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Towards A Sustainable Agriculture Strategy for Egypt

"Results from An Agriculture Economy Interaction Model"

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نحو استراتيجية زراعية مستدامة لمصر

"نتائج نموذج لتشابكات القطاع الزراعي والاقتصاد"

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Abstract

The study seeks to build an economy-wide analytical tool to address structural distortions in Egypt's agriculture sector, assess different policy measures and development alternatives, and capture its interactions with the rest of the economy. To this end, an agriculture economy interaction model based on social accounting matrix (SAM) principles and the computable general equilibrium (CGE) modeling tradition was developed. Two scenarios, the reference path scenario and the agriculture development scenario, are developed and assessed using the model through 2024/25. The reference path scenario maintains Egypt's recent socioeconomic reform program, as well as the agriculture enhancement scenario, which aims to increase the share of agriculture in investments and public spending, while also increasing agricultural productivity. By adopting the agriculture development scenario, the economic growth of the agriculture sector is improved, food security strategy is supported, the production capacity of agricultural activities is enhanced, national saving behavior is improved, most per capita welfare indicators are increased, and finally, overall GDP growth is enhanced. However, this scenario necessitates increasing investment and reliance on imported goods, thus resulting in deterioration.

Keywords: Economic reform policies, agriculture sustainable development, Social Accounting Matrix (SAM), Computable General Equilibrium (CGE) Model, Egyptian economy.

المستخلص

تهدف الدراسة الحالية إلى تطوير نموذج اقتصادي متعدد القطاعات؛ لدراسة الاختلالات الهيكلية في قطاع الزراعة المصري، وتقييم عدد من السياسات والبدائل التنموية. ولتحقيق هدف الدراسة التحليلي، تم بناء نموذج يرتكز على منهجية مصفوفة الحسابات الاجتماعية ونماذج التوازن العام الحسابي؛ من أجل ربط قطاع الزراعة بباقي قطاعات الاقتصاد الوطني في إطار متسق وشامل.

ويُعدُّ هذا النموذج امتدادًا لنماذج التوازن العام التقليدي، وتحديثًا لها؛ حيث تم استخدام النموذج لصياغة واختبار سيناريوهين تنمويين بديلين حتى نهاية عام (2024–2025)؛ الأول يتضمن المسار المرجعي الذي يعكس أداء الاقتصاد المصري، بافتراض استمرار نفس توجهات وسياسات الإصلاح الاقتصادي الراهن، في حين يتضمن المسار الثاني تعزيز قدرات القطاع الزراعي من خلال زيادة حجم الاستثمار في القطاع الزراعي، وزيادة مخصصات الزراعة من الإنفاق العام، بالإضافة إلى تبنِّي سياسات رامية إلى زيادة إنتاجية القطاع الزراعي. وتشير النتائج إلى الأثر الإيجابي لسيناريو تنمية القطاع الزراعي في تعزيز النمو الاقتصادي للقطاع الزراعي، ودعم استراتيجية الأمن الغذائي، وتحسين القدرة الإنتاجية للأنشطة الزراعية، وتحسن معدلات الادخار الوطني، وتحسين معظم مؤشرات رفاهة المواطن، وأخيرًا ارتفاع معدلات نمو الناتج المحلي الإجمالي. ومع ذلك، فإن نجاح هذا السيناريو التنموي يتطلب زيادة الاستثمار، ومن ثمَّ زيادة الاعتماد على الواردات؛ مما يؤدي إلى زيادة العجز في الميزان التجاري والحساب الجاري لميزان المدفوعات.

الكلمات الدالة: الإصلاح الاقتصادي، التنمية الزراعية المستدامة، مصفوفة الحسابات الاجتماعية، نماذج التوازن العام الحسابي، الاقتصاد المصري.

1. Introduction

The agriculture sector is extremely significant to the Egyptian economy. Agriculture represented 11.57% of GDP in 2020, with agricultural production valued at roughly EGP 4 trillion in constant prices (World Bank, 2022). In the same year, agricultural investments totaled EGP 42 million, accounting for 5.29% of total national investments. On the other hand, agricultural exports reached USD 2.9 billion, thus, accounting for 9.9% of total exports in 2020 (CAPMAS, 2022).

Furthermore, agriculture is regarded as the greatest absorber of employment, accounting for about 24% of total employment on average during (2014-2020). However, the impact of the agriculture sector is not just limited to employment. This economic activity employs a considerable number of the Egyptian population; rural population in Egypt is 58.55 million in 2020, equivalent to 57%of the overall Egyptian population (World Bank, 2022).

