Estimating the Value of Loans and Initial Investments Required to Achieve Self-sufficiency and Food Security for Fish in the Kingdom of Saudi Arabia

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Submission: October 30, 2024; **Published:** November 11, 2024

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Abstract

This study aimed to estimate the financing needs necessary to achieve self-sufficiency and food security for fish. The study showed an increase in the self-sufficiency rate from 38.2% in 2000 to 62.8% in 2022. The amount of surplus directed to develop the strategic reserve also exceeded the amount of deficit or withdrawal from the reserve. The strategic stock of fish reached 128.29 thousand tons at the end of the period 2000-2022. In light of domestic consumption amounting to 294.4 thousand tons in 2022, the food security factor for fish is estimated at about 0.44. The maximum contribution of domestic production to meeting consumer needs and food security for fish reached 50.4% and 22.1% at a confidence level of 95% for each of them, respectively, while the maximum contribution of imports to meeting consumer needs and food security for fish reached 87.6% and 38.5% at a confidence level. 95% for each of them, respectively, during the period 2000-2022. The value of the initial investments necessary to achieve self-sufficiency and complete food security for fish is estimated at approximately 456.12 and 1390.05 million riyals for each, respectively.

Keywords: Loans; Investments; Self-sufficiency; Food security; Fish
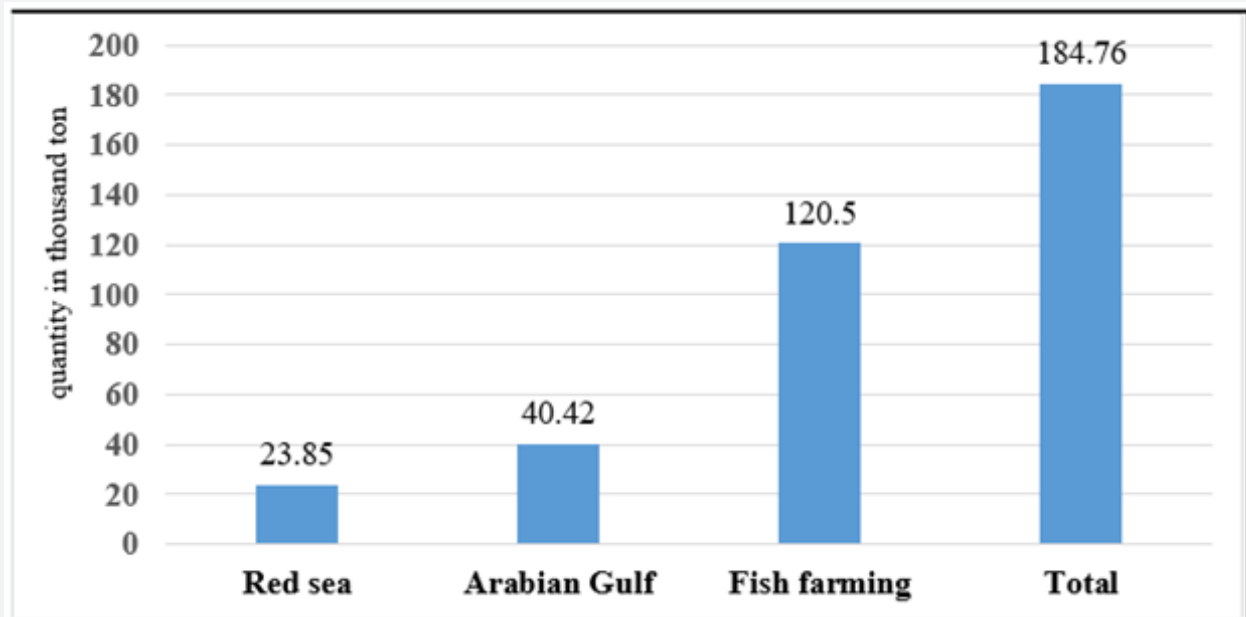
Introduction

Fish is of great nutritional importance, as it contains most animal proteins, fatty substances, vitamins and mineral salts, in addition to its ease of digestion and high utilization factor. The coast of the Kingdom of Saudi Arabia extends to more than 2,900 kilometers on the Red Sea and the Arabian Gulf. Marine fisheries employ 9.22 thousand boats, and the number of fishermen and fishing workers in the Kingdom reached 30.1 thousand people, a ratio of 0.30% of the total number of workers in the government and private sectors, which amounted to 10.84 million people in 2022 [1]. Fish farming in marine and fresh waters is considered the main source of fish production in the Kingdom of Saudi Arabia, as its production reached 120.5 thousand tons, representing 65.21% of the total fish production for Saudi fisheries, which amounts to 184.76 thousand tons in 2022, followed by the Arabian Gulf with 21.88%, then the Red Sea. By 12.91% (Figure 1).

