

The Increase of Wheat Crop Production in Egypt through Rotated Loading with the Cotton Crop

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Abstract: The study aims to find out a new method to increase wheat crop in Egypt in order to increase the crop self-sufficiency rate through the wheat crop horizontal expansion by wheat loading cultivation over the cotton crop. The study has clarified that wheat-loaded over cotton can be cultivated in the governorates of cotton cultivation. Because of the loading process, it cannot be cultivated with the same intensity and thus it occupies about 65% of the cotton cultivated land. Therefore, it necessitates the cultivation of anti-dormancy types which are of the highest quality of acre productivity. Among the most important results which the study has concluded is that it is possible to increase wheat crop production by its cultivation loaded over the cotton crop according to the recommended anti-dormancy types and in the governorates which have the highest productivity of each type and give production increase of about 4183.973 thousand ardab and contribute to cover the wheat gap in Egypt by 54.4%. The study has expected that the wheat gap will increase in the future, a matter that entails the prediction of the expected increase amount in production, consumption and gap in order to work out solutions and suggestions to lessen the gap size. Therefore, the study has assumed several scenarios to predict the gap size in 2030 and 2050.

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1. Introduction:

The wheat crop is considered one of the most important winter grain crops and of the food crops in general. However, the production amount of the wheat crop is insufficient for the domestic consumption. Thus, the state seriously attempts to narrow the food gap through multiple programs aim to production increase whether by horizontal or vertical increase. This could be done by encouraging the farmers to implant wheat to face the population steady increase. This population increase leads to wheat and its products demand increase. It leads as such to wheat imports increase estimated about 7-9 million tons during the average period (2008-2011); a matter which increases burdens on the state budget.

Problem of the study:

In spite of the acre productivity increase of the wheat grains estimated (17.77 ardab / feddan) in 2011 as an average production all over the republic as the average production in the old lands within the valley estimated (18.64 ardab/ feddan). However, there is still a huge gap between production and consumption, as the state imports annually 7-9 million tons.

Aim of the study:

The study aims to find out a new method to increase wheat crop in Egypt in order to increase the crop self-sufficiency rate through the wheat crop horizontal expansion by wheat loading cultivation over the cotton crop. Achieving the study aim requires the investigation of the expectations resulted

from wheat gap size in the future and the study of benefits and advantages to rotated cotton loading with wheat through the study of wheat production increase when loaded with cotton, areas of cotton production in Egypt and current and future status of wheat production and consumption.

Data sources and the study technique:

The study has relied on the secondary data published by the ministry of agriculture and land reclamation, agricultural research center, the public system for statistics and mobilization in addition to some electronic websites⁽¹⁾, other relevant researches in order to achieve the aim of the study. The study has adopted the descriptive and analytical technique to analyze the study related data.

Results and Discussion:

The wheat and cotton crops are considered two of the most important winter and summer crops in the Egyptian agriculture. They are two of the most important strategic crops as well as cotton come first in exports as compared to other field crops because of its worldly high-quality distinction among world-cotton crops in terms of staple, smoothness and uniformity. It is one of the manufacturing crops as many industries such as ginning, spinning and weaving are based on it, while other industries based on cotton oil and its products. Whereas squeezed remnants are used as animal fodder, firewood is used for producing organic fertilizers. The cotton crop is considered as one of the crops that play a large role in the industrial and agricultural manpower as the cotton

and its products labor estimated 30% (cultivation, marketing, manufacturing, exporting).

The loading cotton-wheat rotated program is considered as one of the best programs that aim to increase the wheat crop in Egypt as it does not defect the general crop formula, it rather increase the wheat crop production which is used in the production of bread and macaroni manufacturing, etc. this can be achieved through cultivating wheat loaded over cotton by 65% of cotton-cultivated area. This program provides an acre-productivity equals to its single-cultivation counterpart besides the cotton crop.

The wheat-research Department at the field crops research institute affiliated to the agriculture research center has devised types of early-matured short-term wheat that is distinguished with high quality and can be cultivated by loading over cotton.

