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Analytical Study of Production Costs for Some Crops in Egypt and most important Economic Efficiency Indicators when it cultivated Intercropping

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Abstract: Egypt's agricultural and food policies are usually directed towards increasing production of strategic commodities from available domestic sources, unless belonging to a regional group that allows providing the populations' food needs safely.

In the context of the comparative advantages that govern the production policies for these groups, and the limited amounts of agricultural production resources, on top of which comes agricultural land, it is clear that there is a dire need to search for modern methods that help optimize the use of available resources to increase agricultural production and self-sufficiency in strategic crops in order to achieve food security, which can be achieved through intensification.

Therefore, the research aimed to identify variable cost items for single and intercropped strategic crops, including wheat, broad beans, maize, cotton, tomatoes, soybeans, and peanuts grown in five selected Governorates, these are Fayoum, Ismailia, Qalyoubia, Menia, and Menofia.

Main findings regarding the relative importance of variable cost items revealed that labor cost ranked first at the level of the study crops and Governorates. Machinery rent ranked second, chemical fertilizers ranked third, and pesticides ranked last. It was also found that intercropping wheat with cotton resulted in improving farmer's income by raising net revenue per feddan due to realizing a higher investment profit of LE 2.19, in addition to raising wheat production. In contrast, intercropping wheat with tomatoes resulted in lower net revenue per feddan due to lower investment profit that declined from LE 5.49 under single production to as low as 0.3 under intercropping. Findings also revealed that intercropping winter tomatoes with broad beans, and maize with peanuts resulted in improving farmer's income, in addition to raising production of summer vegetables without cutting any part of the area under cereal crops.

Keywords: Production Cost, Net return, Intercropping, return of Invested Pound, Total Revenue.

Introduction:

Food security is a national security issue. Therefore, the Government of Egypt (GOE) works hard to achieve a higher level of food security that is based on domestic production as much as possible, given the risk of economic and political fluctuations surrounding foreign sources. This is the reason why Egypt's agricultural

and food policies are usually directed towards providing strategic commodities from domestic resources. (Afa and Ahlam 2015)

Food security can be achieved when the country is able to provide sufficient quantities of food for her citizens at appropriate prices throughout the year, whether from local or external sources. However, the limited amounts of agricultural production resources, on top of which comes agricultural land, it is important to search for modern methods that help optimize the use of available resources to increase agricultural production and self-sufficiency in strategic crops, thus achieve food security, which can be achieved through intensification. (National Research Center project2015)

Intercropping is one of the intensification systems used to realize maximum benefit per unit of land to help raise self-sufficiency in strategic crops, including wheat, broad beans, maize, cotton, tomatoes, soybeans, and peanuts. .(International Information Network, 2013)

Research Problem

Self-sufficiency ratios in major crops are low in Egypt, and therefore modern production methods are required to optimize the use of available resources to increase agricultural production and self-sufficiency in strategic crops to achieve food security, which can be done using intensification. Intercropping is one of the intensification systems used to realize maximum benefit per unit of land to help raise self-sufficiency in strategic crops, including wheat, broad beans, maize, cotton, tomatoes, soybeans, and peanuts.

Research Objective

The research aims to identify variable cost items for single and intercropped strategic crops, including wheat, broad beans, maize, cotton, tomatoes, soybeans, and peanuts grown in five selected Governorates: Fayoum, Ismailia, Qalyoubia, Menia, and Menofia. and to identify on the economic efficiency of single and intercropped agriculture.

Material and Method

The research applied descriptive and quantitative statistical analysis tools to primary data collected through field survey from a biased sample of farmers adopting intercropping of the study crops grown in the selected study Governorates. The research also relied on secondary data regarding single production of the study crops, published by the Ministry of Agriculture and Land Reclamation, the Central Agency for Public Mobilization and Statistics, in addition to some electronic Websites related to the research subject. Using some economic efficiency Criteria as Net return, Return of Invested Pound

Results and Discussion

Relative Importance of Variable Cost Items

This part focuses on identifying the cost of production for each of the study crops under single production system, in addition to identifying the main variable cost items for the same crops grown under intercropping by the sample farmers in the selected study Governorates.

1. Fayoum Governorate

Fayoum Governorate is famous for cultivating wheat, broad beans, cotton, and tomato during the winter, either single or intercropped. The following are the production costs for each crop classified according to relative importance:

Wheat

Findings revealed that total variable cost of wheat production reached LE 3685/feddan. Labor cost ranked first by amounting to LE 1700, i.e., 46.13% of the total variable cost per feddan of wheat. Table (1) indicates that chemical fertilizers' cost ranked second by amounting to LE 520, i.e., 14.11% of the total variable cost per feddan. Machinery rent reached LE 490, i.e. 13.3% of the total variable cost per feddan. Together, these

items account for 73.54% of the total variable cost per feddan. Pesticides' cost represented only 2.71% of the total variable cost per feddan of wheat, as shown in Table (2).

