

The role of modern varieties in increasing the total production of the summer yellow maize crop in Egypt

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ABSTRACT

The research results indicate the importance of expanding the cultivation of high-yield varieties of the summer yellow maize crop, in order to bridge the gap between consumption and local production thereof, which contributes to increasing the state's trade balance deficit as a result of the import from abroad. The results also indicated a proposal for a varietal map represented in the cultivation of high-yield varieties, single hybrid 168, yellowish-golden, single hybrid 3062 in the Upper Egypt sector, and varieties of single hybrid 176, single hybrid 162, single hybrid 168, single hybrid 166, and triple hybrid 360 in the outside the valley, while maintaining the cultivation of the current varieties in the Lower Egypt and Middle Egypt sectors. The application of this varietal map results in an increase in ardab yield by an estimated increase of 6.6% and 1.5% in the sectors of Upper Egypt and outside the Valley, respectively, in addition to increasing the income of yellow maize producers and raising the percentage of self-sufficiency therefrom. The study recommends the necessity of applying the proposed varietal map, with the provision of improved seeds from them at appropriate prices in their production areas, in addition to providing extension services and technological methods that lead to an increase in the feddan yield of yellow maize.

Keywords: Modern Varieties Ardab yield; Variance Analysis; Least Significant Difference (L.S.D)

INTRODUCTION

Yellow maize is one of the important strategic grain crops in Egypt, as it is the basis for the establishment and renaissance of the white and red meat industries and their products, as it enters by up to 40% in red meat rations and milk production, and by 60-70% in the manufacture of poultry and fish rations. It also depends on it in many important industries such as corn oil production, starch, and energy production fields (Morsey.Doaa, Sharabin 2021). The area of the summer yellow maize crop is estimated at about 732.8 thousand feddans, representing about 9.8% of the area of grain crops amounting to about 7.52 million feddans, and about 32.6% of the total area of the summer maize crop. The average total production of it is estimated at 16.8 million ardabs, and the average feddan yield is estimated at 22.8 ardabs / feddan as an average for the period (2015-2019) (Ministry of Agriculture and Land Reclamation, Economic Affairs Sector), and modern varieties are considered one of the methods of bio technology that aims to increase the yield of the ardabs and thus achieve the maximum possible production in light of the scarce resources available. The lack of availability is also considered one of the most important economic constraints that affect crop production, so focusing on modern varieties programs is considered the most important method of vertical agricultural development that works to increase the total production of the crop (Khattab. Manal, 2018).

Research Issue:

The issue of the study is that despite the efforts made by the state to increase the total production of the yellow maize crop, it suffers from the existence of a nutritional gap between its local production and meeting consumer needs therefrom, as the gap amounted to about 7.625 million tons, which is covered by imports from abroad, where the amount of its imports amounted to about 7.8 million tons, with an estimated value of about 1.7 billion dollars, as an average for the period (2015-2019)(FAO), which increases the deficit in the agricultural trade balance.

Research Objective:

The main objective of the research is to develop a proposed varietal map for the summer yellow maize crop by redistributing the high-yielding varieties in the cultivated areas to achieve compatibility between the feddan yield and the cultivated area, thus achieving an increase in the total production of this crop and estimating the potential economic effects of this proposed distribution, through the study of:

- 1- The current productive situation of the summer yellow maize crop in Egypt.
- 2- The relative importance of the sectors producing it, the varieties grown in them and their impact on the ardab yield.
- 3- Determining the amount of increase in production upon the proposed redistribution of the cultivated area and studying its economic effects on the indicators of efficiency and the national economy.

Research Method & Data Sources:

In achieving its objectives, the research depends on the published and unpublished secondary data during the period (2015-2019), which were obtained from the Ministry of Agriculture and Land Reclamation, the Economic Affairs Sector, and the Central Agency for Public Mobilization and Statistics (CAPMAS). The method of descriptive and quantitative analysis was used in data analysis, in addition to the use of some statistical methods of averages and percentages, and analysis of variance in two directions to test the effect of variety and time on the ardab yield of the yellow maize crop, and the least significant difference test (L. S. D), and economic efficiency criteria such as the net return and the profitability of the invested pound and other criteria.

Research results & Discussion

First: The current productive status of the summer yellow maize crop:

A- Development of the Cultivated Area:

The data in Table (1) indicate an increase in the area planted with summer yellow maize during recent years; as it increased from about 56,4 thousand feddans in 2000 as a minimum to about 307.5 thousand feddans in 2010 and then to about 846.8 thousand feddans in 2018 as a maximum. The average cultivated area thereof was estimated at 341.2 thousand feddans as an average for the period (2000-2019), and the general time trend equation No. (1) in Table (2) indicates an increase in the area cultivated with summer yellow maize by an annual statistically significant amount estimated at 42.03 thousand feddans, with an annual increase of about 12.32% of its annual average during the study period.

B- Development of the Ardab yield:

The data in Table (1) show that the feddan yield of the summer yellow maize crop ranged between a minimum of about 21.16 ardabs/ feddan in 2010 and a maximum of about 24.52 ardabs / feddan in 2001, with an estimated decrease of 12.6% compared to 2001, and an annual average estimated about 22.81 ardab/feddan as an average for the period (2000-2019). The results of the equation of the general time trend of feddan yield No. (2) in Table (2) indicated that there is no significant change in the feddan yield during the study period, which indicates that it revolves around its arithmetic average.

