
23	G2	Wheat	X1	3452.65	6.85	11183.62
24	G2	Barley	X2	0	1.5	0
25	G2	Sugar beet	X3	517.95	2.6	1346.66
26	G2	Clover Tahreesh	X4	690.62	2.1	1450.31
27	G2	Clover Crop	X5	1300	2.7	3510
28	G2	Tomato	X6	192.78	1.5	289.17
29	G2	Potatoes	X7	357.94	1.5	536.91
30	G2	Summer maize	X8	1506.36	4	6025.44
31	G2	Summer sorghum	X9	412.32	4.3	1772.97
32	G2	Cotton	X10	500	3.6	1800
33	G2	summer tomato	X11	171.58	2.6	446.12
34	G2	summer potatoes	X12	152	2.6	395.2
35	G2	nili maize	X13	0	2.2	0
36	G2	nili tomato	X14	175.14	1.9	332.77
37	G2	nili potatoes	X15	0	1.9	0
38	G2	Onions	X16	211.14	2	422.28
39	G2	the Garlic	X17	38.98	2.6	101.34
40	G2	Summer Peanuts	X18	157.48	3.4	535.44
41	G2	Summer sesame	X19	102.37	3.3	337.81
42	G2	summer soybeans	X20	29.95	4.6	137.75
43	G2	summer sunflower	X21	17.82	3.1	55.24
44	G2	the fruits	X22	1632.65	6.85	11183.62
	G1	Goal		Value	(Max.) =	142057.8
	G2	Goal		Value	(Min.) =	41862.64

Source: The results of programming goals using the (Win QSB) program for the data of Table No. (1) in the appendices.

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Discussing the results of solving goal programming models for cropping pattern in Egypt:

The following are the most important results of the goal programming models that could be reached:

The first scenario: the expected cropping pattern (after adding 500,000 feddans of new lands) to the Egyptian agricultural lands:

Table No. (2) shows the cropping pattern according to the first scenario compared to the existing cropping pattern in 2020. From the table it is clear that the changes that occurred in the study crops produced according to this scenario include the stability of the cultivated area with some crops such as barley, winter tomato, summer sorghum, summer tomato , nile tomatoes, garlic, summer peanuts, summer sesame, summer soybeans, sunflowers, while the area cultivated with the following crops increased, including wheat by about 88 thousand feddans, sugar beet by about 45.5 thousand feddans, alfalfa by about 70.5 thousand feddans, alfalfa Sustainable by about 102 thousand feddans, winter potatoes by about 18.6 thousand feddans, maize by about 95.9 thousand feddans, cotton by about 18.4 thousand feddans, summer potatoes by about 9.3 thousand feddans, onions by about 11 thousand feddans and fruits by about 40 thousand feddans. As for the net yield of the cropped area, it increased from 142.058 billion pounds in 2020 to about 148.118 billion pounds in the case of the next cropping pattern, an increase of about 6.060 billion pounds over what it was in the case of the existing cropping pattern.

While the total cropped area in the proposed cropping pattern amounted to about 12.659 million feddans, and the amount of increase in the cropped area amounted to about 500.02 thousand feddans, which means that the proposed cropping pattern achieves an increase in the cropping area estimated at 4.11% over the one used in the existing cropping pattern in 2020.

The proposed cropping combination achieves an increase in the total net return of the cropping installation estimated at 4.27% over the existing cropping combination achieved in 2020, which means that the proposed cropping combination achieves the desired goal of this model, which is maximizing the total net return.

On the other hand, the total amount of irrigation water used in the existing cropping pattern in 2020 was about 41.862 billion cubic meters, while the total amount of irrigation water used in the proposed cropping pattern was about 42.711 billion cubic meters, and the amount of water increase was about 0.848 billion cubic meters, which means that the proposed cropping pattern requires an increase in irrigation water resources estimated at 2.03% over the existing cropping pattern used in 2020, as a result of adding 500 thousand feddans.