Despite the government's efforts to increase the cultivated land areas to fulfill the population's food demands, yet the country remains, to a large extent, dependent on food imports due to low levels of self-sufficiency, particularly in strategic food groups such as grain, oil, and legumes. In 2020, self-sufficiency rates for grain, oil, and legume groups were 42.3%,13.3%, and 7.82%, respectively (CAPMAS, 2022).

According to the revised strategy for sustainable agricultural development in Egypt Vision 2030, the agricultural sector continues to be a key sector in the Egyptian economy for being a major pillar for food security. Therefore, self-sufficiency is regarded as one of the agricultural policy's objectives (Kassim et al., 2018). Egypt ranked 60 out of 113 countries in the 2020 Global Food Security Index (CAPMAS, 2022)

Egypt’s agriculture sector is dominated by small-scale farmers, applying traditional practices that do not cope with technological advancements, or internationally recognized standards. Farmers' practices tend to overuse and misuse agricultural chemicals and use outdated technologies and tools for land preparation, irrigation and harvesting. As a result, these practices result in increasing production costs, reducing yields, decreasing soil fertility, and consequently limiting marketing opportunities. They are further constrained by lack of cold storage infrastructure, transport systems, and market information (USAID, 2022).

The Government of Egypt (GoE) is taking corrective measures and implementing an ambitious medium- long-term plan based on the following policy measures:

i. Improving irrigation systems, reaching the maximum economic effectiveness of allocating and using land and water resources, and ensuring a growth rate of agricultural output by about 3.6% per year.

ii. Achieving high levels of food security of strategic commodities, strengthening the competitiveness of agricultural products in the world's markets, and going towards environmentally friendly organic farming and safe use of pesticides to improve the quality of agricultural products.

iii. Allocating direct investments to implement supportive programs for the agriculture sector, including the expansion of the area of agricultural land, and mechanization of the system of agricultural tenure, with around EGP 87.5 million allocated to complete the project of the mechanization system,

iv. Building a database of holders and providing audited data to help follow the agricultural development programs.

This paper seeks to construct an economy-wide analytical tool to address the persistent structural distortions in Egypt's agriculture sector, test its alternative policy measures and development options, as well as capture its interactions with the rest of the economy. To achieve the above analytical purpose of the paper, an agriculture economy interaction model based on the social accounting matrix (SAM) principles (Breisinger et al., 2009; Khorshid, 2002, 2008) and the computable general equilibrium modeling (CGE) tradition was developed (Burfisher, 2011; Cardenete et al., 2012; Drud & Kendrick, 1986). The agriculture activity and commodity are disaggregated into four sectors: horticulture, cereals, other plant production and animal & fish production. Other activities of the economy are divided into sectors relevant to the agricultural sectors; such as textile and apparel, food and beverage industries, and other industries. Given the above economic rationale, a social accounting with special purpose Input-Output table is assembled and balanced based on recent published Input-Output tables, household's income and spending surveys, balance of payments, and estimated income distribution and redistribution data.

The paper suggests an agriculture economy interaction model that includes two parts. The first part represents the static sub-model, which is determined through three factors: i) the structure of the economy and its circular flow of income as reflected by the issue-specific base year social accounting matrix (SAM), ii) the independent decisions of the agents intervening in the economy; such as producers,

consumers, and exporters, and iii) the set of closure rules that ensures the consistency of all these decisions and reflects the policy options adopted by the Government of Egypt (GoE). The second part includes the dynamic features represented by population growth, capital accumulation, in addition to updating some exogenous variables.

As an analytical tool, the model -as well as its SAM- reflect a modeling approach that begins by a consistent accounting framework, and then with a model. It represents an issue-oriented economy-wide model that establishes the linkages between agriculture sector and the rest of the economy. It establishes the linkages between investment spending of domestic origin and foreign direct investment (FDI) flows. The model also provides an elaborated inter-period dynamic adjustment sub model to explain the future development path of Egypt's economy.

Given the importance of the agriculture and fishing sectors for food security and satisfaction of basic needs, the developed model would constitute a valuable tool in support of Egypt's Government. Results of policy analysis exercises based on the model structure and economic rational have established a practical consistent decision-making system for economic wide development planning and agricultural policy domain.

