IMPACT OF IMPROVED SEEDS AND SOME MODERN TECHNOLOGIES ON INCREASING THE SUPPLY OF WHEAT CROP IN IRAQ FOR THE AGRICULTURAL SEASON 2019-2020

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ABSTRACT

This research was aimed to study the impact of modern technologies represented by (High-productivity improved seeds, fertilizer of leaves, Atlantis pesticide) on increasing production both quantitatively and qualitatively. The importance of the research comes from take a set of programs and use some modern technologies in order to increase the productivity of the donum for the purpose of vertical increase of production per unit area. The problem of the research was the low rate of wheat crop productivity for Iraq compared to global productivity rates, and given the importance of achieving self-sufficiency in wheat from local production due to the decreasing global stockpile, high supply prices and low local production in the past years with limited available resources. A set of programs have been taken and some modern technologies have been introduced in order to increase the productivity of the donum and achieve the vertical increase of production per unit area through the program to enhance food security. The Harry, Ayer & Edward Schuh model was used in order to measure the degree of transition of the supply function of the program fields compared to the traditional fields, in order to estimate the relative transition coefficient in the supply function resulting from the technical change represented by the adopting of modern technologies from this crop, as the results of the analysis showed that modern technologies lead to a shift in the supply function by (2.9-8.04-5.3%) for the three improved wheat varieties, respectively. The results also showed the presence of a large waste of the water resource that led to a negative impact on the production.

Keyword: food security, vertical expansion, productivity, harry, ayer and edward schuh.
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اثر البذور المحسنة وبعض التقانات الحديثة في زيادة عرض محصول القمح في العراق للموسم الزراعي 2019–2020

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المستخلص

هدف البحث الى دراسة اثر التقانات الحديثة المتمثلة بـ(الاصناف المحسنة عالية الانتاجية و التسميد الورقي بالعناصر الصغرى ومبيد اتلنتس) على زيادة الانتاج كماً ونوعاً، وتاتي أهمية البحث من أهمية اتخاذ مجموعة من البرامج وإدخال بعض التقانات الحديثة لاجل زيادة غلة الدونم لغرض تحقيق الزيادة العمودية للإنتاج بوحدة المساحة، وتمثلت مشكلة البحث في تدني معدل غلة محصول القمح للعراق مقارنة بمعدلات الغلة العالمية، ونظراً لأهمية تحقيق الاكتفاء الذاتي للقمح من الانتاج المحلي بسبب تناقص الخزين العالمي وارتفاع أسعار المعروض وانخفاض الإنتاج المحلي في السنوات الماضية مع محدودية الموارد المتاحة فقد تم اتخاذ مجموعة من البرامج وإدخال بعض التقانات الحديثة لاجل زيادة غلة الدونم وتحقيق الزيادة العمودية للإنتاج بوحدة المساحة عن طريق برنامج تعزيز الامن الغذائي، وتم الاستعانة بنموذج هاري اير – ادوارد شو لغرض قياس درجة انتقال دالة العرض لحقول البرنامج مقارنة بالحقول التقليدية ، ليتم تقدير معامل الانتقال النسبي في دالة العرض والناتج عن التغير التقني المتمثل في اعتماد تقنيات حديثة من هذا المحصول، اذ اظهرت نتائج التحليل ان التقانات الحديثة تؤدي الى انتقال دالة العرض بنسبة (2.9 – 8.04 – 5.3) % لاصناف القمح المحسنة الثلاثة على الترتيب، كما اظهرت النتائج وجود هدر كبير في مورد المياه ادى الى التأثير السلبي على الانتاج.

كلمات مفتاحية: الأمن الغذائي، التوسع العمودي، الانتاجية، هاري آير – ادوارد شو.
***جزء من رسالة ماجستير للباحث الاول.**

