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The economic effects of climate change and environmental pollution on Fayoum lakes

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ABSTRACT:
The agricultural sector in Egypt holds significant importance and exhibits a high degree of adaptability. The object possessed the capacity to endure and assimilate impacts. From this perspective, the sustainable development strategy has been revised to ensure the conservation of resources and assets for the benefit of future generations. The Fayoum lakes hold significant importance as inland bodies of water within the Egyptian region. The geographical features encompassing Lake Qarun, spanning an area of 333 square kilometers, have been traced back to the era of ancient Egyptians. Recently, Al-Rayyan Lakes, established covering an expanse of 170 square kilometers, is also part of this region. The decline in fish production in Lake Qarun since 2019 AD can be attributed to environmental pollution, climatic changes, and the proliferation of the Isopoda insect. The Al-Rayyan Lakes are drying up because of climate change and human activity that draws water from the region.
Furthermore, the main source of water for the lakes is agricultural drainage water, which often contains contaminants from human waste and agricultural operations. The findings indicated a decline in production due to elevated pollution levels and climatic fluctuations, alongside the negligent conduct of certain fishermen, community members, and the local governing body. The implementation of legal measures to criminalize water pollution, coupled with integrating irrigation practices to enhance water resources, has facilitated the execution of environmental development initiatives. These projects aim to utilize local resources to generate income for fishermen while concurrently focusing on protecting and conserving wildlife within the Qarun and Al-Rayyan natural reserves.

I. INTRODUCTION:

The agricultural sector in Egypt is considered one of the important sectors and one of the main pillars of the national economy due to its contribution to providing food and raw materials for national industries and its contribution to the gross domestic product and commodity exports. Updating the sustainable development strategy 2016 in the economic reform program, rationalizing support, climatic, economic, social, and international changes, and achieving Egyptian food security requires relying on sustainable local sources. Egypt's fish production increased by about 104,249 tons in 2019 by 5.39% compared to 2018; the seas contributed about 4.85%, lakes contributed 10.82%, the Nile River contributed about 3.79%, while fish farming contributed about 80.53%, estimated The value of production for the same year is about 61.08 billion pounds, an increase of 62.60% compared to the year 2018 AD, and in the year 2020 AD, the Egyptian production of fish came to the fore in the African continent and the sixth in the world. Despite that, the production of Egyptian lakes moved by a tenth or slightly more. Al Rayyan lakes produce the first third, about 17.7% of the production of the internal lakes. In Qarun, production has diminished during the last ten years until it disappeared in 2019. So far, some scientific and governmental efforts are concerned with environmental affairs, the economy, and the governorate within whose scope the lakes are located. The initiative of the President of the Republic included the development of About 65 villages that were entered by the sewage system, which alleviated the environmental problem of Lake Qarun, in addition to trying to reduce salinity, bringing in types of fish seed that coexist with the current conditions and the isopods cannot intrude on them, and attempts to restore the ecological balance of the reserve, while maintaining the

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sustainability of the Wadi El Rayan Reserve and the production of its lakes For the next generations.

Natural fisheries: Natural fisheries are the main source of fish production in Egypt, including the Mediterranean, the Red Sea, lakes, inland waters, and fish farming. The lakes are classified according tolocation into the northern lakes, including Mariout, Idku, Burullus, and Manzala; Coastal depressions, including Port Fouad, Alborzoil, and lakes. The interior includes Al-Murra, Al-Temsah, Suez Canal, Qarun, Al Rayyan first and third, water bodies in the New Valley, Lake Nasser, Toshka spillway, and water bodies in Siwa Oasis.

Fayoum lakes: Fayoum Governorate is located in the southwest of Cairo and is about 100 km from Cairo. Lake Qarun is located northwest of the Fayoum Governorate, while the first and third Rayyans are located southwest. Lake Qarun is a nature reserve by Resolution No. 943 of 1989 AD. Its area is 1385 square kilometers. Lake Qarun contains an area of about 55 thousand acres. It is the oldest natural lake in the world. It is the remains of the ancient Morris Lake. It is unique among the world's lakes containing fresh and saltwater fish such as tilapia: Green, moose, mullet, and invertebrates such as white shrimp. The reserve includes many Pharaonic, Coptic, and Roman relics. The lake contains many rare birds, the most famous of which is the flamingo. There are also many rare and lonely animals and reptiles, the most famous of which is in the Qatrani mountain for a strange animal called the Recinothrium. He lived in the region 35 million years ago, resembling a rabbit and his feet. There are two islands in the lake: Hammoud and the Golden Horn.

The first has an area of one square kilometer, and the second area is 376 acres, to which more than 88 types of migratory birds migrate; there are also about 17 types of wild plants and 16 types of rare wild animals. Scientists have monitored about 30 types of reptiles. The Wadi El-Rayan Reserve was declared a nature reserve by Resolution No. 943 in 1989 AD and amended by Resolution No. 2954 in 1997 AD, with an area of about 1759 square kilometers. It is the largest and most important of Egypt's reserves regarding its scientific value, the diversity of natural life and environmental components, and what it contains for World Heritage. It is about 40 km away from Fayoum. The valley is a large depression of Eocene stone about 43 meters below sea level, and its lowest points are About 64 meters above sea level. In the seventies of the last century, the depression was used to reduce the drainage pressure on Lake Qarun and reduce the groundwater level in the surrounding areas. The waters are two artificial lakes, the Upper Lake, whose area is 55 square kilometers. The lower lake has an area of 115 km, connected by the area of the famous waterfalls, and Wadi El Rayan accommodates about 250 million cubic meters annually of agricultural drainage water. The area has a natural environment in addition to Wadi Hitan, which is rich in world heritage, in addition to about three sulfur springs located behind the lower lake, and the area has about seven oil wells and about 100 acres of fish farms, including about 90 basins for intensive breeding, about 15 farms in the lower lake, and about 200 licensed fish farms in the region Since 1999 AD.