Cotton

Findings revealed that total variable cost of cotton reached LE 2998/feddan. Labor cost ranked first by amounting to LE 1200, i.e., 40.02% of the total variable cost per feddan of cotton. Table (1) indicates that chemical fertilizers' cost ranks second by amounting to LE 630, i.e., 20.01% of the total variable cost per feddan of cotton. Together, these two cost items account for 61.03% of the total variable cost per feddan. The costs of manure and pesticides followed by accounting for 10% each, whereas the cost of seeds represented only 3.5% of the total variable cost per feddan of cotton, as shown in Tables (1) and (2).

Tomatoes

Tomatoes are grown in Fayoum over three seasons. Findings indicate that total variable cost per feddan varied from LE 3592 for winter tomatoes, to LE 3559 for summer tomatoes, and LE 2690 for Nili tomatoes. The relative importance of cost items is the same for the three seasons, but the focus is on winter tomatoes due to sharing the same season with broad beans, and thus can be grown together under intercropping system.

Labor cost ranked first by amounting to LE 1375, i.e., 38.28% of the total variable cost per feddan of. Chemical fertilizers' cost ranked second by accounting for 14.48%, followed by machinery rent which accounted for 13.36%, seeds (13.64%), and pesticides (6.12%). Manure cost represented only 5.85% of the total cost per feddan of winter tomatoes, as shown in Tables (1) and (2).

Broad Beans

Total variable cost of broad beans grown single amounted to LE 2657 per feddan. Labor cost ranked first by accounting for 45.16% of the total variable cost, followed by the costs of seed and manure, each of which accounted for 11.29% of the broad beans production cost, as shown in Tables (1) and (2).

2. Ismailia Governorate

This part focuses on studying the production costs of summer maize and peanuts grown in Ismailia Governorate given the fact they share the same planting time and thus can be intercropped. The following are the variable cost items for each crop classified into labor and inputs cost as shown in Table (1). Table (2), on the other hand, illustrates the relative importance of production cost items:

Summer Maize

Findings indicate that total variable cost of summer maize amounted to LE 3602 per feddan. Labor cost ranked first by amounting to LE 1475, i.e., 40.95% of the total variable cost of summer maize. Chemical fertilizers, machinery rent, seeds, and pesticides followed with amounts estimated at LE 700, LE 550, LE 30, LE 180, and LE 100, respectively, which account for 19.43%, 15.27%, 8.33%, 5%, and 2.78% of the total variable cost per feddan of summer maize, respectively, as shown in Tables (1) and (2).

Peanuts

Findings revealed that total variable cost of peanuts amounted to LE 2981 per feddan. It has been noted that the relative importance of variable cost items followed the same pattern like summer maize. Labor cost ranked first by amounting to LE 1575, i.e., 52.83% of the total variable cost per feddan of peanuts. Machinery rent ranked second by accounting for 13.92% of the total variable cost. Seeds, chemical fertilizers, manure, and pesticides followed by accounting for 10.06%, 8.39%, 4.02%, and 1.68% of the total variable cost per feddan of peanuts, respectively, as shown in Tables (1) and (2).

3. Qalyoubia Governorate

Table (1) presents the classification and relative importance of variable cost items for summer maize and summer tomatoes grown in Qalyoubia Governorate.

Summer Maize

Findings revealed that total variable cost of summer maize amounted to LE 3355 per feddan. Labor cost ranked first by amounting to LE 1430, i.e., 42.62% of the total variable cost per feddan of summer maize. Chemical fertilizers, seeds, machinery rent, and manure followed with amounts estimated at LE 480, LE 450, LE 418, and LE 300, respectively, i.e., 14.31%, 13.41%, 12.46%, and 8.94% of the total variable cost per feddan of summer maize, respectively, as shown in Tables (1) and (2).

Summer Tomatoes

As shown in Tables (1) and (2), total variable cost of summer tomatoes amounted to LE 3761 per feddan. Labor cost and machinery rent ranked first by accounting for 56.23% of the total variable cost per feddan of summer tomatoes. Chemical fertilizers, seeds, pesticides, and manure followed with amounts estimated at LE 575, LE 430, LE 200, and LE 130, respectively, i.e., 15.29%, 11.43%, 5.32%, and 3.46% of the total variable cost per feddan of summer tomatoes, respectively.