Table 1. The development of the cultivated area, ardab yield, and total production of the summer yellow maize crop during the period (2000-2019)

Year	Cultivated area (thousand feddan)	Ardab yield (ardab/ feddan)	Total production (million ardabs)
2000	56.4	21.26	1.199
2001	63.2	24.52	1.549
2002	116.6	24.38	2.844
2003	78.0	22.15	1.726
2004	113.8	23.71	2.697
2005	149.6	23.91	3.577
2006	141.5	22.28	3.153
2007	177.2	22.93	4.063
2008	217.0	22.47	4.877
2009	262.5	22.93	6.020
2010	307.5	21.16	6.507
2011	276.3	22.19	6.131
2012	317.9	22.21	7.060
2013	415.2	22.61	9.388
2014	467.1	23.46	10.961
2015	519.0	21.31	11.061
2016	673.4	22.80	15.353
2017	842.2	23.94	20.161
2018	846.8	22.64	19.168
2019*	782.7	23.33	18.261
Overall average	341.2	22.81	7.788

Source: estimated and calculated from Saleh and Enas (2013) Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Cairo, various issues.

* Website of the Economic Affairs Sector: agri.aljeelalmoshreq.com

Table 2. Equations of the general time trend for each of the area, yield and total production of the summer yellow maize crop in Egypt during the period (2000 - 2019)

S.n	Item	Fixed amount	Regression coefficient B	R ²	Average	Annual rate of change (%)	F
1	Area (thousand ardabs)	100.14 (-2.36)*	42.03 (11.84)**	0.886	341.2	12.32	140.19**
2	yield (ardab/ardab)	23.01 (49.27)**	-0.02 (-0.49)	0.013	22.81	0.09	0.24
3	Production (million ardabs)	-2.333 (-2.19)**	0.964 (10.87)**	0.73	7.788	12.37	118.19**

- The numbers below the regression coefficients indicate the computed value (t),
- (***) Significant at 0.01, (*) Significant at 0.05, (-) Non-significant

Source: It was calculated from the data in Table (1).

C- Development of the Total Production: Table (1) indicates an increase in the total production of the summer yellow maize crop from about 1.199 million ardabs in 2000 as a minimum to about 20.161 million ardabs in 2017 as a maximum, and an annual average of about 7.788 million ardabs during the study period. The general time trend equation No. (3) in Table (2) indicates that the total production is increasing by a statistically significant annual amount, estimated at 0.964 million ardabs, with an annual increase rate of about 12.37% of its annual average during the study period.

Second: Geographical distribution of the summer yellow maize crop among the sectors of the Republic:

Table (3) indicates the concentration of the summer yellow maize crop in the Lower Egypt sector, with relative importance estimated at 55.1% of the area cultivated with the crop at the level of the Republic, amounting to about 732.79 thousand feddans, and about 59.46% of the total production of the crop at the level of the Republic, which amounts to about 16.80 million ardabs, followed by the sectors of Upper Egypt and Middle Egypt, with relative importance estimated at 20.9%, 12.7%, respectively, of the average total cultivated area, and about 16.37% and 12.03%, respectively, of the average total production at the level of the Republic. The relative importance of the sector outside the valley was estimated at 11.3% and 12.14% of the average cultivated area and total production, respectively. The data of the same table indicates that the average in feddan yield of the Lower Egypt sector amounted to about 24.75 ardab/feddan, followed by the sector outside the valley by about 24.64 ardab/feddan, followed by the sectors of Middle Egypt and Upper Egypt by about 21.61, 17.97 ardab/feddan, respectively, as an average for the period (2015 - 2019).

By testing the effect of each of the sectors, and the time represented in the time period (2015-2019) on the yield of ardabs of the summer yellow maize crop through the analysis of variance in two directions (Macfarland, 2012), the results in Table (4) indicated that there were significant differences in feddan yield between sectors, while the statistical significance was not established over time. Accordingly, the least significant difference (L.S. D) test was conducted to test the significance of differences in ardab yield between sectors (Glen, 2003), which are shown in Table (5). The results were divided into two groups, the first represented in (the Lower Egypt and outside the valley), which did not prove significant differences between them, while it was found that there were significant differences between them and the sectors of the second group, which is represented in (Middle Egypt and Upper Egypt).

Table 3. The relative importance of the summer yellow maize production sectors as an average for the period (2015-2019)

Sectors	Cultivated area in thousand ardabs	Relative importance %	Total production in million ardabs	Relative importance %	Yield
Total Lower Egypt	403.55	55.1%	9.99	59.46%	24.75
Total Upper Egypt	152.98	20.9%	2.75	16.37%	17.97
Total Middle Egypt	93.47	12.7%	2.02	12.03%	21.61
Total outside the valley	82.79	11.3%	2.04	12.14%	24.64
Total Republic	732.79	100%	16.80	100%	22.92

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Cairo, various issues.

Table 4. Results of the analysis of variance in two directions to test the effect of each of the sectors and time on the feddan yield of the summer yellow maize crop during the average period (2015-2019)

Sources of difference	Degrees of freedom (Dfs)	Sum of squares of total deviations	Average sum of squares of total deviations	"F" Value
Between sectors	3	154.806	51.602	39.944**
Between years	4	12.275	3.069	2.375
error	12	15.502	1.292	
Total	19	182.583		

- (**) significant at 0.01, (-) non-significant

Source: Collected and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Cairo, various issues.