The rotated loading means two or more crops cultivation entwined with the main crop in its great growth stages. According to this system, the second crop is cultivated after the first crop reaches the post-flowering stage and before final maturity. The benefits and advantages of cotton-rotated loading with wheat:

The most important scientific and applied benefits of this system can be summarized in the following points:

1. The productivity increase of the winter food crops (wheat) without defecting the crop formula and the agricultural cycle as cultivated in the cotton rank.
2. The productivity increase of area unit when cultivating wheat and cotton together.
3. The economic return increase and its distribution over the year and avoiding the bad effects of relying on one crop cultivation.
4. The cultivation of cotton together with wheat occurs in early March with the protection benefits from the weather circumstances using wheat plants warming which leads to increase cotton germination rate.
5. Escape from the injury of pink spinal almond worms through early cultivation.
6. Lessening the cotton affection risk with excavator, cutworm aphids thrips and thus reducing environmental pollution and pesticide, plants, leading to reduced costs for the previous reasons resistance and thus increase economic returns per unit area.
7. Lessening the water amount used for both crops together.

In addition to the special advantages related to loading in general such as maximum benefit of the weather and land elements and benefit from the different soil layers⁽²⁾.

The most important wheat types in Egypt:

The preferred recommended types are high-quality, early matured and dormancy resistant such as (gemiza 7, sakha 93, sakha 61).

Wheat is cultivated in November and earliness or delay are not recommended in order to provide suitable temperature degrees for wheat growth stages and avoid high temperature effect at the season end particularly in Upper Egypt. The lack of commitment of suitable cultivation times reduces the crop by not less than 25% and in order not to delay harvest and its long accompany with cotton that is cultivated in March.

Wheat is cultivated on the bench surface in the Gore in five lines with between lines distance 12 centimeters at the depth of 3-5 centimeters from the soil surface while leaving an area on both sides to cultivate cotton and in March cotton is cultivated on the bench two feathers at the distance of 25-30 centimeters between the Gore according to soil fertility and type and the wheat final irrigation should be the surviving cotton irrigation.

Production of Wheat crop loaded with cotton in Egypt: Current situation of wheat cultivation in Egypt:

The wheat crop is cultivated nearly in all governorates because its food importance not only for the Egyptian countryside but the urban population as well. The total wheat cultivated in Egypt estimated 3001.38 Fadden in 2010 producing about 7169.024 tons with a fadden average productivity reached almost 2.389 ton/ Fadden. The Governorate of Sharkia comes first in terms of the wheat cultivated are estimated about 399.92 Fadden representing almost 13.32% of the total wheat are in Egypt. It is followed by Dakahlia, El-Bihera, Kafr El-Sheikh, El-Minya, and El-Fayoum with areas estimated nearly 296.39, 293.26, 234.82, 212.37 and 168.28 thousand Fadden respectively representing about 9.87%, 9.77%, 7.82%, 7.07%, 5.61% of the total wheat area in Egypt successively as shown in table 1⁽³⁾. As for total production, the Sharkia Governorate comes first with total production of 926.82 thousand tons followed by El-Behira, Dakahlia, Kafr El-Sheikh, Minya and El-Fayoum with production estimated about 767.62, 754.91, 598.43, 554.92, 397.56 thousand tons respectively representing nearly 12.93%, 10.71%, 10.53%, 8.35%, 7.74%, 5.54% successively of total wheat production in Egypt in 2010 as shown in table 1.

Areas of Cotton crop production in Egypt:

The cotton crop is cultivated in most Egyptian governorates as Kafr El-Sheikh governorate comes first with an area estimated about 100.24 thousand Fadden representing almost 27.15% of total cotton cultivated areas in Egypt which reached 369.14

thousand Fadden in 2010. It is followed by El-Behira, Dakahlia, and Sharkia respectively with areas estimated about 99.44, 53.48, 41.17 thousand Fadden representing nearly 26.94%, 14.49%, 11.15% successively of total cotton cultivated areas in Egypt in 2010.