From the above, it is clear that the total fish production reached 184.76 thousand tons, while local consumer needs reached 294.4 thousand tons. Therefore, the self-sufficiency rate for fish reached 62.8% in 2022. Despite the expansion of the fishing water area and the increase in the numbers of both fishermen and fishing boats, the Fish production does not meet the growing consumer needs, and therefore the state was forced to import from abroad, as the amount of fish imports amounted to 152.0 thousand tons, with a value of 2.59 billion riyals, representing 2.75% of the total value of food imports amounting to 94.3 billion riyals in 2022 [2].

Given the increasing population numbers, increased demand for fish, and rising prices, increased production and the availability of strategic stocks to achieve food security ensure the continued flow of fish to local markets, the stability of their prices and their non-increase throughout the year, and prevent the emergence of

food crises in the future, especially in light of emergency economic conditions. There is no doubt that the expansion of production and the availability of a strategic stock of fish requires greater financing needs to establish fish farms in marine waters. In the field of estimating financing needs, Alqunabit and Ghanem [3] estimated the value of loans and investments needed for broiler chicken projects until the year 2020, and how to distribute them in a way that achieves a balance between production areas. This study showed that the total value of loans and additional investments necessary to cover the difference between the expected production and consumption of broiler chickens is estimated at approximately 876.16 and 1752.32 million riyals for each of them, respectively, during the period 2012-2020. This study recommended the need for the Agricultural Development Fund to allocate 876.16 million riyals to chicken projects. Broiler chickens and their distribution to production areas according to the relative importance of the population of each area to meet the expected demand for broiler chickens until 2020.

Source: Ministry of Environment, Water and Agriculture (2022). The Statistical Book, p. 83.

Figure 1: Total fisheries production in the Kingdom of Saudi Arabia for the year 2022.

Ministry of Environment, Water and Agriculture [4] launched the National Program Initiative to develop the livestock and fisheries sector in line with the Kingdom's Vision 2030, with the aim of achieving sustainable development and increasing the contribution of the livestock, fisheries and fish farming sector to the gross domestic product. The National Program for the Development of the Livestock and Fisheries Sector aims to: (1) achieve sustainable development and make optimal use of livestock and fisheries, (2) support the fish farming sector in marine waters, (3) achieve self-sufficiency in marine food, (4) diversify food sources income in the Kingdom, (5) localizing areas of partnership with the private sector and attracting foreign and local investments, (6) creating and providing job opportunities of up to 200,000 direct and indirect job opportunities.

Ghanem et al. [5] estimated the value of investments and imports necessary to achieve food security for fish in Egypt. This study showed that achieving food security for fish requires increasing local production by an amount ranging between a minimum of 1.09 million tons and a maximum of 1.62 million tons at a 95% confidence level. The increase in fish imports ranges between a minimum of 88.76 thousand tons and a maximum of 621.35 thousand tons at a confidence level of 95%. The value of additional investments at a 10% discount rate to achieve food security for fish ranges between a minimum of 6.28 billion pounds and a maximum of 9.35 billion pounds at a confidence level of 95%. The value of the increase in fish imports ranges between a minimum of 1.41 billion pounds and a maximum of 9.85 billion pounds at a confidence level of 95%.

Finally, Al-Nafissa, et al. [6] estimated the financing needs and the amount of water needed to achieve self-sufficiency and food security for poultry meat in the Kingdom of Saudi Arabia. The study indicated that the strategic stock of poultry meat is estimated at approximately 658.1 thousand tons, sufficient for local consumption for 152.7 days. The food security coefficient for poultry meat is estimated at about 0.42 at the end of the period 1995-2018. The value of the investments necessary to achieve

self-sufficiency and complete food security for poultry meat is estimated at approximately 218.19 and 671.21 million riyals for each, respectively. Finally, this study recommends the necessity of achieving self-sufficiency and food security for poultry meat, in line with the National Transformation Program and the Kingdom's Vision 2030, through the Agricultural Development Fund providing the necessary loans and investments to establish new projects or expand the production capacity of existing projects.