Table 5. The results of the test (L, S, D) to test the significant differences between the feddan yield of the sectors producing yellow maize crop as an average for the period (2015-2019)

Sectors	Yield	Outside the valley	Middle Egypt	Upper Egypt
Lower Egypt	24.75	0.11 ⁻	3.14**	6.78**
Outside the valley	24.64	-	3.03**	6.67**
Middle Egypt	21.61		-	3.64**
Upper Egypt	17.97			-

- (**) significant at 0.01, (-) non-significant

Source: It was collected and calculated from the data in Table (3).

The most important summer yellow maize varieties grown in the sectors of the Republic:

Many summer yellow maize varieties are grown in the Republic, distributed in different sectors.

1- Lower Egypt Sector:

Table (6) shows that the following varieties: Single Hybrid 168, Triple Hybrid 352, Single Hybrid 2066, Single Hybrid 3062, Single Hybrid 30n11 are the most important varieties grown in the summer yellow maize crop in the Lower Egypt sector, as the area cultivated with them together represents about 58.8% of the average total cultivated area in the sector, which amounts to about 403.55 thousand feddans, and about 58.8% of the average total production of about 9.98 million ardabs. Single hybrid 168 ranked first with relative importance estimated at 18.57%, 18.45% of the average total cultivated area and total production in the sector respectively, while triple hybrid 352, single hybrid 2066, single hybrid 3062, and single hybrid 30 n 11 ranked second, third, fourth, and fifth, respectively, with relative importance estimated at 12.59%, 9.91%, 9.63%, 7.73%, respectively, of the average cultivated area in the sector, and about 12.62%, 10.13%, 9.72%, 7.88% of the average total production of the sector, while the single hybrid 2055 and triple hybrid 360 ranked last, respectively, with relative importance estimated at 6.05%, 3.4% of the average cultivated area in the sector, respectively, and about 6.01%, 3.34% of the average total production of the sector, respectively, as an average for the period (2015- 2019). The data in the same table also indicate that the highest variety in terms of feddan yield is the single hybrid variety 3084, where its yield reached about 25.35 ardabs / feddan, representing about 102.4% of the average feddan yield of the summer yellow maize crop in the sector, followed by the single hybrid variety 2066 with an average yield of about 25.16 ardabs/feddan, then single hybrid 30 N11 with an average yield of about 25.13 ardabs/ardabs. Also, the triple hybrid variety 352 ranked last as the least productive feddan variety, estimated at about 24.14 ardab/feddan, representing about 97.5% of the average feddan yield of the crop in the sector, as an average for the study period.

2- Middle Egypt Sector:

The data in Table (6) indicate that the single hybrid variety 3062 ranks first among the summer yellow maize varieties grown in the Middle Egypt sector in terms of the cultivated area, with an estimated rate of 24.99% of the total area planted with the crop at the sector level, which amounts to about 93.46 thousand feddans, then Single Hybrid 2066, Single Hybrid 2055, Single Hybrid 168, Single Hybrid 30 N11 ranked from second to fifth with relative importance estimated at 18.65%, 15.05%, 13.22%, 7.43% for each of them, respectively.

The area of these varieties together represents about 79.4% of the total cultivated area in the sector, while the two varieties single hybrid 3084 and triple hybrid 352 occupied the last two ranks with a relative importance estimated at about 6.55%, 4.69% of the average cultivated area. It was also found that the single hybrid variety 3062 is the highest variety in terms of production, with a relative importance estimated at 24.86% of the total production of the crop at the sector level, which amounts to about 2.02 million ardabs. The varieties (Single Hybrid 2066, Single Hybrid 2055, Single Hybrid 168, Single Hybrid 30 N11) ranked from second to fifth with relative importance estimated at 18.33%, 15.16%, 13.32%, 7.44%. In order of the average total production of the crop, the two varieties single hybrid 3084 and triple hybrid 352 occupied the last two ranks with a relative importance estimated at 4.24%, 3.1% of the average total production of the sector, respectively, as an average for the study period (2015-2019).

It was also shown from the same table that the highest yielding feddan variety is the single hybrid variety 30 N11, where its feddan yield reached about 21.84 ardabs / feddan, representing about 101.1% of the general average feddan yield of the summer yellow maize crop in the sector, followed by the single hybrid 2055 with an average feddan yield amounted to 21.64 ardabs / feddan, then the single hybrid variety 3062 with an average yield of about 21.46 ardabs / feddan, while the single hybrid 3084 ranked last as the lowest productive feddan variety, estimated at 21.17 ardab / feddan, representing about 97.9% of the average ardab yield of the crop as an average for a period studying.

3- Upper Egypt Sector:

Table (6) shows that the varieties: yellow gold, balady, single hybrid 3062 are considered the most important varieties grown in the yellow the maize crop in the Upper Egypt sector, as the area planted with them together represents about 65.4% of the average total cultivated area in the sector, which is about 500.74 thousand ardabs, and about 74.1 percent of the sector's total average production, which is about 152.97 million ardabs. The yellow gold variety ranked first, with a relative importance estimated at 41.54%, 44.36% of the average cultivated area and the total production of the sector, respectively, and the two varieties Baldy, Single Hybrid 3062 ranked second and third, respectively, with relative importance estimated at 16.59%, 15.92 % of the average cultivated area, respectively, and about 12.73%, 17.09% of the average total production of the sector, respectively, while the two varieties Triple Hybrid 352 and Single Hybrid 168 occupied the last two ranks, respectively, with relative importance estimated at about 11.83%, 3.06% of the average cultivated area, and about 9.46%, 3.27% of the average total production of the sector, respectively, as an average for the period (2015-2019).

