Original Research Article

Impact of Agricultural Price Policy on Main Crops in Egypt

ABSTRACT

Agricultural production, like other economic activities, is affected by the success of agricultural economic policies pursued by government from leaving the farmer free to cultivate his land with the desired crops, and to take his production and marketing decisions in light of the mechanisms of supply and demand and the movement of prices in the markets without any intervention by the government. Therefore, the government's intervention influences the farmers' desire to grow any of the crops through its agricultural policies by imposing taxes or subsidizing inputs. Wheat, maize, rice, and potatoes are among the most crucial strategic food and industrial crops in Egypt. The Policy Analysis Matrix (PAM) can be calculated by calculating nominal and effective protection coefficients, and then identifying the policy adopted by the government, whether it is a protectionist policy or a policy of direct or indirect taxes on the producers of those crops, as well as the calculation of the cost of domestic resources to determine the relative advantage. The results showed that the financial value of workers' wages in the production of wheat, maize, rice, and potatoes at market prices exceeded the border prices, while the values of the nominal protection coefficients of outputs were about 0.81, 0.81, 0.80, 0.83 for wheat, maize, rice, and potatoes. Nominal protection coefficient values for production inputs were 0.83, 0.83, 0.85, and 0.84 respectively for the four crops, while the effective protection plant values for wheat, maize, rice, and potato crops were 0.80, 0.80, 0.80 and 0.84, respectively. The values of the comparative advantage of the four crops, respectively, were 0.49, 0.52, 0.38, and 0.37.

Keywords: Policy Analysis Matrix, Nominal Protection Coefficient, Effective Protection Coefficient, Domestic Resource Costs.

1. INTRODUCTION

As Egypt progressed from a largely agricultural country to a country with a more diverse economy, agriculture itself slowly declined in prominence as a pillar of the Egyptian economy. Trends in the contribution of agriculture to national income give an indication of this. Between 1970 and 2000, agriculture's contribution had fallen from 29.0 to 16.5 percent of GDP, with output falling at an annual average of 2.8 percent between 1960 and 1980 [1,2]. This slow progress is also reflected in high unemployment and poverty levels. Nevertheless, today, agriculture is still expected to generate hard currency revenue via high-quality products for export and to provide food security for the country's population via the cultivation of enough staple crops. That is, agriculture is to provide income, employment, and food for the Egyptian population [3].

Cereal crops, mainly wheat, maize and rice, are staple food crops for many nations, especially in developing countries. They also play a strategic role in the policies of developed countries as they use such crops as a tool for practicing pressure on other countries. That is why most developing countries seek to achieve self-sufficiency in cereal crops. In Egypt, official statistics indicate that cereal production reached 22.37 million tons, while domestic consumption reached 47.47 million tons, indicating a gap of 25 million tons worth US$ 4.3 billion. In 2017, self-sufficiency in cereals reached 47.12% [4].

In addition, cereal crops occupy an important position in Egypt's agriculture, either in terms of contribution to national income, or to resources, with cultivated land area estimated at 12.19 million acers representing

76% of total cropped area, estimated at 16.04 million acres [5].Also, Vegetables crops occupy an important position in Egypt's agriculture, either in terms of contribution to national income, or to resources, with cultivated land area estimated at 1.88 million acres representing 11.72% of total cropped area [6].

Wheat, maize, rice and potatoes are major crops in Egypt, domestic wheat production declined from 9.34 million tons in 2016 to 8.42 million tons in 2017, down by 9.9%. In 2017, average per capita share of wheat amounted to 163.9 kg/year and self-sufficiency rate amounted to 34.5%. While Maize production increased from 7.17 million tons in 2016 to 7.66 million tons in 2017, average per capita share of maize amounted to 52.2 kg/year and self-sufficiency rate amounted to 46.10%. Rice production also declined from 5.31 million tons in 2016 to 4.96 million tons in 2016, down by 10.2%. In 2017, average per capita share of rice amounted to 38.7 kg/year and self-sufficiency rate amounted to 87.96%. Potatoes production also declined from 5.02 million tons in 2016 to 4.84 million tons in 2017, average per capita share of potatoes amounted to 25.4 kg/year and self-sufficiency rate amounted to 116.28% [7].