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Table (2): The results of the expected cropping pattern for the first scenario (after adding 500,000 feddans of new lands) to Egyptian agricultural lands using goal programming:

	Goal	Decision		solution	differences	profit or unit cost	Total	Differences
	Level	Variable		The value is in thousand	for space and yield	thousand	million	for space and yield
1	G1	Wheat	X1	3541.2	88.55	3.25	287.45	287.45
2	G1	Barley	X2	0	0	2.72	0	0
3	G1	Sugar beet	X3	563.48	45.53	4.28	194.93	194.93
4	G1	Clover Tahreesh	X4	1287.3	596.68	2.76	1646.23	1646.23
5	G1	Clover Crop	X5	1402	102	8.86	903.82	903.82
6	G1	Tomato	X6	192.8	0.02	44.04	0.79	0.79
7	G1	Potatoes	X7	376.5	18.56	3.4	63.16	63.16
8	G1	Summer maize	X8	1602.3	95.94	3.29	315.17	315.17
9	G1	Summer sorghum	X9	412.32	0	1.41	0	0
10	G1	Cotton	X10	518.4	18.4	7.94	146.17	146.17
11	G1	summer tomato	X11	171.58	0	20.45	0	0
12	G1	summer potatoes	X12	161.29	9.29	7.86	73.05	73.05
13	G1	nili maize	X13	0	0	2.88	0	0
14	G1	nili tomato	X14	188.8	13.66	10.49	143.34	143.34
15	G1	nili potatoes	X15	0	0	1.55	0	0
16	G1	Onions	X16	222.31	11.17	24.08	268.97	268.97
17	G1	the Garlic	X17	38.98	0	15.77	0	0
18	G1	Summer Peanuts	X18	157.48	0	3.67	0	0
19	G1	Summer sesame	X19	102.37	0	7.07	0	0
20	G1	summer soybeans	X20	29.95	0	3.96	0	0
21	G1	summer sunflower	X21	17.82	0	1.07	0	0
22	G1	the fruits	X22	1672.65	40	50.42	2016.85	2016.85
23	G2	Wheat	X1	3541.2	88.55	2.7	-1622.38	-1622.38
24	G2	Barley	X2	0	0	1.5	0	0
25	G2	Sugar beet	X3	563.48	45.53	2.6	118.39	118.39
26	G2	Clover Tahreesh	X4	1287.3	596.68	2.1	1253.02	1253.02
27	G2	Clover Crop	X5	1402	102	2.7	275.4	275.4
28	G2	Tomato	X6	192.8	0.02	1.5	0.03	0.03
29	G2	Potatoes	X7	376.5	18.56	1.5	27.84	27.84
30	G2	Summer maize	X8	1602.3	95.94	4	383.76	383.76
31	G2	Summer sorghum	X9	412.32	0	4.3	0	0
32	G2	Cotton	X10	518.4	18.4	3.6	66.24	66.24
33	G2	summer tomato	X11	171.58	0	2.6	0	0
34	G2	summer potatoes	X12	161.29	9.29	2.6	24.15	24.15
35	G2	nili maize	X13	0	0	2.2	0	0
36	G2	nili tomato	X14	188.8	13.66	1.9	25.95	25.95
37	G2	nili potatoes	X15	0	0	1.9	0	0
38	G2	Onions	X16	222.31	11.17	2	22.34	22.34
39	G2	the Garlic	X17	38.98	0	2.6	0	0
40	G2	Summer Peanuts	X18	157.48	0	3.4	0	0
41	G2	Summer sesame	X19	102.37	0	3.3	0	0
42	G2	summer soybeans	X20	29.95	0	4.6	0	0
43	G2	summer sunflower	X21	17.82	0	3.1	0	0
44	G2	the fruits	X22	1672.65	40	6.85	274	274
	G1	**Goal**		Value		(Max.) =	148117.71	6059.93
	G2	**Goal**		Value		(Min.) =	42711.39	848.746

Source: The results of programming goals using the (Win QSB) program for the data of Table No. (1) in the appendices and No. (1) in the research.