In this domain, the study raises several questions, the most important of which are: (1) Has the Kingdom achieved the desired level of self-sufficiency and food security for fish?, (2) What is the relative importance of the contribution of both local production and imports to meeting local consumer needs and the current food security for fish?, (3)) What is the amount of increase in local production necessary to achieve self-sufficiency and the desired food security for fish? (4) What is the value of the financing needs necessary to achieve self-sufficiency and the desired food security for fish in the Kingdom of Saudi Arabia?

Research objectives

This research aimed to estimate the value of loans and initial investments necessary to achieve self-sufficiency and food security for fish in the Kingdom of Saudi Arabia, by studying the following sub-objectives:

i. The current status of Saudi fish production, consumption and foreign trade.

ii. Estimating the surplus, deficit, strategic stock, and fish food security coefficient during the period 2000-2022.

iii. Estimating the relative importance of the contribution of both local production and imports to meeting local consumption needs and food security for fish.

iv. Estimating the value of loans and initial investments necessary to achieve different levels of self-sufficiency and food security for fish in the Kingdom of Saudi Arabia.

Material and methods

This study relied on obtaining secondary data published from several sources, the most important of which are: (1) the statistical book issued by the Ministry of Environment, Water and Agriculture, (2) the data contained in the website of the Food and Agriculture Organization (FAOSTAT) [7], (3) the statistics of exports and imports issued by the Authority General Statistics [8], (4) Annual reports issued by the Agricultural Development Fund. In estimating the strategic stock and food security factor for fish, this study relied on the following economic equations:

$$PSP_{lc} = LPRO_f \div LCONS_d$$
$$PCI_{lc} = QIMPO_f \div LCONS_d$$
$$ASD_f = \left[\left(SLSPCI_{lc} - 365 \right) \times LCONS_d \right] - QSPO_f$$

[9]

$$FSF_f = QSS_{lc} \div LCONS_y \text{ [10]}$$

whereas:

PSP_{lc}: represents the period of sufficient production for local fish consumption.

$LPRO_f$: represents the total domestic fish production.

$LCONS_d$: represents the daily local consumption of fish.

PC_{lc}: represents the import coverage period for domestic fish consumption.

$QIMPO_f$: represents the amount of surplus and deficit in local fish consumption.

ASD_f: represents the sum of the periods of production adequacy and import coverage for domestic fish consumption.

$SLSPCI_{lc}$: represents the amount of fish exports.

$QSPO_f$: represents the food security factor for fish.

FSF_f: Represents the amount of strategic fish stocks.

QSS_{lc}: Annual local consumption of fish.

The value of the food security coefficient ranges between zero and one. The closer the value of the food security coefficient to zero, the more food insecurity there is, and vice versa. The closer the value of the food security coefficient to one, the greater the level of food security for fish [10].

The Bernouli distribution, which is sometimes known as the binomial distribution, and standard errors at 95% confidence were used to estimate the percentage or probability that both domestic production and imports will contribute to meeting local consumer needs and the relative food security of fish during the period 2000-2022. When estimating the percentage or the probability of contribution, the estimate is accompanied by standard errors that are considered when estimating confidence intervals as follows:

Standard error of probability at 95% confidence = $\pm 1.96 * \sqrt{\frac{P(1-P)}{N}}$

95% confidence interval for probability = $P \pm 1.96 * \sqrt{\frac{P(1-P)}{N}}$

Whereas: P represents the probability of contributing to meeting local consumer needs and food security, (1-P) represents the probability of not contributing, N represents the length of the time series 2000-2022 Gujaratic, translated and reviewed by Odeh [11].