The current research investigates the problems arising from impact of agricultural price policy in agricultural production through adopting development strategies that aim to achieve free market economy [8] and dependency on interaction between supply and demand forces as main pillar to raise efficiency of the national economy and achieve the hoped for development, which all resulted in producers bearing the burden of paying indirect taxes (implicit) due to price distortions resulting from imbalances between domestic and international prices [9].Such situation obstructs efforts exerted to achieve optimum economic efficiency in domestic resources' use as well as the welfare of producers and consumers. As a result, producers started choosing to cultivate other crops that are not subject to taxes and in the same time are profitable [10].

Accordingly, the current research mainly aims at assessing the impact of agricultural price policy by studying and analyzing the indicators that can be deduced from PAM, which can help identify trends of agricultural policies implemented in the agricultural sector and measure the efficiency of economic resources' use. To assess the impact of the implemented policy by measuring Nominal Protection Coefficient for outputs and inputs, Effective Protection Coefficient and Comparative Advantage Coefficient (Domestic Resource Cost Coefficient).

2. MATERIALS AND METHODS

To achieve the research objectives, the impacts of agricultural price policy will be assessed for main crops in Egypt, as follows:

2.1 Policy Analysis Matrix (PAM)

Policy analysis matrix is one of the most important modern methods used in policy analysis, where it helps examine the impacts of government's intervention policies across different stages of the flow of goods, which in turn helps assess and measure such policies' efficiency in achieving the hoped for objectives and examine their impacts on producers, consumers and the macro-level economic conditions [11].The set of indicators that can be deduced from PAM can help identify trends of agricultural policies implemented in the agricultural sector and measure the efficiency of economic resources' use [12].PAM is usually built using farm budget, including revenues and costs, which occur in the form of tradable inputs (production inputs) and domestic resources (land and labor). In PAM, both revenues and costs are evaluated financially (at market prices) and economically (at border prices) to assess the impact of the implemented policy by measuring Nominal Protection Coefficient for outputs and inputs, Effective Protection Coefficient and Comparative Advantage Coefficient (Domestic Resource Cost Coefficient). The general structure of PAM is presented as follows:

Table 1: General Structure of Policy Analysis Matrix

	Total revenue	Total production input	Total cost of domestic			Net Revenue	Value Added
			Total labor	**Total rent (land)**	**Total**		

Financial prices	A	B	C	D	E	F	G
Economic prices	H	I	J	K	L	M	N
Policy impact	O	P	Q	R	S	T	U

Nominal Protection Coefficient on Tradable Outputs (NPC_O)[1]: Nominal Protection Coefficient on Tradable Outputs provides a comparison between domestic and economic prices of outputs. It represents such kinds of protection or taxes that prevent equating domestic prices with border prices. It reflects the level of incentives or non-incentives offered to domestic farmers. It can be calculated as follows:

$$NPC = \frac{A}{H}$$

- NPC> 1 means that domestic prices are higher than border prices, indicating implicit subsidy for producers.
- NPC <1 means that domestic prices are lower than border prices, indicating that producers incur implicit taxes.
- NPC = 1 means absence of intervention in price policy, as well as absence of protection.

Nominal Protection Coefficient on Tradable Inputs (NPC_I)[2]: Nominal Protection Coefficient on Tradable Inputs is the ratio between domestic and economic prices of outputs:

$$NPCI = \frac{B}{I}$$

- NPCI> 1 means that the government subsidizes production inputs.
- NPCI <1 means that the government imposes taxes on inputs.
- NPCI = 1 means lack of distortions in input prices.

Effective Protection Coefficient (EPC)[3]: Effective Protection Coefficient is an extension of the concept of the Nominal Protection Coefficient. However, it measures price distortions at the level of output and input markets, where it measures the net impact of economic policy on domestic output and input markets. It is the ratio of the value added [4] of a particular product in domestic market price to the value added in economic price:

$$EPC = \frac{G}{N}$$

- EPC = 1 means lack of distortions.
- EPC> 1 means effective protection or incentives for producers.
- EPC <1 means negative protection in the form of taxes imposed on producers.