The data of the same table indicates that the single hybrid variety 168 has the highest yield in terms of feddan yield, reaching about 19.59 ardab/feddan, followed by the golden yellow variety with an average yield of about 19.21 ardab/feddan, then the single hybrid variety 3062 with an average yield of about 18.77 ardabs/feddan, while the variety ranked last as the least productive feddan variety, estimated at 13.89 ardabs/feddan as an average for the study period.

Table 6. The relative importance of the summer yellow maize varieties in the sectors of the Republic as an average for the period (2015-2019)

Sector	Variety	Cultivated area per thousand ardabs	Relative importance %	Total production in million ardabs	Relative importance %	Ardab yield
Lower Egypt	Single Hybrid 168	74.95	18.57	1.84	18.45	24.53
	Triple Hybrid 352	52.26	12.95	1.26	12.62	24.14
	Single Hybrid 2066	40.00	9.91	1.01	10.13	25.16
	Single Hybrid 3062	38.87	9.63	0.97	9.72	24.83
	Single Hybrid 30 N 11	31.18	7.73	0.79	7.88	25.13
	Single Hybrid 3084	29.22	7.24	0.74	7.44	25.35
	Single Hybrid 2055	24.40	6.05	0.60	6.01	24.42
	Triple Hybrid 360	13.71	3.40	0.33	3.34	24.65
	Other varieties	98.96	24.52	2.44	24.41	24.48
Total Lower Egypt	403.55	100%	9.98	100%	24.75	
Middle Egypt	Single Hybrid 3062	23.36	24.99	0.50	24.86	21.46
	Single Hybrid 2066	17.43	18.65	0.37	18.33	21.43
	Single Hybrid 2055	14.06	15.05	0.31	15.16	21.64
	Single Hybrid 168	12.36	13.22	0.27	13.32	21.28
	Single Hybrid 30 N 11	6.94	7.43	0.15	7.44	21.84
	Single Hybrid 3084	6.12	6.55	0.14	6.66	21.17
	Triple Hybrid 352	4.38	4.69	0.09	4.69	21.41
	Other varieties	8.81	9.42	0.19	9.54	21.74
	Total Middle Egypt	93.46	100%	2.02	100%	21.61
Upper Egypt	Golden yellow	63.54	41.54	1.22	44.36	19.21
	Balady (Domestic)	25.38	16.59	0.35	12.73	13.89
	Single Hybrid 3062	24.35	15.92	0.47	17.09	18.77
	Triple Hybrid 352	18.10	11.83	0.26	9.46	16.43
	Single Hybrid 168	4.68	3.06	0.09	3.27	19.59
	Other varieties	16.92	11.06	0.36	13.09	21.08
	Total Upper Egypt	152.97	100%	2.75	100%	17.97
Outside the valley	Single Hybrid 168	18.64	22.52	0.47	23.05	25.12
	Single Hybrid 166	12.59	15.21	0.32	15.69	23.23
	Triple Hybrid 352	7.04	8.50	0.13	6.37	20.43
	Single Hybrid 176	6.90	8.33	0.18	8.82	26.01
	Single Hybrid 162	5.42	6.55	0.14	6.86	25.13
	Triple Hybrid 360	5.41	6.54	0.13	6.37	22.88
	Single Hybrid 167	2.45	2.96	0.06	2.94	18.69
	Other varieties	24.34	29.39	0.61	29.90	24.61
Total outside the valley	82.79	100%	2.04	100%	24.64	

Source: Collected and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Cairo, various issues.

4- Outside the Valley Sector:

The data in Table (6) shows that the single hybrid variety 168 ranks first among the summer yellow maize varieties grown in the outside valley sector in terms of the cultivated area, with an estimated rate of about 22.52% of the total area planted with the crop in the sector, which is about 82.79 thousand ardabs, followed by the varieties Single Hybrid 166, Triple Hybrid 352, Single Hybrid 176, Single Hybrid 162 with relative importance estimated at 15.21%, 8.5%, 8.33%, 6.55%, respectively, of the total area planted with the crop at the sector level, respectively. Their combined area represents about 61.11% of the total cultivated area in the sector, while the single hybrid variety 167 ranked last, with a relative importance estimated at 2.96% of the total area of the crop in the sector. The single hybrid 168 variety is considered the highest in terms of production, with a relative importance estimated at 23.05 percent of the total production of the crop at the sector level, which amounts to about 2.04 million ardabs. The varieties Single Hybrid 166, Single Hybrid 176, Single Hybrid 162, Triple Hybrid 352 ranked second to fifth with relative importance estimated at 15.69%, 8.82%, 6.86%, and 6.37%, respectively, of the total production of the crop in the sector. The single hybrid variety 167 ranked last as the least "totally" productive variety, with a relative importance estimated at 2.94% of the average total production of the crop in the sector for the study period (2015-2019).