II. REVIEW OF LITERATURE:

Azza Abdullah,2008 has studied the environmental geomorphology of the Lake Qarun area in Fayoum and the extent of the impact of the environmental changes that occurred in the area using geographic information systems, studying the environmental problems that the area suffers from and preparing maps of dangerous sites in the lake and its surroundings. 1: 50,000 in 1990, and topographic maps at a scale of 1: 100,000 in 1956 and 1986 to prepare a model and study the general features of the surface, determine the phenotypic characteristics, monitor environmental changes and analyze satellite visuals from 1990 to 2000, 2005, and through analysis tools The study concluded by analyzing 64 samples from different locations that there is no relationship between the depth of the lake and the concentration of salts. The increase in salts to 39 g / liter in 1995 resulted in a decrease in fish production and thus increased The percentage of salinity in the groundwater and then the lake turned into a salt lake gradually, and there is a correlation between the increase in salinity and the increase in the areas of buildings around the lake area, which harmed the marine and terrestrial environment, and indicated one good effect of human intervention in the environment, which is the salt factory as it rids the lake of large quantities Of the salts because the proportions of sulfate salts, chloride, calcium, and magnesium are less than the internationally permissible limit. The lake's production of fish decreased, and the examination of satellite images showed the clear growth of the buildings around the lake and the surrounding villages, and the features and shape of the beach disappeared. The study recommended legalizing wastewater to maintain the lake level and the balance of the environment Treating sewage due to the high levels of heavy metals, expanding the cultivation of the adjacent desert with appropriate

irrigation methods, taking care of purifying the drains feeding the lake, building a wall on the northern coast to stop the encroachment of sand dunes, building any tourist villages on the northern coast, and finally legalizing fishing to maintain the ecological balance.

In 2021, Imad Abdel-Shahid and Amal Ahmed studied the production capacity of fish from natural sources and the effect of seasonal fluctuations on it. They studied seasonal fluctuations in the fisheries of the Republic and the gap that occurs in several months. They estimated the consumption function and the most important problems of the fish sector in Egypt. The study indicated that The average per capita consumption of fish in Egypt during the period (2005 to 2018) ranged between (18.15 kg/year) as a minimum in 2005 and about 23.57 kg/year as a maximum in 2018, and the seasonal fluctuations of the Egyptian lakes during the period (2016). It was clear from the estimation of the monthly seasonal rates that there are two distinct periods. The first includes the months of January, February, March, April, May, June, July, and August and is characterized by lower production than the average of the year. Winter months, in addition to the lack of possibilities to preserve fish during the months of an abundance of fish, which are September, October, November, and December, where fish breed in the summer months and natural feeding is carried out, and the harvest comes in the winter season, and workers in the fish production sector stressed that the most important Problems are the environmental pollution that leads to the loss of a lot of fries, and therefore fish production in general.

In 2022, Shaima Naguib applied the international model for agricultural commodity and trade policy analysis to study the potential economic effects of climate change on Egyptian food security, as she studied the current situation of agricultural production of plants, animals, and fish in 2000/2019. The general time trend, and the percentage of fish production's contribution to the value of agricultural production in 2000 was about 7% and increased in 2019 to 12%, this indicates the development of production and the progress of the fish farming industry in Egypt clearly, and the percentage of fish production's contribution to net food during the same two years 1.8% and 1.5%, respectively, and the study presented some possible scenarios for the impact of climate on the waters of the Nile River because of its impact on agricultural production in general and fisheries production in particular inside Egypt away from the coast, where the Nile water declined during the year 2040 by about 20%, while one scenario predicted an increase The Nile River flow rates after 2045, and the study reviewed the impact of the sinking of some coastal areas in northern Egypt and the potential shortage of production, despite the trend of both The assessment of agricultural, vegetable, animal and fish production at increasing rates of growth amounted to about 9.79, 10, 9.3, 12.1, respectively, during the study period, but it is still insufficient to meet the increasing demand for the growing population in Egypt, and indicated that the state approved 23 billion pounds to confront climate changes, and establish The National Council on Climate Change.

The study Problem : Fish production is one of the important economic activities in Fayoum governorate due to the presence of the elements that support production in this field, where the abundance of labor that has experience inherited through generations, and the expansion of the areas of its lakes, which amount to about 398 square kilometers, despite that, Lake Qarun loses production for two consecutive years, which are 2019 m, 2020 m for an area of approximately 233 square kilometers as a result of the increase in environmental pollution rates with sanitation, agricultural and industrial sewage, and the spread of the isopod insect that inhabits the gills and parasitizes on the skin, thus obtaining fish food to leave it meager, in addition to the effects of climate change, which negatively affects production and the surrounding environment, which in turn affects Negatively affects the human being and the surrounding environment, including birds, wild animals, and even microorganisms, and what makes the matter worse is the blockage of water from the Upper Rayyan Lake by a noticeable amount as a result of the excessive withdrawal of water to irrigate the reclaimed lands in the region, and the recent climatic changes and high rates of evaporation, and what increases the importance of the problem is that the Fayoum lakes were announced Nature reserves .

Aim of the study: The study aims to study and analyze the qualitative and quantitative changes in Fayoum lakes during the study period and the impact of these changes on production, the local environment, and fishermen through the following sub-objectives

1 -Identifing the current situation of the Fayoum lakes.

2 -Studying the development of production during the study period from 2011 AD to 2021 AD

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3 -The effect of environmental changes on the varietal change of fish in Lake Qarun and Lakes Al Rayyan First and Third.
4 -Study the most important problems the reserves suffer from and the most important proposals for solutions to these problems.
Research method and data sources:
The study relied on descriptive and quantitative analysis methods, as well as on published and unpublished secondary data that could be obtained from the official GATT concerned with fisheries and natural reserves, and on primary data from the field study sample, as well as on previous studies and research related to the subject of the study.

III. RESULTS:

Lake Qarun suffers from environmental pollution with agricultural, health, and industrial wastewater from factories in the neighboring industrial area. Careful examination and acclimatization before the fingerlings descend into the lake, and it is an insect that parasitizes on oval-shaped fish that may reach two centimeters in length and one centimeter in width. Large numbers of legs on the sides of the abdomen ends with hooks for fixing the host. It appeared in California in the seventies of the last century. It moved in some way to many From the Mediterranean countries; the parasite lives in stagnant, polluted, and salty waters. It does not live in home waters and thrives above salinity degrees of 18 thousand parts per million, equivalent to 18 grams/liter. There is a direct relationship between the increase in the spread of isopods and the increase in temperatures and recent climatic changes and parasitizes on fish. To obtain from them, more than 60% of the food becomes meager and unable to move and swim, leading to the death of large numbers of fish and losing weight. It constitutes the main food for birds, some animals, and the local population in the region.

Table (1) The development of fish production in Lake Qarun in tons during the period (2011-2020)

year	Tilapia fish	Shrimp	Hanchan fish	Dennis	Saigon fish	Mullet family	Bass	Musa	Other ypes	Total
2011	1173	699	11	7	5	1424	19	1018	8	4364
2012	1226	912	6	2	3	1283	15	946	17	4410
2013	1265	902	8	2	4	1207	12	1002	18	4420
2014	1312	862	6	5	2	1198	10	1111	12	4518
2015	426	102	76	0	0	191	17	176	136	1124
2016	327	147	16	0	0	151	0	139	13	878
2017	225	91	1	0	0	142	0	137	2	1061
2018	156	58	2	0	0	92	0	90	0	832
2019	0	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	0

Source: Annual Fish Statistics Book for the year 2020.

