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Marketing efficiency and policies analysis of potato crop in Egypt

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Abstract: Potato crop is considered as an important vegetable crop in Egypt. It's an important source of domestic agricultural income and the foreign exchange needed to push the wheel of economic development, as Egyptian potato exports are at the top of Egyptian agricultural exports. The importance of potato crop in Egypt is due to the large cultivated area and farmers' interest in it as an export crop to cover the needs of local market. Due to the increase in mediators share during marketing operations, as well as high marketing costs and farmers receive low farm prices that with high retail prices paid by consumers, consequently low marketing efficiency. Also Potato crop, like other crops, is affected by the extent of success and safety of agricultural policies pursued by the state, as well as direct and indirect intervention in the price policies of potato crop, whether in relation to inputs or outputs, which creates a differences in local and international prices, in addition to not optimizing the use of agricultural inputs. The research aimed to identify the productive position and marketing system of potato crop, estimate the marketing margins and marketing efficiency, in addition to estimating the financial and economic evaluation of all items of production costs of potato crop to analyze the current situation and map future policies and programs for producing and marketing of potato crop. The study relied on descriptive and quantitative analysis methods represented in the simultaneous equations consisting of linear regression equations in Egyptian potato market. In addition to estimating items of production costs and revenues of the potato crop financially and economically, also calculating the nominal and effective protection coefficients and domestic resources coefficient of the potato crop through the Policy Analysis Matrix (PAM) during the period (2004-2018). Most important conclusions can be summarized as the increase of Retail price per ton of potato crop by 10%, lead to increases marketing efficiency of potato crop by 5%. Also the increase of average of productivity per feddan of potato crop by 1%, lead to increases cost production per feddan of potato crop by 9.59%. In addition Egypt has a comparative advantage in producing potato crop, as the benefits from importing this crop are greater than its production cost, or it is desirable to expand its domestic production.

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Key words: Comparative advantage, Policy Analysis Matrix, Marketing efficiency, potato crop.

1. Introduction:

Potato crop is considered as an important vegetable crop in Egypt, as the Egyptian citizens consume it a lot, in addition to using it as a raw material in many food industries. It is also an important source of domestic agricultural income and the foreign exchange needed to push the wheel of economic development, as Egyptian potato exports are at the top of Egyptian agricultural exports. The importance of potato crop in Egypt is due to the large cultivated area and farmers' interest in it as an export crop to cover the needs of local market, Because of its high nutritional value and it can be cultivated under different environmental and climatic conditions (**Elsaied and Sahra, 2015**). Therefore, an efficient marketing system must be provided to reduce the production losses, as the performance efficiency of the marketing services during the marketing stages are among the factors that affect the agricultural stability, expansion of the crop, improved economic and social environment in which potato producers work and format directions that help in achieving agricultural development, accordingly it has implications for producers decisions.

The Research Problem:

The research problem is represented in the increase in mediators share during marketing operations, as well as high marketing costs and farmers receive low farm prices that with high retail prices paid by consumers, consequently low marketing efficiency. Potato crop, like other crops, is affected by the extent of success and safety of agricultural policies

pursued by the state, as well as direct and indirect intervention in the price policies of potato crop, whether in relation to inputs or outputs, which creates a differences in local and international prices, in addition to not optimizing the use of agricultural inputs.

The Research Objective:

The research aims to identify the productive position and marketing system of potato crop, estimate the marketing margins and marketing efficiency, in addition to estimating the financial and economic evaluation of all items of production costs of potato crop. Also, the results can be used by economic and agricultural decision makers to analyze the current situation and map future policies and programs for producing and marketing of potato crop.

2. Methodology and data sources:

The study relies on descriptive analysis method represented in averages and growth rates, and quantitative analysis method represented in the simultaneous equations consisting of linear regression equations in Egyptian potato market. In addition to estimating items of production costs and revenues of the potato crop financially and economically, also calculating the nominal and effective protection coefficients and domestic resources coefficient of the potato crop through the Policy Analysis Matrix (PAM).

Market structure means the organizational features that define the relationship between sellers with each other, the relationships between buyers with each other, the relationships between sellers and buyers, as well as the relationships between sellers in the market with others who offer the commodity whether they are present or expected to be present.

First: Marketing Efficiency

It can be defined as maximizing the ratio between outputs and inputs. Where the outputs refer to the marketing income resulting from the consumer's satisfaction with the goods and services, and the inputs refer to the costs of the various items involved in the marketing processes such as labor, capital and management (**Abdel-Kader, S., et. al, 2015**). Thus, the most important components of marketing efficiency are the level of performance of marketing services and the costs of performing these services. If the marketing system includes a decent level of service but is expensive, this does not necessarily mean an improvement in marketing efficiency.