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INTRODUCTION

The wheat is one of the most important cereal crops in the world and Iraq and it ranks first in terms of production, consumption and cultivated area, as more than one-third of the world's population depends on this crop (10). The wheat crop contains important nutrients, most notably carbohydrates as well as high calories, so the crop is a strategic feature in international economic relations (16) and given the many nutritional uses of wheat, it has been called: the King of Food Crops (22). The wheat crop is tops the strategic crops in Iraq and due to its importance as a major source of food and its role in economic and social development, especially because of the widening food gap, the largest part of which is due to the global deficit and the increase in consumption, which reached 49% globally (1). The backwardness of the agricultural sector in general and low productivity of the unit area in developing countries necessitate that those interested in this sector focus their attention on methods leading to increased production. Therefore, most international agricultural organizations resorted to the use of modern technologies in the production, including international Centre for Agricultural Research in the Dray Areas (ICARDA), which adopted the project to enhance food security in developing countries and was supervised by the Agricultural Research Directorate /Ministry of Agriculture. The activities of the program were initiated in evaluating and publishing the technologies if they were successful (19).Hence, this research is conducted for the purpose of assessing the program from an economic point of view and knowing the results reached by the program. The importance of the research comes from the importance of studying the possibility of vertical expansion in agriculture as one of the solutions to achieve the goals of agricultural development, which is to increase the efficiency of the use of agricultural economic resources and to obtain the maximum possible production, and it also stems from the importance of the crop as the first crop in consumption in the world. Iraq suffers from a low rate of wheat productivity compared to global productivity rates. And given the importance of achieving self-sufficiency in wheat from local production due to the decreasing global stockpile, high supply prices and low local production in the past years with limited available resources, it is important to take a set of programs and introduce some modern technologies in order to increase the productivity of donums for the purpose of the vertical increase of production per unit area, which stimulate researchers to study this impact and these changes in productivity rates. The research assumes that the use of modern technologies in the field of agriculture in general leads to increases production, improving quality, and have a significant impact on increasing the productivity of wheat crop through increasing the productivity of resources and making the maximum use of seeds, fertilizers, and other production components. As a result of this increase in productivity there will be an increase in total production, which leads to shifting the function of crop supply to the right (upward), which reflects the efficiency of the use of farm resources. The research aims to study the impact of modern technologies (improved seeds high-productivity, fertilizer of leaves, and the Atlantis pesticide) on improving and increasing production in quantity and quality, which results in an increased in a farm income, especially with regard to wheat crop, and to achieve this a number of the following sub-objectives:

1- This study was aimed to investigate impact of modern technologies on the productivity of per donum of wheat crop.

2- The economic impact of modern technologies on the supply function transition of the wheat crop.

3- Recognizing the impact of applying modern technologies on wheat crop production

MATERIALS AND METHODS

Both the descriptive method for the economic phenomena of the wheat crop under study, and the quantitative analytical method for the economic phenomena and variables were used in some statistical and mathematical methods in analyzing the data collected through a questionnaire form specially designed for this purpose, and the Harry, Ayer & Edward Schuh model was used to measure the degree of transition of the supply function in order to estimate the relative transition coefficient in

the supply function, which results from the technical change of use of new varieties of this crop (7):

$$K = \sum ((\!(1 - \frac{Yu.Fu}{Ya.Fa})\!) . Pa) * 100$$

Where:

K : The relative amount of transition in supply

Yu: Average productivity of traditional cultivation

Ya: Average productivity of modern technologies cultivation

Fu: Extraction ratio for traditional cultivation

Fa: Extraction Ratio for cultivation with Modern Technologies

Pa: The relative importance of cultivated area with modern technologies to the average of cultivated area of the whole crop.

The impact of the use of modern technologies on the productivity per donum under study was measured for each of the areas used for these technologies compared to the traditional areas that did not use those technologies, and with regard to data sources, data were collected from their primary sources through a questionnaire designed for this purpose, it includes all farmers participating in the food security enhancement program of about (70) farmers in the governorates (Diwania, Wasit, Diyala, Baghdad), as well as the areas of farmers not included in the program for the purpose of comparison between them, as well as secondary data obtained from food security enhancement program, Ministry of Agriculture, Ministry of Planning and relevant authorities. This topic has been addressed by many researchers for different crops (5, 6, 8, 23).

RESUITS AND DISCUSSION

In this part of the research, some quantitative and relative statistical indicators were calculated, which were represented by the growth rates of production, productivity, and the cultivated area at the level of Iraq and the studied governorates, some statistical tests and quantitative comparisons of production, productivity, and area for the study sample and comparison sample, as well as analysis variance and tests for significant differences tests T-Test for the two samples. Concerning the growth rate, which is one of the important indicator that gives a preliminary view of the nature of the studied variable, so the growth rates of area, production, and productivity were calculated for the period (1990-2019), as the growth rate of the cultivated area at the level of Iraq reached (-0.00206) and this means that the cultivated area on the level of Iraq recorded negative growth, and this due to agricultural policies that are heading towards vertical increases and reducing horizontal expansion. The entry of ISIS gangs led to the suspension of some areas from production and the exit of other areas from production due to the decrease in water imports from the neighboring countries with Iraq and due to the salinity and waterlogging of some areas, all of this led to a reduction in the area under wheat cultivation at throughout Iraq. The percentage of areas under wheat crop cultivation in rainfed areas constitutes a large percentage, as it amounts to more than (60%) of the area under wheat cultivation in Iraq (4). It should be noted that Iraq is losing annually, a percentage that may reach 5% of the arable area, and the World Bank estimates that what is lost annually globally is 2% and that the difference between the two percentages indicates the extent of the lack of maintenance, sustainability and preservation of agricultural area in Iraq (3).Production growth has reached (0.051), this means that there is a relative increase in production amounting to (5.1%) at throughout Iraq as a whole, and this confirms our previous words, which led to directing policies towards vertical expansion, which led to the emergence of a production growth at a rate higher than the area growth rate which appeared in a negative percentage, which confirms the occurrence of an increase in the productivity of the unit area, that led to an increase in production. As for the productivity, the growth rate reached (0.051) and this means an increasing in productivity by (5.1%). As for Wasit Governorate, the growth rate of the area under cultivation reached (0.027), which means an increase in the cultivated area by (2.7%), and for the growth rate of production reached (0.066). This means that the increase in production amounted to about (6.6%) in Wasit Governorate, as for productivity, the growth rate was recorded at about (0.039), which means an increasing in productivity by (3.9%) in Wasit Governorate. As for Baghdad Governorate, the growth rate of the cultivated