Table 1. Areas and production of Wheat crop in Egyptian Governorates in 2010 Areas in acre-productivity in ton/ Fadden - production in ton

Governorate	Area	Productivity	Total Production
Alexandria	60424	2.451	148099
Behira	293263	2.618	767616
El-Gharbia	147883	2.642	390366
Kafr El-Sheikh	234816	2.549	598429
Dakahlia	296392	2.547	754910
Demmittes	27592	2.349	64814
Sharkia	399923	2.318	926822
Ismalia	54138	2.397	129769
Port Said	18940	2.178	41251
Suez	4884	2.353	11494
Munifia	107552	2.720	292488
Kalubia	49106	2.502	122862
Cairo	11062	2.495	27760
Giza	29322	2.647	81266
Beni Sueif	127721	2.385	304615
Fayoum	168281	2.363	397564
Minya	212371	2.613	554925
Assuit	165328	2.375	390197
Sohag	180589	2.199	397115
Qena	96638	1.615	156118
Luxor	43911	2.004	87998
Aswan	46432	1.921	89219
The New Valley	65496	1.905	124770
Matrouh	24575	1.496	36572
South Sinia	128	1.352	173
El-Noubaria	135614	2.001	271364
Total	3001381	2.389	7169024

Source: Ministry of Agriculture and Land Reclamation- Central Administration for Economics and Statistics- Agricultural Economics Newsletter, 2010.

There is about 73.1% of the republic governorates share production of cotton and wheat crops which shows there is a possibility to load the wheat crop over that of cotton. As such it is possible to exploit the cotton cultivated areas by cultivating loaded wheat with it by about 65% of the total cotton cultivated area without affecting the wheat crop productivity in the case of its loaded cultivation but it sometimes increases. Table 2 shows it is possible to cultivate about 239.94 thousand Fadden of wheat loaded over cotton to produce almost 3.967 million ardab. The same table shows as well El-Behira governorate comes first in loaded wheat production by about 127.85 thousand ardab followed respectively by Kafr El-Sheikh, Dakahlia, Sharkia, to produced loaded wheat estimated about 1107.033, 590.28 and 413.44 thousand ardab⁽⁴⁾.

Table 2. Expected production of loaded wheat over cotton Area in Fadden - productivity in ardab/Fadden- production in million ardab

Governorate	Cotton area	Wheat Productivity	Wheat area	Total expected wheat production
Alexandria	4194	16.34	2726.1	0.0445
Behira	99436	17.45	64633.4	1.128
El-Gharbia	18294	17.61	11891.1	0.209
Kafr El-Sheikh	100243	16.99	65157.95	1.107
Dakahlia	53482	16.98	34763.3	0.509
Demmittes	6587	15.66	4281.5	0.067
Sharkia	41169	15.45	26759.8	0.413
Ismalia	717	15.98	466.1	0.007
Port Said	2042	14.52	1327.3	0.019
Munifia	3100	15.69	2015	0.032
Kalubia	670	18.13	435.5	0.009
Beni Sueif	7765	16.56	5047.2	0.084
Fayoum	15492	16.71	10069.8	0.168
Minya	1847	16.73	1200.5	0.02
Assuit	6465	16.80	4202.2	0.071
Sohag	2118	15.90	1376.7	0.022
The new valley	17	16.60	11.0	0.001
El-Noubaria	5503	15.38	3576.9	0.057
Total	369141	-	239944.6	3.967

Source: collected and computed from the data of Ministry of Agriculture and Land Reclamation-Central Administration for Economics and Statistics-Agricultural Economics Newsletter, 2010