4. Menia Governorate

Summer Maize

Studying the production cost items of summer maize grown in Menia Governorate indicates that labor and machinery rent accounted for the majority of the variable cost items, where they represented 64.21% of the total variable cost estimated at LE 2928 per feddan. Chemical fertilizers cost amounted to LE 656, i.e., 22.4% of the total variable cost, followed by the cost of seeds, which amounted to LE 150, i.e., 5.12% of the total variable cost per feddan of summer maize, as shown in Tables (1) and (2).

Soybeans

Soybean is a summer crop grown in Menia Governorate. As clear from Tables (1) and (2), the relative importance of variable cost items is similar to that of soybeans. Labor cost and machinery rent amounted to LE 790 and LE 550 per feddan, which account for 36.76% and 25.59% of the total variable cost, respectively. Together, the two items account for 62.35% of the total variable cost estimated at LE 2149 per feddan of soybeans. The costs of chemical fertilizers, pesticides, and seeds amounted to LE 452, LE 100, and LE 80, respectively, which account for 21.03%, 4.65%, and 3.72% of the total variable cost per feddan of soybeans, respectively.

Menofia Governorate

Menofia Governorate cultivates cotton and wheat, which both can be grown under intercropping system. Studying the costs of production for both crops revealed that total variable cost of wheat amounted to LE 3631/feddan, whereas that of cotton amounted to LE 3596/feddan.

Cotton

As clear from Tables (1) and (2), total variable cost of cotton amounted to LE 3596 per feddan. Labor cost ranked first by amounting to LE 1865 representing 51.86% of the total variable cost per feddan of cotton. Machinery rent ranked second by amounting to LE 554 representing 15.41%. The costs of chemical fertilizers, manure, pesticides, and seeds followed by accounting for 10.84%, 5.56%, 5.14%, and 2.08% of the total variable cost per feddan of cotton, respectively.

Wheat

As clear from Tables (1) and (2), total variable cost of wheat amounted to LE 3631 per feddan. Labor cost ranked first by amounting to LE 1400 representing 38.56% of the total variable cost per feddan of wheat. The costs of machinery rent, manure, chemical fertilizers, seeds, and pesticides followed by accounting for 21.37%, 11.02%, 8.95%, 6.88%, and 4.13% of the total variable cost per feddan of wheat, respectively.

It is clear from what proceeded that labor cost ranked first at the level of the study crops and Governorates, followed by machinery rent and chemical fertilizers. Pesticides' cost recorded the lowest amount at the level of all the study crops and Governorates.

Measuring Economic Efficiency For The Study Crops Under Single and intercropping Production System:

Economic efficiency can be measured using several indicators, including net *return*, benefit/cost ratio, and Return of Invested Pound

1. Net return: (total returns –Costs)

Variable Cost :

Data in Table (1) indicate that summer tomatoes grown in Qalioubia recorded the highest variable cost, estimated at LE 3761 per feddan. Total variable cost of wheat grown in Fayoum ranked second by amounting to LE 3685 per feddan. Wheat grown in Menoufia ranked third, with total variable cost estimated at LE 3631 per feddan. Summer maize grown in Ismailia ranked fourth, with total variable cost estimated at LE 3602 per feddan. Cotton grown in Menoufia ranked fifth, with total variable cost estimated at LE 3596 per feddan. Soybeans recorded the lowest total variable cost at the level of the study crops, estimated at LE 2149 per feddan.

Table (1) production costs for the under study crops in case of single agriculture in the selected Governorates distributed among the most important items in 2013 (LE)

Minya		Ismailia		Qalubia		Menoufia		Fayoum				governorate
soybeans	corn	peanuts	corn	tomato	corn	Cotton	Wheat	broad bean	tomato	Cotton	Wheat	costs items
80	150	300	180	430	450	75	250	300	490	105	240	Seed
550	660	415	550	770	418	554	776	275	480	190	490	Machines Wages
452	656	250	700	575	480	390	325	260	520	630	520	Chemical fertilizer
790	1220	1575	1475	1345	1430	1865	1400	1200	1375	1200	1700	Wages
-	-	120	300	130	300	200	400	300	210	300	300	Composting
100	-	50	100	200	-	185	150	80	220	300	100	Pesticides
177	242	271	297	311	277	327	330	242	297	273	335	Expenses
2149	2928	2981	3602	3761	3355	3596	3631	2657	3592	2998	3685	Variable costs
7074	7324	12699	8136	20750	7613	9244	10537	6073	23317	6537	9504	Total Revenue
3.29	2.5	4.26	2.26	5.52	2.27	2.57	2.9	2.29	6.49	2.18	2.58	Revenue to cost
1.47	3.186	1.563	3.368	14.135	3.197	0.951	3.204	1.01 1	15.10	0.835	2.7	Productivity per feddan

Source: Calculated from the Ministry of Agriculture and Land Reclamation data - Central Administration of Agricultural Economics and Statistics, Agricultural Economics and Statistics Bulletin -2013 m .