2. Literature Review

Lofgren (1995) examined the short-term effects of eliminating price-distorting subsidies for domestic oil products, and for commodities covered by the consumer subsidy program, using a computable general equilibrium model for Egypt that is based on 1991/92 data. There are two sets of simulations run each resulting in greater government savings. The first includes bringing up local oil products' prices in line with those in the international market, while the second replicates what would happen if consumer subsidies were eliminated. The findings show that both approaches, in all macro closures, are contractionary. Repaying foreign debt caused the biggest decline in real GDP and other indices. The oil policy simulations predicted greater exports and a 6–8% cut on domestic oil use (along with a corresponding drop in air pollution). Due to low income and price elasticity, the household consumption decline caused by the consumer subsidy decrease was primarily confined to other industrial products and services.

According to Robinson and Gehlhar (1995), the tax and subsidy system in Egypt between 1986 and 1988 was severely distorted, with significant output taxes and subsidies that varied widely by sector. They emphasized the substantial input subsidies and the absence of water charges. This combination of policies is captured in their work by an 11-sector computable general equilibrium (CGE) model, with a particular emphasis on the use of land and water in agriculture and the connections between agriculture and the rest of the economy. According to empirical findings, policies between 1986 and

1988 were biased against agriculture, and resulted in an agricultural production system that conserved water. The equilibrium market price would have been close to zero, if Egypt had introduced water markets between 1986 and 1988, since land, not water, was the limiting factor. The demand for water rises as a result of policy reform, as does overall wellbeing. Due to the inelastic nature of water demand and the stress placed on the current water distribution system, as a result of the policy changes in the output side, water would become far more valuable to agricultural producers than land. Policy reform would benefit rural employment, given that prior policies didn't provide enough care for agricultural sector, and lessen motivation for rural-urban migration.

By incorporating expectations for the future, the study conducted by Elshennawy et al., (2016) enhances the state of the art in country-level computable general equilibrium analysis for climate change effects and adaptation analysis. The analytic approach is used to investigate Egypt's long-term economic potential in a changing climate. The consequences of climate change on total consumption, investment, and income are simulated using the model up to 2050. According to the simulation research, real GDP in the mid-century will be 6.5% lower than in a hypothetical baseline that does not account for climate change and policy-led adaptation measures. The GDP loss in 2050 might be reduced to about 2.6% with a mix of adaptation measures, including coastal protection investments for sensitive areas in the low-lying Nile delta, assistance for crop management practice changes, and investments to increase irrigation efficiency.

3. An Agriculture Economy Interaction Social Accounting Matrix

An aggregate version of the SAM for Egypt, constructed by Khorshid and El-Sadek (2013), is shown in Table (1). In order to achieve the analytical purpose of the paper and capture the interaction between the agriculture sector and the rest of the economy, the agriculture activity and commodity is disaggregated into four sectors (horticulture, cereals, other plant production, and animal and fish production). Other activities of the economy are divided into sectors relevant to the agricultural sectors; such as textile and apparel, food industries and other industries. Based on the above rationale, an Input-Output table is constructed (Table (2)).

In addition, the commodity accounts in the SAM are grouped into four types: composite, domestic, imported and exported, with each divided according to the production activities. Factors are represented in the SAM by two accounts: labor compensation and capital services. They are further disaggregated by economic sector and production activity. The economy includes three domestic institutions: households, firms and government. The government is broken down into five accounts. One account for general government income and spending and three tax accounts (direct, indirect and import taxes) in addition to one subsidy account.

Finally, the SAM includes a capital account representing savings of domestic institutions and investment spendings. The SAM is constructed for the fiscal year 2010/11, and it is computed in EGP Millions. Besides the constructed SAM, there is a pressing need for additional data and parameters for model calibration and estimation. It is also noteworthy that the total investments in the economy are divided into investments of domestic origin and foreign direct investments (FDI).

Table 1

An Aggregate SAM for Egypt

2010/2011			Activities	Commodities	Factors				Institutions							Investment-Savings	ROW	Total
									Government									
			Remittances	Labor	Capital	Investment Income	Household	Firms	Government	Direct Taxes	Indirect Taxes	Tariffs on Imports	Subsidies					
Activities				2102.91														**2102.91**
Commodities			793.03						1036.20		156.96					234.53	281.91	**2502.63**
Factors	Remittances																14.20	**14.20**
	Labor		364.77															**364.77**
	Capital		945.12															**945.12**
	Investment Income																3.10	**3.10**
Institutions	Household				14.20	364.77	386.89		10.00	330.21	135.82							**1241.90**
	Firms						552.43	2.40	76.66	75.58	32.31	99.31	76.25	13.90	-28.93		62.30	**801.69**
	Government	Government					5.80	0.70	8.39	54.43							0.40	**230.24**
		Direct Taxes							19.36	79.95								**99.31**
		Indirect Taxes		76.25														**76.25**
		Tariffs on Imports		13.90														**13.90**
		Subsidies		-28.93														**-28.93**
Investment-Savings									91.28	227.13	-99.90						16.01	**234.53**
ROW				338.50						34.38	5.04							**377.93**
Total			**2102.91**	**2502.63**	**14.20**	**364.77**	**945.12**	**3.10**	**1241.90**	**801.69**	**230.24**	**99.31**	**76.25**	**13.90**	**-28.93**	**234.53**	**377.93**	

Source: (Khorshid & El-Sadek, 2013).