In estimating the value of loans and initial investments necessary to achieve fish self-sufficiency, this study also relied on the following economic equations [5]:

i. Targeted production amount = targeted self-sufficiency rate x local fish consumption.

ii. The amount of increase in local production (additional

production) = the amount of targeted production - the local production for the last year in the time series (2022).

iii.   The value of additional loans needed to achieve self-sufficiency = the amount of increase in local production necessary to achieve self-sufficiency x the average unit share (ton of fish) of loans granted by the Agricultural Development Fund.

iv.   The value of the additional investments needed to achieve self-sufficiency = double the value of the additional loans needed to achieve self-sufficiency, given that the Agricultural Development Fund contributes 50% of the project's investment costs, while the investor or project owner bears 50%.

The value of loans and initial investments necessary to achieve food security for fish was also estimated based on the following economic equations:

i.   Amount of targeted strategic stock = target food security coefficient x local fish consumption.

ii.   The amount of increase in the strategic stock = the targeted strategic stock - the estimated strategic stock at the end of the time series (2000-2022).

iii.   The value of additional loans needed to achieve food security = the amount of increase in the strategic stock necessary to achieve food security x the average unit share (ton of fish) of loans granted by the Agricultural Development Fund.

iv.   The value of the additional investments needed to achieve food security = twice the value of the additional loans needed to achieve food security, given that the project's investment costs are distributed among both self-owned or owned capital and borrowed capital at a rate of 50% for each.

v.   Total financing needs needed to achieve food security = the value of additional investments needed to achieve food security + the value of fish imports.

Results and discussion

The current status of fish production and consumption in the Kingdom of Saudi Arabia

i.   By studying the development of production, consumption, exports, imports, and the two periods of production adequacy and import coverage for domestic fish consumption during the period 2000-2022, it is clear from the data in Tables (1 & 2) that:

ii.   Domestic fish production increased from 54.7 thousand tons in 2000, to 184.76 thousand tons in 2022, with an annual average estimated at about 99.73 thousand tons. Local fish production increased at an annual growth rate of 4.9% during the study period. Domestic fish consumption also increased from 143.16 thousand tons in 2000, to 294.40 thousand tons in 2022, with an annual average estimated at about 289.84 thousand tons. Domestic fish consumption increased at an annual growth rate of 4.1% during the study period. In light of local production and

consumption, the rate of self-sufficiency in fish increased from 38.2% in 2000 to 62.8% in 2022, meaning it increased at an annual growth rate of 1.13% during the study period.

iii.   The amount of Saudi fish imports increased from 90.63 thousand tons in 2000, to 152.09 thousand tons in 2022, with an annual average estimated at about 229.49 thousand tons. The amount of Saudi fish imports increased at an annual growth rate of 5.0% during the study period. The amount of Saudi fish exports also increased from 2.55 thousand tons in 2000, to 42.45 thousand tons in 2022, with an annual average estimated at about 32.73 thousand tons. The amount of Saudi fish exports increased at an annual growth rate of 12.5% during the study period.

iv.   Both production and domestic consumption of fish were characterized by relative stability, as the coefficient of variation reached 13.23% and 29.25% for each of them, respectively, during the period 2000-2022. The quantity of Saudi exports was also characterized by relative stability, as the coefficient of variation reached 39.39%, while the quantity of Saudi imports was characterized by instability, due to the increase in the coefficient of variation to 63.12% during the study period.

v.   The period of sufficient production for domestic fish consumption increased from 139.46 days in 2000, to 228.1 days in 2022, with an annual average estimated at about 128.58 days. Also, increased at an annual growth rate of 1.21% during the study period.

vi.   The import coverage period for domestic fish consumption increased from 231.07 days in 2000, to 318.6 days in 2020, then decreased to 187.8 days in 2022, with an annual average estimated at about 280.67 days during the study period. The coverage period of imports for domestic fish consumption increased at a small annual growth rate of 0.9% during the study period.

vii.   Both periods of production adequacy and import coverage for domestic fish consumption were characterized by near relative stability, with the coefficient of variation reaching 29.98% and 38.15% for each of them, respectively, during the period 2000-2022.