area amounted to about (0.046), which means the cultivated area by (4.6%), while the growth rate of production reached (0.095). This means that the production increased by (9.5%) in Baghdad Governorate. As for productivity, the growth rate was recorded by (0.049), which means an increase in productivity by (4.9%) in Baghdad Governorate. The growth rate of the cultivated area in Diwania Governorate reached (0.039), which means an increase in the cultivated area by (3.9%), as for the production growth rate, it reached (0.076) and this means that the production increased by (7.6%) in Diwaniyah Governorate. As for productivity, the growth rate was recorded (0.038), which means an increase in productivity by (3.8%) in Diwania Governorate. In Diyala Governorate, the growth rate of the cultivated area reached (0.010), which means an increase in the cultivated area by (1%), while the growth rate of production reached (0.082). which means an increase in production by (8.2%) in Diyala Governorate during the period. As for productivity, the growth rate was recorded at about (0.072), which means an increase in productivity by (7.2%) in Diyala Governorate, Table 1:

Table 1. Growth rate of cultivated area, production and productivity in Iraq and some governorates

Governorate	Variable	Growth Rate %
Iraq	Cultivated area	-0.00206
	Production	5.1
	Productivity	5.1
Wasit	Cultivated area	2.7
	Production	6.6
	Productivity	3.9
Baghdad	Cultivated area	4.6
	Production	9.5
	Productivity	4.9
Diwania	Cultivated area	3.9
	Production	7.6
	Productivity	3.8
Diyala	Cultivated area	1
	Production	8.2
	Productivity	7.2

Source: By researcher based on Ministry of Planning/Central Statistical Office data

Comparison of productivity before and after the application technologies

Economists defined productivity as the amount of production obtained from one or all of the factors of production. Several factors, including technical factors, such as the quality and quantity of seeds, fertilizers, pesticides, irrigation method, etc., and technical factors such as how agricultural operations are conducted, cultivation method, planting dates, and so on, affect productivity (17). So it is important to compare the productivity of the fields covered by the program before applying set of technologies and after applying these technologies, as it is necessary to prove the positive impact of applying technologies on productivity, which is one of the most important goals on the basis of which the implementation of the program was adopted. In this regard, there is a set of statistical tests shows that there are differences between productivity before and after applying the set of technologies:

Table 2. Farmers' productivity changes after a technology are applied

Productivity	Number of Farmers	Percentage
Farmers whose productivity has declined	3	% 4
Farmers whose productivity has not changed	5	% 7
Farmers whose productivity has improved	62	% 89

Source: Prepared by the Researchers based on the questionnaire form

Result in Table 2, show the difference in productivity of farmers before and after the applying the program set of technologies, we note that there are some differences in the productivity of the largest percentage of farmers, whose productivity has increased significantly after the applying the technologies, and in this regard and through the data of the questionnaire form, it became clear that (3) farmers their percentage made up (4%) whose productivity did not improve, but rather decreased from the previous level, but this decrease was at very sample rates, and (5) of the farmers constituted (7%) their productivity rates did not change, but they achieved the same previous level, and the largest and remaining percentage, which is (89%) of farmers achieved productivity larger and at higher rates than the previous level, and their number was (62) farmers , and here it can be said that the program achieved (89%) of its desired goal, which is to increase the productivity of farmers covered, and this gives an indication that there are significant differences between productivity levels before and after the application of technologies that must be proven or denied. Through the appropriate statistical tests mentioned below.

Statistical tests for the Research sample:

1- Paired sample T –test

This test is adopted to compare the averages of two samples on which technologies have been applied, and before and after changes are taken (11). In order to apply this test, the hypotheses for this test must be formulated. These hypotheses are:

$H_{0:}$ Average productivity of farmers before technologies = Average productivity of farmers after technologies (there are no significant differences before and after the application of technologies).

H_1: Average productivity of farmers before technologies ≠ average productivity of farmers after technologies (there are significant differences before and after the application of technologies).