Table 2

Input-Output Table for the Egyptian Economy in 2010/11

2010/11	Horticulture	Cereals	Other Plant Production	Fish and Animal Production	Extractions	Textile & Apparel	Food industries	Other industries	Services	Intermediate consumption	Household consumption	Government consumption	Investment	Exports	Final Demand	Total Demand
Horticulture	53.96	0.00	0.00	0.00	0.00	0.00	6078.98	360.69	4287.77	10781.40	60395.412	581.433	64.133	7322.085	68363.064	79144.460
Cereals	0.00	1201.05	0.00	1494.23	0.00	0.00	14836.76	0.00	775.33	18307.37	30324.008	291.932	34.076	107.214	30757.229	49064.598
Other Plant Production	0.00	0.00	670.54	16477.33	0.00	531.70	12569.94	1112.16	628.19	31989.87	10320.279	99.354	29.708	2341.385	12790.727	44780.597
Fish and Animal Production	741.50	61.94	19.52	728.11	0.00	0.00	24094.17	5.93	1431.46	27082.63	69942.332	2187.960	77.683	203.541	72411.516	99494.145
Extractions	18.021	30.11	17.91	0.00	424.34	53.00	5.98	157618.04	1250.80	159418.19	21991.582	0.700	0.00	45737.325	67729.607	227147.800
Textile & Apparel	0.00	0.00	0.00	0.00	10.60	8967.38	3.88	1232.90	4065.80	14280.54	29874.477	376.409	1373.225	14082.731	45706.843	59987.387
Food industries	0.00	0.00	0.00	9690.99	11.796	77.44	12021.76	633.76	16811.54	39247.29	123912.698	1561.260	120.505	12491.890	138086.353	177333.643
Other industries	2302.84	4913.95	2002.79	655.27	5990.88	4266.33	3799.36	156710.55	106457.15	287099.12	201100.462	2533.801	215012.670	82118.903	500765.836	787864.951
Services	1397.81	361.36	150.12	5087.94	9316.79	2362.19	4976.52	58838.27	122328.27	204819.27	488338.749	149328.250	17819.200	117506.726	772992.925	977812.192
Remittances	18423.34	2942.74	1060.12	6314.099	5340.10	7778.19	11074.39	84707.92	227127.30	364768.20						
Operating Surplus	49298.71	17147.83	33854.02	57943.95	189258.00	26222.60	61982.33	89925.47	419488.10	945121.00						
Indirect Tax	82.87	302.31	84.01	13.420	3297.20	282.47	2149.04	36801.49	33233.10	76245.90						
Tariffs on Imports	291.21	1062.40	295.23	47.160	88.70	265.73	615.47	5676.80	5557.30	13900.00						
Subsidies	-9.03	-2830.00	-7.17	-18.214	0.00	-1615.30	-1879.68	-13241.72	-9329.90	-28931.00						
Imports	6543.23	23870.91	6633.49	1059.87	13409.40	10795.66	25004.75	207482.69	43700.00	338500.00						
Total supply	**79144.46**	**49064.60**	**44780.60**	**99494.15**	**227147.80**	**59987.39**	**177333.64**	**787864.95**	**977812.19**	**2502629.77**	**1036200.000**	**156961.100**	**234531.200**	**281911.800**	**1709604.100**	**2502629.773**

Source: (Khorshid et al., 2016)

4. Model Structure and Economic Rationale

The constructed agriculture economy interaction model of Egypt includes two sub-models. The first represents the static sub-model, which is determined by three factors: i) the structural features of the economy and its circular flow of income as reflected by the issue-specific base year social accounting matrix (SAM), ii) the independent decisions of the economic agents intervening in the economy; such as producers, consumers, importer and exporters, and iii) the set of closure rules that ensures the consistency of independent decisions of various economic agents, as well as the policy choices adopted by the Egyptian government. The second sub-model includes the dynamic adjustment mechanisms relying on population growth, capital stock in the base year, gross fixed capital formation in addition to exogenous parameters describing future development scenarios for the Egyptian economy (Khorshid, 1994, 1995, 1996, 2010, 2013, 2014).