Thus, causing severe environmental damage, as evidenced by the previous table's data. The production decreased until it reached zero during 2019 and 2020, so 2014 became the best year of production, reaching about 4518 tons, as indicated by the table data. The decay came quickly to catfish, bream, and single species.

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Table (2) The development of fish production in the first and third lakes of Rayyan in tons during the period (2011-2020)

Total	Other types	Mussa	Silver Mabrouk	Mabrouk weed	white scale fish	catfish	Sea bass	mullet family	snorkeling fish	Denies fish	Hanchan fish	Shrimp	jumbo	white fish	Tilapia fish	Year
3053	74	0	97	667	203	0	5	692	0	0	0	0	0	185	1130	2011
3451	69s	0	149	466	683	10	12	804	0	2	32	0	0	193	1031	2012
3416	366	0	114	523	271	9	9	811	0	1	13	0	0	203	1096	2013
3782	29	0	203	663	306	8	3	997	0	1	3	0	0	285	1284	2014
4539	37	239	242	729	380	11	4	1093	0	1	5	0	0	330	1468	2015
5966	0	274	284	1214	495	13	9	1552	34	1	7	0	27	383	1673	2016
6499	0	364	340	1228	569	103	9	1137	67	0	128	0	17	523	2014	2017
6295	2129	322	187	810	329	5	7	891	17	1	113	13	11	262	1198	2018
6711	2351	351	209	806	363	5	7	914	21	1	106	15	12	279	1271	2019
6750	2281	205	235	776	379	91	0	853	19	9	38	0	8	422	1436	2020

Source: Annual Fish Statistics Book for the year 2020

It is noted from the previous table's data that the predominance of tilapia, whites, mullet family, white shells, and carp of both types. The production also entered the production of point fish with an amount of 300 tons in the year 2020 AD; it was added to the other fish in the last item of the table. Also, the production recently entered the varieties of gibbon and shrimp, shakrum and Musa, The production increased by 4217 tons during the study period due to the adaptation of the dominant species in the first and third Rayyan lakes.

Table 3: Equations of the general time trend of Lake Qarun:

The Statement	The Equation	R^2	F
Tilapia fish	Y = 1545-169.9 X (-6.5) * *	0.84	42.6
Shrimp	Y =1016 -116.13 X (-4.8) * *	0.74	23.16
Denies fish	Y = 5 – 0.618 X (- 3.18) * *	0.55	10.14
Saigan fish	Y = 4.4 – 0558 X (- 4.8) * *	0.74	23.4
Mullet fish	Y = 1588 -185.3 X (- 6.2) * *	0.82	38.7
Sea bass	Y = 20 – 2.3 X (- 5) * *	0.75	25.1
Mussa fish	Y = 1238.6 – 141.2 X (-5.3) * *	0.77	28.14
Total period	Y = 5450 -598.2 X (-6.2) * *	0.82	38.8

Source: compiled and calculated from my table (1).

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y is the estimated value of the dependent variable
X time variable
The numbers in parentheses below the equations indicate the calculated t value.
Indicates significance * * at the 0101. level

The data of the previous table refer to the equations of the general time trend of Lake Qarun from the data of Table No. 1 that there is a general decreasing time trend for the varieties of tilapia, shrimp, bream, seagan, mullet family, sea bass, Musa and the total study period, and the amount of the significant decrease was at 0.01 Ma 169.9, 116.13, 0.618, 0.558, 185.3, 2.3, 141.2, 598.2, respectively. The value of the coefficient of determination indicates that the factors reflected by the time element are responsible for about 84%, 74%, 55%, 74%, 82%, 75%, 77 %, and 82 % of the previous varieties suffered the same previous order of changes that occur in rapidly declining production as a result of pollution and recent climatic changes that had a severe impact on production and the environment in the natural reserve.

Table 4: Equations of the general time trend of the first and third Rayyan lakes:

The Statement	The Equation	R^2	F
Silver catfish, Bayad	Y1799+23x (2.3) *	0.40	5.4
Gilt-head bream	Y 2.3 +0.4851x (9.3) * *	0.91	86.5
Pomadasys	Y 750 __ 269x (3.4) * *	0.59	11.95
Mugilidae	Y 59.13 _ 42.6 x (3.9) * *	0.66	15.9
Dicentrarchuslabrax	Y 97.4 + 91.8 x (2.8) *	0.49	7.9
Total period	Y 13.4 _ 170 x (2.27) *	0.39	5.16

Source: compiled and calculated from my table (2).

It is clear from the previous table that the results of the analysis of the equations of the general time trend of the varieties produced in the first and third lakes of Al Rayyan during the period shown in Table No. 2 showing the increase of the varieties, Dennis, Shakhram, Bourieh family, a significant increase at the level of 0.01, and the value of the coefficient of determination indicate that the factors reflected by the element Time are responsible for about 91%, 59%, 66% of the changes in production. As for white fish, bass, and the total period a significant increase at a significant

The level of 0.05 is due to the recent entry of the species into the lakes, and their quantities are less than the other quantities. The value of the coefficient of determination refers to The factors reflected by the time factor responsible for about 40% and 49% of the changes in production. They were insignificant for tilapia, shrimp, henshan, catfish, white scales, and carp.

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Table (5) results of a chemical analysis of water samples for Lake Qarun during the period 2011-2022, The Pearl District

Year	PH PPT	O2 PPM	SAL PPT	HAR PPM	ALK PPM	Nh4 PPM	NO2 PPM	PO4 PPM	Fe PPM	CU PPM	NI PPM	ZN PPM	HET	NTU UNIT
2011	8.4	6	26.7	OR	300	0.2	0.1	_	0.2	_	_	0.2	30	_
2012	8.5	9.5	35.5	OR	220	0.09	0.1	5	0.18	0.34	0.006	0.21	30	_
2013	8.3	6	36	OR	240	0.17	0.3	3	0.17	0.37	0.07	0.1	27.5	_
2014	8.9	5.6	36.5	OR	_	OR	_	_	0.01	0.28	0.07	0.3	28	_
2015	6.6	4.2	33	OR	_	OR	_	Effects	_	0.6	_	0.8	29	_
2016	8.1	5.3	20.6	OR	_	0.52	_	2	0.80	0.61	0.19	0.21	28.5	22
2017	7.7	5.2	23	OR	295	OR	_	0.1	_	0.60	_	0.80	17.9	_
2018	7.8	5.3	22	OR	290	OR		1.2	0.85	0.69	_	0.9	23.2	22.7
2019	7.1	4.2	29.2	OR	360	OR	76	1	0.84	0.79	2.6	_	24.1	22.6
2020	8.2	4.1	29	OR	295	OR	_	1.7	0.8	0.61	0.91	_	32.6	
2021	8.3	4	28.6	OR	297	OR	_	2	_	0.23	0.71	_	30	40
2022	8.12	5	25.3	OR	285	OR	_	3.65	0.03	0.12	0.49	_	22	45.5

Source: Fayoum Fisheries, Research Department, unpublished data.