Measure of marketing efficiency is necessary to improve it, and in this way it is necessary to define some indicators which it can judge the efficiency of the marketing system for agricultural products as follow:

a. Distribution of Consumer pound is considered as an analytical methods for identifying the marketing efficiency and means distributing the value of consumer one pound paid between the agricultural product and the various marketing authorities concerned with marketing of the commodity. It is expressed by the ratio between the absolute difference of price of the competent marketing authority and the retail price.

b. Price Spread is the sum of the price differences for a group of marketing stages. The price spread between the farmer and the consumer can be defined as the difference between the consumer price and the price charged by the farmer for a quantity of agricultural products.

c. Marketing system efficiency reflects the ratio between the total marketing costs and the total costs (productivity and marketing) of the marketed crop as follow:

$$\text{Marketing system efficiency} = \frac{100 - (\text{total marketing costs} \times 100)}{\text{Total costs (productivity and marketing) of the marketed crop}}$$

d. Marketing Costs is the actual expenditures necessary to move goods and services from the product to the consumer, thereby fulfilling the conditions for the desired shape, location and time. Marketing costs include the actual fixed and variable costs borne by marketing agencies.

e. Marketing Margins is one of the main criteria for identifying marketing differences and the factors affecting them to determine marketing problems as well as judging the efficiency of marketing activity. A marketing margin is defined as the difference between the price paid by the final consumer and the price charged by the producer, and then includes all the marketing costs of marketing services and the profits of brokers. The marketing margin is calculated in an absolute or a relative form, where the absolute margin expresses the marketing margins in monetary units, while the relative margin expresses the ratio between absolute marketing margin related to the selling price. Marketing margins include the costs of various marketing services such as transportation, storage, sorting, grading, packing, assembly, selling, financing, and other profits that mediators receive **(Gewelly, 1971).**

f. Price levels of crops and agricultural commodities are numerous, but they can be divided to three price levels:

1. Product price: It is the cost of producing the commodity plus all fees and taxes imposed on the commodity minus subsidies.

2. Wholesale price: It is the selling price of a commodity without changing its shape by wholesale trade establishments to retailers or to commercial and industrial establishments or to other wholesalers.

3. Retail price: is the price of selling a good without changing its shape by retailers to the final consumer of the commodity for personal or family consumption.

Second: Identifiably of model's equations

Within the framework of the econometric approach, the equation included in a particular model can be identified on the basis of the number of variables that do not appear in that equation but appear in the rest of the model equations **(Koutsoyiannis, 1981)**. In other words, the equation is just identified if we cannot form an equation similar to it through the algebraic operations of other equations in the model to include the same variables that appear in the consider equation (**Taha et al. 1998**). The rank condition can be used to determine model equations as follows:

$(G - 1) > (k - M)$

Where:

G = Number of equations in the model (Number of internal variables).

K = Number of all variables in the model (internal and external variables).

M = Number of variables in the considered equation.

According to the previous:

1-Over identified equation: if the number of the total variables that did not appear in that equation but within the variables of the other equations of the model, is equal to (Number of the equations of the model – 1), $(k - M) = (G - 1)$.

2- Just identified equation: when $(k - M) > (G - 1)$.

3- Under identified equation: when $(k - M) < (G - 1)$.

By applying rank condition to the proposed model, it's found that all the equations included in the model are over-identified, thus the three-stage squares method (3 s.l.s) is used to avoid the bias resulting from the simultaneous model.

Third: The structure of the policy analysis matrix: It is considered one of the modern tools and methods used in the analysis of agricultural policies, and it is defined as a coordinated framework for analyzing market distortions and intervention policies in order to measure the effects resulting from the state's intervention policy and its impact on each: the producer, consumer and society as a whole, as it is considered an effective tool To measure the extent of inconsistency and consistency between the objectives of the agricultural policy and the means of its implementation to the extent that reflects the profits, losses of the product and the benefit of the consumer, accordingly, the calculation of the matrix of the analysis of agricultural policies requires studying the following basic components, **(Emam Sh. and Hassanain Hadil, 2018)** Table (1):

Table (1) The structure of the policy analysis matrix

Item	Revenues	Costs		Profits
		Tradable Inputs	Domestic Factors	
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Divergences	I	J	K	L

Private profit: D=A-(B + C), Social profit: H=E – (F+ G)
A - E = Production divergences: I
B - F= Tradable Inputs divergence: J
C -G = Untradeable Inputs (domestic factors) divergence: K
(I –J- K) = (D - H) = Net divergences:L
Source: Eric A. Monke and Scott R. Pearson, "The Policy Analysis Matrix for Agricultural Development", Cornell University Press (Ithaca, New York, USA, 1989).

Impact of agricultural policy using the policy analysis matrix

1-**Nominal protection coefficient** is the ratio of the domestic market price to the border price of a concerned commodity. In the policy analysis matrix, it equals the ratio of private profits to social profits, so that measuring the impact of government interference in price policy to protect domestic production, either by subsidizing the product or by imposing indirect taxes on it.

2-The effective protection coefficient (EPC) measures the aggregate effects of policies (or interference) on tradable outputs as well as on tradable input markets. EPC is defined as the ratio of added value measured in private prices (revenue by private prices – tradable inputs costs by private prices) to

added value measured in social prices (Revenues by social prices - tradable inputs costs by social prices).