Total returns

Table (1) presents the total revenue for each of the study crops. It is clear that winter tomatoes grown in Fayoum realized the highest total revenue estimated at LE 23317 per feddan. Summer tomatoes grown in Qalyoubia ranked second by realizing a total revenue of LE 20750 per feddan. Peanuts grown in Ismailia followed by realizing a total revenue of LE 12699 per feddan. Wheat grown in Menoufia and Fayoum ranked last by realizing total revenues of LE 10537 and Le 9504 per feddan, respectively.

Table (2) The relative importance of the production costs terms for the under study crops of selected Governorates

Minya		Ismailia		Qalubia		Menoufia		Fayoum				governorate
soybeans	corn	peanuts	corn	tomato	corn	Cotton	Wheat	broad bean	tomato	Cotton	Wheat	costs items
3.72	5.12	10.06	5.00	11.43	13.41	2.08	6.88	11.29	13.64	3.50	6.51	Seed
25.59	22.54	13.92	15.27	20.47	12.46	15.41	21.37	10.35	13.36	6.34	13.30	Machines Wages
21.03	22.40	8.39	19.43	15.29	14.31	10.84	8.95	9.78	14.48	21.01	14.11	Chemical fertilizer
36.76	41.67	52.83	40.95	35.76	42.62	51.86	38.56	45.2	38.28	40.03	46.13	Wages
-	-	4.02	8.33	3.46	8.94	5.56	11.02	11.29	5.85	10.00	8.14	Composting
4.65	-	1.68	2.78	5.32	-	5.14	4.13	2.71	3.01	6.12	10.00	Pesticides
8.24	8.26	9.09	8.24	8.27	8.26	9.09	9.09	9.11	8.27	9.11	9.09	Expenses

Source: collected and Calculated from Table (1)

I. Return of Invested Pound

Table (4) compares the profit per pound invested in producing the study crops in the selected Governorates. It is clear that winter tomatoes realized the highest invest profit, estimated at LE 5.49, compared to LE 1.27 for summer tomatoes. Invest profit for peanuts, wheat, and cotton grown at the level of the study sample reached LE 3.26, LE 1.58, and 1.18, respectively.

Comparing the economic efficiencies of production systems(single versus intercropped)for the study crops in each of the selected Governorates revealed the following results, listed in Tables (3) and (4):

First: Single Production of Cotton versus Intercropping with Wheat

Table (3) most important economic efficiency indicators of intercropped crops in the field sample under study

Corn+ Soybeans	corn+ peanuts	tomatoes+ corn	broad bean+ tomatoes	Wheat+ tomatoes	Wheat+ cotton	The statement	
4407	7275	8420	8217	9203	5288	Total variable costs	
4700	14750	24200	18620	12008	16892	Total revenue	
293	7475	13780	7072	2805	11604	Revenue - variable costs	
13 Ardebs	15 Ardebs	21 Ardebs	5 Ardebs	11.5 Ardebs	14.13 Ardebs	The first	Productivity per feddan
700 Kilo	20	20	11.6	7 tons	8.75 Quintal .	The second	
1.1	2.03	2.87	2.27	1.3	3.19	The proportion of the revenue / cost	
0.1	1.03	1.87	1.27	0.3	2.19	Return of Invested Pound	

Source: Calculated from the Ministry of Agriculture and Land Reclamation data - Central Administration of Agricultural Economics and Statistics, Agricultural Economics and Statistics Bulletin -2013 m

Table (4) most important economic efficiency indicators of some crops cultivated singly under study

peanuts	summer tomato	Winter tomatoes	Summer corn	cotton	wheat	The statement
2981	3761	3592	3355	2998	3685	Total variable costs
12699	20750	23317	7613	6537	9504	Total revenue
9718	16989	19725	4258	3539	5819	Revenue - variable costs
1.563	14.135	15.101	3.197	0.835	2.7 0	Productivity per feddan
4.26	2.27	6.49	2.57	2.18	2.58	The proportion of the revenue / cost
3.26	1.27	5.49	1.57	1.18	1.58	Return of Invested Pound

Source: Calculated from the Ministry of Agriculture and Land Reclamation data - Central Administration of Agricultural Economics and Statistics, Agricultural Economics and Statistics Bulletin -2013 m

Findings illustrated in Tables (3) and (4) compare the economic efficiency indicators for single grown cotton versus intercropping with wheat. It is clear that total variable cost under the two systems amounted to LE 5288 and LE 2998 per feddan, respectively. Total revenues amounted to LE 16892 and LE 6537, respectively, indicating that total revenue under intercropping is higher by LE 10355 representing 1.58% of the variable cost. Net revenues, excluding rent, amounted to LE 11604 and LE 3539, respectively. Benefit/cost ratios amounted to 3.19% and 2.18%, respectively, whereas invest profits amounted to LE 2.19 and LE 1.18, respectively.