Table (6) results of a chemical analysis of water samples for Lake Qarun during the period 2011-2022, Kahk area.

Year	PH PPT	O2 PPM	SAL PPT	HAR PPM	ALK PPM	Nh4 PPM	NO2 PPM	PO4 PPM	Fe PPM	CU PPM	NI PPM	ZN PPM	HET	NTU UNIT
2011	8	5	27	OR	280				0.1		_	_	29	_
2012	8.1	7	28	OR	220	0.14	0.2	3	0.12	0.64	_	0.18	26	_
2013	8.3	6.5	28.2	OR	240	OR	0.1	1	0.2	0.3	_	0.25	27	_
2014	8.5	5.3	33.8	OR	_	OR	_	_	_	0.51	_	0.3	25	_
2015	6.9	4	31.5	OR	_	OR	_	_	0.29	0.03	_	0.01	26.5	_
2016	8.7	5.2	26.2	OR	_	OR	0.1	4	0.16	0.30	1	0.3	18.1	_
2017	7.6	3.7	28.9	OR	255	OR	_	1.3	0.30	_	_	_	21	_
2018	7.7	3.9	29.7	OR	200	OR	_	1.2	0.31	_	_	_	22	_
2019	7.6	3	32.3	OR	145	OR	_	0.21	2.5	0.22	0.05	0.6	31.2	10.25
2020	7.5	3.1	33.1	OR	220	OR	0.2	0.3		0.2	_	_	33	12.5
2021	6.7	3	37.6	OR	295	OR	0.02	4.5	0.32	0.1	_	_	31.7	16.93
2022	7.7	8.3	27.3	OR	290	1.03	_	0.43	0.08	0.42	0.66	0.22	13.5	34.62

Source: Fayoum Fisheries, Research Department, unpublished data.

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Table (7) results of a chemical analysis of water samples for Lake Qarun during the period 2011-2022, Abu Nima area

Year	PH PPT	O2 PPM	SAL PPT	HAR PPM	ALK PPM	Nh4 PPM	NO2 PPM	PO4 PPM	Fe PPM	CU PPM	NI PPM	ZN PPM	HET	NTU UNIT
2011	8.31	5	38.7	OR	280	_	0.25	1	_	_	_	_	27	_
2012	8.2	7	28	OR	220	0.14	0.25	3	_	0.3	0.2		30	_
2013	8.3	5	38	_	280	_	0.1	1	0.01		0.02	0.001	24	_
2014	8.6	4.9	39	OR	_	OR	_	_	0.13	0.41	0.24	0.02	25	_
2015	7.6	4.2	35.7	OR	_	OR	_	_	0.28	0.02		0.02	28.5	_
2016	8.4	3.9	24.2	OR	_	OR	_	3.5	0.01		0.55	0.16	19	_
2017	7.8	6.4	27.3	OR	285	OR	_	0.02	0.18	0.40		0.39	21	_
2018	8.6	5.6	32.2		95	OR	1.2		0.5	0.01	2.15	0.14	26.1	13.9
2019	6.7	4.1	30.9	OR	150	OR	_	0.89	0.5	0.26	6.7	0.15	29.3	25.47
2020	6.9	5	29.1	OR	160	0.43	0.1	2	0.3	0.2	_	_	33	_
2021	7	7.5	28.6	OR	270	0.14	0.01	7.3	0.15	_	_	_	33.4	7.72
2022	8.06	10.2	26.8	OR	300	1.58	_	0.5	0.04	0.3	0.58	0.09	13.5	29.85

Source: Fayoum Fisheries, Research Department, unpublished data.

Table (8) results of a chemical analysis of water samples for Lake Qarun during the period 2011-2022, Amisal region

Year	PH PPT	O2 PPM	SAL PPT	HAR PPM	ALK PPM	Nh4 PPM	NO2 PPM	PO4 PPM	Fe PPM	CU PPM	NI PPM	ZN PPM	HET	NTU UNIT
2011	8.9	6	41.2	OR	280	_	_	_	_	_	_	_	29	_
2012	8	7.5	26.5	OR	220	0.2	0.1	3	0.18	0.24	_	0.06	30	_
2013	8	4.1	35.2	_	400	0.3	0.2	3	0.12	0.06	0.24		27.5	_
0214	8.9	5.5	41.2	OR	_	OR	_	1.4	0.3	0.28	0.25	0.6	26	_
2015	8.2	4.7	39.5	OR	_	OR	_	1.2	0.12	0.72	_	0.27	26.7	_
2016	9.4	4.4	26.7	_	_	OR	_	1.05	0.37	0.37	0.64	0.31	19.4	_
2017	8.1	5.7	30.1	_	295	OR	_	2.7	0.20		0.57	0.19	21	_
2018	7.7	5.8	24.9	OR	320	OR	_	1.9	0.17	0.38	0.1	0.11	32	44.9
2019	7.6	3.2	33	OR	340	OR	_	0.23	0.70	_	2.2	_	36.2	25.4
2020	7.1	4.1	33.5	OR	280	OR	0.02	2.2	0.60	_	_	_	36.5	_
2021	6.9	4.6	45.3	OR	200	OR	0.01	4.3	0.55	0.12	_	_	32.6	4.09
2022	8.7	7	29.5	OR	390	OR	_	3.1	0.16	0.13	0.14	0.12	13.5	36.2

Source: Fayoum Fisheries, Research Department, unpublished data

As shown in the previous tables related to the analysis of the waters of Lake Qarun, many changes occurred that led to an imbalance in the ecological system and a heavy economic loss by completely losing fish production in the lake as a result of pollution with agricultural, industrial, and sanitary wastewater and climatic changes. The temperatures in the tables are according to the season of collecting samples for analysis, the breeding season has changed during the period, the growth rate has been affected and the fish's need for food has increased with the large increase in the

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spread of the isopod insect and the high infection rates and the death of a large number of fish as a result of the insect's parasitism and its access to fish, and the increase The rates of evaporation and salinity are more than their normal levels, as there is a noticeable decrease in oxygen, and the temperatures in summer and winter are higher than their average, and phosphates have decreased, which indicates a lack of available food, iron, copper, nickel, zinc, and turbidity significantly increased, and ammonia has increased from the normal rates, and the transformation of Water to hard water due to the salinity being higher than the normal rates, but the percentage of oxygen returned to the rise during the last year, and as a result of the absence of fish in Lake, the fishermen left the place to Lake Nasser and the marine coasts, and others resorted to the participation of Al Rayyan fishermen in fishing, as many birds and wild animals migrated to the lake, which upset the natural balance in the reserve.