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Table (3): Comparison between the results of the current and expected cropping patterns for the .first scenario (after adding 500 thousand feddans of new land) to the Egyptian agricultural lands

Statement	Current best cropping pattern	Best cropping pattern for the expected first scenario	the difference	change % Between of them
Total cropped area (thousand Fadden)	12159.5	12659.52	500.02	4.11
Total net yield of cropped area (million pounds)	142057.78	148117.71	6059.93	4.27
total water requirements (million cubic meters)	41862.644	42711.39	848.746	2.03

Source: Programming goals results in Tables No. (1) and No. (2)

The second scenario: the expected cropping pattern (after adding one million feddans of new lands) to the Egyptian agricultural lands:

Table No. (4) shows the cropping pattern according to the second scenario compared to the existing cropping pattern in 2020, and from the table it is clear that the changes that occurred in the study crops produced according to this scenario include the stability of the cultivated area with some crops such as barley, winter tomato, summer sorghum, summer tomato, Summer potatoes, summer maize, onions, garlic, summer peanuts, summer sesame, summer soybeans, and sunflowers, while the area cultivated with the following crops, including wheat, increased by about 111.7 thousand feddans, sugar beets by about 85.9 thousand feddans, alfalfa by about 85.9 thousand feddans. 360.4 thousand feddans, sustainable alfalfa about 98 thousand feddans, winter potatoes about 9.7 thousand feddans, maize about 95.9 thousand feddans, cotton about 120.3 thousand feddans, indigo(nile) tomatoes about 13.6 thousand feddans, fruits about 108.3 thousand feddans. As for the net yield of the cropped area, it increased from 142.058 billion pounds in 2020 to about 153.152 billion pounds in the case of the next cropping pattern, an increase of about 11.095 billion pounds over what it was in the case of the existing cropping pattern.

While the total cropped area in the proposed cropping pattern amounted to about 13.163 million acres, and the amount of increase in the cropped area amounted to about 1003.84 thousand acres, which means that the proposed cropping pattern achieves an increase in the cropping area estimated at 8.26% over the one used in the existing cropping pattern in 2020.

The proposed cropping pattern achieves an increase in the total net return of the cropping pattern estimated at 7.81% over the current cropping pattern achieved in 2020, which means that the proposed cropping pattern achieves the desired goal of this model, which is maximizing the total net return.

On the other hand, the total amount of irrigation water used in the existing cropping pattern in 2020 was about 41.862 billion cubic meters, while the total amount of irrigation water used in the proposed cropping pattern was about 44.277 billion cubic meters, and the amount of water increase was about 2.415 billion cubic meters, which means that the proposed cropping pattern requires an increase in irrigation water resources estimated at 5.77% over the existing cropping pattern used in 2020 as a result of adding one million feddans.

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Table (4): The results of the expected cropping pattern **for the second scenario (after adding one million** feddans **of new lands) to Egyptian agricultural lands using goal programming:**