Therefore, it is possible to cultivate the wheat crop loaded over cotton in cotton cultivation governorates. However, as the loading process it is not cultivated with the same intensity and thus it occupies about 65% of the cotton crop cultivated area. Therefore, it is necessary to cultivate other types which are against dormancy and at the same time which have high productivity. There are four types against dormancy, namely Sakha 93, Giza 168, Sakha 61 and Gemiza 7. The productivity of these types differs a governorate to another. Therefore, it is necessary to cultivate the highest productivity type in the governorate where it has high quality, a matter which is known as localization of types. The suitable localization of the investigated types as shown in table 3 refers to the possibility of cultivating Gemiza 7 type in the governorates Gharibia and Munifia as it gives the highest productivity there about 18.63 and 18.67 ardab/ Fadden respectively. The Giza type 168 has good quality in the governorate Kafr El-Sheikh, Sharkia, Beni Sueif, Fayoum, Minya and the new valley whose productivity estimated in these governorates about 18.39, 16.05, 15.93, 15.78, 17.43, 12.66 ardab/ Fadden respectively. These are the highest current quality types cultivated in the same governorates. The Sakha 93 type has good quality

when cultivated in other governorates at the republic level.

Table 3. Expected production of anti-dormancy types which has highest productivity in Egyptian governorates

Governorate	Proposed cultivated type	Productivity ardab/ Fadden	Area Thousand Fadden	Production thousand ardab
45.373	2.73	16.62	Sakha 93	Alexandria
1144.6	64.63	17.71	Sakha 93	Bihera
70.77	4.2	16.85	Sakha 93	Assuit
605.15	34.76	17.41	Sakha 93	Dakalia
20.56	1.38	14.9	Sakha 93	Sohag
67.88	4.28	15.86	Sakha 93	Demmittes
7.37	0.435	16.95	Sakha 93	Kalubia
19.31	1.33	14.52	Sakha 93	Port Said
48.22	3.58	13.47	Sakha 93	Noubaria
429.5	26.76	16.05	Giza 168	Sharkia
80.45	5.05	15.93	Giza 168	Beni Sueif
158.9	10.07	15.78	Giza 168	Fayoum
20.92	1.2	17.43	Giza 168	Minya
1198.29	65.16	18.39	Giza 168	Kafr El-Sheikh
221.51	11.89	18.63	Gemiza 7	Gharbia
37.53	2.01	18.67	Gemiza 7	Minufia
0.14	0.011	12.66	Gemiza 168	New Valley

Source: collected and computed from the data of Ministry of Agriculture and Land Reclamation-Central Administration for Economics and Statistics-Agricultural Economics Newsletter, 2010.

Table 3 shows it is possible to cultivate the wheat crop loaded over cotton according to the anti-dormancy recommended types which have the highest quality for each type and give production increase estimated about 4176.473 thousand ardab and contribute to cover the wheat gap by about 54.4%.

Cultivation of Sakha type 93: it is possible to cultivate about 117.79 thousand Fadden with the Sakha 93 type in the governorates of Alexandria, Behira, Dakahlia, Demmittes, Ismalia, Port Said, Kalubia, Assuit, Sohag, and Noubaria in areas reached respectively about 2.73, 64.63, 34.76, 4.28, 0.47, 1.33, 0.435, 4.2, 1.38 and 3.58 thousand acres producing almost 45.37, 1144.7, 605.15, 67.88, 7.5, 19.31, 7.37, 70.77, 20.56 and 48.22 with total production of 2029.233 thousand ardab as shown in table 3.

Cultivation of Giza 168: it can cultivate about 108.25 thousand Fadden of Giza 168 wheat distributed in the provinces of Kafr el-Sheikh, Sharkia, Beni Sueif, Fayoum, Minya, New Valley with the area of approximately 65.16, 26.76, 5.05, 10.07, 1.2, 0.011 thousand acres, respectively producing about 1198.29, 429.5, 80.45, 158.9, 20.92, 0.14 thousand Ardebs respectively, with a total production of about 1888.2 thousand ardebs.

Cultivation of Gemiza 7: It can be cultivated around 11.89, 2.01 thousand acre wheat Gemiza 7

loaded over cotton in the western provinces and Cairo producing around 221.51, 37.53, with total production of about 259 thousand Ardabs of wheat respectively⁽³⁾.