One of the prerequisites for this test is that the difference between the two correlated samples follows a normal distribution if the sample size is less than (30) observations, this means that the sample size is large and does not require this condition (2), and in our study the sample size exceeds (30) observations, so the test is applied directly. When applying the test, the results show in Table 3 as follows:

Table 3. T- test between productivity before application of techniques and after application of techniques

Productivity	Sample	Arithmetic average kg/donum	Standard Deviation	Average sample difference (kg/donum)	Correlation Coefficient	T. Test	Sig
After Technologies	70	1003.9	215.8	203.2	0.68 (0.000007)	9.86	0.0000 very significant
Before Technologies	70	800.7	2016.6				

Source: Prepared by the Researcher based on the questionnaire form

The T-test from Table 3, showed that the arithmetic average of productivity after technologies was (1003.9) kg/donum, while the arithmetic average of productivity before technologies was (800.7) kg/donum, which means that there is a difference between the mean of the sample before and after technologies, and this difference is (203.2) kg/donum, as the standard deviation index showed that the dispersion in productivity before technologies is greater than the dispersion in productivity after technologies, and this means that farmers have achieved better levels than before in the stability of productivity, and the results also showed that the correlation coefficient between the two samples amounted to (68%) and this means that the two samples are somewhat related, and this was confirmed by the significant of the correlation coefficient if it appeared to be significant at the level of (1%), which means that the two samples are positively correlated, and the tabular T value of productivity before technology was (9.86), which is significant at the level (1%), which means that we reject the null hypothesis and accept the alternative hypothesis, which states that there are significant differences between the means of the two groups, and this is evidence that there are Significant differences between the

averages of the samples before and after applying the set of technologies, and these differences are in a positive direction, which means that the application of technologies led to an improvement in productivity farmers and had a clear positive effect.

The significant differences between the cultivated varieties (improved seeds and classic seeds):

The Food Security Enhancement Program adopted a set of technologies that were applied at the same time, and these technologies are improved seeds, Fertilizer of leaves, and Atlantis pesticide. Here, it is necessary to compare the productivity of the program fields applied to the technologies and other areas that did not apply the set of technologies. The one-way analysis of variance test was adopted to test the significant differences between program fields and other fields. This test is performed on the assumption of a set of hypotheses. These hypotheses are tested, and our assumption here are:

H_0: the first sample average = the second sample average = the third sample average = the last sample average (there are no differences between averages).

$H_{1:}$ There are at least two unequal averages (there is at least one difference between averages).

It should be noted here that the study sample based on three improved seeds of the wheat crop (Bhooth 22, Ebaa 99, and Bhooth 10).

The comparative sample included seven varieties (Sabah, Abu Ghraib, Barcelona, Tamuz, Rashid, Edna, and Bora). The productivity of these varieties was compared for the purpose of studying the significant differences, and the results in Table 4 show the following:

Table 4. Variation analysis to test the existence of significant differences between the productivity of varieties

Group	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	**1644708.665**	**9**	**182745.407**		
Within Groups	**6755737.585**	**130**	**51967.212**	**3.517**	**0.001**
Total	**8400446.250**	**139**	**-**		

Source: SPSS output

Table 4 revealed that the calculated F value about (3.51), and its significance is less than 1%, which means that reject the null hypothesis that there are no significant differences between averages and accept the alternative hypothesis that there are significant differences between the means of the studied samples. Also it is clear that there are significant differences at the level of (1%) between the productivity of the studied varieties, and this certainly requires accurate identification of these differences between the different varieties (as long as the variance test proved the presence of significant differences), and the significant differences are revealed by resorting to post test (Post Hoc Tests), which are used in case of proving that there are significant differences between the averages through the analysis of variance Table, and this what has achieved in Table 5:

There are many tests that are relied upon to calculate the significant differences, and each test has its own hypotheses, and the appropriate test for our study is the L.S.D. (Leas Significant Different) test because there is a variation in the sample size of farmers' who used the varieties, which is allowed by this test. This test is one of the simplest and most widely used to make a comparison of coefficients (varieties) and is used only when F is a significant value because if F is not significant, it means accepting the null hypothesis, that is, equal to the average coefficients, it is only necessary to compare them in case of prior independent comparisons (21). The difference between any two averages is calculated and compared with the L.S.D value, each difference is greater or equal to the L.S.D. is considered to be a significant difference and when the difference is smaller than the L.S.D. is a non-significant difference. (12).After applying the test, the results show in Table 5:

Table 5. LSD test to detect significant between varieties

(J) variety	variety(I)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Bhooth 22	Bhooth 10	217.50000	110.11668	.050	-435.3527	.3527
	Ebaa 99	-31.78571	56.71876	.576	-143.9970	80.4256
	Sabah	72.50000	110.11668	.511	-145.3527	290.3527
	Edna	130.77586*	59.36508	.029	13.3291	248.2226
	Tamuz	293.92857*	95.68766	.003	104.6220	483.2352
	Bora	212.50000*	95.68766	.028	23.1934	401.8066
	Abu Ghraib	133.61111	86.63934	.125	-37.7945	305.0167
	Barcelona	136.13636	80.35255	.093	-22.8315	295.1043
	Rashid	222.50000	166.48077	.184	-106.8623	551.8623
Bhooth 10	Ebaa 99	185.71429	108.98725	.091	-29.9039	401.3325
	Sabah	290.00000*	144.17658	.046	4.7639	575.2361
	Edna	348.27586*	110.38757	.002	129.8873	566.6645
	Tamuz	511.42857*	133.48157	.000	247.3512	775.5059
	Bora	430.00000*	133.48157	.002	165.9227	694.0773
	Abu Ghraib	351.11111*	127.15179	.007	99.5565	602.6657
	Barcelona	353.63636*	122.95420	.005	110.3862	596.8865
	Rashid	440.00000*	190.72768	.023	62.6681	817.3319
Ebaa 99	Sabah	104.28571	108.98725	.340	-111.3325	319.9039
	Edna	162.56158*	57.24291	.005	49.3133	275.8098
	Tamuz	325.71429*	94.38572	.001	138.9834	512.4452
	Bora	244.28571*	94.38572	.011	57.5548	431.0166
	Abu Ghraib	165.39683	85.19925	.054	-3.1597	333.9534
	Barcelona	167.92208*	78.79765	.035	12.0304	323.8138
	Rashid	254.28571	165.73589	.127	-73.6029	582.1743

Source: spss output

It is clear through the L.S.D test that there are statistically significant differences between the improved seed (Bhooth 22) and classic seeds (Edna, Bora) at the (5%) level, and with the classic seed (Tamuz) at the (1%) significant level, while the variety did not prove the significant difference between it and other classic seeds (Sabah, Abu Ghraib, Barcelona, Rashid). In the same way, there are significant differences between the improved seed (Bhooth 10) and each of the varieties (Edna, Tamuz, Bora, Abu Ghraib, Barcelona) at level of (1%) and between the two classic seeds (Sabah, Rashid) at a (5%) level, which means that the improved seed (Bhooth 10) is significantly different from all the studied classic seeds. As for the improved seed (Ebaa 99), it was proven to be different with each of the classic seeds (Edna, Tamuz) at the level (1%) and with the varieties (Bora, Barcelona) at the (5%) level, while the significant difference with the varieties (Sabah, Abu Ghraib, Rashid) was not proven. It is also noted that the significant differences between the improved seeds themselves have not been proven significantly, and this means that all the improved seeds studied behave the same behavior in the aspect of productivity and thus achieve levels close to them.

The Impact of using technology on increasing production or reduced area

In the foregoing, it was proved that there are differences between the productivity of fields that applied the technologies and other fields, and it was also proven that the productivity of the improved seeds is higher than that of classic seeds once, and here this positive impact should be reflected on the total production and the cultivated area, as the increase in productivity is a result of adopting technologies will lead to farmers achieving a set of benefits, the most important of which is: Either they will be able to obtain greater production on the same cultivated area at the present time, and thus they will be obtain greater returns that lead to improving their incomes, or these technologies will enable them to obtain the same current level of production with the use of less areas as a result increased productivity. Both cases (increase production with the same current area or reduce the area while maintaining the same level of production) is one of the efficiency

indicators that should be calculated and disseminated to all areas of the governorate as an assumption based on a field study, and this part of the study deals with this proposition in more detail.

1- The impact of using technologies on increasing production

For the purpose of knowing the extent of the impact of technology on increasing the production of the wheat crop, and through the questionnaire forms, the average productivity of the improved was seeds obtained in the governorates (Wasit, Baghdad, Diwania, and Diyala) and the extent of the impact of technology on increasing production and the percentage of the real increase in production was calculated, as shown in Table 6 below:

Table 6. The impact of using technologies on the governorates production of wheat

Governorate	The area under wheat cultivation/ donum (1)	Actual production /ton (2)	Actual productivity kg /donum (3)	Average post-technical productivity kg /donum (4)	Production with technology /ton 4*1 (5)	Impact of technology on production /ton 5-2 (6)	The effect of technology on productivity 4-3 (7)	Percentage increase in production % 7÷3*100 (8)
Wasit	702987	515286	733	1025	720561	205275	292	39.8
Baghdad	102101	86416	846.4	962.5	98272.5	11856.5	116.1	13.7
Diwania	556266	492025	884.5	994.23	553056.2	61031.2	109.7	12.4
Diyala	671291	556659	829.2	1062.5	713246.5	156587.5	233.3	28.1