3-The coefficient of domestic resources cost is the ratio between costs of the domestic inputs required to produce a specific product estimated by social prices and the added value resulting from using the same amount of resources estimated by social prices, therefore domestic resources costs is the opportunity cost of the domestic resources needed to produce a specific product.

The study based on secondary data which is published by Ministry of Agriculture and Land Reclamation and the Central Agency for Public Mobilization and Statistics during the period (2004-2018).

3. Results

a. Cultivated area

Data in table (2) showed that cultivated area of potato is 248.04 thousand feddans in 2004, and increased to 408.08 thousand feddans in 2018. Average of cultivated area is 596.91 thousand feddans during the period (2004 – 2018), with an increase in the annual growth rate by 3.37%. It is also showed that the average of cultivated area of winter potato is 245.71 thousand feddans during the study period (2004 - 2018), followed by average of cultivated area of summer potato, is 243.32 thousand feddans, then the average cultivated area of nili potato was about 107.89 thousand feddans. In addition, The cultivated area of winter potato achieved the highest annual increase growth rate by 7.17%, followed by the cultivated area of summer potato, which has an increase growth rate by 0.28%, and finally the cultivated area of nili potato has a decrease growth rate by 1.05%.

a. Productivity

Data in table (2) showed that productivity of potato is 10.01 ton/ feddan in 2004, and increased to 11.39 ton/feddan in 2018. Average of productivity of potato is 10.77 ton/feddan during the period (2004 – 2018), with an increase in the annual growth rate by 0.86 %. It is also showed that the average of productivity of summer potato is 12.16 ton/feddan during the study period (2004 - 2018), followed by average of productivity of winter potato, is 10.75 ton/feddan, then the average of productivity of nili potato is about 9.39 ton/feddan. In addition, The productivity of winter potato achieved the highest annual increase growth rate by 1.56%, followed by the productivity of nili potato, which has an increase growth rate by 0.57%, and finally the productivity of summer potato has a increase growth rate by 0.43%.

b. Total production

Data in table (2) showed that the total production of potato is 2546.61 thousand tons in 2004, and increased to 4960.06 thousand tons in 2018. Average of total production of potato is 3665.34 thousand tons during the period (2004 – 2018), with an increase in the annual growth rate by 4.54 %. It is also showed that the average of total production of winter potato is 1869.09 thousand tons during the study period (2004 - 2018), followed by average of total production of summer potato, is 1375.23 thousand tons, then the average of total production of nili potato is 421.02 thousand tons. In addition, total production of winter potato achieved the highest annual increase growth rate by 8.84%, followed by total production of summer potato, which has an increase growth rate by 0.71%, and finally total production of nili potato has a decrease growth rate by 0.48% because of the decrease of cultivated area of potato.

Table (2): Total production, productivity, cultivated area, of potato crop in Egypt, 2004-2018.

year	Cultivated area (thousand feddan)				Productivity (ton / Fadden)				Total production (thousand feddans)			
	Winter	summer	nili	total	winter	summer	nili	total	winter	summer	nili	total
2004	90.29	97.23	60.52	248.04	10.03	11.69	8.32	10.01	906.04	1136.83	503.74	2546.61
2005	141.86	113.28	45.53	300.66	10.04	11.81	8.91	10.25	1424.10	1337.79	405.54	3167.43
2006	102.37	934.89	367.50	1404.76	9.87	11.82	9.48	10.39	1010.40	79.07	38.75	1128.23
2007	1132.31	1038.83	589.33	2760.46	10.37	12.10	9.51	10.66	109.19	85.85	61.99	257.03
2008	148.97	122.06	56.40	327.42	10.33	12.01	9.98	10.77	1538.44	1465.93	562.68	3567.05
2009	153.75	120.66	55.32	329.72	10.76	12.01	10.04	10.94	1654.54	1449.54	555.21	3659.28
2010	156.06	133.91	44.67	334.64	10.59	11.84	8.88	10.44	1652.13	1585.46	396.63	3634.22
2011	183.99	151.14	55.68	390.81	10.61	12.22	9.70	10.84	1951.44	1846.89	540.10	4338.43
2012	208.43	158.10	55.35	421.88	10.77	12.47	9.77	11.01	2245.43	1971.79	540.82	4758.04
2013	195.77	133.68	51.93	381.38	10.94	12.26	9.33	10.84	2142.11	1638.81	484.26	4265.18
2014	203.51	158.10	55.35	416.96	11.18	12.47	9.77	11.14	2275.94	1971.79	540.82	4788.55
2015	271.57	128.94	36.87	437.39	11.18	12.34	8.90	10.81	3036.23	1590.94	328.28	4955.45
2016	210.92	123.91	41.80	376.63	10.57	12.15	9.04	10.59	2229.87	1505.52	378.05	4113.44
2017	230.84	133.68	50.34	414.86	11.41	12.70	10.13	11.41	2633.83	1697.28	509.92	4841.04
2018	254.97	101.42	51.69	408.08	12.65	12.47	9.06	11.39	3226.63	1265.00	468.44	4960.06
average	245.71	243.32	107.89	596.91	10.75	12.16	9.39	10.77	1869.09	1375.23	421.01	3665.34
Growth rate	7.17%	0.28%	-1.05%	3.37%	1.56%	0.43%	0.57%	0.86%	8.84%	0.71%	-0.48%	4.54%

Source: Central Agency for Public Mobilization and Statistics, various issues.