Current and Future situation of wheat production and consumption in Egypt under the possible economic and environmental changes:

The economic development situation of the wheat crop can be studied through the following indicators:

Development of wheat crop cultivated area:

The study of certain investigated economic changes during the period (1995-2010) indicates as shown in table 4 that the wheat crop cultivated area increased by about 37 Fadden annually during the study duration. It indicates as well that the time factor is responsible for about 40% of this increase.

Development of total production of the wheat crop:

The study of production size development of the wheat crop during the study duration indicates that it increases by about 174 thousand tons annually during the study duration and asserts that this is a significant increase while the time factor is responsible for 72% of this increase as shown in table 4.

Development of wheat crop acre productivity:

The results of general time oriented analysis show the development of Fadden production of the wheat crop by about 0.29 tons during the study duration.

Egyptian Consumption development of wheat:

The increase of wheat available amounts is a significant increase during the study duration by about 332 thousand tons. It is provided from the produced amounts besides the imported and stored amounts from the previous year as shown in table 4.

Development of Wheat gap size:

The wheat gap size increased by about 3.409 million tons in 1999 as a minimum to 7.500 million tons in 2008 as a maximum compared to the local consumption increase of the wheat crop during the study duration by an increase rate estimated 120%. The general gap average during the study duration estimated about 5.107 million tons. The annual increase of wheat gap as indicated in the time-oriented dichotomy of the study estimated by about 138 thousand tons as shown in table 4.

The study of wheat crop imports:

The study of Egyptian wheat imports size, necessary to meet the wheat gap size of most population's required food needs, indicates that the Egyptian imports size increased by about 4.89 million tons in 1995 to almost 7.12 million tons in 2010. The minimum imports amount reached about 4.06 million tons in 2003, while the maximum reached about 8.33 million tons in 2008 with an

increase estimated almost 105% with a general average of about 5.411 million tons during the study duration.

Table 4: Equation of general time oriented direction of the economic variables investigated in the study during the period (1995-2010).

Equation no.	variable	equation	R2	F
1	Total production in thousand tons	$\hat{Y}_i = 5.415 + 0.174 X_i$ (5.726)	0.716	32.785
2	Acre production ton/ Fadden	$\hat{Y}_i = 2.386 + 0.929 X_i$ (5.205)	0.676	27.097
3	Available for consumption in thousand/tons	$\hat{Y}_i = 9190.276 + 331.78 X_i$ (6.240)	0.730	38.938
4	Gap size in thousand tons	$\hat{Y}_i = 4004.838 + 137.70 X_i$ (2.470)	0.319	6.099
5	Imports amount in million tons	$\hat{Y}_i = 4.242 + 0.146 X_i$ (2.427)	0.312	5.891

Collected and computed from table no. 3.

Where:

\hat{Y}_i = estimated value of variable investigated and shown in the table according to the year I.

X_i = time variable as I= 1, 2, 3, 4----- N of years
- Value in brackets means computed t value.

Therefore, it is expected that the wheat gap size will increase in the future, a matter which necessitates the prediction of the expected increase in production, consumption and gap in order to work out solutions and suggestions to lessen the gap size. Thus, the study introduces a number of scenarios of the gap size prediction during the years 2030 and 2050 as shown in table 5.

The First Scenario:

This scenario depends on the prediction of population number during the last two years with the aid of the general time direction during the period of 1995-2010. It indicates the population increase by an annual growth rate of about 1.931% on which the expectation based that population increase in 2030 and 2050 by about 102.196 and 127.826 million people. It assumes as well the constancy of total wheat production, and individual average consumption in 2030 and 2050 estimated almost 7.169 million tons and 0.184 million tons respectively. The total wheat consumption is expected to increase by 18.804 and 23.518 million tons in the two years respectively. Consequently, this leads to the gap size increase during the same two years by about 11.635 and 16.349 million tons successively. The production of wheat crop loaded

over cotton, estimated almost one million ardab, will contribute to cover about 27.7% and 19.8% of the gap size respectively. The wheat-loaded cotton crop production in Egypt, estimated about 4.18 million ardab, will contribute to cover almost 36% and 26% of the gap size successively.