The data of the previous table also indicated that the single hybrid 176 variety had the highest yield in feddan at about 26.01 ardab / feddan, representing about 106.1% of the general average feddan yield of the summer yellow maize crop in the sector, followed by the single hybrid variety 162 with an average feddan yield estimated at 13.25 ardabs / feddans, then the single hybrid 168 variety, with an average feddan yield estimated at 25.12 ardabs/feddan. Also, the single hybrid variety 167 ranked last as the least productive feddan variety, estimated at 18.69 ardabs / feddans, representing about 76.2% of the average feddan yield of the crop as an average for the study period.

Statistical analysis of the effect of the most important varieties grown in the sectors of the Republic on the feddan yield of the summer yellow maize crop as an average for the period (2015-2019):

A two-way analysis of variance was conducted to test the effect of the cultivated varieties and the time represented in the time period (2015-2019) on the feddan yield of the summer yellow maize crop in the Republic sectors.

Lower Egypt Sector:

The results of the analysis shown in Table (7) indicated that there was no statistical significance of the differences in ardab yield among the varieties, while it was found that there were significant differences in ardab yield between the years of study, due to the effect of other technological methods that are reflected in the time element and not measured by the model. Accordingly, the current varietal map can be considered the best map in the current situation to achieve the highest ardab yield in the Lower Egypt sector, with the need to work on increasing the feddan yield and devising modern high-yield varieties to increase the feddan yield and the total production of the summer yellow maize crop in the sector.

1- Middle Egypt Sector:

The results of the analysis of variance in Table (7) showed that the statistical significance of differences in ardab yield between varieties was not proven, while it was found that there were significant differences in ardab yield between years of the study, due to the effect of other technological methods that are reflected in the time element and not measured by the model. Accordingly, the current varietal map can be considered the best map in the current situation to achieve the highest yield in feddan of the summer yellow maize crop in the sector.

2- Upper Egypt Sector:

The results of the analysis of variance shown in Table (7) indicated that there were significant differences in the feddan yield among the cultivated varieties, while the significant differences for the time component were not proven, which explains the effect of the cultivated varieties on the difference in the feddan yield in the Upper Egypt sector. Accordingly, the least significant difference (L.S.D) test was conducted to test the significance of the differences between the varieties and some of them, which is shown in Table (8), where it was found that there were significant differences between the single hybrid variety 168 as the highest cultivated variety in feddan yield and between the two varieties (triple hybrid 352, balady). It was also found that there were significant differences between the balady variety as the lowest cultivated variety in feddan yield and the rest of the varieties except for the variety (triple hybrid 352), while the significance of the rest of the varieties was not proven.

Table 7. The results of the analysis of variance to test the effect of each of the cultivated varieties and the time on the feddan yield of the summer yellow maize crop in the sectors of the Republic during the period (2015-2019)

Sector	Sources of difference	Degrees of freedom (DFs)	Sum of squares of total deviations	Average sum of squares of total deviations	"F" Value
Lower Egypt	between varieties	8	6.44	0.81	0.87
	Between years	4	19.54	4.89	5.25**
	error	32	29.81	0.93	
	Total	44	55.79		
Middle Egypt	between varieties	7	1.78	0.25	0.47
	Between years	4	142.35	35.59	66.20**
	error	28	15.05	0.54	
	Total	39			
MiddleEgypt Upper Egypt	between varieties	5	166.523	33.305	6.547**
	Between years	4	18.289	4.572	0.899
	error	20	101.743	5.087	
	Total	29	286.555		
Outside the valley	between varieties	7	227.29	32.47	2.514*
	Between years	4	42.21	10.55	0.817
	error	28	361.69	12.92	
	Total	39	631.19		

– (**) Significant at 0.01, (*) Significant at 0.5, (-) non-significant

Source: Collected and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Cairo, various issues.

Table 8. The results of the test (L, S, D) to test the significant differences between the ardab yield of the most important summer yellow maize varieties in the Upper Egypt and outside the Valley sectors during the average period (2015-2019)

Sector	Variety	Yield	Golden yellow	Single Hybrid 3062	Single Hybrid 352	Balady		
Middle Egypt Upper Egypt	Single Hybrid 168	19.59	0.38	0.82	3.16*	5.7**		
	Golden yellow	19.21	-	0.44	2.78	5.32**		
	Single Hybrid 3062	18.77		-	2.34	4.88**		
	Triple Hybrid 352	16.43			-	2.54		
	Balady	13.89				-		
	Other varieties	21.08						
Outside the valley	Variety	yield	Single Hybrid 162	Single Hybrid 168	Single Hybrid 166	Triple Hybrid 360	Triple Hybrid 352	Single Hybrid 167
	Single Hybrid 176	26.01	0.88	0.89	2.78	3.13	5.58*	7.32**
	Single Hybrid 162	25.13	-	0.01	1.9	2.25	4.7*	6.44**
	Single Hybrid 168	25.12		-	1.89	2.24	4.69*	6.43**
	Single Hybrid 166	23.23			-	0.35	2.8	4.54
	Triple Hybrid 360	22.88				-	0.35	2.8
	Triple Hybrid 352	20.43					-	2.45
	Single Hybrid 167	18.69						-

- (**) significant at 0.01, (*) significant at 0.5, (-) non-significant

Source: It was collected and calculated from the data in Table (6).