Estimating the strategic stock and food security factor for fish during the period 2000-2022

i.   The strategic fish stock was estimated by estimating the surplus and deficit in domestic fish consumption during the period 2000-2022. It is clear from the data in (Table 3) that:

ii.   A surplus accumulated from local consumption and Saudi exports of fish, with a total amounting to 132.06 thousand tons during the years 2002, 2004, 2008, 2013, 2014, 2016-2021. In light of local consumption, this surplus is sufficient for a period estimated at approximately 140.68 days, or 4.7 months.

iii.   A deficit also appeared in domestic fish consumption during the years 2000, 2001, 2003, 2005-2007, 2009-2012, 2015,

and 2022, where the total deficit was estimated at approximately 3.77 thousand tons during the deficit period of 5.20 days.

iv. According to the concept of the strategic stock as the difference between the total surplus and the total deficit, the strategic stock of fish is estimated at approximately 128.29 thousand tons. In light of the domestic consumption of fish amounting to 294.4 thousand tons in 2022, the food security factor is estimated at about 0.44 at the end of the period 2000-2022.

Table 1: Production, consumption, foreign trade, and the periods of production adequacy and import coverage for domestic fish consumption during the period 2000-2022.

year	Local production in thousand ton	Local consumption in thousand ton	Self-sufficiency ratio %	Imports in thousand ton	Exports in thousand ton	Production adequacy period per day	Import coverage period per day
2000	54.7	143.16	38.2	90.63	2.55	139.46	231.07
2001	61.34	170.68	35.9	109.65	2.52	131.16	234.48
2002	63.96	166.71	38.4	107.99	4.93	140.02	236.44
2003	67.3	167	40.3	112.42	13.08	147.09	245.7
2004	66.59	202.46	32.9	146.52	10.66	120.05	264.16
2005	64.78	221.63	29.2	162.92	16.13	106.68	268.3
2006	81.06	250.2	32.4	188.38	19.6	118.25	274.81
2007	85.2	264.8	32.2	199.75	19.73	117.44	275.33
2008	91.01	221.86	41	152.36	21.59	149.73	250.67
2009	94.09	223.91	42	154.99	25.93	153.38	252.66
2010	91.51	309.28	29.6	256.55	38.79	108	302.77
2011	79.24	307.27	25.8	267.24	41.15	94.13	317.45
2012	88.67	366.24	24.2	318.67	32.58	88.37	317.6
2013	70.96	372.55	19	320.56	29.22	69.52	314.06
2014	91.87	384.2	23.9	332.9	42	87.27	316.27
2015	103.65	381.14	27.2	326.03	46	99.26	312.23
2016	106.82	385.84	27.7	326.22	47	101.05	308.59
2017	121.4	379.05	32	326.33	56	116.9	314.24
2018	140.32	352.73	39.8	304.59	56.5	145.2	315.18
2019	141.54	408.82	34.6	330.43	40.12	126.37	295.01
2020	165.63	393.31	42.1	343.31	82	153.71	318.6
2021	177.26	299.15	59.3	247.7	62.23	216.2	302.1
2022	184.76	294.4	62.8	152.09	42.45	228.1	187.8
average	99.7	289.8	35.2	229.5	32.7	128.6	280.7
Standard deviation	38	86.9	10.3	90.4	20.7	37.6	37.1
Coefficient of variation %	38.1	30	29.33	39.4	63.1	29.2	13.2

Source: Compiled and calculated from: (1) Ministry of Environment, Water and Agriculture, Statistical Book, Period 2000-2022, (2) General Authority for Statistics, Export and Import Statistics. Period 2000-2022, (3) Food and Agriculture Organization (FAO), website, period 2000-2022.

Table 2: General trend equations for production, consumption, self-sufficiency ratio, imports and exports, two periods of production adequacy, and import coverage of domestic fish consumption during the period 2000-2022.

Variable	Annual growth rate %	F	R²	Model
Local production	4.9	140.65	0.87	$Ln\hat{Y}_1 = 3.957 + 0.049T$ $(70.57)^{**}$ $(11.86)^{**}$
Local consumption	4.1	56.78	0.73	$Ln\hat{Y}_2 = 5.123 + 0.041T$ $(67.84)^{**}$ $(7.54)^{**}$
Self-sufficiency ratio	1.13*	13.58	0.58	$Ln\hat{Y}_3 = 48.695 - 3.993T + 0.183T^2$ $(10.07)^{**}$ $(-4.30)^{**}$ $(4.88)^{**}$
Export quantity	12.5	74.37	0.78	$Ln\hat{Y}_4 = 1.683 + 0.125T$ $(8.49)^{**}$ $(8.62)^{**}$
Import quantity	5	30.41	0.59	$Ln\hat{Y}_5 = 4.745 + 0.050T$ $(37.95)^{**}$ $(5.51)^{**}$
Production adequacy period	1.21*	13.56	0.58	$Ln\hat{Y}_6 = 177.57 - 14.52T + 0.67T^2$ $(10.10)^{**}$ $(-4.30)^{**}$ $(10.10)^{**}$
Import coverage period	0.9	4.47	0.18	$Ln\hat{Y}_7 = 5.523 + 0.009T$ $(97.41)^{**}$ $(2.12)^{**}$