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It should be noted that the nominal protection coefficient for both inputs and outputs is used to estimate the structure of incentives at the commodity level, while effective protection coefficient is a measure of price incentives.

Local Resource Cost Ratio (DRC)[5]**:** it is the ratio between benefits and costs. It is a measure of efficiency or comparative advantage of a certain commodity system. A commodity system is considered to enjoy a comparative advantage when DRC is less than or equal to the equilibrium exchange rate. It can be computed as follows:

(1) Nominal Protection Coefficient on Tradable Outputs (NPC_O).
(2) Nominal Protection Coefficient on Tradable Iutputs (NPC_I).
(3) Effective Protection Coefficient (EPC).
(4) Value added = Revenue – Inputs excluding domestic factors
(5) Domestic Resource Costs (DRC).

$$DRC = \frac{L}{N}$$

- DRC <1 means that using less than one unit of domestic resources yields one unit of hard currency, indicating that the country enjoys a comparative advantage.
- DRC> 1 means that more than one unit of domestic resources is used to acquire one unit of hard currency, indicating that country has no comparative advantage in the global market. Alternatively, the opportunity cost of using domestic resources exceeds the value added estimated at world prices, indicating that the economic activity is unprofitable.

2.2 Sources of Data

The research relied on published and unpublished secondary data from various sources, including: the Ministry of Agriculture and Land Reclamation, the Central Agency for Public Mobilization and Statistics (CAPMAS), the National Planning Institute, websites of Food and Agriculture Organization of the United Nations, the United Nations and the World Bank, in addition to other websites specialized in publishing data statistics. The research also used some references and researches relevant to the study subject.

3. RESULTS AND DISCUSSION

Input Cost Analysis using Domestic and Border Prices

Financial analysis of average production cost per acre has been computed using domestic farmgate prices and border prices over the period 2000-2017. Findings reveal the following:

3.1 Domestic Resource Cost

3.1.1 Labor Wages

Figures in Table (2) indicate that wages of labor hired for wheat, maize, rice and potatoes production in market prices is higher than wages computed in border prices. Average value of labor wages in financial prices reached 108.6, 140.89, 126.97, 173.92 US$ while that computed in economic prices reached 81.75, 105,67, 95.23, 130.44 US$.

Table 2: Production Cost Items Assessed in Financial and Economic Prices of main crops Grown in Egypt over the period 2000-2017

		Wheat		Maize		Rice		Potatoes	
		Financial Prices	Economic prices*	Financial Prices	Economic prices*	Financial Prices	Economic prices*	Financial Prices	**Economic prices***
Total cost of domestic	Labor Wages	108.6	81.75	140.89	105.67	126.97	95.23	173.92	130.44
	Wages of Draft Animals	3.7	3.7	1.01	1.01	5.83	5.83	5.94	5.94
	Wages of Machinery	75.4	84.45	56.64	63.44	93.81	105.07	68.05	76.22
	General Expenses	28.4	28.4	28.66	28.66	31.02	31.02	93.92	93.92
	Rent	213.5	189.11	175.89	240.41	240.41	157.89	148.46	240.41
	Total cost of domestic resource	429.6	387.41	403.09	438.52	498.04	395.04	490.29	**546.93**
Total production	Seeds Cost	26.9	30.13	28.66	32.09	26.18	29.32	576.41	645.58
	Manure	11.6	11.6	24.01	24.01	4.6	4.6	46.69	46.69
	Fertilizers	51.2	74.24	60.81	88.17	45.51	65.99	127.59	185.00
	Insecticides	11.3	12.32	8.02	8.74	17.61	19.19	44.67	48.69
	Total production inputs	129.44	156.69	150.16	181.67	124.92	150.12	889.28	1020
	Total costs	230.44	284.98	271.66	334.68	218.82	269.22	1684.62	**1945.96**

Source: Author Calculation, 2019.