Evolution of product, wholesale and retail price of potato crop in Egypt:

Data in table (3) showed that the product price is 650 L.E per ton in 2004 and increase to be 2320.50 L.E per ton in 2018. Average of product price is 1229.67 L.E per ton during the period (2004 – 2018) with an increase in the annual growth rate by 9%. In addition data in table (2) showed that the whole price is 1148 L.E per ton in 2004 and increase to be 5560 L.E per ton in 2018. Average of whole price is 2860.67 L.E per ton during the period (2004 – 2018) with an increase in the annual growth rate by 11%. As well as, its showed that the retail price is 1501.7 L.E per ton in 2004 and increase to be 7060 L.E per ton in 2018. Average of retail price is 3753.31 L.E per ton during the period (2004 – 2018) with an increase in the annual growth rate by 11%.

Distribution of consumer pound

Data in table (3) showed that product's share in consumer pound is estimated to be 43.28% in 2004 and increased to be 32.87% in 2018. Average of product's share in the consumer pound is estimated to be 37.32% during the study period (2004 – 2018) with a decrease in the annual growth rate by 2%. Also its showed that wholesaler's share in consumer pound is estimated to be 33.16% in 2004 and increased to be 45.89% in 2018. Average wholesaler's share in consumer pound is estimated to be 39.5% during the study period (2004 – 2018) with an increase in the annual growth rate by 2%. In addition data in table (3) showed that retailer's share in the consumer pound is estimated to be 23.55% in 2004 and decreased to be 21.25% in 2018. Average of retailer's share in consumer pound is estimated to be 23.17% during the study period (2004 – 2018) with a decrease in the annual growth rate by 1%. As well as its showed that mediator's share in the consumer pound is estimated to be 56.72% in 2004 and increased to be 67.13% in 2018. Average of mediator's share in the consumer pound is estimated to be 62.68% during the study period (2004 – 2018) with an increase in the annual growth rate by 1%.

Table (3) Evolution of product price, Wholesale price, Retail price and distribution of consumer pound of potato crop in Egypt during the period (2004-2018).

Year	Prices (LE/ton)			Consumer Pound Distribution (%)			
	Product (1)	Wholesale (2)	Retail (3)	Product's share (4)	Wholesaler's share (5)	Retailer's share (6)	Mediators' share (7)
2004	650	1148	1501.7	43.28	33.162	23.553	56.715
2005	588.5	853	1146	51.35	23.080	25.567	48.647
2006	746.5	1209	1712	43.60	27.015	29.380	56.396
2007	959	1470	1640	58.48	31.158	10.365	41.524
2008	1022.5	1560	2070	49.40	25.966	24.637	50.603
2009	1121	1960	2430	46.13	34.526	19.341	53.868
2010	1162	2370	2860	40.63	42.237	17.132	59.370
2011	1314	3400	4060	32.36	51.379	16.256	67.635
2012	1190.5	4060	5040	23.62	56.934	19.444	76.378
2013	1247.5	4500	5970	20.90	54.480	24.623	79.103
2014	1262	3280	4780	26.40	42.217	31.380	73.598
2015	1273	3250	4740	26.86	41.7089	31.434	73.143
2016	1621.5	4400	5900	27.48	47.093	25.423	72.516
2017	1966.5	3890	5390	36.48	35.686	27.829	63.515
2018	2320.5	5560	7060	32.87	45.885	21.246	67.131
Average	1229.667	2860.67	3753.31	37.32	39.502	23.174	62.676
Growth rate	9%	11%	11%	-2%	2%	-1%	1%

(1) Product's share of consumer price = (farm price/export price) (100).
(2) Wholesaler's share = (wholesale price - product price) + retail price (100).
(3) Retailer's share = (retail price - product price) + retail price (100).
(4) Retailer's share = (retail price - product price) + retail price (100).

Source: Ministry of Agriculture and Land Reclamation, Agricultural Economy Department Central of Bulletin Statistics Agricultural, various issues.

Marketing margins

Data in table (4) showed the absolute marketing margin (wholesaler - producer) is 498 L.E/Ton in 2004 and increased to be 3240 L.E/Ton in 2018. Average of absolute marketing margin (wholesaler - producer) is 1631 L.E/Ton during the period (2004-2018), with annual growth rate increased by 13%. Also its showed the relative marketing margin (wholesaler - producer)

is 43.38% in 2004 and increased to be 58.26% in 2018. Average of relative marketing margin (wholesaler - producer) is 51.54% during the study period, with annual growth rate increased by 2%.