As an analytical CGE tool, the model, as well as its social accounting matrix, introduced two technical contributions to the CGE modeling practice and applications. First, it represents an issue-oriented economy-wide modeling approach that establishes the linkages between agriculture sector and the rest of the economy. Second, aggregate investment spending is broken down into investment of domestic origin and foreign direct investment (FDI) inflows.

In the model, output is determined through maximizing profit subject to a two-stage constant elasticity of substitution function (CES). At the first level, total output is distributed between gross value added and intermediate inputs. Demand for labor and capital services are computed as a function of the value added generated in each production activity at the second level.

Return on Capital (or gross operating surplus in real term) is computed using base year capital stock, gross fixed capital formation and consumption of fixed capital (depreciation). When determining demand for labor, broken down by economic sector or production activity, and estimating the supply of labor (based on population growth rate and labor participation rate), unemployment rate can be computed.

Demand for goods and services is satisfied by imports and domestic sales using the composite commodity approach. According to Armington assumption, domestically consumed goods are composed of domestic sales and imported goods using a CES function. This approach allows imports to be an imperfect substitute for domestic supply depending on relative prices and the elasticity of substitution.

Supply of exports of goods and services are imperfect substitutes as well, and they are computed from a constant elasticity of transformation (CET) function. The supply of exports interacts with world demand on the Egyptian export –affected by the elasticity of trade as well as the ratio of supply price of exports and their international price– to determine the equilibrium volume of exports.

Government revenue consists mainly of the operating surplus of public enterprises, domestic and foreign transfers, and income from various taxes. Direct taxes are computed as a function of the revenues of households and firms' sectors; indirect taxes and tariffs depend on the domestic and imported goods and the level of production. Finally, external transfers to the government are fixed in foreign currency.

Government income is used to pay wage bill, purchase goods and services and make transfers to other institutions. Final consumption of the government is fixed in real term, whereas other expenditures are fixed in nominal term (or current prices). In the model, government spending is treated as a policy measure (or exogenous). Given government income and expenditure variables, public savings are determined as the difference between revenues and current expenditure (or as a clearing variable).

Household income includes the compensation of employees, workers' remittances, operating surplus of private companies and other current expenditures. Current expenditures and transfers of households' sector are calculated as a fixed share of their income, while spending on final goods and services are modeled using a linear expenditure system (LES).

Public and private enterprises revenues include operating surpluses of productive activities, with a share determined according to the distribution of ownership at the sector level. In addition, there are different types of transfers from domestic and foreign institutions. The current expenditures of the firms are determined as a percent of their income. These expenditures include payment of direct taxes and transfers to households, government sector and the external sector, in addition to accumulated savings.

Based on the economic structure and policy measures adopted by the Government of Egypt, a set of market closure rules are defined. These rules are classified according to markets of goods and services, market factors and the macroeconomic closure rules.

Product markets clearing mechanisms function at flexible prices to clear the market, and this is in line with the price liberalization policy currently adopted in Egypt. Markets factors include labor and capital. Government wage bill is fixed in real terms; labor demand in the public and private sectors is determined by the level of output and the form of the production function. Return on capital (or gross operating surplus in real term) is considered an exogenous variable. In the inter-period dynamic part, it is computed, however, as a function of last year capital stock, gross fixed capital formation and the consumption of fixed capital.

The model is composed of static and dynamic sub-models. The static model is composed of 851 equations, and nominal exchange rate is selected as the numeraire of the model. The model is implemented on computer using the general algebraic software modeling system (GAMS).

Formulation of Alternative Scenarios

Increasing food availability and improving rural household income can be achieved through increasing agricultural productivity. The formerly realized growth was mainly a result of area expansion rather than improvements in land productivity. To achieve the goals set for Egypt's development strategy, agriculture growth will depend excessively on productivity, to offset the current challenges represented by the decline in suitable land area, limited water resources and climate change. In this respect, total factor productivity (TFP) of the agriculture production function is considered.

On the other hand, increasing and attracting new investments will be an effective way to enhance the output of the agriculture sector and then reduce hunger and poverty. To do so, it is necessary to contribute to gross fixed capital formation at the farm level. As small-scale farmers with below-average land holdings dominate Egypt's agriculture sector, investments are needed to support value chain from producers to consumers through boosting agro-industries and providing supportive infrastructure as roads, electricity, education, and technology.