* Economic value has been computed using conversion factors estimated by experts from the World Bank in 2000, as follows: 1.12 for seeds; 1.45 for chemical fertilizers; 1.09 for pesticides; 0.75 for human labor; 1.12 for machinery. Other items remained unchanged. As for land, opportunity cost is the revenue producer can get from his land without bearing the burdens of risks in agricultural production, which is usually the economic rent (leasing to others for one year) assessed on the basis of duration of crop stay in land **(world bank, 2000)**.

3.1.2 Cost of Machinery

Figures in Table (2) indicate that cost of machinery rented for wheat, maize, rice and potatoes production in market prices is less than that computed in border prices. Average rent in financial prices reached 75.4, 56.64, 93.81, 68.05 US$, while that computed in economic prices reached 84.45, 63.44, 105.07, 76.22 US$.

3.1.3 Cost of Production Inputs

Figures in Table (2) indicate that average cost of production inputs in financial prices (including fertilizers, pesticides and seeds) reached 89.4, 97.49, 89.3, 748.67 US$, while that computed in economic prices reached 116.69, 129, 114.5, 879.27 US$.

3.2 Impact of Agricultural Price Policy on wheat Crop:

It is also clear from Table (3), which illustrates the results of PAM applied to wheat grown in Egypt over the period (2000-2017), that average revenue reached US$ 735.43 in financial prices, while reached US$ 925.55 in economic prices, resulting in a policy impact of US$ 190.12, indicating that wheat producers incurred implicit taxes estimated at US$ 190.12 as average of the study period.

Table 3: Policy Analysis Matrix for wheat Grown in Egypt over the Period 2000-2017

	Total revenue	Total production input	Total cost of domestic			Net Revenue	Added Value
			Total labor	Total rent (land)	Total		
Financial prices	735.43	129.42	187.65	213.48	401.13	204.9	606.01
Economic prices	925.55	152.69	168.42	189.11	357.53	415.33	772.86
Policy impact	(190.12)	(23.27)	19.23	24.37	43.6	(210.43)	(166.85)

Numbers between the brackets are Negative

Source: Author Calculation, 2019.

Results also show that wheat farmers bear costs of production inputs during the study period (2000-2017), estimated at US$ 129.42 in financial prices, corresponding to US$ 152.69 in economic prices, resulting in a policy impact of US$ 23.27, which means that cost of production inputs declined by US$ 23.27 during the study period.

In addition, wheat farmers incurred implicit taxes on hired labor (as domestic resource) estimated at US$ 19.23 as average of the study period. As for net revenue, which reflects implicit taxes incurred by producers and subsidy received, it can be noted from Table (3) that it amounted to US$ 204.9 in financial prices and US$ 415.33 in economic prices, resulting in a policy impact of US$ 210.43, indicating that wheat producers incurred implicit taxes amounting to US$ 210.43 as average of the study period.

3.2.1 Nominal Protection Coefficient on Outputs (NPC_o)

As shown in Table (4), Nominal Protection Coefficient on Outputs amounted to 0.79, which is less than unity, indicating absence of fair production policy over the study period 2000-2017. In other words, domestic prices of wheat is lower than international prices, resulting in wheat producers incurring implicit taxes amounting to 21% due to receiving only 79% of the real price they should get for their product. Such result means that the implemented policy was not in favor of domestic wheat producers.

Table 4: Nominal Protection Coefficient, Effective Protection Coefficient and Domestic Resource Cost Ratio for Wheat Grown in Egypt over the Period 2000-2017

Items	Value
NPC_o	0.79
NPC_I	0.85
EPC	0.78
DRC	0.46

Source: Calculated from table 2.

3.2.2 Nominal Protection Coefficient on Inputs (NPC_I)

Results in Table (4) show that Nominal Protection Coefficient on Inputs amounted to 0.85, which is less than unity, indicating very low subsidy on inputs used in wheat production over the study period 2000-2017. In other words, wheat producers received a subsidy as low as 15% on production inputs. This also means that subsidy to wheat producers is diminishing, which complies with the implemented agricultural policy of gradual removal of subsidy on production inputs until reaching price levels proportionate to their economic cost thus international prices. Such finding indicates that the implemented economic liberalization policy resulted in very limited subsidy on production inputs for wheat producers.