Source: Prepared by the researcher based on questionnaire form and Ministry of Planning/Central Statistical Office data

Table 6, shows the impact of the use of technologies on production, as the increase in productivity arising from the use of technologies will lead to an increase in the quantities produced for each governorate, and this increase was calculated and the results of the field study were circulated to all areas of the included governorate. Through Table 6, we find that actual productivity of Wasit governorate (without technology) amounted to about (733) kg/donum, while the technologies in productivity (1025) kg/donum, with an increase of (39%), an if these technologies were applied to all areas in the governorate, production would shift from the current production the amount of (515286) tons to production based on modern technologies, which will reach (720561) tons, an absolute increase of (205275) tons, depending on the same current area of the governorate. In the same way, with regard to the governorate of Baghdad, where the current productivity is (846.4) kg/donum, and the productivity of the donum, with the presence of technologies, can reach (962.5) kg/donum, with an increase of (13%) over the current productivity, and this means that the production of Baghdad governorate on the same area will increase from the current level of (86416) tons to the new level of (98272.5) tons, with an absolute increase in production of (11856.5) tons. It is also possible through technologies to increase the productivity of each of the governorate of Diwania and Diyala by (12.4% and 28.1%), respectively, and thus the production of the two governorates will increase on the same area with an increase in production from (492024) tons to (553056) tons and an absolute increase in production of (61031.2) tons for Diwania governorate, and Production will increase from (556659) tons to (713246.5) tons with an absolute increase of (156587.5) tons for Diyala governorate. These large increases in production as a result of the adoption of modern technologies are of great importance and play an important role in the issue of food security, as the increase in agricultural production is one of the most important components of agricultural development. It is noted that this increase is very large and influential, even if it was applied to all governorates of Iraq, it would have led to significant increases in wheat production, and higher levels of self-sufficiency will be achieved.

2- **The impact of using technologies on the cultivated areas**

For the purpose of knowing the extent of the impact of technologies on the areas under cultivation with wheat crop, and through the questionnaire forms, the extent of the impact of technologies on increasing the cultivated areas and the equivalent area was calculated, Table 7:

Table 7. Impact of the presence of technology on cultivated areas

Governorate	The area under wheat cultivation /donum (1)	Actual production /ton (2)	Production with technology /ton (3)	Equivalent area/donum (1) * (2) ÷ 3 (4)	Equivalent area - total area/donum (4) – (1) (5)	Percentage reduction in cultivated area % (5) ÷ (1) * 100 (6)
Wasit	702987	515286	720561	502718.52	-200268.5	28.5
Baghdad	102101	86416	98272.5	89782.6	-12318.4	12.1
Diwania	556266	492025	553056.2	494880.6	-61385.41	11.1
Diyala	671291	556659	713246.5	523914.5	-147376.51	21.96
Total	2032645	-	-	-	421348.82	20.7

Source: Prepared by the researcher based on questionnaire form and Ministry of Planning/Central Statistical Office data

Table 7, shows the impact of the presence of technology on the areas under cultivation with wheat, as the increase in productivity as a result of using technologies will lead to a reduction in the areas under cultivation with wheat for each governorate. Through productivity after technologies, the equivalent area was calculated, which represents the amount of reduction in the possible area as a result of increasing productivity with maintaining the same level of production, as this reduction in the cultivated area was calculated and the results of the field study were generalized to all the cultivated areas of the governorates covered by the research. From Table 7, reveal that the area under cultivation with wheat in Wasit Governorate before using technologies was (702987) donum, and if the technologies are applied to all the cultivated areas in the governorate, the cultivated area (equivalent area) will be about (502718.52) donum, i.e. a reduction of the cultivated area by (28.5%) and an absolute reduction of (200268.5) donums while maintaining the same level of production. In the same way with regard to the governorate of Baghdad, we find that the area under cultivation with wheat crop in the governorate of Baghdad before the use of the technologies was (102101) donum, and if the technologies were applied to all the cultivated areas in the governorate, it would be about (89782.6) donum, i.e. a reduction of the cultivated area by (12.1%) and a reduction an absolute amount of (12318.4) acres, while maintaining the same level of production. It is also possible, through technologies, to reduce the cultivated area of each of the governorates of Diwaniyah and Diyala by (11.1% and 21.96%), respectively, and thus the cultivated area in the two governorates will decrease from (556266) donum to (494880.6) donum, with an absolute reduction in the area of (61385.41) donum for the governorate Diwaniyah, and the cultivated area will decrease from (671291) donum, to (523914.5) donum, with an absolute reduction in the cultivated area of (147376.51) donum, for Diyala Governorate. This significant reduction in the area of (421348.8) donum for the four governorates while maintaining the same level of production is one of the important matters, as any reduction in the area means a reduction in many of the resources that are wasted on these additional areas, as well as a reduction in many of the costs borne by the farmer, which he can abandon or not bear by adopting some simple technologies, as well as the possibility of planting them with other crops, and finally, reducing the area has a positive impact on water consumption, which is one of the main problems that Iraq suffers from, so this matter it will greatly reduce water use during the water crisis that Iraq is experiencing during this period.