In addition, data in table (4) showed the absolute marketing margin (retailer - wholesaler) is 354 L.E/Ton in 2004 and increased to be 1500 L.E/Ton in 2018. Average of absolute marketing margin (retailer - wholesaler) is 893 L.E/Ton during the period (2004-2018), with annual growth rate increased by 10%. Also its showed the relative marketing margin (retailer - wholesaler) is 23.55% in 2004 and decreased to be 21.25% in 2018. Average of relative marketing margin (retailer - wholesaler) is 23.17% during the study period, with annual growth rate decreased by 1%.

As well as, data in table (4) showed the absolute marketing margin (retailer -producer) is 852 L.E/Ton in 2004 and increased to be 4740 L.E/Ton in 2018. Average of absolute marketing margin (retailer - producer) is 2524 L.E/Ton during the period (2004-2018), with annual growth rate increased by 12%. Also its showed the relative marketing margin (retailer -producer) is 56.72% in 2004 and increased to be 67.13% in 2018. Average of relative marketing margin (retailer -producer) is 62.68% during the study period, with annual growth rate decreased by 1%.

Data in table (4) showed the production cost of potato crop in Egypt during the period (2004- 2018) as it estimated to be 426.23 L.E/Ton in 2004 and increased to be 1680.85 L.E/Ton in 2018. Average of production cost of potato crop is 848.83 L.E/Ton with annual growth rate increased by 10%.

Also data in table (4) showed the marketing efficiency of potato crop in Egypt during the period (2004- 2018) as it estimated to be 66.65% in 2004 and increased to be 73.82% in 2018. Average of marketing efficiency of potato crop is 74.83% with annual growth rate increased by 1%.

Marketing efficiency model of potato crop

The internal and external model variables have been studied to study the marketing efficiency of potato crop in Egypt during the study period (2004-2018), where the model consists of three probability equations as the follow: The first equation explains the most important factors affecting the marketing efficiency of potato crop during the study period (2004-2018), while the second equation explains the most important variables affecting the retail price and the third equation explain the factors affecting the production costs of feddan of the potato crop. The mathematical form of the model can be illustrated as follows:

(1) $Y1t = f(X1t, X2t, Y2t)$
(2) $Y2t = f(X1t, X3t)$
(3) $Y3t = f (X4t)$

Table (4): Marketing efficiency of Potato crop in Egypt during the period (2004-2018)

Year	Wholesaler - Producer		Retailer – Wholesaler		Retailer - Producer		Production cost	Marketing efficiency
	Absolute (LE/ton)	Relative (%)	Absolute (LE/ton)	Relative (%)	Absolute (LE/ton)	Relative (%)		
2004	498.00	43.38	353.70	23.55	851.70	48.65	426.23	66.65
2005	264.50	31.01	293.00	25.57	557.50	56.40	493.64	53.04
2006	462.50	38.25	503.00	29.38	965.50	41.52	557.07	63.41
2007	511.00	34.76	170.00	10.37	681.00	50.60	623.83	52.19
2008	537.50	34.46	510.00	24.64	1047.50	53.87	751.25	58.23
2009	839.00	42.81	470.00	19.34	1309.00	59.37	759.92	63.27
2010	1208.00	50.97	490.00	17.13	1698.00	67.64	774.94	68.66
2011	2086.00	61.35	660.00	16.26	2746.00	76.38	805.20	77.33
2012	2869.50	70.68	980.00	19.44	3849.50	79.10	852.56	81.87
2013	3252.50	72.28	1470.00	24.62	4722.50	73.60	903.82	83.94
2014	2018.00	61.52	1500.00	31.38	3518.00	73.14	776.35	81.92
2015	1977.00	60.83	1490.00	31.43	3467.00	72.52	814.32	80.98
2016	2778.50	63.15	1500.00	25.42	4278.50	63.52	1082.98	79.80
2017	1923.50	49.45	1500.00	27.83	3423.50	67.13	1429.51	70.54
2018	3239.50	58.26	1500.00	21.25	4739.50	62.68	1680.85	73.82
Average	1631.00	51.54	892.65	23.17	2523.65	0.01	848.83	74.83
Growth rate	13%	2%	10%	-1%	12%	1%	10%	1%

1- Wholesale – Producer (Absolute) = Wholesale Price - Product Price
2- Wholesale - Producer (Relative) = (Wholesale Price - Product Price) / Wholesale Price ×100.
3- Retailer - Wholesaler (Absolute) = Retail Price -Wholesale Price
4- Retailer - Wholesaler (Relative)= (Retail Price - Wholesale Price) / Retail Price×100.
5- Retailer -Producer (Absolute)= Retail Price - Producer Price.
6- Retailer -Producer (Relative)= (Retail Price - Product Price) / Retail Price ×100.
7- Marketing efficiency=100- [5)/ (5+7)] x 100.
Source: calculated from data in table (2).