	Goal	Decision		Solution	differences	profit or unit cost	Total	Differences
	Level	Variable		The value is in thousand	for space and yield	thousand	million	for space and yield
1	G1	Wheat	X1	3564.32	111.67	3.25	362.49	362.49
2	G1	Barley	X2	0	0	2.72	0	0
3	G1	Sugar beet	X3	603.85	85.9	4.28	367.75	367.75
4	G1	Clover Tahreesh	X4	1577.2	886.58	2.76	2446.06	2446.06
5	G1	Clover Crop	X5	1398	98	8.86	868.38	868.38
6	G1	Tomato	X6	192.78	0	44.04	0	0
7	G1	Potatoes	X7	367.6	9.66	3.4	32.87	32.87
8	G1	Summer maize	X8	1602.3	95.94	3.29	315.17	315.17
9	G1	Summer sorghum	X9	412.32	0	1.41	0	0
10	G1	Cotton	X10	620.33	120.33	7.94	955.9	955.9
11	G1	summer tomato	X11	171.58	0	20.45	0	0
12	G1	summer potatoes	X12	152	0	7.86	0	0
13	G1	nili maize	X13	0	0	2.88	0	0
14	G1	nili tomato	X14	202.4	27.26	10.49	286.04	286.04
15	G1	nili potatoes	X15	0	0	1.55	0	0
16	G1	Onions	X16	211.14	0	24.08	0	0
17	G1	the Garlic	X17	38.98	0	15.77	0	0
18	G1	Summer Peanuts	X18	157.48	0	3.67	0	0
19	G1	Summer sesame	X19	102.37	0	7.07	0	0
20	G1	summer soybeans	X20	29.95	0	3.96	0	0
21	G1	summer sunflower	X21	17.82	0	1.07	0	0
22	G1	the fruits	X22	1740.93	108.28	50.42	5459.89	5459.89
23	G2	Wheat	X1	3564.32	111.67	2.7	-1559.96	-1559.96
24	G2	Barley	X2	0	0	1.5	0	0
25	G2	Sugar beet	X3	603.85	85.9	2.6	223.35	223.35
26	G2	Clover Tahreesh	X4	1577.2	886.58	2.1	1861.81	1861.81
27	G2	Clover Crop	X5	1398	98	2.7	264.6	264.6
28	G2	Tomato	X6	192.78	0	1.5	0	0
29	G2	Potatoes	X7	367.6	9.66	1.5	14.49	14.49
30	G2	Summer maize	X8	1602.3	95.94	4	383.76	383.76
31	G2	Summer sorghum	X9	412.32	0	4.3	0	0
32	G2	Cotton	X10	620.33	120.33	3.6	433.19	433.19
33	G2	summer tomato	X11	171.58	0	2.6	0	0
34	G2	summer potatoes	X12	152	0	2.6	0	0
35	G2	nili maize	X13	0	0	2.2	0	0
36	G2	nili tomato	X14	202.4	27.26	1.9	51.79	51.79
37	G2	nili potatoes	X15	0	0	1.9	0	0
38	G2	Onions	X16	211.14	0	2	0	0
39	G2	the Garlic	X17	38.98	0	2.6	0	0
40	G2	Summer Peanuts	X18	157.48	0	3.4	0	0
41	G2	Summer sesame	X19	102.37	0	3.3	0	0
42	G2	summer soybeans	X20	29.95	0	4.6	0	0
43	G2	summer sunflower	X21	17.82	0	3.1	0	0
44	G2	the fruits	X22	1740.93	108.28	6.85	741.75	741.75
	G1	Goal		Value		(Max.) =	153152.3	11094.55
	G2	Goal		Value		(Min.) =	44277.43	2414.786

Source: The results of goal programming using the (Win QSB) program for the data of Table No. (1) in the appendices and No. (1) in the research.

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Table (5): Comparison between the results of the current and expected cropping pattern for the second scenario (after adding one million feddans **of new lands) to the Egyptian agricultural lands.**

Statement	current best cropping pattern	Best cropping pattern for expected the first scenario	the difference	change % between of them
Total cropped area (thousand Fadden)	12159.5	13163.34	1003.84	8.26
Total net yield of cropped area (million pounds)	142057.78	153152.33	11094.55	7.81
total water requirements)million cubic meters(	41862.64	44277.43	2414.79	5.77

Source: Programming goals results in Tables No. (1) and No. (4)

The third scenario: the expected cropping pattern (after adding one and a half million feddans of new lands) to the Egyptian agricultural lands:

Table No. (6) shows the cropping pattern according to the third scenario compared to the existing cropping pattern in 2020. From the table, it is clear that the changes that occurred in the study crops produced according to this scenario include the stability of the cultivated area with some crops such as barley, winter tomatoes, summer sorghum, tomatoes summer, summer potatoes, indigo maize, indigo potatoes, onions, garlic, summer peanuts, summer sesame, summer soybeans, sunflower, while the area cultivated with the following crops increased, including wheat by about 211.7 thousand feddans, sugar beets by about 145.9 thousand feddans , alfalfa vegetation about 660.4 thousand feddans , sustainable alfalfa about 98 thousand feddans , winter potatoes about 9.7 thousand feddans , maize about 95.9 thousand feddans , cotton about 150.3 thousand feddans , indigo tomatoes about 13.6 thousand acres, fruits about 154.3 thousand feddans . As for the net yield of the cropped area, it increased from 142.058 billion pounds in 2020 to about 157.119 billion pounds in the case of the most suitable cropping pattern, an increase of about 15.061 billion pounds over what it was in the case of the existing cropping pattern.

While the total cropped area in the proposed cropping pattern amounted to about 13.699 million feddans , and the amount of increase in the cropped area amounted to about 1539.84 thousand acres, which means that the proposed cropping pattern achieves an increase in the cropping area estimated at 12.66% over the one used in the existing cropping pattern in 2020.