Table (9) Production forecast for Lake Qarun.

		Lower 95.0%	Upper 95.0%
Period	**Forecast**	**Limit**	**Limit**
2021.0	-1129.4	-3565.08	1306.28
2022.0	-1727.6	-4281.2	826.0
2023.0	-2325.8	-5010.44	358.838
2024.0	-2924.0	-5750.97	-97.0322
2025.0	-3522.2	-6501.17	-543.229
2026.0	-4120.4	-7259.64	-981.156
2027.0	-4718.6	-8025.18	-1412.02
2028.0	-5316.8	-8796.77	-1836.83
2029.0	-5915.0	-9573.54	-2256.46
2030.0	-6513.2	-10354.8	-2671.62
2031.0	-7111.4	-11139.9	-3082.92
2032.0	-7709.6	-11928.3	-3490.88

Source: Data Table (1)

Forecasting is a quantitative estimate of the expected values of the dependent variables in the future through information recorded in the past and present, given that future economic phenomena result from the behavior of those phenomena in the past and present.

The data of the previous table indicates the prediction of the total production of Lake Qarun during the period 2021-2032 to a decreasing increase. The graph shows the linear picture of production, and this means that the situation does not improve and is rapidly moving towards severe deterioration. The value is about -1129.4 tons in 2021 to a maximum of 95%. 130628, a minimum of 95% reached - 3565.08 at the beginning of the forecast period, while the value reached about -7709.6 tons in 2032, a maximum of 95% reached -3490.88, and a minimum of - 11928.3 at the end of the forecast period for Lake Qarun. The illustration confirms the future negative impact of the continued lack of Production if measures are not taken for reform, and the Council of Ministers directed that the Meccan Wealth Authority be dependent on it, which directed efforts towards measures that would improve the lake and production. In the first and third captains, the production reached about 7160.78 tons, to a maximum of 95%, which amounted to 8280.02, and a minimum of 95% reached 6041.53 at the beginning of the study period. He predicted that the production would reach 11,679.3 tons by 2032, a

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maximum of 95% reached 15556.5, and a minimum of 95% reached 7802.15 at the end of the forecast period. This is evident from the illustration of the production forecast in Al-Rayyan.

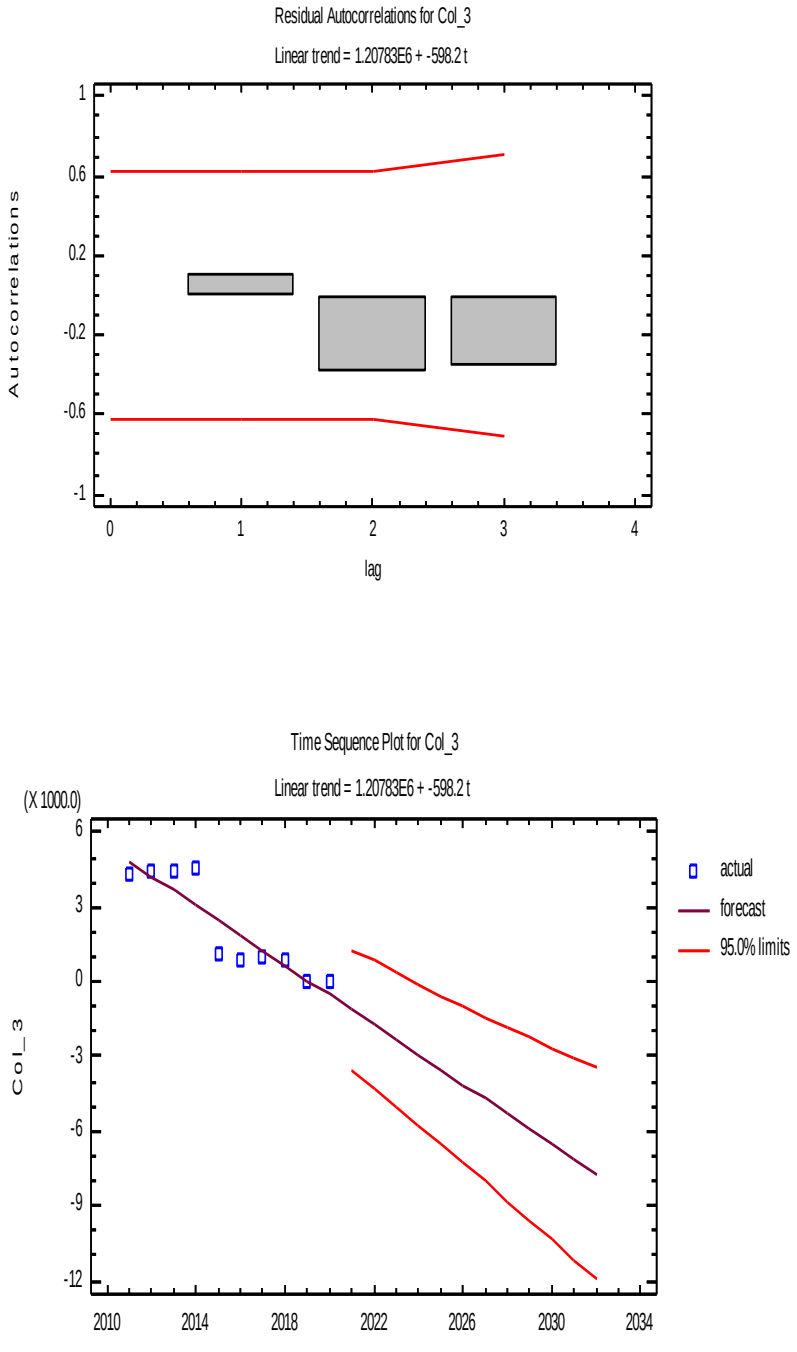

Figure number (1)

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Table (10) Production forecast for Al Rayyan Lakes first and third.