As agricultural development relies heavily on government finance including both current and capital spending, its share from public finance has to increase in line with the planned achievements. It has been found that there is an inverse relationship between instability in agricultural government expenditure and the growth of the agriculture sector.

R&D investment returns in terms of poverty reduction, across several studies, are not only often stronger, but also more stable than other types of agricultural public spending. Just as the effect of different functional investments in agriculture may vary in magnitude, agricultural public spending might also differ by the commodity being targeted. Ex-ante analyses show stronger economy wide effects of investments in staple crops than in export crops, through the formers' stronger cross-sectoral forward and backward linkages and employment effects.

Rather than considering the components of agricultural spending, such as R&D, irrigation, or other functions, or the investments specifically targeted at certain commodities, some studies have explored how effective agricultural expenditure in its aggregate is at increasing welfare and development. In contrast to analyses of investments in particular elements in agriculture, in the case of studies of aggregate agricultural spending the picture is more mixed. This suggests that policy should ultimately target productive components of agricultural expenditures, and that increasing agricultural spending without attention to heterogeneous impacts of different types of agricultural investments may not bring about the strongest outcomes.

Public investment designed to provide public goods can increase the profitability of private investment, but can also have crowding-out effect on private investment, through the economy wide multiplier effects. The net effect on private investment may thus be positive or negative. The existing evidence on this is strongly mixed, thus inconclusive, but is also only limited to a specific developing region, and thus needs to be better understood in different settings.

Based on the above socioeconomic rationale, the agriculture-economy-interaction model is used to assess the economy wide impact of two medium term development scenarios. The first one is based on the continuation of the currently adopted policy measures, especially those pertaining to the agriculture sector. This first scenario reflects then the "Reference Development Path" of Egypt's economy in the absence of agricultural-specific productivity-driven policy instruments. It reflects, however, policy measures included in the recent agreement with the International Monetary Fund (IMF) in 2014/15. The second "Agriculture Enhancement" development scenario is mainly adopted to improve the role of the agriculture sector in Egypt's sustainable development strategy 2030 (SDS 2030) on one hand, and improving food security and rural household income on the other hand. It is based on three main policy directives: i) increase the overall capital spending on the agriculture sector (EGP 500 Billion) along with its investment allocation shares by (1%), ii) increase total factor productivity (TFP) of agricultural production by (1%) and non-agricultural production by (2%), and iii) increase the share of government current spending on agriculture products and services by (1%).

5. Experimental Analysis

The agriculture economy CGE model is used to test the economy wide impact of the two alternative development scenarios with special emphasis on the performance of the agriculture sector. Tables (3) to (7) summarize the results from the model. Table (3) describes the sources of GDP growth in real terms under the two development scenarios. In both scenarios, private consumption continues to represent the largest source of growth with around 99% of GDP. Gross capital formation comes as the second source with a percent of GDP ranging from 20 to 27. Despite the adopted foreign exchange policy of moving to a floating exchange rate, the share of imports is still representing more than 40% of GDP under all tested scenarios. Given the moderate growth of exports, trade balance of goods and services shows a negative trend. The dual effect of investment spending and agriculture-oriented policy measure results in an increase of real GDP from 4.06%, under the reference path scenario, to around 4.3%, when adopting the agriculture development scenario for 2024/25. In Table (3), final consumption expenditure follows approximately the same trend. It is to be noted here that due to Egypt's development planning strategy, it is assumed that investment spending in real terms will witness an average annual growth rate ranging from 7.8 in the reference path condition to 10% in case of the agriculture development path. Despite its positive contribution to growth and productivity, a worsening of the external balance would be expected, if appropriate financing policies were not adopted.

Table 3

Impact of Development Scenarios on GDP Uses at Market Price

(In Fixed Prices of 2010/11& Billion EGP)

Economic Indicator	Base Year		Reference Path Scenario			Agricultural Development Scenario		
	2019/20		2024/25			2024/25		
	Value	%	value	%	AAGR*	value	%	AAGR*
Household Consumption	1754.61	99.7	2136.13	99.5	4.02	2167.21	99.6	4.32
Government Consumption	190.18	10.8	232.27	10.8	4.08	232.27	10.7	4.08
Total Consumption	1944.79	110.5	2368.40	110.4	4.00	2399.48	110.3	4.28
Total Investments	360.08	20.5	525.33	24.5	7.86	586.77	27.0	10.26
Agricultural Investment	13.35	0.8	19.47	0.9	7.86	21.75	1.0	10.26
Non-Agricultural Investment	346.73	19.7	505.85	23.6	7.86	565.01	26.0	10.26
Total Exports	223.62	12.7	246.24	11.5	1.94	246.82	11.3	2.00
Total Imports	768.21	43.6	993.72	46.3	5.26	1057.47	48.6	6.60
GDP Uses (at Market Price)	1760.28	100.0	2146.25	100.0	4.06	2175.60	100.0	4.34

**AAGR*: Average Annual Growth Rate

Source: Results of the Agriculture Economic Interaction Model of Egypt.