3.2.3 Effective Protection Coefficient (EPC)

It is clear from Table 4 that Effective Protection Coefficient amounted to 0.78, which is less than unity, indicating that wheat producers incur implicit taxes. In other words, value added in domestic prices is lower than that in international prices, which means absence of protection policy during the study period. Such result means that the government has been imposing taxes, either direct or indirect, or it has been subsidizing wheat imports.

3.2.4 Domestic Resources Cost Ratio DRC (Comparative Advantage)

Results in Table 4 show that Domestic resource Cost Ratio amounted to 0.46, indicating that Egypt enjoyed a comparative advantage in wheat production during the study period 2000-2017, which means that domestic production of wheat is preferred to dependency on imports.

3.3 Impact of Agricultural Price Policy on maize Crop:

It is also clear from Table (5), which illustrates the results of PAM applied to maize grown in Egypt over the period (2000-2017), that average revenue reached US$ 799.63 in financial prices, while reached US$ 1006.34 in economic prices, resulting in a policy impact of US$ 206.71, indicating that maize producers incurred implicit taxes estimated at US$ 206.71 as average of the study period.

Table 5: Policy Analysis Matrix for maize Grown in Egypt over the Period 2000-2017

	Total revenue	Total production input	Total cost of domestic			Net Revenue	Added Value
			Total labor	Total rent (land)	Total		
Financial prices	799.63	150.15	198.54	175.89	374.43	275.05	649.48
Economic prices	1006.34	178.26	170.76	240.41	411.17	416.91	828.08
Policy impact	(206.71)	(28.11)	27.78	(64.52)	(36.74)	(141.86)	(178.6)

Numbers between the brackets are Negative

Source: Author Calculation, 2019.

Results also show that maize farmers bear costs of production inputs during the study period (2000-2017), estimated at US$ 150.15 in financial prices, corresponding to US$ 178.26 in economic prices, resulting in a policy impact of US$ 28.11, which means that cost of production inputs declined by US$ 28.11 during the study period.

In addition, maize farmers incurred implicit taxes on hired labor (as domestic resource) estimated at US$ 27.78 as average of the study period. As for net revenue, which reflects implicit taxes incurred by producers and subsidy received, it can be noted from Table (5) that it amounted to US$ 275.05 in financial prices and US$ 416.91 in economic prices, resulting in a policy impact of US$ 141.86, indicating that maize producers incurred implicit taxes amounting to US$ 141.86 as average of the study period.

3.3.1 Nominal Protection Coefficient on Outputs (NPC_o)

As shown in Table (6), Nominal Protection Coefficient on Outputs amounted to 0.79, which is less than unity, indicating absence of fair production policy over the study period 2000-2017. In other words, domestic prices of maize is lower than international prices, resulting in maize producers incurring implicit taxes amounting to 21% due to receiving only 79% of the real price they should get for their product. Such result means that the implemented policy was not in favor of domestic maize producers.

Table 6: Nominal Protection Coefficient, Effective Protection Coefficient and Domestic Resource Cost Ratio for maize Grown in Egypt over the Period 2000-2017

Items	Value
NPC_o	**0.79**
NPC_I	**0.84**
EPC	**0.78**
DRC	**0.46**

Source: Calculated from table 6.

3.3.2 Nominal Protection Coefficient on Inputs (NPC_I)

Results in Table (6) show that Nominal Protection Coefficient on Inputs amounted to 0.84, which is less than unity, indicating very low subsidy on inputs used in maize production over the study period 2000-2017. In other words, maize producers received a subsidy as low as 16% on production inputs. This also means that subsidy to maize producers is diminishing, which complies with the implemented agricultural policy of gradual removal of subsidy on production inputs until reaching price levels proportionate to their economic cost thus international prices. Such finding indicates that the implemented economic liberalization policy resulted in very limited subsidy on production inputs for maize producers.