Calculation the transition in the supply function according to Harry, Ayer & Edward Schuh model:

The Harry, Ayer & Edward Schuh model shows the economic impact of the introduction of modern technologies in agriculture and its impact on increasing production. Through the model, it is possible to obtain the percentage increase in the supply of the studied crop, and then it is possible to know the percentage and direction of the transition of the supply function (9). The percentage obtained from the model is positive, this means that the supply function will shift to the right; this will result in many changes in the price and equilibrium quantity (the quantity of production increases and the price decreases) as a result of this transition. These changes take place in the case of the availability of a perfectly competitive market for the studied commodity and in the absence of government intervention

represented in setting prices. Conversely, if the percentage obtained from the model appears negative, this means that the supply function has shifted to the left, causing a decrease in the quantity produced and an increase in price. To study the impact of modern technologies on the transition of the supply function of wheat crop in the governorates of (Wasit, Baghdad, Diwaniyah, Diyala) during the study period, the relative transition coefficient in the supply function was estimated using the Harry, Ayer & Edward Schuh model of modern technologies for the three groups, and the results were obtained in the Table 8, the extraction percentage of the improved seeds of wheat crop was obtained under an experiment held in the Agricultural Research Directorate on a sample weighing (1) kg. The extraction percentage (purification) was calculated after grinding, and the percentages for the varieties grown according to modern technologies were obtained by (0.73) for the mentioned varieties, as for the extraction rate of classic seeds, it was obtained from the Ministry of Trade amounted to 0.80.

Table 8. Wheat Crop supply Function Transition under Harry, Ayer & Edward Schuh Model

Group	The relative importance of the area % Pa	The average productivity of an improved seeds Ya	Extraction ratio for improved seeds Fa	Extraction ratio for classic seeds Fu	The average productivity of classic seeds Yu	The rate of transition in the supply function K
Group I (Bhooth 22 + Foliar Fertilizer of leaves + Pesticide Atlantis) K_1	37.12	972.5				2.922
Group II (Ebaa 99 + Foliar Fertilizer of leaves + Pesticide Atlantis) K_2	7.45	1004.3	0.73*	0.80*	817.5	8.042
Group III (Bhooth 10 + Foliar Fertilizer of leaves + Pesticide Atlantis) K_3	2.18	1190				5.388

Source: Prepared by the Researcher based on the questionnaire form
***Ministry of Trade**

Through Table 8 the relative importance of varieties area was calculated of the varieties to which the technology has been applied (three aggregates) and the transition ratio of the supply function was calculated according to the Harry, Ayer & Edward Schuh model for the aforementioned varieties. Table 8 shows that all the set of the technologies led to the shift of the supply function to the right during the study period, which means an increase in the quantity supplied of the wheat crop, and the percentage of transition in the supply function of the wheat crop to the modern technologies of the three groups was about (2.922%, 8.042%, 5.388%) respectively. For the purpose of knowing the impact of the transition ratio of the supply function of the wheat crop on the total production, the increase in total production was calculated when the supply ratio of the three groups was increased according to Tables 9, 10, and 11 respectively:

Table 9. The impact of increasing total production using modern technologies (First group)

Governorate	Actual Production (1)	Ratio Transition in Supply % (2)	Amount of increase in Production (1)*(2) (3)	Production using modern technologies (1)+(3) (4)
Wasit	515286	2.922	15056.657	530342.66
Baghdad	86416		2525.0755	88941.076
Diwania	492025		14376.971	506401.97
Diyala	556659		16265.576	572924.58

Source: Researcher's work based on Harry, Ayer & Edward Schuh equation, questionnaire form, and Ministry of Planning/Central Statistical Office data

In Table 9, shows the positive ratios recorded by the Harry, Ayer & Edward Schuh model of modern technologies for the first group (Bhooth 22 + Foliar Fertilizer of leaves + Pesticide Atlantis), amounting to (2.9%), which is the increase that can occur when adopting modern technologies (Group I) to cultivate all the area of the studied governorates, and that this procedure will lead to an increase in production by (15056- 2525 – 14376 – 16265) tons in each governorates (Wasit, Baghdad, Diwania, Diyala), respectively, and production will increase by adopting the modern technologies of the group with the same percentage of transfer in supply function.