3- Outside the Valley Sector:

The results of the analysis of variance in Table (7) indicate that there are significant differences in ardab yield among the varieties, while the significant differences were not proven for the time component, and accordingly, the least significant difference test was conducted (L.S.D) to test the significance of the differences between the varieties and some of them shown in Table (8), where it was found that there were no significant differences between the varieties of single hybrid 176, single hybrid 162, and single hybrid 168 as the highest cultivated varieties in feddan yield, but there are between them and my varieties (triple hybrid 352, single hybrid 167) significant differences, while the significance of the rest of the varieties was not proven.

In light of the above, it is clear that there is no agreement between the arrangement of varieties in the sectors of Upper Egypt and outside the valley in terms of the cultivated area, and their arrangement according to the "feddan yield of the summer yellow maize crop as an average for the period (2015-2019), where the balady variety in the Upper Egypt sector ranked second in terms of area the farm while ranking the fifth place in terms of feddan yield. Also, the single hybrid 168 variety ranked fifth in terms of cultivated area and came in first place in terms of feddan yield in the same sector, and triple hybrid 352 in a sector outside the valley ranked third in terms of cultivated area and came in sixth place in terms of feddan yield, while the single hybrid 176 ranked fourth in terms of cultivated area and came first in terms of feddan yield in the same sector. Therefore, it is necessary to expand the cultivation of high-yield summer yellow maize varieties as a single

hybrid 168, in addition to improving the feddan yield of the rest of the other low-yield feddan varieties by adopting modern technological methods in order to increase the agricultural production of yellow maize.

Fifth: Suggested varietal map for summer yellow maize crop:

The proposed varietal map, which was reached through the results of the study and recorded in Table (9), is represented in the stability of the current varietal map in the Lower and Middle Egypt sectors with the expansion of cultivation of some varieties at the expense of other varieties in the Upper Egypt and outside the valley sectors as follows:

Upper Egypt Sector:

Replacement of varieties (Single Hybrid 168, Golden Yellow, Single Hybrid 3062) to replace all other cultivated varieties at the sector level, which leads to an increase in production to about 2.93 million ardabs, as a result of increasing the average ardab yield of the crop from about 17.97 ardabs/feddan to about 19.15 ardabs / feddans, with an increase of about 1.18 ardabs / feddan, with an increase of about 6.6% of the current average feddan yield, as shown in **Table (10)**.

Outside the Valley Sector:

Replacement of the varieties (Single Hybrid 167, Single Hybrid 162, Single Hybrid 168, Single Hybrid 166, Triple Hybrid 360) to replace all other cultivated varieties at the sector level, which leads to an increase in production to about 2.07 million ardabs, and an increase in the average ardab yield of the crop from about 24.64 ardabs / feddans to about 25.02 ardabs / feddans, with an increase of about 0.38 ardabs / feddan, with an estimated increase of about 1.5% of the current average feddan yield, as shown in **Table (10)**.

The application of the proposed varietal map at the level of the Republic results in increasing the feddan yield from 22.92 ardabs / feddan to 23.21 ardabs / feddan, an increase of about 0.29 ardabs / feddan, and an increase of about 1.3% of the current feddan yield of the summer yellow maize crop at the level of the Republic. Thus, the total production increased to about 17.01 million ardabs.

Table 9. Suggested varietal map of summer yellow maize crop in Egypt

Sector	Variety	Average yield Per ardab/ ardab	The proposed area to be cultivated in thousand ardabs	Expected production in millions of ardab
Lower Egypt	Current varietal map	24.75	403.55	9.99
Middle Egypt	Current varietal map	21.61	93.47	2.02
Upper Egypt	Single Hybrid 168	19.59	37.17	0.73
	Golden yellow	19.21	77.66	1.49
	Single Hybrid 3062	18.77	38.14	0.71
	Total	19.15	152.97	2.93
Outside the valley	Single Hybrid 176	26.01	34.48	0.896
	Single Hybrid 162	25.13	8.55	0.214
	Single Hybrid 168	25.12	21.76	0.546
	Single Hybrid 166	23.23	12.59	0.292
	Triple Hybrid 360	22.88	5.41	0.123
	Total	25.02	82.79	2.07
Republic	Overall average	23.21*	732.79	17.01

Where: * indicates the overall area-weighted average of the proposed varieties.

Source: Collected and calculated from: **Table (10)**

Table 10. The expected increase in the total production of the summer yellow maize crop according to the proposed varietal map

Sector	Variable	Current situation	Suggested situation	Change amount	% For change
Lower Egypt	Ardab yield in ardab/ ardab	24.75	24.75	-	-
	Total production in millions of ardab	9.99	9.99	-	-
Middle Egypt	Ardab yield in ardab/ ardab	21.61	21.61	-	-
	Total production in millions of ardab	2.02	2.02	-	-
Middle Egypt	Ardab yield in ardab/ ardab	17.97	19.15	1.18	6.6
Upper Egypt	Total production in millions of ardab	2.75	2.93	0.18	6.6
Outside the valley	Ardab yield in ardab/ ardab	24.64	25.02	0.38	1.5
	Total production in millions of ardab	2.04	2.07	0.03	1.5
Republic	Ardab yield in ardab/ ardab	22.92	23.21	0.29	1.3
	Total production in millions of ardab	16.80	17.01	0.21	1.3

Whereas: Amount of change = the variable in the proposed situation - the variable in the current situation

% For change = (amount of change/variable in the current situation) x 100

Source: Collected and calculated from: Table (6) to (9)