The proposed cropping pattern achieves an increase in the total net return of the cropping pattern estimated at 10.60% over the existing cropping pattern achieved in 2020, which means that the proposed cropping pattern achieves the desired goal of this model, which is maximizing the total net return.

On the other hand, the total amount of irrigation water used in the existing cropping pattern in 2020 was about 41.862 billion cubic meters, while the total amount of irrigation water used in the proposed cropping pattern was about 45.756 billion cubic meters, and the amount of water increase was about 3.894 billion cubic meters, which It means that the proposed cropping pattern requires an increase in irrigation water resources estimated at 9.30% over the existing cropping pattern used in 2020, as a result of adding one and a half million feddans.

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Table (6): The results of the expected cropping pattern for the third scenario (after adding 1.5 million feddans of new lands) to Egyptian agricultural lands using goal programming:

	Goal	Decision		Solution	differences	profit or unit cost	Total	Differences
	Level	Variable		The value is in thousand	for space and yield	thousand	million	for space and yield
1	G1	Wheat	X1	3664.32	211.67	3.25	687.09	687.09
2	G1	Barley	X2	0	0	2.72	0	0
3	G1	Sugar beet	X3	663.85	145.9	4.28	624.61	624.61
4	G1	Clover Tahreesh	X4	1877.2	1186.58	2.76	3273.76	3273.76
5	G1	Clover Crop	X5	1398	98	8.86	868.38	868.38
6	G1	Tomato	X6	192.78	0	44.04	0	0
7	G1	Potatoes	X7	367.6	9.66	3.4	32.87	32.87
8	G1	Summer maize	X8	1602.3	95.94	3.29	315.17	315.17
9	G1	Summer sorghum	X9	412.32	0	1.41	0	0
10	G1	Cotton	X10	650.33	150.33	7.94	1194.22	1194.22
11	G1	summer tomato	X11	171.58	0	20.45	0	0
12	G1	summer potatoes	X12	152	0	7.86	0	0
13	G1	nili maize	X13	0	0	2.88	0	0
14	G1	nili tomato	X14	202.4	27.26	10.49	286.04	286.04
15	G1	nili potatoes	X15	0	0	1.55	0	0
16	G1	Onions	X16	211.14	0	24.08	0	0
17	G1	the Garlic	X17	38.98	0	15.77	0	0
18	G1	Summer Peanuts	X18	157.48	0	3.67	0	0
19	G1	Summer sesame	X19	102.37	0	7.07	0	0
20	G1	summer soybeans	X20	29.95	0	3.96	0	0
21	G1	summer sunflower	X21	17.82	0	1.07	0	0
22	G1	the fruits	X22	1786.93	154.28	50.42	7779.28	7779.28
23	G2	Wheat	X1	3664.32	211.67	2.7	-1289.96	-1289.96
24	G2	Barley	X2	0	0	1.5	0	0
25	G2	Sugar beet	X3	663.85	145.9	2.6	379.35	379.35
26	G2	Clover Tahreesh	X4	1877.2	1186.58	2.1	2491.81	2491.81
27	G2	Clover Crop	X5	1398	98	2.7	264.6	264.6
28	G2	Tomato	X6	192.78	0	1.5	0	0
29	G2	Potatoes	X7	367.6	9.66	1.5	14.49	14.49
30	G2	Summer maize	X8	1602.3	95.94	4	383.76	383.76
31	G2	Summer sorghum	X9	412.32	0	4.3	0	0
32	G2	Cotton	X10	650.33	150.33	3.6	541.19	541.19
33	G2	summer tomato	X11	171.58	0	2.6	0	0
34	G2	summer potatoes	X12	152	0	2.6	0	0
35	G2	nili maize	X13	0	0	2.2	0	0
36	G2	nili tomato	X14	202.4	27.26	1.9	51.79	51.79
37	G2	nili potatoes	X15	0	0	1.9	0	0
38	G2	Onions	X16	211.14	0	2	0	0
39	G2	the Garlic	X17	38.98	0	2.6	0	0
40	G2	Summer Peanuts	X18	157.48	0	3.4	0	0
41	G2	Summer sesame	X19	102.37	0	3.3	0	0
42	G2	summer soybeans	X20	29.95	0	4.6	0	0
43	G2	summer sunflower	X21	17.82	0	3.1	0	0
44	G2	the fruits	X22	1786.93	154.28	6.85	1056.85	1056.85
	G1	**Goal**		**Value**		**(Max.) =**	**157119.2**	15061.42
	G2	**Goal**		**Value**		**(Min.) =**	**45756.53**	3893.886

Source: The results of goal programming using the (Win QSB) program for the data of Table No. (1) in the appendices and No. (1) in the research.