Table 10. The impact of increasing total production using modern technologies (second group)

Governorate	Actual Production (1)	Ratio Transition in Supply % (2)	Amount of increase in Production (1)*(2) (3)	Production using modern technologies (1)+(3) (4)
Wasit	515286	8.042	41439.3	556725.3
Baghdad	86416		6949.5747	93365.575
Diwania	492025		39568.651	531593.65
Diyala	556659		44766.517	601425.52

Source: Researcher's work based on Harry, Ayer & G Edward Schuh equation, questionnaire form, and Ministry of Planning/Central Statistical Office data.

In Table 10, the positive ratios recorded by the Harry, Ayer & Edward Schuh model of modern technologies for the second group (Ebaa 99 + Foliar Fertilizer of leaves + Pesticide Atlantis), amounting to (8.042%), which is the increase that can occur when adopting modern technologies (Group II) to cultivate all the area of the studied governorates, and that this procedure will lead to an increase in the total production by (41439 – 6949 – 39568 - 44766) tons in each of the governorates (Wasit, Baghdad, Diwania, Diyala), respectively, and production will increase by adopting the modern technologies of the group with the same percentage of transfer in supply function.

Table 11. The impact of increasing total production using modern technologies (third group)

Governorate	Actual Production (1)	Ratio Transition in Supply % (2)	Amount of increase in Production (1)*(2) (3)	Production using modern technologies (1)+(3) (4)
Wasit	515286	5.388	27763.61	543049.61
Baghdad	86416		4656.0941	91072.094
Diwania	492025		26510.307	518535.31
Diyala	556659		29992.787	586651.79

Source: Researcher's work based on Harry, Ayer & Edward Schuh equation, questionnaire form, Ministry of Planning / Central Statistical Office data.

In Table 11 as a result of the positive ratios recorded by the Harry, Ayer & Edward Schuh model of modern technologies for the third group (Bhooth 10 + Foliar Fertilizer of leaves + Pesticide Atlantis), amounted to (5.388%), which is the increase that can occur when adopting modern technologies (Group III) to cultivate all the area of the studied governorates, and that this measure will lead to an increase in production by (27763 – 4656 – 26510 - 29992) tons in each of the governorates (Wasit, Baghdad, Diwania, Diyala), respectively, and production will increase by adopting modern technologies of the group with the same percentage of transfer in supply function. In light of the foregoing, according to the Harry, Ayer & Edward Schuh model, the percentage shift and direction of the supply function was known when adopting modern technologies according to the three groups, as the percentage obtained from the model was positive, which means that the supply function shifts to the right, which results in an increase in the supplied quantity from wheat crop and the price is supposed to decrease (because every increase in supply

corresponds to a decrease in price) and this will result in changes in the quantity and equilibrium price, but the wheat crop in Iraq is supported by the state and governed by the agricultural plan determined by the Ministry of Agriculture. Therefore, the conditions of the perfect competition market do not apply to it due to the presence of government intervention represented in setting prices.

Research concluded that, growth rates for both production and productivity at the Iraqi and governorates levels have been higher of the cultivation area, which means that there is a trend towards the vertical expansion of wheat production, and from the results of the research, it turns out that the four governorates are in the study (Wasit, Baghdad, Diwania, Diyala) contribute significantly to the area under wheat cultivation at the level of Iraq, accounting for (32%) of the area under crop cultivation at the level of Iraq. This shows the relative importance of governorates in growing the crop. Therefore, the expansion of the application of modern technologies in all areas of these governorates has a positive impact on Iraq's overall wheat production, whereas the technologies of the national program for the promotion of food security in Iraq have been applied to limited areas within large fields belonging to farmers who's other fields are based on traditional agriculture. There was a clear difference between the program fields and the traditional ones on the productivity and production side, as demonstrated by the LSD test who proved it increased production of wheat crops was the result of improved productivity and the use of improved seeds high-productivity, while cultivated areas had a lower impact on increased production The study proved through the Harry, Ayer & Edward Schuh model demonstrated that the use of modern technologies for the three groups led to a shift of the supply function to the right by (2.9-8.04-5.3%) for the first, second, and third groups, respectively.

Based on the foregoing results of the research, there is an urgent need to adopt modern technologies methods and to promote the dissemination of modern technologies in all fields of these governorates in agriculture, because the study shows that modern technologies have a significant impact on increasing the productivity of the fields and that this increase is reflected in Iraq's overall production. Raise the efficiency of the extension system to lead its role in transmitting information and the results of scientific research to farmers and to promote educational courses in the application of modern technologies, as well as courses to raise the practical level of wheat farmers so that they can accept and adhere to scientific recommendations. Direct farmers to use improved seeds and select high-purity, impurities-free seeds, as they have a significant impact on increased production and productivity and support this varieties, as well as increased support for fertilizer of leaves and sprinkler irrigation systems to reduce water waste.

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