**Significant at the 1% probability level, *Significant at the 5% probability level.

Source: Collected and calculated from the data presented in Table (1).

*The growth rate of the quadratic equation was calculated by the following law: $r = \left(\dfrac{dY}{dX} \div \dot{Y}\right) \times 100$

Table 3: The amount of surplus and deficit in domestic fish consumption during the period 2000-2022.

year	Daily consumption in thousand ton	Surplus		deficit	
		Quantity in thousand ton	Surplus sufficiency period per day	Quantity in thousand ton	deficit period per day
2000	0.39	-	-	0.009	0.023
2001	0.466	-	-	0.011	0.024
2002	0.455	0.279	0.613	-	-
2003	0.456	-	-	0.444	0.973
2004	0.555	0.014	0.025	-	-
2005	0.607	-	-	0.015	0.025
2006	0.685	-	-	0.337	0.492
2007	0.726	-	-	0.169	0.233
2008	0.608	0.052	0.086	-	-
2009	0.613	-	-	0.384	0.626
2010	0.847	-	-	0.008	0.01
2011	0.841	-	-	0.662	0.787
2012	1.034	-	-	0.41	0.397
2013	1.065	1.625	1.526	-	-
2014	1.049	0.026	0.024	-	-
2015	1.014	-	-	0.097	0.095
2016	1.06	0.263	0.248	-	-
2017	1.027	10.299	10.024	-	-
2018	1.083	23.034	21.274	-	-
2019	1.12	32.986	29.451	-	-
2020	1.078	0.002	0.002	-	-
2021	0.82	63.48	77.41	-	-
2022	0.81	-	-	1.22	1.51
total		132.06	140.68	3.77	5.2
Strategic stock		128.29			
Food security coefficient		0.44			

Source: Collected and calculated from the data presented in Table (1).

Estimating the relative importance of the contribution of local production and imports to meeting local consumption needs and the relative food security of fish

By studying the relative importance of the contribution of local production and imports to meeting local consumer needs and food security for fish during the period 2000-2022, it is clear from the data in (Table 4) that local production contributed to meeting local consumer needs at a rate that ranged between a minimum of 12.4% and a maximum of 50.4%. % at 95% confidence. The relative importance of the contribution of imports to meeting local consumption needs for fish ranged between a minimum of 49.6% and a maximum of 87.6% at a confidence level of 95%. It was also shown that local production contributed to achieving the current level of food security at a rate that ranged between a minimum of 5.5% and a maximum of 22.1% at a confidence level of 95%. The relative importance of the contribution of imports to achieving the current level of food security ranged between a minimum of 21.9% and a maximum of 38.5% at a confidence level of 95%.

Table 4: The relative importance of the contribution of local production and imports to meeting local consumption needs and the relative food security of fish during the period 2000-2022.

statement	Fulfilling consumer needs		Relative food security	
	Local production	imports	Local production	imports
Possibility of contribution	0.314	0.686	0.138	0.302
Possibility of not contributing	0.686	0.314	0.302	0.138
Standard error probability contribution	0.0968	0.0968	0.0426	0.0426
Standard error at 95% 95%	0.1897	0.1897	0.0834	0.0834
Possibility contribution at 95%	±0.314 0.1897	±0.686 0.1897	±0.138 0.0834	±0.302 0.0834
Contribution percentage at 95% Lower limit Upper limit	%12.4 %50.4	%49.6 %87.6	%5.5 %22.1	%21.9 %38.5

Source: Collected and calculated from the data contained in tables (1, 3).

Table 5: Average value of loans needed to produce a ton from fish farming during the period 2018-2022.