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Table (7): Comparison between the results of the current and expected cropping patterns for the third scenario (after adding 1.5 million feddans of new lands) to the Egyptian agricultural lands.

Statement	current best cropping pattern	Best cropping pattern for the first expected scenario	the difference	change % between of them
Total cropped area (thousand Fadden)	12159.5	13699.34	1539.84	12.66
Total net yield of cropped area (million pounds)	142057.78	157119.2	15061.42	10.6
total water requirements)million cubic meters(	41862.64	45756.53	3893.89	9.3

Source: goal Programming results in Tables No. (1) and No. (6)

Comparing the results of solving goal programming models for cropping patterns: through the results obtained from solving goal programming models for cropping patterns according to the three previous scenarios, it is possible to come up with some economic indicators that would help decision makers in the field of economic planning and direct the economic resources available to the agricultural sector. Table No. (8) shows the most important of these economic indicators as follows:

The data of Table No. (8) shows that the total net yield of the cropped area with the current cropping pattern in 2020 amounted to about 142.06 billion pounds, and that the optimal pattern of crops produced according to the third scenario is the one at which the total net yield of the cropped area reaches its largest value, which amounts to about 157.119 billion pounds, which means that the cropping pattern according to the third scenario achieves an increase in the total net yield of the cropped area estimated at 10.60%, while the total net yield of the cropped area according to the cropping pattern of the second and first scenarios amounted to about 153.152 and 148.12 billion pounds each, respectively, which means The cropping pattern according to the second scenario achieves an increase in the total net yield of the cropped area estimated at 7.81% and 4.27% for both the second and first expected scenarios of the cropping pattern in Egypt.

The data of Table No. (8) shows that the total water needs for the existing cropping pattern in 2020 amounted to about 41.86 billion cubic meters, and that the optimal pattern of crops produced according to the first scenario is when the total water needs of the cropping pattern reaches its lowest value, which is about 42.71 billion cubic meters. billion cubic meters, while the total water needs for cropping pattern for the second and third scenarios amounted to about 44.277 and 45.756 billion cubic meters each, respectively.

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Table No. (8): Comparison of the results of the cropping pattern according to the three scenarios compared to the existing cropping pattern in 2020.

Statement	actual cropping pattern	First scenario	Second scenario	Third scenario
		The most appropriate cropping pattern after adding 500 thousand feddans	The most appropriate cropping pattern after adding one million feddans	The most appropriate cropping pattern after adding one million and 500 thousand feddans
total net return Crop area (billion pounds)	142.06	148.12	153.152	157.119
%the change	-	4.27	7.81	10.6
total water requirements (billion cubic meters)	41.86	42.71	44.277	45.756
%the change	-	2.03	5.77	9.3

Source: goal Programming results in Tables No. (3,5,7)

Recommendations

From the previous results of the study on the cropping pattern of Egypt, the research reached the most important recommendations that can be taken into account by decision makers as follows:

1-Work to reduce territorial fragmentation through the application of the contract farming policy and activate the role of cooperatives, in order to benefit from the advantages of capacity savings.

2- Working to increase and raise the efficiency of using modern technology in various agricultural operations, from preparing the land for cultivation to post-harvest operations.

3-Activating the role of agricultural legislation to encroach on agricultural lands, through the encroachment laws of 2018.

4-Limiting the expansion of rice cultivation and reducing the current areas in accordance with the laws of the Ministry of Agriculture and Land Reclamation, as it is a water-hungry crop.

5-Working to support small farmers through extension awareness programs, providing production requirements, and working on using incubators to market agricultural crops to reduce losses.

6-Reconsidering the cropping pattern of the Republic according to the different scenarios proposed in the study.

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