	Forecasting	**Lower 95.0%**	**Upper 95.0%**
Period	**Forecast**	**Limit**	**Limit**
2021.0	7160.78	6041.53	8280.02
2022.0	7571.56	5988.7	9154.41
2023.0	7982.33	6043.74	9920.92
2024.0	8393.11	6154.62	10631.6
2025.0	8803.89	6301.18	11306.6
2026.0	9214.67	6473.08	11956.2
2027.0	9625.44	6664.2	12586.7
2028.0	10036.2	6870.52	13201.9
2029.0	10447.0	7089.26	13804.7
2030.0	10857.8	7318.41	14397.1
2031.0	11268.6	7556.44	14980.7
2032.0	11679.3	7802.15	15556.5

Source: Data Table (2)

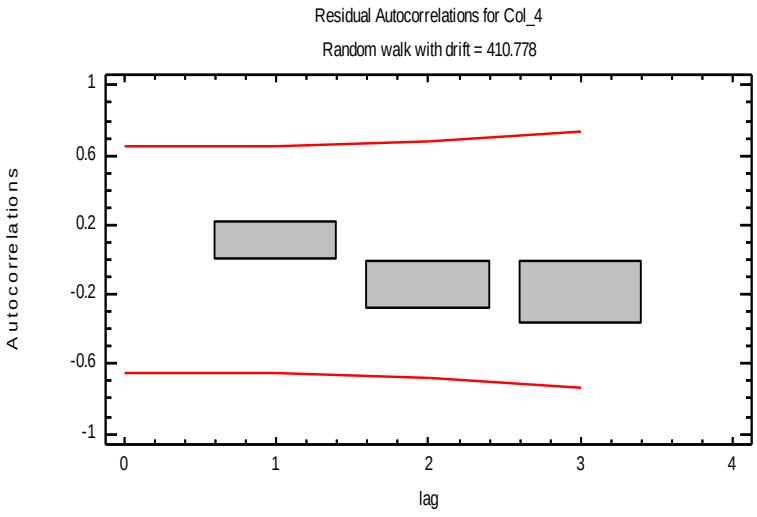

Figure number (2)

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Field study sample:

The rapid rural research approach was used to collect data in the study sample. There were three personal interviews with the right people who had fished in Lake Qarun before coming to the Rayyan lakes. Suggestions they see for solutions to these problems resulted in the following results.

The private individuals enjoyed diversity in age and educational status, as shown in Table (11), about 40% of them were illiterate, 23.3% read and wrote, 36.7 had an academic qualification. About 16.7% were under 18 years old, and 40% of the gravel individuals had an area from 18 to 30 years; the percentage of the age group over 30 years reached 53.3%. The study's most important point of view is for Lake Qarun, as in Table (12) pollution by sewage, sanitation, industrial, waste of tourism facilities, fishing during prohibition times, use of small maca nets, excessive salinity, The isopods spread so heavily that the infections became epidemic, there is no source of livelihood for the right person at the time of the ban, the death of fish and the flight of many animals and birds pecked, which harmed the environment, at rates of 100%, 16.7%, 20%, 60%, 83.3%, 73.3%, 13.3% on the Arranging, while the problems of crafting in Al Rayyan were high costs, the fish shark is not paid and several fish are smuggled, the fishing violation at the time of the ban, the violating nets, the lack of water level in the lake, specifically and with the exception of diversion methods, 50%, 26.7%, 40% are transferred, 30%, 23.3%, 13.3%, 73.3%, drip or sprinkler which increased the withdrawal of sewage to lakes Thus, the impact on the water level in the lake, as well as the sewage in Al Rayyan and Al Shabak, the environment that brings with it risks, viruses and harmful algae, and then you must think about the value of the area from the long-term investment.

Table (11) Educational and age status of the field study sample

Statement	N	%	Statement	N	%
Educational Status			**age status**		
	12	40		5	16.7
Illetrate	7	23.3	under 18 years old	9	30
	11	36.7	From 18 to 30 years old	16	53.3
Reads and writes			31years and over		
Qualified					
Total	30	100	Total	30	100

The source was collected and calculated from the field study sample data.

Table (12) of the problems that Fayoum Lakes suffer from.

Problem	Number	Percentage
For Lake Qarun		
1- Pollution by sewage, agricultural, industrial, and tourism	30	100
2- Hunting prohibition times		
3- Using small nets is a violation	5	16.7
4- Excessive salinity	6	20
5- Insect spread		
6- The isopods spread so heavily that the infections became epidemic	18 25	60 83.3
7- the death of fish and the flight of many animals and birds pecked	22 4	73.3 13.3
Al Rayyan		
1- high costs		
2- the fish shark is not paid		
3- several fish are smuggled	15	50
4- the fishing violation at the time of the ban	8 12	26.7 40
5- the violating nets	9	30
6- the lack of water level in the lake	7	23.3

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7- the sewage in Al Rayyan	4 22	13.3 73.3

Suggestions for solutions from the point of view of fishermen:

The fishermen propose solutions to the problems of Lake Qarun and re-fishing it again. 30 of the sample members decided to prevent drainage from reaching the lake to prevent pollution, representing 100%, and about 24 fishermen suggested taking quick measures to restore life to the lake and their return to fishing in Qarun, representing about 80%, and Najo added 25 Of them, the governorate should find alternatives to livelihood at the time of the ban on fishing, representing 83.3%. As for Rayan, about 22 individuals suggested reducing the fees for obtaining a fishing license, representing 73.3%. All suggestions are good and should be taken into consideration.

A proposal to establish a hatchery in the Fayoum area:

A hatchery can be defined as an area of land that contains facilities suitable for fish breeding and hatching by providing all the environmental needs necessary to complete the hatching process and incubate and care for fertilized eggs with the aim of selling or multiplying them and making a profit from them. Next to an incubator that produces seabream or seabass

Table (13) The value of the proposed assets for the project life

	Item	Value(L.E)	%
1	**a land**	1000000	**5.65**
2	**seed (*)**	480000	**2.71**
3	**Basins**	525000	**2.96**
4	**Administrative building**	4000000	**22.61**
5	**residential building**	4000000	**22.61**
6	**Algae alone**	100000	**0.57**
7	**alone rotifera**	80000	**0.45**
8	**Alone Artema**	2500000	**14.13**
9	**care alone**	1016600	**5.74**
10	**Generators**	3000000	**16.95**
11	**water pumps**	500000	**2.83**
12	**Filters**	30000	**0.16**
13	**Coolers**	260000	**1.46**
14	**irrigation networks**	200000	**1.13**
	Total	17691600	**100**

(*) The seed is an asset because it will continue with the project as elected mothers every year while others are sold

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Table (14) Annual depreciation in pounds for project inputs from fixed assets other than land

Statement Assets	the agedefault	Valuesthe asset	Scrap ratio From the asset	Values Scrap	Valuethe rest	Premium Annual Consumed	consumed valueforthe asset	Unconsumed value for the asset
Basins	10	525000	0.2	105000	420000	42000	420000	0
Administartive building	30	4000000	0.3	1200000	2800000	93333	933333	1866667
residential building	30	4000000	0.3	1200000	2800000	93333	933333	1866667
Algae alone	10	100000	0	0	100000	10000	100000	0
alone rotifera	10	80000	0	0	80000	8000	80000	0
Alone Artema	10	2500000	0	0	2500000	250000	2500000	0
care alone	10	1016600	0	0	1016600	101660	1016600	0
Generators	30	3000000	0.2	600000	2400000	80000	800000	1600000
water pumps	20	500000	0.2	100000	400000	20000	200000	200000
Filters	10	30000	0	0	30000	3000	30000	0
Coolers	20	260000	0.2	52000	208000	10400	104000	104000
irrigation networks	10	200000	0	0	200000	20000	200000	0

Source: It was collected and calculated from data related to the study proposal for the A total of more than 10 years of unamortized value has been calculated for all assets in the project.(*)village of Rahim, Senoras Center, Fayoum Governorate 2022.