Model variables specification

Data in table (5) showed that some endogenous variables appear in some equations as explanatory (independent) variables in another equation. Therefore, the ordinary least squares method (O.L.S) cannot be relied upon estimating the model due to the disappearance of the basic assumptions in estimating that method whereas the independence from the error limits of endogenous variables which appear in some equations as exogenous variables in the equation:{ E (U) ≠0}.

Table (5) specification of economic variables of the standard model of potato marketing efficiency in Egypt during the period (2004-2018)

Variable	Type	Specification
y_{1t}	Endogenous	Marketing efficiency of potato crop in Egypt
Y_{2t}	Endogenous	Retail price per ton of potato crop by L.E
Y_{3t}	Endogenous	Production cost per feddan of potato crop by L.E
X_{1t}	Exogenous	Whale price per ton of potato crop by L.E
X_{2t}	Exogenous	Production cost per ton of potato crop by L.E
X_{3t}	Exogenous	Farm price per ton of potato crop
X_{4t}	Exogenous	Average of productivity per feddan of potato crop

Consequently, the disappearance of this assumption would not lead to obtain unbiased and consistent estimates of structural parameters due to the bias resulting from the simultaneous problem. To avoid this problem given that the model is composed of many equations, the multi- regression method with three stages can be used, which modified the ordinary least square method with three stages because the model is composed of an integrated system of equations**.**

The most important results obtained by estimating of marketing efficiency equations of potato crops in Egypt (over identified) during the period 2004-2018 can be presented as follows:

1-Equation (1): Marketing efficiency of potato crop

This equation included three independent variables: Whale price per ton of potato crop (X_{1t}), Production cost per ton of potato crop (X_{2t}), and Retail price per ton of potato crop (Y_{2t}). Estimated parameters of the model were consistent with economic logic.

Data in table (6) showed a positive relationship between marketing efficiency of potato crop and the retail price per ton of potato crop, but there was an inverse relationship between marketing efficiency of potato crop and each of whale price per ton of potato crop and production cost per ton of potato crop. It also showed the significant effect between marketing efficiency of potato crop and each of Production cost per ton of potato crop and Retail price per ton of potato crop at the level of significance 0.05.

The determination coefficient indicates that 91.1% of the change of marketing efficiency of potato crop is due to the variables in the equation, and the rest of the changes are due to other variables that were not included in the equation.

The coefficient of the response elasticity between marketing efficiency of potato crop and each of: Whale price per ton of potato crop, Production cost per ton of potato crop and Retail price per ton of potato crop estimated about -0,05, -0.33 and 0.5, respectively. Therefore the increase of Retail price per ton of potato crop by 10%, lead to increases marketing efficiency of potato crop by 5%. In addition, the increase in Whale price per ton of potato crop and Production cost per ton of potato crop by 10%, lead to decrease marketing efficiency of potato crop by 0.5% and 3.3% respectively.

Table (6) Estimates of equation (1) in the model

explanatory variables	Parameters	t-calculated	response elasticity
X_{1t}	-0.001	-0.26	-0.05
X_{2t}	-0.03	-5.44	-0.33
Y_{2t}	0.01	2.75	0.5
Constant	62.1	24.58	0.88
R-SQUARE	0.911	DURBIN-WATSON	2.3

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

2-Equation (2): Retail price of potato crop

This equation included two independent variables: Whale price per ton of potato crop and farm price per ton of potato crop. Estimated parameters of the model were consistent with economic logic. Data in table (7) showed a positive relationship between Retail price of potato crop and each of: Whale price per ton of potato crop and farm price per ton of potato crop. It also showed the significant effect between Retail price per ton of potato crop and Whale price per ton of potato crop at the level of significance 0.05. The determination coefficient indicates that 98 % of the change of percentage of Retail price of potato crop is due to the variables in the equation, and the rest of the changes are due to other variables that were not included in the equation.

Table (7) Estimates of equation (2) in the model

explanatory variables	Parameters	t-calculated	response elasticity
X_{1t}	1.31	12.21	0.99
X_{3t}	0.06	0.19	0.02
Constant	-69.86	-0.31	-0.02
R-SQUARE	0.98	DURBIN-WATSON	1.1

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

The coefficient of the response elasticity between percentage of Retail price of potato crop and each of: Whale price per ton of potato crop and farm price per ton of potato crop estimated about 0.99 and 0.02, respectively. Therefore the increase of Whale price per ton of potato crop and farm price per ton of potato crop by 10%, lead to increases Retail price of potato crop by 9.9% and 0.2% respectively.

3-Equation (3): Production cost of potato crop

This equation included one independent variable which is average of productivity per feddan of potato crop. Estimated parameters of the model were consistent with economic logic. Data in table (8) showed a positive relationship between production cost per feddan of potato crop and average of productivity per feddan of potato crop as it also showed the significant effect between them at the level of significance 0.05. The determination coefficient indicates that 67.1 % of the change of percentage of production cost per feddan of potato crop is due to average of productivity per feddan of potato crop, and the rest of the changes are due to other variables that were not included in the equation.