3.3.3 Effective Protection Coefficient (EPC)

It is clear from Table 6 that Effective Protection Coefficient amounted to 0.78, which is less than unity, indicating that maize producers incur implicit taxes. In other words, value added in domestic prices is lower than that in international prices, which means absence of protection policy during the study period. Such result means that the government has been imposing taxes, either direct or indirect, or it has been subsidizing maize imports.

3.3.4 Domestic Resources Cost Ratio DRC (Comparative Advantage)

Results in Table 6 show that Domestic resource Cost Ratio amounted to 0.50, indicating that Egypt enjoyed a comparative advantage in maize production during the study period 2000-2017, which means that domestic production of maize is preferred to dependency on imports.

3.4 Impact of Agricultural Price Policy on Rice Crop:

It is also clear from Table (7), which illustrates the results of PAM applied to rice grown in Egypt over the period (2000-2017), that average revenue reached US$ 950.99 in financial prices, while reached US$ 1169.89 in economic prices, resulting in a policy impact of US$ 218.9, indicating that rice producers incurred implicit taxes estimated at US$ 218.9 as average of the study period.

Table 7: Policy Analysis Matrix for Rice Grown in Egypt over the Period 2000-2017

	Total revenue	Total production input	Total cost of domestic			Net Revenue	Added Value
			Total labor	Total rent (land)	Total		
Financial prices	950.99	124.92	226.61	240.41	467.02	359.05	826.07
Economic prices	1169.89	146.86	205.71	175.89	381.6	641.43	1023.03
Policy impact	(218.9)	(21.94)	20.9	64.52	85.42	(282.38)	(196.96)

Numbers between the brackets are Negative

Source: Author Calculation, 2019.

Results also show that rice farmers bear costs of production inputs during the study period (2000-2017), estimated at US$ 124.92 in financial prices, corresponding to US$ 146.86 in economic prices, resulting in a policy impact of US$ 21.94, which means that cost of production inputs declined by US$ 28.11 during the study period.

In addition, rice farmers incurred implicit taxes on hired labor (as domestic resource) estimated at US$ 20.9 as average of the study period. As for net revenue, which reflects implicit taxes incurred by producers and subsidy received, it can be noted from Table (7) that it amounted to US$ 359.05 in financial prices and US$ 641.43 in economic prices, resulting in a policy impact of US$ 282.38, indicating that rice producers incurred implicit taxes amounting to US$ 282.38 as average of the study period.

3.4.1 Nominal Protection Coefficient on Outputs (NPC_o)

As shown in Table (8), Nominal Protection Coefficient on Outputs amounted to 0.81, which is less than unity, indicating absence of fair production policy over the study period 2000-2017. In other words, domestic prices of rice is lower than international prices, resulting in rice producers incurring implicit taxes amounting to 19% due to receiving only 81% of the real price they should get for their product. Such result means that the implemented policy was not in favor of domestic rice producers.

Table 8: Nominal Protection Coefficient, Effective Protection Coefficient and Domestic Resource Cost Ratio for Rice Grown in Egypt over the Period 2000-2017

Items	Value
NPC_o	0.81
NPC_I	0.85
EPC	0.81
DRC	0.37

Source: Calculated from table 6.

3.4.2 Nominal Protection Coefficient on Inputs (NPC_I)

Results in Table (8) show that Nominal Protection Coefficient on Inputs amounted to 0.85, which is less than unity, indicating very low subsidy on inputs used in rice production over the study period 2000-2017. In other words, rice producers received a subsidy as low as 15% on production inputs. This also means that subsidy to rice producers is diminishing, which complies with the implemented agricultural policy of gradual removal of subsidy on production inputs until reaching price levels proportionate to their economic cost thus international prices. Such finding indicates that the implemented economic liberalization policy resulted in very limited subsidy on production inputs for rice producers.