Table (15) The variable costs of the full operation from the third year of the project

Years	Land rent	Wages	Feed	Fuel	Electricity	maintenance(**)	Total
1	20000	2592000	7666000	260000	100000	43000	10681000
2	20000	2592000	7666000	260000	100000	43000	10681000
3	20000	2592000	7666000	260000	100000	43000	10681000
4	20000	2592000	7666000	260000	100000	43000	10681000
5	20000	2592000	7666000	260000	100000	43000	10681000
(*)6	22000	2851200	8432600	286000	110000	43000	11744800
7	22000	2851200	84326000	286000	110000	43000	11744800
8	22000	2851200	84326000	286000	110000	43000	11744800
9	22000	2851200	84326000	286000	110000	43000	11744800
10	22000	2851200	84326000	286000	110000	43000	11744800

(*)increasing10%from six years except Maintenance = 2.65% of the value of assets, excluding land and seed

Source: It was collected and calculated from data for the study proposal for the village of Rahim, Senoras Center, Fayoum Governorate 2022.

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Table (16) fees of the administrative body delegated to the project from the local unit of the village.

Statement	number	Annual month	Total	year	total
Project manager (*)	2	6000	12000	12	144000
technical engineers	6	4000	24000	12	288000
Executive Engineers	90	2000	180000	12	2160000
Total	98	-	216000	12	2592000

3. Investment costs: usually include 4 items

Fixed costs, working capital, establishment, advertising, and other costs. Since the project is national, there are no last two items. The project's investment costs are estimated at about 2.735 million pounds (assets amounting to 2.34 million pounds, and the value of working capital, two months of annual operating costs amounting to about 0.382 million pounds).

4. Total costs and total annual revenues

Table (17) shows that the project needs about 4.64 million pounds, including assets and annual operating costs. The total annual costs are estimated at 2.29 million pounds, and the project achieves total annual revenues of about 4.02 million pounds (gas and organic fertilizers).

Eleventh

Indicators of the feasibility study and financial indicators of the project

1. Undiscounted measures:

a. Return on Invested Pound = (Total Revenues / Total Costs) = 38.6/24.4 = 1.58

Every pound spent in the project achieves an annual return = 0.58 pounds throughout its useful life.

B. Return on investment = net annual income/investment costs

=(1.69/2.73)*100=61.9%

This means that the money invested in the project achieved a rate of return of 61.9%.

C. Average annual income of the project:

=(Total annual net income)/project life=16.87/10=1.69 million pounds.(The project each year average income of 1.69 million pounds).

Table (17): Items of costs and revenues for the year of full operation of a large biogas unit in Rahim Village in 2022.

Items	Value(L.E)
the land	1000000
Basins	525000
Administrative building	4000000
residential building	4000000
Algae alone	100000
alone rotifera	80000
Alone Artema	2500000
care alone	1016600
Generators	3000000
water pumps	500000
Filters	30000
Coolers	260000
irrigation networks	200000
Fixed costs sentence	17211600
Pretext	480000
Assets	34923200

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land rent	20000
Wages	2592000
Feed	76660000
Fuel	260000
Electricity	100000
Maintenance	43000
Annual depreciation	911726
Total operating costs for the first year	320586726
Total revenue for the first year	48060000

Source: collected and calculated from data for the study proposal for the village of Rahim, Senoras Center, Fayoum Governorate 2022

Table (18) analysis of the economic return for a biogas production unit based on animal waste.

Years	Years Total Costs	Total Revenues	Net Revenues
0	1528574 (*)	2011099	482525
1	1851939(**)	3016649	1164710
2	2291879	4022198	1730319
3	2291879	4022198	1730319
4	2291879	4022198	1730319
5	2291879	4022198	1730319
6	2291879	4022198	1730319
7	2291879	4022198	1730319
8	2291879	4022198	1730319
9	2291879	4022198	1730319
10	2291879	5414791 (***)	3122912
Total	24442088	38597925	14155837

(*) Investment costs = fixed costs + operating costs for two months (publicization and establishment expenses and others not calculated for a national project). (**) 50% of waste and water costs only. (***) 75% of waste and water costs have been calculated. Just. And starting from the third year, the costs will be in full. (****) The values of land and scrap of assets and non-depreciated values of assets have been added to the income of the last year.

Source: compiled and calculated from the cost table (17)

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Table (19) annual income statement in a million pounds

statement/year	1	2	3	4	5	6	7	8	9	10
Total revenue	2.1	3.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	5.41
materials	0.73	1.1	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46
labor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
water transfer value	0.02	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Electricity value	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Depreciation value	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
maintenance value	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total costs(*)	1.52	1.91	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28
Gross profit	0.49	1.11	1.74	1.74	1.74	1.74	1.74	1.74	1.74	3.13
land rent	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Net profit	0.486	1.106	1.736	1.736	1.736	1.736	1.736	1.736	1.736	3.126

Source: compiled and calculated from my table (17,18).

2. Discounted measures: cash flow statement

A. Discount rate:

Reflects the opportunity cost of investing capital in the community.

= a / (a + t) n where t = interest rate, n = number of years of project life.

a. Payback period = investment costs / average net cash flow = 2.73/0.546 = 5 years

B. The net present value at a discount rate (12%) = 5.46 million pounds

It shows the difference between the current values of cash inflows and outflows. It is accurate, objective and depends on discounting cash flows to arrive at current values. It is considered one of the international standards for evaluating projects for international financial institutions.

C. Ratio (inflows/outflows) at a discount rate (12%)=20.6/15.1= 1.36

The project is considered economically acceptable if the output is greater than the correct one and economically rejected if the output is less than the correct one. It is clear from Table (20) that the return on costs amounted to 1.36

D. Internal rate of return = 31%

Theoretically = the smallest discount price + the difference between the two prices *(present value at the smallest / sum of the two present values at the two prices without reference). It is considered one of the important criteria for differentiating between the proposed projects and investment alternatives, as It is relied on by international financial institutions when providing investment loans. It is known as the discount rate,which has the same cash inflows and outflows, or the discount rate, which gives a present value = zero.