Year	Production in thousand ton	Loan value in million riyals	Per ton of loans (SAR/ton)
2018	72.31	14.49	200.4
2019	75.33	115.2	1529.3
2020	100	773.84	7738.4
2021	113.9	93.6	821.8
2022	120.5	13.33	110.6
average	96.41	202.09	2080.1

Source: Compiled and calculated from: (1) Ministry of Environment, Water and Agriculture (2022). Statistical Book, (2) Agricultural Development Fund (2022). annual report.

Table 6: The value of loans and initial investments necessary to achieve fish self-sufficiency in the Kingdom of Saudi Arabia.

Self-sufficiency rate (%)	Target production in thousand tons	Consumption in thousand tons	Additional production (thousand tons)	Value of loans (million riyals)	Value of investments (million riyals)
65	191.4	294.4	6.6	13.73	27.46
70	206.1	294.4	21.3	44.35	88.7
75	220.8	294.4	36	74.97	149.93
80	235.5	294.4	50.8	105.59	211.17
85	250.2	294.4	65.5	136.2	272.41
90	265	294.4	80.2	166.82	333.65
95	279.7	294.4	94.9	197.44	394.89
100	294.4	294.4	109.6	228.06	456.12

Source: Collected and calculated from the data contained in tables (1, 4).

Table 7: The amount of additional loans and investments and the total value of the financing needs necessary to achieve food security for fish meat.

Food security coefficient	Target strategic stock in thousand tons	Consumption in thousand tons	Increase in strategic stock (thousand tons)	Imports (thousand tons)
0.5	147.2	294.4	18.91	152.09
0.6	176.64	294.4	48.35	152.09
0.7	206.08	294.4	77.79	152.09
0.8	235.52	294.4	107.23	152.09
0.9	264.96	294.4	136.67	152.09
1	294.4	294.4	166.11	152.09

Table 8: Its completion.

Food security coefficient	Additional loans (million riyals)	Additional investments (million riyals)	Value of imports (million riyals)	Total (million riyals)
0.5	39.33	78.67	699	777.67
0.6	100.57	201.15	699	900.15
0.7	161.81	323.62	699	1022.62
0.8	223.05	446.1	699	1145.1
0.9	284.29	568.57	699	1267.57
1	345.53	691.05	699	1390.05

Source: Collected and calculated from the data contained in tables (3, 4).

Loans and initial investments necessary to achieve different levels of Self-sufficiency and food security of fish

Estimating the value of loans and initial investments needed to achieve fish self-sufficiency

By studying the development of the value of loans granted by the Agricultural Development Fund for fish farming projects during the last five years, it is clear from the data in (Table 5) that in light of local production and the value of loans granted for fish farming projects, the average share of a ton of fish in the value of loans ranged between a minimum of 110.6 riyals/ton in 2022 and a maximum of 7738.4 riyals/ton in 2020, with an annual average of 2080.1 riyals/ton during the period 2018-2022.

The value of the initial loans and investments necessary to achieve self-sufficiency was estimated based on the production needed to meet local consumer needs and the average share per ton of fish from loans granted to fish farming projects, amounting to 2080.1 riyals/ton during the period 2018-2022. It is clear from the data in (Table 6) that in light of the local production necessary to achieve different levels of self-sufficiency, the amount of additional production (the difference between the necessary production and its counterpart of 184.76 thousand tons in 2022) is expected to increase from 6.6 thousand tons at the self-sufficiency rate of 65% to 109.6 thousand tons at 100% self-sufficiency rate. The amount of increase in local production necessary to achieve self-sufficiency requires financing needs (loans and investments) to establish new fish farms in marine waters. The value of loans is expected to increase from 13.73 million riyals at a self-sufficiency rate of 65% to 228.06 million riyals at a self-sufficiency rate of 100%. In light of the lending regulations of the Agricultural Development Fund, which included the Agricultural Development Fund financing 50% of the total investment costs of the projects to be established, the value of the initial investments necessary to achieve self-sufficiency in fish is twice the value of the loans that must be provided to achieve additional production, meaning that the value of the additional investments is expected to increase. From 27.46 million riyals at a self-sufficiency rate of 65% to 456.12 million riyals at a self-sufficiency rate of 100%.