The coefficient of the response elasticity between cost production per feddan of potato crop and average of productivity per feddan of potato crop estimated about 9.59. Therefore the increase of average of productivity per feddan of potato crop by 1%, lead to increases production cost per feddan of potato crop by 9.59%.

Table (8) Estimates of equation (3) in the model

explanatory variables	Parameters	t-calculated	response elasticity
X_{4t}	8226.3	4.97	9.59
Constant	79331-	-4.45	-8.59
R-SQUARE	0.671	DURBIN-WATSON	1.2

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

Results of the Agricultural Policy Analysis Matrix of Potato Crop during the period (2015-2018)

Data in table No. (9) showed that the private revenues of potato crop during the period (2015-2018) are estimated about 19464.28 L.E/feddan, which is less than the economic (social) revenues by 73.75%, where the economic (social) revenues is 74150.6 L.E/feddan, which is what It indicates that the producers of potato crop during the study period were charging a lower domestic price than its international prices.

As for the costs of potato tradable inputs, which is represented in (chemical fertilizers - pesticides - seeds) during the period (2015-2018) was estimated by private (financial) prices at 6140.75 L.E/feddan which is less than costs of these inputs estimated by economic (social) prices by about 22.43%, where the cost of potato tradable inputs estimated by economic (social) prices is 7915.92 L.E/feddan. Also divergences of tradable inputs costs of potato crop is negative, which is 1775.17 L.E/feddan during the study period. This means that the government imposes taxes on prices of tradable inputs used by potato producers during the study period.

Also costs of potato untradeable (domestic) inputs was estimated by private (financial) prices

during the period (2015-2018) was 7792.5 L.E/feddan, which exceeds the costs of these inputs estimated by economic (social) prices by 14.3%, where the cost of potato untradeable (domestic) inputs estimated by economic (social) prices is 6677.83 L.E/feddan during the same period. Also divergences of untradeable (domestic) inputs costs of potato crop is positive means that potato producers pay more than opportunities cost of untradeable (domestic) inputs, because government imposes taxes on them.

Table (9) Agricultural Policy Analysis Matrix of Potato during the period (2015-2018)

Item	Revenues	Costs		Profits
		Tradable Inputs	Domestic Factors	
Private Prices	19464.28	6140.75	7792.50	5531.03
Social Prices	74150.60	7915.92	6677.83	59556.84
Divergences	-54686.32	-1775.17	1114.67	-54025.81

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

On the other hand, net profits of potato crop estimated by private (financial) prices is 5531.03 L.E/feddan, which is less than that of the economic (social) profits by 90.71% during the period (2015-2018) as the economic (social) profits is 54025.81 L.E/feddan. Consequently, divergences of net profits for the potato crop are negative, which was estimated about 54025.81 L.E/feddan during the period (2015-2018), which confirms that the potato producers were charging a domestic price lower than international prices, and thus incurring an implicit tax represented in the difference between the net profits denominated in local prices and international prices.

Impact of agricultural policy using the policy analysis matrix of the potato crop

Data in table no. (10) showed the results of measuring both the nominal protection coefficient of potato crop, the effective protection coefficient, and the coefficient of domestic resources cost of potato crop during the period (2015-2018).

1-Nominal protection coefficient

Table (10) showed that the nominal protection coefficient of potato crop during the period (2015-2018) is 0.26 (less than one), which indicates that there is no fair production policy during the that period or in other words, the decrease in the domestic prices of potatoes than their international prices and thus the producers incurred implicit taxes of about 0.74 during the study period, so that potato producers get 26% of their production value at international prices, which estimated about 74150.6 L.E/feddan during the study period. This means that those policies were not in favor of potato producers.

2-Effective protection coefficient

Data in table (10) showed that the value of effective protection coefficient is less than the one, as it estimated during the period (2015-2018) about 0.20, which indicates the existence of implicit taxes on the producers of potato crop, or in other words, added value of potato crop estimated by domestic prices is less than added value of potato crop estimated by international prices, which means that potato crop did not have a protection during the period (2015 – 2018), and this indicated that the state imposes direct or indirect taxes on potato producers, or the state supports what is imported from this crop.

3-The coefficient of domestic resources cost

Data in table (10) showed that the value of DRC during the period (2015-2018) is 0.10, which means that the cost of domestic input is less than the social benefits resulting from domestic resources. In this case, Egypt has a comparative advantage in producing potato crops, as the benefits from importing this crop are greater than its production cost, or it is desirable to expand its domestic production.

Table (10) Impact of agricultural policy using the policy analysis matrix of the potato crop (2015-2018

Coefficient	Value
Nominal protection coefficient	0.26
Effective protection coefficient	0.20
Coefficient of Domestic resources cost	0.1

Source: calculated from data of table (9).