Table (20) shows the internal rate of return for a biogas production unit.

Years	**0**	**1**	**2**	**3**	**4**	**5**	**6-9**	**10**
Item	**50**	**75**	**100**	**100**	**100**	**100**	**100**	**100**
%Operation								
cash flows in	-	-	100	100	100	100	100	100
Revenues	0	2011099	-	-	-	-	-	-
Working capital	0	0	30166	4022198	40221	40221	16088	4022198

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recovery			49		98	98	792	
Scrap and unused value	0	0	0	0	0	0	0	190990
the price of the land	0	0	0	0	0	0	0	1001603
Total cash inflows	0	2011099	0	0	0	0	0	200000
cash outflow	-	-	3016649	4022198	4022198	4022198	16088792	5414791
investment costs	2726543	0	-	-	-	-	-	-
Operating costs	0	1528574	0	0	0	0	0	0
Total cash outflows	2726543	1528574	1851939	2291879	2291879	2291879	9167516	2291879
net annual cash flow	-2726543	482525	1851939	2291879	2291879	2291879	(*)10084268	2521067
Discount rate factor at 12%	1	0.893	0.797	0.712	0.635	0.567	0.431	0.322
Adjusted net cash flow	-2726543	430895	928274	1231987	1098753	981091	2587950	931779
internal rate of return	-	-	-	-	-	-	-	31%

(*) Outflows have been increased by 10% from the sixth year as a safety measure for the study of annual inflation.
Source: compiled and calculated from my table (13,14).
Twelfth: Sensitivity Analysis:
1. Increasing costs by 10% with stable revenues (Table 21)

A. Payback period = investment costs / average net cash flow = 2.73/0.422 = 6 years and 5 and a half months
B. The net present value at a discount rate (12%)=4.22 million pounds
C. Ratio (inflows/outflows) at a discount rate (12%) = 20.6/16.3 = 1.26
D. IRR = 25%

Table(21) The internal rate of return for a biogas production unit with an increase in variable costs by 10%.

Years	**0**	**1**	**2**	**3**	**4**	**5**	**6-9**	**10**
Item %Operation	**50**	**75**	**100**	**100**	**100**	**100**	**100**	**100**
cash flows in	-	-	-	-	-	-	-	-
Revenues	0	2011099	3016649	4022198	4022198	4022198	16088792	4022198
Working capital recovery	0	0	0	0	0	0	0	190990
Scrap and unused value	0	0	0	0	0	0	0	1001603
the price of the land	0	0	0	0	0	0	0	200000
Total	0	2011099	3016649	4022198	4022198	4022198	1608879	5414791

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cash inflows							2	
cash outflow	-	-	-	-	-	-	-	-
investment costs	2726543	0	0	0	0	0	0	0
Operating costs	0	1528574	1851939	2291879	2291879	229187	10084268	2521067
Total cash outflows	2726543	1681431	2037133	2521067	2521067	2521067	11092695	2773174
net annual cash flow	-2726543	329668	979516	1501131	1501131	1501131	4996096	2641617
Discount rate factor at 12%	1	0.89	0.8	0.71	0.635	0.567	0.431	0.322
Adjusted net cash flow	-2726543	293405	783613	1065803	953218	851141	2153317	850601
internal rate of return	-	-	-	-	-	-	-	25%

Source: compiled and calculated from my table (16,17).

Table (22) The internal rate of return for a biogas production unit with an increase in costs by 10%, a decrease in revenues by 10%

Years	0	1	2	3	4	5	6	7	8	9	10
cash flows in	-	-	-	-	-	-	-	-	-	-	-
Revenues	0	21627	21627	21627	21627	21627	21627	21627	21627	21627	21627
Working	0	0	0	0	0	0	0	0	0	0	3257
Scrap and	0	0	0	0	0	0	0	0	0	0	5637
the price of the	0	0	0	0	0	0	0	0	0	0	1
Total cash	0	21627	21627	21627	21627	21627	21627	21627	21627	21627	30525
cash outflow	-	-	-	-	-	-	-	-	-	-	-
investment	19694	0	0	0	0	0	0	0	0	0	0
Operating costs	0	12554	12554	12554	12554	12554	13724	13724	13724	13724	13724
Total cash	19694	12554	12554	12554	12554	12554	13724	13724	13724	13724	13724
net annual cash	-19694	9073	9073	9073	9073	9073	7903	7903	7903	7903	16801
Discount rate	1	0.89	0.8	0.71	0.635	0.567	0.507	0.452	0.404	0.361	0.322
Adjusted net	-19694	8102	7231	6460	5761	5144	4007	3572	3193	2853	5410
internal rate of	-	-	-	-	-	-	-	-	-	-	29%

Source: compiled and calculated from my table (16,17).

2. Increasing variable costs by 10%, decreasing revenues by 10%, Table (22)

A. Payback period = investment costs/average net cash flow

= 51733 / 19694=2 years,7.5 months

B. Net Present Value at Discount Rate (12%)

= Present value of cash inflows - Present value of cash outflows = 32.04 million pounds

C. Ratio (inflows/outflows) at a discount rate (12%) = 51.7/19.7 = 2.63

D. Internal rate of return = 29%

From the above, it is clear that despite the increase in the increase of some items of operating costs by 10% from the sixth year in the basic data to address the impact of inflation on the Egyptian economy, then applying the sensitivity analysis method in the first two scenarios, increasing some items of operating costs by 10% from the first year with revenues remaining the same The second is an increase in some items of operating costs by 10% from the first year while reducing revenues by 10% from the first year. The project's internal rate of return did not fall below 14%. However, such national projects are negatively affected to a large degree when revenues are reduced, and this does not prevent the continuation of such purposeful projects, where the social return must prevail over the economic return.

IV. SUMMARY AND RECOMMENDATIONS:

The Egyptian agricultural sector is one of the most important pillars of the national economy, as it provides the local product with cash and commodity flows to the local market and export, in addition to the food it provides to the population. The state takes great care to fix any production defect, especially in the Egyptian lakes, including the Fayoum lakes, which are burdened with environmental problems. Preventing drainage in all its forms from reaching the waters of the lakes, criminalizing the dumping of waste for tourist and industrial facilities, and reducing fishermen's licensing fees with the provisions of control regarding fishing with illegal nets and fishing at the time of closure, and coordination with irrigation regarding an increase in the water supply of lakes with provisions for control over the withdrawal of drain water in favor of land transfer Reclamation adjacent to lakes from modern irrigation to surface irrigation.

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