Estimating the value of loans and initial investments needed to achieve food security for fish

The financing needs necessary to achieve food security include both the value of loans and initial investments needed to expand local production, in addition to the value of imports. The value of the loans and investments necessary to achieve food security was estimated based on the amount of increase in the strategic stock and the average share of a ton of fish from loans granted to fish farming projects amounting to 2080.1 riyals/ton during the period 2018-2022. It is clear from the data in (Table 7) that in light of the strategic stock of 128.29 thousand tons at the end of the period 2000-2022, and its counterpart necessary to achieve food security, requires increasing the strategic stock by 18.91 thousand tons when the food security coefficient is 0.5 to 166.11 thousand tons when the food security coefficient reached one. There is no doubt that the increase in the strategic stock necessary to achieve food security requires additional loans for fish farming projects in marine waters. The value of additional loans is expected to increase from 39.33 million riyals at a food security coefficient of 0.5 to 345.53 million riyals at a food security coefficient of one. In light of the lending regulations for the Agricultural Development Fund, the value of additional investments is expected to increase from 78.67 million riyals at a food security coefficient of 0.5 to 691.05 million riyals at a food security coefficient of one. In light of the relative importance of the contribution of imports to achieving food security for fish, the total value of financing needs increases from 777.67 million riyals when achieving the level of 0.5 for the food security coefficient, to 1.39 billion riyals when achieving the full level of food security (Table 8).

Conclusion

Although the coast of the Kingdom of Saudi Arabia extends to more than 2,900 kilometers on the Red Sea and the Arabian Gulf, it contributed no more than 34.79% of the total fish production in 2022. This is due to the environmental problems that marine fisheries have been exposed to and the phenomenon of overfishing, which is Increased number of fishing trips on the same area of fishing water, resulting in the biological growth

rate not keeping pace with the catch rate of fish. Pollution of the aquatic environment of Saudi marine fisheries is attributed to several factors, the most important of which are:

a.   The movement of petroleum tankers and commercial ships between East and West, which makes marine fisheries vulnerable to pollution during loading and unloading operations, fueling ships, and unloading waste,

b.   Discharge of untreated sewage and waste from industrial facilities built on the shores of the Red Sea and the Arabian Gulf,

c.   Port disinfection operations, ship maintenance and painting,

d.   Conducting search and exploration operations for oil and minerals in marine waters,

e.   Port management and oil companies may have to use chemicals to disperse oil stains resulting from some accidents and unintentional spills, which leads to... It can cause severe damage to marine life when used in shallow waters less than ten meters [12].

In light of the local production and consumption of fish, the self-sufficiency rate increased from 38.2% in 2000, to 62.8% in 2022, in view of the increase in loans and investments allocated to fish farming in inland and marine waters. The cumulative number of licensed fish farming projects reached 282 projects until the end of 2022, including 12 projects in marine waters, with a production capacity of 89.63 thousand tons, representing 74.4%, while the cumulative number of projects in inland waters reached 270 projects, with a production capacity of 30.86 thousand tons, representing 25.6%. % of the total fish farm production of 120.5 thousand tons in 2022 [1].

By calculating the amount of surplus and deficit in local fish consumption, it was found that the strategic stock is estimated at approximately 128.29 thousand tons, sufficient for local consumption for 158.4 days, or 5.3 months. In light of domestic consumption of 294.4 thousand tons in 2022, the food security coefficient is estimated at about 0.44 at the end of the period 2000-2022. To achieve self-sufficiency and complete food security for fish, this requires the expansion of fish farming projects in marine waters, with initial investments estimated at approximately 456.12 and 1390.05 million riyals for each, respectively. These results are consistent with the strategy of the Ministry of Environment, Water and Agriculture and the Kingdom's Vision 2030, which included increasing the total production of marine fisheries and fish farming until it reaches 600 thousand tons at the end of 2030 [4].

Through the results of this study, it recommends the necessity of raising the rate of self-sufficiency and the level of food security for fish, through expanding fish farming in marine waters and providing the necessary fish fry, considering the preservation of the aquatic environment from pollution, through the strict application of laws to protect the fish. Aquatic environment of marine fisheries. This recommendation is being implemented through the Ministry of Environment, Water and Agriculture issuing the necessary licenses to establish fish farms in marine waters, in addition to the Agricultural Development Fund providing the necessary financing needs to establish these projects.

Acknowledgement

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