It is therefore clear that intercropping of cotton with wheat helped increase farmer's income by raising net revenue per feddan, in addition to increasing wheat production, which helps narrow the gap between wheat production and consumption. Other benefits include savings in some factors of production like irrigation water and chemical fertilizers.

Second: Single Production of Winter Tomatoes versus Intercropping with Wheat

Findings illustrated in Tables (3) and (4) compare the economic efficiency indicators for single grown winter tomatoes versus intercropping with wheat in Fayoum Governorate. It is clear that total variable costs amounted to LE 9203 and LE 3592 per feddan, respectively. Total revenues amounted to LE 12008 and LE 23317, respectively, which is lower by LE 11309 representing 48.5% of the variable cost. Net revenues amounted to LE 2805 and LE 19725, respectively. Benefit/cost ratios amounted to 1.3% and 6.49%, respectively, whereas invest profits amounted to LE 0.3 and LE 5.49, respectively.

It is therefore clear that intercropping of winter tomatoes with wheat resulted in lower net revenue per feddan.

Third: Single Production of Winter Tomatoes versus Intercropping with Broad Beans

Findings illustrated in Tables (3) and (4) compare the economic efficiency indicators for single grown winter tomatoes versus intercropping with broad beans in Fayoum Governorate. It is clear that total variable costs amounted to LE 8217 and LE 3592 per feddan, respectively. Total revenues amounted to LE 18620 and LE 23317, respectively, which is lower by LE 4697 representing 20% of the revenue under single production. Net revenues amounted to LE 7072 and LE 19725, respectively. Benefit/cost ratios amounted to 2.27% and 6.49%, respectively, whereas invest profits amounted to LE 1.27 and LE 5.49, respectively.

It is therefore clear that intercropping of winter tomatoes with broad beans resulted in lower invest profit.

Fourth: Single Production of Maize versus Intercropping with Winter Tomatoes

Findings illustrated in Tables (3) and (4) compare the economic efficiency indicators for single grown maize versus intercropping with winter tomatoes in Qalyoubia Governorate. It is clear that total variable costs amounted to LE 8420 and LE 3355 per feddan, respectively. Total revenues amounted to LE 24200 and LE 7613, respectively. Net revenues amounted to LE 13780 and LE 4258, respectively (including the value of rent in both cases), which is higher by LE 9522 representing 224%. Benefit/cost ratios amounted to 2.87% and 2.57%, respectively, whereas invest profits amounted to LE 1.87 and LE 1.57, respectively.

It is therefore clear that intercropping of maize with winter tomatoes resulted in higher farm income, in addition to increasing the produced quantities of summer vegetables without affecting the area under grain crops.

Fifth: Single Production of Summer Maize versus Intercropping with Winter Peanuts

Tables (3) and (4) illustrated in compare the economic efficiency indicators for single grown summer maize versus intercropping with peanuts in Ismailia Governorate. It is clear that total variable costs amounted to LE 7275 and LE 2981 per feddan, respectively. Total revenues amounted to LE 14750 and LE 12699, respectively. Net revenues amounted to LE 7474 and LE 9718, respectively. Benefit/cost ratios amounted to 2.03% and 4.26%, respectively, whereas invest profits amounted to LE 1.3 and LE 3.26, respectively. therefore intercropping of summer maize with peanuts resulted in lower invest profit. However, intercropping resulted in increasing the produced quantity of summer maize by 20 Ardabs per feddan.

Sixth: Single Production of Summer Maize versus Intercropping with Winter Soybeans

Tables (3) and (4) were illustrated in compare the economic efficiency indicators for single grown summer maize versus intercropping with soybeans in Menia Governorate. It is clear that total variable costs amounted to LE 4407 and LE 3355 per feddan, respectively. Total revenues amounted to LE 4700 and LE 7613, respectively. Net revenues amounted to LE 293 and LE 4259, respectively. Benefit/cost ratios amounted to 0.1% and 2.5%, respectively.

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