3.4.3 Effective Protection Coefficient (EPC)

It is clear from Table 8 that Effective Protection Coefficient amounted to 0.81, which is less than unity, indicating that rice producers incur implicit taxes. In other words, value added in domestic prices is lower than that in international prices, which means absence of protection policy during the study period. Such result means that the government has been imposing taxes, either direct or indirect.

3.4.4 Domestic Resources Cost Ratio DRC (Comparative Advantage)

Results in Table 8 show that Domestic resource Cost Ratio amounted to 0.37, indicating that Egypt enjoyed a comparative advantage in rice production during the study period 2000-2017, which means that domestic production of rice is preferred to dependency on imports.

3.5 Impact of Agricultural Price Policy on Potatoes Crop:

It is also clear from Table (9), which illustrates the results of PAM applied to Potatoes grown in Egypt over the period (2000-2017), that average revenue reached US$ 1986.60 in financial prices, while reached US$ 2389.51 in economic prices, resulting in a policy impact of US$ 402.91, indicating that Potatoes producers incurred implicit taxes estimated at US$ 402.91 as average of the study period.

Table 9: Policy Analysis Matrix for Potatoes Grown in Egypt over the Period 2000-2017

	Total revenue	Total production input	Total cost of domestic			Net Revenue	Added Value
			Total labor	Total rent (land)	Total		
Financial prices	1986.60	889.26	247.92	184.46	432.38	664.96	1097.34
Economic prices	2389.51	1058.2	222.54	240.41	462.95	868.36	1331.31
Policy impact	(402.91)	(168.94)	25.385	(55.95)	(30.57)	(203.4)	(233.97)

Numbers between the brackets are Negative
Source: Author Calculation, 2019.

Results also show that Potatoes farmers bear costs of production inputs during the study period (2000-2017), estimated at US$ 889.26 in financial prices, corresponding to US$ 1058.2 in economic prices, resulting in a policy impact of US$ 168.94, which means that cost of production inputs declined by US$ 168.94 during the study period.

In addition, Potatoes farmers incurred implicit taxes on hired labor (as domestic resource) estimated at US$ 25.385 as average of the study period. As for net revenue, which reflects implicit taxes incurred by producers and subsidy received, it can be noted from Table (9) that it amounted to US$ 664.96 in financial prices and US$ 868.36 in economic prices, resulting in a policy impact of US$ 203.4, indicating that Potatoes producers incurred implicit taxes amounting to US$ 203.4 as average of the study period.

3.5.1 Nominal Protection Coefficient on Outputs (NPC_o)

As shown in Table (10), Nominal Protection Coefficient on Outputs amounted to 0.83, which is less than unity, indicating absence of fair production policy over the study period 2000-2017. In other words, domestic prices of Potatoes is lower than international prices, resulting in Potatoes producers incurring implicit taxes amounting to 17% due to receiving only 83% of the real price they should get for their product. Such result means that the implemented policy was not in favor of domestic Potatoes producers.

Table 10: Nominal Protection Coefficient, Effective Protection Coefficient and Domestic Resource Cost Ratio for Potatoes Grown in Egypt over the Period 2000-2017

Items	Value
NPC_o	**0.81**
NPC_I	**0.85**
EPC	**0.81**
DRC	**0.37**

Source: Calculated from table 8.

3.5.2 Nominal Protection Coefficient on Inputs (NPC_I)

Results in Table (11) show that Nominal Protection Coefficient on Inputs amounted to 0.84, which is less than unity, indicating very low subsidy on inputs used in Potatoes production over the study period 2000-2017. In other words, Potatoes producers received a subsidy as low as 16% on production inputs. This also means that subsidy to Potatoes producers is diminishing, which complies with the implemented agricultural policy of gradual removal of subsidy on production inputs until reaching price levels proportionate to their economic cost thus international prices. Such finding indicates that the implemented economic liberalization policy resulted in very limited subsidy on production inputs for Potatoes producers.

3.5.3 Effective Protection Coefficient (EPC)

It is clear from Table 10 that Effective Protection Coefficient amounted to 0.82, which is less than unity, indicating that Potatoes producers incur implicit taxes. In other words, value added in domestic prices is lower than that in international prices, which means absence of protection policy during the study period. Such result means that the government has been imposing taxes, either direct or indirect.