The expected economic effects of applying the proposed categorical map on indicators of economic efficiency: **Table (11)**. shows the expected positive impact of applying the proposed varietal map for summer yellow maize crops through its impact on some economic indicators. The table shows an increase in the main and secondary outputs of the summer yellow maize crop by 0.29 ardab / feddan, 0.14 Heml (Heap of hay)/ feddan, respectively, which resulted in an increase in their value by 120 and 9.35 pounds, respectively, over their average value in the current situation. It also shows the decrease in the cost of production of the ardab unit from 338.57 to 334.19 pounds, a rate of about 1.3% of the average total production costs of the ardab in the current situation, which leads to an increase in the total feddan yield from 9.85 to 9.98 thousand pounds, an increase that represents about 1.3% of the average total revenue in the current situation. Thus, the net return increased to 2.22 thousand pounds, an increase representing about 6.2% of the average net return in the current situation, which amounts to about 2.09 thousand pounds, and the profitability of the invested pound, the profit margin of the product, increased by an estimated 6.2%, 4.8%, respectively, from the average of their value is in the current situation.

Table 11. The expected economic effects of applying the proposed varietal map on the indicators of economic efficiency of the summer yellow maize growers

Economic Indicator	Current situation	Suggested situation	Change amount	% For change
Average main production in ardab	22.92	23.22	0.29	1.3
Average by-product	10.62	10.76	0.14	1.3
The value of the main product in EGP	9140	9260	120	1.3
The value of the by-product in EGP	709.42	718.77	9.35	1.3
Total return in thousand pounds	9.85	9.98	0.13	1.3
Average costs of producing an ardab in EGP	338.57	334.19	4.38	1.3
The feddan net return in thousand pounds	2.09	2.22	0.13	6.2
Return on unit water in EGP/m	0.179	0.190	0.011	6.2
Profitability of the invested pound	26.93	28.61	1.68	6.2
Product profit margin ratio	21.22	22.24	1.02	4.8

Whereas: The current situation and various economic data were calculated for the average period (2015-2019)

Total return = value of the main product + value of the secondary product, - net return = total return - total costs

Return on unit water = net yield in feddan / feddan water ration for yellow maize crop

Profitability of the invested pound = (net return / total costs) x 100

Product profit margin ratio % = (net return / total return or revenue) x 100

The price of an ardab of the main product during the average period (2015-2019) was estimated at about 398.8 pounds, and the price of the lamb from the secondary product was about 66.8 pounds, the total costs were about 7.76 thousand pounds, and the feddan water ration for the yellow maize crop was about 11,683 thousand cubic meters.

Source: Collected and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Cairo, various issues.

Central Agency for Public Mobilization and Statistics, Annual Bulletin of Irrigation and Water Resources Statistics, various issues.

The expected economic effects of applying the proposed categorical map to the national economy

The estimates of **Table (12)** indicate that the application of the proposed varietal map for the summer yellow maize crop at the national level, leads to an increase in the average total production of the crop from about 16.80 million ardab, which is equivalent to about 2.352 million tons, to about 17.01 million ardab, which is equivalent to about 2.382 million tons, an increase of about 0.21 million ardab, equivalent to about 0.03 million tons, and an increase of about 1.3% of the average total production in the current situation, and an increase in the average value of the expected crop production to about 7.313 billion pounds, an increase of about 1.3% from the average value of the crop production in the current situation, which amounts to about 7.218 billion pounds, which led to an increase in the self-sufficiency rate to about 23.99%, an increase of about 1.3% from the average rate of self-sufficiency in the current situation, which is about 23.69%; in addition to reducing the average quantity of imports to about 7.55 million tons, with an average value of about 20.898 billion pounds, a decrease of about 0.3% from its current quantity of about 7.58 million tons, with an average value of about 20.981 billion pounds, which contributes to reducing the value of agricultural imports from about 218.22 billion pounds to about 218.137 billion pounds. Consequently, the deficit in the agricultural trade balance decreased by 0.083 billion pounds, which represents about 0.06% of its value in the current situation.

Table 12. The expected economic effects of applying the proposed varietal map of the summer yellow maize crop on the national economy

Economic Indicator	Current situation	Expected situation	Change amount	% For change
Total production in millions of ardab	16.80	17.01	0.21	1.3
Total production in million tons	2.352	2.382	0.03	1.3
Production value in billion pounds	7.218	7.313	0.095	1.3
Gap size in million tons	7.58	7.55	- 0.03	- 0.40
Self-sufficiency ratio	23.69	23.99	0.3	1.3
Imports in million tons	7.58	7.55	- 0.03	- 0.40
The value of imports in billions of pounds	20.981	20.898	- 0.083	-0.40
The value of agricultural imports in billion pounds	218.22	218.137	- 0.083	- 0.04
Deficit in the agricultural trade balance in billion pounds	130.70	130.617	- 0.083	- 0.06

Whereas: Gap size = total consumption - total production

- Imports value = quantity of imports x average import price in ton
- Net agricultural trade balance = value of agricultural exports - value of agricultural imports
- The area planted with the yellow corn crop during the average period (2015-2019) was estimated at about (0.732 million ardab), the average total consumption was about (9.93 million tons), the average import price in ton was about (2.768 thousand pounds), the average value of agricultural exports was about (70.6 billion pounds).