Table (4) shows the performance of real GDP by production activity under the two alternative scenarios. Modeling results indicate that average annual growth rate of agriculture and fishing sector increases from 5.06% in the reference path to 5.18% when the agriculture development scenario is adopted. This moderate improvement in results is mainly due to adopting productivity enhancement measures, as well as reallocation of investment towards agriculture and food products. In both tested future scenarios, the percentage share of agriculture and fishing sector in aggregate GDP increases from 15.5% in 2019/20 to around 16% in 2024/25. Other non-agriculture sectors of the economy also witness improved annual growth rates when adopting the agriculture development scenario. This represents a direct result of increasing total gross capital formation annually from 8% in the reference path to around 10% in the agriculture development scenario. Given the important share of other industries in the structure of the investment allocation pattern, and the composition of gross fixed capital goods, as well as the existing linkages between agriculture products and other industries, both increasing investment spending and enhancing the productivity of agriculture activity improve the growth performance of this sector. Model projections show that average annual growth rate of other industries increases in 2024/25 from 4% in the reference path to 5.16% when adopting the agriculture development scenario.

Table 4

Impact of the Development Scenarios on Sectoral GDP at Factor Cost

(In Fixed Prices of 2010/11& billion EGP)

Economic Indicator	Base Year		Reference Path Scenario			Agricultural Development Scenario		
	2019/20		2024/25			2024/25		
	Value	%	Value	%	AAGR*	Value	%	AAGR*
GDP at Factor Cost	1801.81	100.0	2238.90	100.0	4.44	2287.00	100.0	4.90
Agriculture& fishing Sector	279.67	15.5	357.96	16.0	5.06	360.33	15.8	5.18
Horticulture	100.05	5.6	122.56	5.5	4.14	123.66	5.4	4.34
Cereals	29.55	1.6	38.31	1.7	5.32	38.48	1.7	5.42
Other Plant Production	51.01	2.8	67.35	3.0	5.72	67.70	3.0	5.80
Animal & Fish Production	99.06	5.5	129.74	5.8	5.56	130.49	5.7	5.68
Extractions	245.52	13.6	338.83	15.1	6.64	350.82	15.3	7.40
Total Industries	396.64	22.0	490.33	21.9	4.32	508.57	22.2	5.10
Textile and Apparel	42.81	2.4	52.80	2.4	4.28	53.30	2.3	4.48
Food Industries	107.50	6.0	137.92	6.2	5.12	138.72	6.1	5.22
Other Industries	246.34	13.7	299.60	13.4	4.00	316.55	13.8	5.16
Services	879.98	48.8	1051.79	47.0	3.60	1067.28	46.7	3.92

**AAGR:* Average Annual Growth Rate
Source: Results of the Agriculture Economic Interaction Model of Egypt.

Table (5) summarizes the principal aggregates of national accounts in nominal terms under the two development scenarios, along with the relative change between the results of the two tested scenarios in 2024/25. The percentage of change of gross domestic product (GDP), gross national product (GNP) and gross national income (GNI) increases under the agricultural development scenario by around 4% on the average. The overall relative growth of final consumption under the agriculture development scenario compared to the reference path is computed also as 3%. The agriculture development scenario improves the performance of national savings compared to the reference path case. This important result is the outcome of the enhanced productivity measures associated with the agricultural development scenario, although investment spending has witnessed an increase under this scenario approaching 13% compared to the reference path. However, the external balance measured by the current account deficit is negatively affected.