3.5.4 Domestic Resources Cost Ratio DRC (Comparative Advantage)

Results in Table 10 show that Domestic resource Cost Ratio amounted to 0.35, indicating that Egypt enjoyed a comparative advantage in Potatoes production during the study period 2000-2017, which means that domestic production of Potatoes is preferred to dependency on imports.

4. Conclusion and recommendations:

Wheat, maize, rice and potatoes are major crops in Egypt, domestic wheat production declined from 9.34 million tons in 2016 to 8.42 million tons in 2017, down by 9.9%. In 2017, average per capita share of wheat amounted to 163.9 kg/year and self-sufficiency rate amounted to 34.5%. While Maize production increased from 7.17 million tons in 2016 to 7.66 million tons in 2017, average per capita share of maize amounted to 52.2 kg/year and self-sufficiency rate amounted to 46.10%. Rice production also declined from 5.31 million tons in 2016 to 4.96 million tons in 2016, down by 10.2%. In 2017, average per capita share of rice amounted to 38.7 kg/year and self-sufficiency rate amounted to 87.96%. Potatoes production also declined from 5.02 million tons in 2016 to 4.84 million tons in 2017, average per capita share of potatoes amounted to 25.4 kg/year and self-sufficiency rate amounted to 116.28%.The current research investigates the problems arising from impact of agricultural price policy in agricultural production through adopting development strategies that aim to achieve free market economy and dependency on interaction between supply and demand forces as main pillar to raise efficiency of the national economy and achieve the hoped for development, which all resulted in producers bearing the burden of paying indirect taxes (implicit) due to price distortions resulting from imbalances between domestic and international prices. Such situation obstructs efforts exerted to achieve optimum economic efficiency in domestic resources' use as well as the welfare of producers and consumers.

The research applied Policy analysis matrix to determine indicators that can be help to identify trends of agricultural policies implemented in the agricultural sector and measure the efficiency of economic resources' use. PAM is usually built using farm budget, including revenues and costs, which occur in the form of tradable inputs (production inputs) and domestic resources (land and labor). In PAM, both revenues and costs are evaluated financially (at market prices) and economically (at border prices) to assess the impact of the implemented policy by measuring Nominal Protection Coefficient for outputs and inputs, Effective Protection Coefficient and Comparative Advantage Coefficient (Domestic Resource Cost Coefficient).

The results showed that the financial value of workers' wages in the production of wheat, maize, rice, and potatoes at market prices exceeded the border prices, while the values of the nominal protection coefficients of outputs were about 0.81, 0.81, 0.80, 0.83 for wheat, maize, rice, and potatoes. Nominal protection coefficient values for production inputs were 0.83, 0.83, 0.85, and 0.84 respectively for the four crops, while the effective protection plant values for wheat, maize, rice, and potato crops were 0.80, 0.80, 0.80 and 0.84, respectively. The values of the comparative advantage of the four crops, respectively, were 0.49, 0.52, 0.38, and 0.37.

Based on the research results, we recommend the following:

I. Expansion of wheat and maize crops to reduce the quantity imported.

II. Revisiting governmental policies and devoting more attention to increasing wheat, maize, rice and potatoes planted areas in main producing governorates based on production efficiency indicators, and taking into account wheat, maize, rice and potatoes profitability relative to the profitability of competing crops.

III. Vertical expansion in wheat, maize, rice and potatoes production via developing new high yielding varieties to boost wheat, maize, rice and potatoes production.

IV. Providing support to wheat, maize, rice and potatoes farmers in the form of good varieties of seed, fertilizers and other production inputs to encourage farmers cultivate the crop.

V. Setting a procurement price, close to the international prices of wheat, maize, rice and potatoes, three months prior to wheat, maize, rice and potatoes planting season, such that the announced price is fair to producers, i.e., it covers production cost and provide a fair profit margin, and in the same time is a fair price for consumers.

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