Source: Collected and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Cairo, various issues.

Summary:

This research aimed at suggesting a varietal map for the summer maize crop by redistributing the high-productivity varieties in the areas where they are cultivated in order to achieve compatibility between the feddan yield and the cultivated area and to estimate the economic effects of that map. The results concluded that there is no agreement between the cultivated area and the feddan productivity of the summer maize varieties grown in the production sectors at the level of the Republic. The proposed varietal map included the expansion of the cultivation of high-yield varieties, single hybrid 168, gold yellow, single hybrid 3062 in the Upper Egypt sector, and varieties of single hybrid 176, single hybrid 162, single hybrid 168, single hybrid 166, triple hybrid 360 in outside the valley sector, while maintaining on the cultivation of the current varieties in the Lower and Middle Egypt sectors. The application of this varietal map results in an increase in the feddan productivity by an estimated increase of 6.6% and 1.5% in the sectors of Upper Egypt and outside the valley, respectively, which leads to an increase in the general average of acre productivity to 23.21 ardab / feddan, with an increase of 1.3% over its current counterpart. It was also found that the application of the proposed varietal map leads to an increase in the net yield of acres, the return on the unit of water, the profitability of the invested pound, with an estimated increase of 6.2% from the average present value of each of them, respectively, and an increase in the product's profit margin by 4.8%. The positive impact of the proposed varietal map on the national economy was also shown by increasing the total production, the value of production, the self-sufficiency ratio of summer maize by about 1.3% for each of them, respectively, which contributes to a decrease in the size of the food gap, and the quantity and value of imports by about 0.4 percent, in addition to reducing the deficit in the agricultural trade balance by 0.083 billion pounds. Therefore, the study recommends the application of the proposed varietal map and the cultivation of high-yield varieties as a single hybrid variety 168 to replace the low-productivity varieties, and the need to provide improved seeds for the proposed varieties at reasonable prices in their production areas, in addition to providing extension services and technological methods that lead to an increase in the feddan productivity of yellow maize.

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دور الأصناف الحديثة في زيادة الإنتاج الكلي لمحصول الذرة الشامية الصفراء الصيفية في مصر

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الملخص

أستهدف البحث إقترح خريطة صنفية لمحصول الذرة الشامية الصفراء الصيفية من خلال إعادة توزيع الأصناف عالية الإنتاجية بالمناطق المنزرعة بها بما يحقق التوافق بين الإنتاجية الفدانية والمساحة المنزرعة وتقدير الآثار الاقتصادية لتلك الخريطة، وقد توصلت النتائج إلى عدم وجود توافق بين المساحة المنزرعة والإنتاجية الفدانية لأصناف الذرة الشامية الصفراء الصيفية المنزرعة بقطاعات الانتاج على مستوى الجمهورية، وقد تضمنت الخريطة الصنفية المقترحة التوسع في زراعة الأصناف عالية الإنتاجية هجين فردى 168، أصفر ذهب، هجين فردى 3062 بقطاع مصر العليا، وأصناف هجين فردى 176، هجين فردى 162، هجين فردى 168، هجين فردى 166، هجين ثلاثى 360 بقطاع خارج الوادى، مع الإبقاء على زراعة الأصناف الحالية بقطاعى الوجه البحرى ومصر الوسطى، ويترتب على تطبيق هذه الخريطة الصنفية زيادة الإنتاجية الفدانية بنسبة زيادة تقدر بنحو 6.6%، 1.5% في قطاعى مصر العليا وخارج الوادى على الترتيب، وبما يؤدي إلى زيادة المتوسط العام للإنتاجية الفدانية إلى 23.21 أردب/ فدان بنسبة زيادة تقدر بنحو 1.3% عن نظيرتها الحالية، كما تبين أن تطبيق الخريطة الصنفية المقترحة تؤدي إلى زيادة كل من صافي العائد الفدانى، والعائد على وحدة المياه، أرباحية الجنيه المستثمر بنسبة زيادة تقدر بنحو 6.2% من متوسط القيمة الحالية لكل منهم على الترتيب، وزيادة هامش ربح المنتج بنحو 4.8%، كما تبين الأثر الإيجابي للخريطة الصنفية المقترحة على الاقتصاد القومى وذلك من خلال زيادة كل من الإنتاج الكلى، قيمة الإنتاج، نسبة الاكتفاء الذاتى للذرة الشامية الصفراء الصيفية بنحو 1.3% لكل منهم على الترتيب، مما يساهم في إنخفاض حجم الفجوة الغذائية، وكمية وقيمة الواردات بنحو 0.4%، بالإضافة إلى خفض العجز في الميزان التجارى الزراعى بمقدار 0.083 مليار جنيه، ولذا توصى الدراسة بتطبيق الخريطة الصنفية المقترحة وزراعة الأصناف عالية الإنتاجية كصنف هجين فردى 168 محل الأصناف منخفضة الإنتاجية، وضرورة توفير التقاوى المحسنة للأصناف المقترحة بأسعار مناسبة بمناطق إنتاجها، بالإضافة إلى تقديم الخدمات الإرشادية والأساليب التكنولوجية التى تؤدي إلى زيادة الإنتاجية الفدانية للذرة الشامية الصفراء.

الكلمات المفتاحية: الأصناف الحديثة - الإنتاجية الفدانية - تحليل التباين - أقل فرق معنوى LSD