The second scenario:

This scenario assumes the increase of wheat total production during the two periods by about 11.679 and 15.159 million tons in the years 2030 and 2050 respectively. This leads to lessen the gap size to almost 7.125 and 8.359 million tons in the two year 2030 and 2050 respectively while the individual-wheat consumption average and population growth rate remain constant during the two same periods. The production of wheat crop loaded over cotton, estimated about 45.3% and 38.6% respectively, covers 23 million ardabs. The production of wheat crop loaded over cotton estimated about 4.18 million ardabs in the case of anti-dormancy types cultivation which has the highest quality will contribute as well to cover almost 58.7% and 50% successively of the gap size.

The Third scenario:

It assumes that the individual wheat average is about 0.05 tons a year. This reduces the wheat total consumption by about 13.694 and 17.127 million tons in the years 2030 and 2050 respectively. Thus it reduces the gap size to almost 2.015 and 1.968 million tons during the same two years successively. The production of wheat loaded over cotton estimated one million ardab will cover about 100% of the gap size and there will be a surplus for export estimated about 3.23, 1.262 and 1.215 million tons respectively. The production of wheat loaded over cotton in Egypt estimated by almost 4.18 million ardabs in the case of cultivating anti dormancy types with the highest quality will cover about 100% of the gap size and there will be a surplus estimated about 2.165 and 2.212 million tons respectively.

The Fourth scenario:

If the state can rationalize individual wheat consumption through consumers' awareness of rationalization importance at the national and individual levels in order to improve bread making to get a good loaf of which we do not lose any part, we can lessen the individual consumption average to reach the international individual average estimated almost 0.084 annually. In this case wheat self-sufficiency can be realized. In addition, surplus can be exported abroad estimated about 3.095 million tons and 4.423 million tons in 2030 and 2050 successively. In the case of producing wheat loaded over cotton, the surplus becomes about 6.325, 7.653 and 3.23 million tons successively. The production of wheat loaded over cotton estimated about 4.18

million ardabs in the case of cultivating the anti-dormancy types with the highest quality will contribute to increase the surplus size to about 7.275 and 8.603 million tons respectively. Therefore, the study recommends focusing on the third and fourth scenarios as they both achieve wheat self-sufficiency in Egypt with a surplus for export purpose. The fourth scenario achieves higher surplus than the third scenario.

Table 5: Future situation of wheat total production, consumption and gap during the years of 2030 and 2050 Production, consumption and gap in million tons

variable	2010	2030	2050
First scenario			
Population	76.576	102.196	127.816
Total consumption	14.858	18.804	23.518
Total production	7.169	7.169	7.169
Gap	7.689	11.635	16.349
Second scenario			
Total production	7.169	11.679	15.159
Total consumption	14.858	18.804	23.518
Gap	7.689	7.125	8.359
Third scenario			
Total production	7.169	11.679	15.159
Total consumption	14.858	13.694	17.127
Gap	7.689	2.015	1.968
Fourth scenario			
Total production	7.169	11.679	15.159
Total consumption	14.858	8.584	10.736
Gap or surplus	7.689	3.095	4.423

Source: Collected and computed based on the early mentioned study data.

Recommendations:

The cultivation of wheat crop loaded over the cotton crop results the increase of wheat crop production by about 3.23 million ardab that will contribute to meet the gap by almost 42%. The cultivation of the wheat crop loaded over the cotton crop in Egypt and according to the recommended anti-dormancy types and in the governorates where it has highest productivity for each type and which give a production increase estimated about 4182.973 thousand ardab that will contribute to narrow the wheat gap in Egypt by almost 54.4%. The study has indicated that the future expected gap of the wheat crop can be lessened by about (27.7% and 19.8%) and by almost (45.3% and 38.6%) in the first and second scenarios with full coverage of the gap in the third and fourth scenarios with achieving surplus. It is possible as well to lessen the expected gap by about (36% and 26%) and by almost (58.7% and 50%) in the first and third scenarios with full coverage of the gap under the third and fourth scenarios with achieving surplus in the case of cultivating the wheat crop loaded over cotton and according to the recommended anti-dormancy and in the governorates

where it has the highest productivity for each type. Therefore, the most important recommendation that the study has introduced is the concentration on achieving the third and fourth scenarios as they both can achieve wheat self-sufficiency in Egypt while the surplus will be directed for export. The fourth scenario achieves surplus higher than that of the third scenario.