Table 5

Impact of Development Scenarios on Main Aggregates of National Accounts

(In current prices and billion EGP)

Economic Indicator	Base Year	Reference Path Scenario	Agricultural Development Scenario	Relative Change (%)
	2019/20	2024/25	2024/25	
Gross Domestic Product	3922.56	4792.69	4984.47	4.00
(+) Net Factor Income	47.05	49.75	49.75	0.00
(=) Gross National Product	3969.60	4842.45	5034.22	3.96
(+) Net Current Transfers	-39.82	-17.38	-22.13	27.33
(=) Gross National Income	3929.78	4825.06	5012.09	3.88
(-) Final Consumption expenditure	3966.66	4830.95	4977.77	3.04
(=) Total Savings	-36.88	-5.89	34.33	-682.85
(-) Total Investments	692.78	1021.02	1156.98	13.32
(=) Current Account Surplus	-729.66	-1026.91	-1122.65	-9.32

Source: Results of the Agriculture Economic Interaction Model of Egypt.

The balance of payment current account of Table (6) has shown a worsening performance of both the trade balance of goods and services and the current account deficit, when adopting the agriculture development scenario. Net imports of goods and services (imports less exports) increases under this development scenario.

Table 6

Impact of Development Scenarios on Balance of Payments Accounts

(In current prices and billion EGP)

Economic Indicator	Base Year	Reference Path Scenario	Agricultural Development Scenario	Relative Change (%)
	2019/20	2024/25	2024/25	
Total Exports	373.77	372.31	372.16	-0.04
Total Imports	1110.66	1431.58	1522.44	6.35
Trade Balance	-736.89	-1059.27	-1150.27	8.59
Net Factor Income	47.05	49.75	49.75	0.00
Net Current Transfers	-39.82	-17.38	-22.13	27.29
Current Account Surplus	-729.66	-1026.91	-1122.65	-9.32

Source: Results of the Agriculture economic interaction Model of Egypt

Finally, Table (7) provides some per capita socioeconomic indicators. Both Per Capita real and nominal GDP performance improves under the agriculture development scenario. The relative change is respectively 1.37 and 4% in 2024/25. Per Capita Gross National Product (GNP) in nominal terms witnesses also an improvement under the agriculture development scenario with a relative change of 3.96% in 2024/25. To sum up, the results confirm the superiority of the agriculture development scenario with respect to welfare and growth measures of the Egyptian economy.

Table 7

Impact of Development Scenarios on Main per Capita Indicators

(In current prices and billion EGP)

Per capita Economic Indicator	Base Year	Reference Path Scenario	Agricultural Development Scenario	Relative Change (%)
	2019/20	2024/25	2024/25	
Real GDP	18143	20197	20473	1.37
Nominal GDP	40429	45101	46906	4.00
GNP	40914	45570	47374	3.96
Household consumption	36832	40871	42176	3.19
Government consumption	4052	4591	4668	1.68
Total consumption	40884	45461	46843	3.04

Source: Results of the Agriculture Economic Interaction Model of Egypt

6. Concluding remarks

Issue-oriented and sector-specific economy wide simulation models, based on CGE social accounting principles and CGE tradition, represent an extremely useful policy analysis tool for development planning. They combine both economy wide and sector specific analytical dimensions with a special reference to economic interactions and multiplier effects. They complement the partial equilibrium models in sectoral policy formulation and testing. Despite the considerable progress of information technology, computing infrastructure and database management systems, these models require more time and effort to properly verify and validate the modeling structure and ensure the consistency and reliability of collected socioeconomic data and associated accounting structures. The benefits, gained from constructing this type of disaggregated models, would, nevertheless, justify their use as efficient and effective economy wide policy analysis and assessment tools.

In this research paper, an agriculture-economy-interaction model is constructed, implemented, and used to draw up alternative policy scenarios related to economy wide development process with a special emphasis on agriculture sector and its interaction with the rest of the economy. The model breaks down the agriculture and fishing sector into four sub-sectors: horticulture, cereals, other plant production and animal and fish production. Other sectors of the economy are grouped into two categories: i) sectors with strong linkages with agriculture; such as food industry and textile, and ii) remaining activities; such as extraction, other industries and services.

Two scenarios are formulated in accordance with Egypt's sustainable development strategy 2030 (SDS 2030) and tested via the model up to 2024/25. The reference scenario path assumes the continuation of the policy measures and development options of Egypt's recent socioeconomic reform program endorsed by the IMF. The agriculture enhancement scenario aims at increasing the share of agriculture sector in investments and public spending, as well as enhancing the productivity of agriculture production.

Adopting the agriculture development scenario improves the economic growth of agriculture sector, supports food security strategy, enhances the production capacity of agricultural activities, improves national saving behavior, increases most per capita welfare indicators, and finally contributes to enhancing overall GDP growth. This scenario requires, however, more spending on investment and reliance on imported commodities that leads to worsening the performance of trade balance and the current account deficit of the balance of payment.

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