Conclusion and Recommendations

Potato crop is considered as an important vegetable crop in Egypt, as the Egyptian citizens consume it a lot. It is also an important source of domestic agricultural income and the foreign exchange needed to push the wheel of economic development, as Egyptian potato exports are at the top of Egyptian agricultural exports. The importance of potato crop in Egypt is due to the large cultivated area and farmers' interest in it as an export crop to cover the needs of local market. Therefore, an efficient marketing system must be provided to reduce the production losses, as the performance efficiency of the marketing services during the marketing stages are among the factors that affect the agricultural stability, expansion of the crop, improved economic and social environment in which

potato producers work and format directions that help in achieving agricultural development, accordingly it has implications for producers decisions.

The research problem is represented in the increase in mediators share during marketing operations, as well as high marketing costs and farmers receive low farm prices that with high retail prices paid by consumers, consequently low marketing efficiency. Potato crop, like other crops, is affected by the extent of success and safety of agricultural policies pursued by the state, as well as direct and indirect intervention in the price policies of potato crop, whether in relation to inputs or outputs, which creates a differences in local and international prices, in addition to not optimizing the use of agricultural inputs. The research aimed to identify the productive position and marketing system of potato crop, estimate the marketing margins and marketing efficiency, in addition to estimating the financial and economic evaluation of all items of production costs of potato crop to analyze the current situation and map future policies and programs for producing and marketing of potato crop.

The study relied on descriptive and quantitative analysis methods represented in the simultaneous equations consisting of linear regression equations in Egyptian potato market. In addition to estimating items of production costs and revenues of the potato crop financially and economically, also calculating the nominal and effective protection coefficients and domestic resources coefficient of the potato crop through the Policy Analysis Matrix (PAM). So that the study based on secondary data which is published by Ministry of Agriculture and Land Reclamation and the Central Agency for Public Mobilization and Statistics during the period (2004-2018). As the most important conclusion can be summarized as follow:

- Average of cultivated area of winter potato is 245.71 thousand feddans during the study period (2004 - 2018), followed by average of cultivated area of summer potato, is 243.32 thousand feddans, then the average cultivated area of nili potato was about 107.89 thousand feddans. In addition, The cultivated area of winter potato achieved the highest annual increase growth rate by 7.17%, followed by the cultivated area of summer potato, which has an increase growth rate by 0.28%, and finally the cultivated area of nili potato has a decrease growth rate by 1.05%.

- It is also showed that the average of productivity of summer potato is 12.16 ton/feddan during the study period (2004 - 2018), followed by average of productivity of winter potato, is 10.75 ton/feddan, then the average of productivity of nili potato is about 9.39 ton/feddan. In addition, The productivity of winter potato achieved the highest annual increase growth rate by 1.56%, followed by the productivity of nili potato, which has an increase growth rate by 0.57%, and finally the productivity of summer potato has a increase growth rate by 0.43%.

-It is also showed that the average of total production of winter potato is 1869.09 thousand tons during the study period (2004 - 2018), followed by average of total production of summer potato, is 1375.23 thousand tons, then the average of total production of nili potato is 421.02 thousand tons. In addition, total production of winter potato achieved the highest annual increase growth rate by 8.84%, followed by total production of summer potato, which has an increase growth rate by 0.71%, and finally total production of nili potato has a decrease growth rate by 0.48% because of the decrease of cultivated area of potato.

-Average of production cost of potato crop is 848.83 L.E/Ton with annual growth rate increased by 10%, resulted to average of marketing efficiency of potato crop is 74.83% with annual growth rate increased by 1%.

-Increasing of Retail price per ton of potato crop by 10%, lead to increases marketing efficiency of potato crop by 5%. In addition, the increase in Whale price per ton of potato crop and Production cost per ton of potato crop by 10%, lead to decrease the percentage of marketing efficiency of potato crop by 0.5% and 3.3% respectively.

- Nominal protection coefficient of potato crop during the period (2015-2018) is 0.26 (less than one), which indicates that there is no fair production policy during the that period or in other words, the decrease in the domestic prices of potatoes than their international prices and thus the producers incurred implicit taxes of about 0.74 during the study period.

-There is a positive relationship between cost production per feddan of potato crop and average of productivity per feddan of potato crop as it also showed the significant effect between them at the level of significance 0.05, as the coefficient of the response elasticity estimated about 9.59. Therefore the increase of average of productivity per feddan of potato crop by 1%, lead to increases cost production per feddan of potato crop by 9.59%.

So that this study recommended that:

1- Government is necessary to supervise the markets in terms of providing the requirements for producing potato crops at rates that suit the actual needs of crops at a suitable time and at prices close to their real cost without being affected by changes in world prices, which leads to an increase in the productivity per feddan of potato crop.

2- Developing crop marketing systems by establishing grouped marketing centers to assist farmers in obtaining the appropriate price, in addition

to providing commercial insurance institutions so that each product can insure itself against the risks of price fluctuations.

3- Providing the necessary financing for farmers to carry out the sorting and grading process to reduce the marketing losses by organizing trading operations after harvest so that the mediators cannot raise the commission and the farmers exploit.

4- Developing storage methods and using marketing methods to store potato.

5- Working to improve marketing efficiency by organizing wholesale markets to reduce marketing differences.

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