Conclusion

The study aims to increase the self-sufficiency of wheat crop. The study has clarified that wheat-loaded over cotton can be cultivated in the governorates of cotton cultivation with intensity about 65% of the cotton cultivated land. The study has concluded is that it is possible to increase wheat crop production by its cultivation loaded over the cotton crop according to the recommended anti-dormancy types and in the governorates which have the highest productivity of each type and give production increase of about 4183.973 thousand ardab and contribute to cover the wheat gap in Egypt by 54.4%.

The study has expected that the wheat gap will increase in the future, a matter that entails the prediction of the expected increase amount in production, consumption and gap in order to work out solutions and suggestions to lessen the gap size. Therefore, the study has assumed several scenarios to predict the gap size in 2030 and 2050.

This scenario depends on the prediction of population number during the last two years with the constancy of total wheat production and individual average consumption. It indicates the population increase by an annual growth rate of about 1.931% on which the expectation based that population increase in 2030 and 2050 by about 102.196 and 127.826 million people. The total wheat consumption is expected to increase by 18.804 and 23.518 million tons in the two years respectively. The second scenario assumes the total production of wheat crop by about 11.679 and 15.159 million tons during the two years 2030 and 2050 respectively. Consequently, the increase lessens the gap to almost 7.125 and 8.359 million tons during the two years 2030 and 2050 successively with the constancy of total wheat production and individual average consumption and population growth rate during these two periods. However, the third scenario assumes that the rationalization of individual average consumption of wheat by about 0.05 tons annually leads to the reduction of total wheat consumption by almost 13.694 and 17.127 million tons during the years 2030 and 2050 respectively. Finally, the fourth scenario clarifies the important role of the state in rationalizing the individual wheat consumption through consumers' awareness and improvement of

bread making to lessen bread waste. Thus, we can lessen the individual consumption average to reach the international individual average estimated almost 0.084 tons annually. In this case wheat self-sufficiency can be realized. In addition, surplus can be exported abroad estimated about 3.095 million tons and 4.423 million tons in 2030 and 2050 successively. In the case of producing wheat loaded over cotton, the surplus becomes about 6.325, 7.653 and 3.23 million tons successively. Therefore, the study recommends focusing and adopting this scenario to achieve wheat self-sufficiency in Egypt. The study has clarified that the cultivation of wheat crop loaded over the cotton crop results the increase of wheat crop production by about 3.23 million ardab that will contribute to meet the gap by almost 42%. The cultivation of the wheat crop loaded over the cotton crop in Egypt and according to the recommended anti-dormancy types and in the governorates where it has highest productivity for each type and which give a production increase estimated about 4182.973 thousand ardab that will contribute to narrow the wheat gap in Egypt by almost 54.4%. The study has indicated that the future expected gap of the wheat crop can be lessened by about (27.7% and 19.8%) and by almost (45.3% and 38.6%) in the first and second scenarios with full coverage of the gap in the third and fourth scenarios with achieving surplus. It is possible as well to lessen the expected gap by about (36% and 26%) and by almost (58.7% and 50%) in the first and third scenarios with full coverage of the gap under the third and fourth scenarios with achieving surplus in the case of cultivating the wheat crop loaded over cotton and according to the recommended anti-dormancy and in the governorates where it has the highest productivity for each type. Therefore, the most important recommendation that the study has introduced is the concentration on achieving the third and fourth scenarios as they both can achieve wheat self-sufficiency in Egypt while the surplus will be directed for export. The fourth scenario achieves surplus higher than that of the third scenario.

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