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# The Impact of Policies Related to Confronting the Water Gap on Egyptian Agricultural Exports

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## Supplementary Data

**Table 1.** Results of the general time trend equations for the development of the value of Egyptian agricultural exports for the period (2000-2023)

| variable | equation of the general time trend | The coefficient of determination | Calculated t value | Annual rate of change %(•) | General average | The calculated value of F in some mathematical forms | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Linear form | Logarithmic form | Exponential form |
| The value of Egyptian agricultural exports | Y=-3.5+ 0.19 X | 0.70 | (50.05)** | 3.7 | 5.1 | (30.74)** | (21.68)** | (12.96)** |

**(**) Significant at the probability level of 0.01,**

**- Annual rate of change = (regression coefficient/general average)*100,**

**Y = estimated value of the dependent variable X = number of years**

**Source:** Collected and calculated from: Table1 in the Appendix

**Table 2.** Exported quantities and virtual water for the most important Egyptian fresh agricultural exports from commodity groups as an average for the period 2018-2023.

| Agricultural commodity | The quantity exported ( thousand tons) | Virtual water source (million m3) |
|---|---|---|
| the fruit | 426 | 363 |
| Vegetables | 1738 | 699 |
| Cereals | 8 | 5 |
| Oil crops | 45 | 119 |
| Medicinal and aromatic plants | 49 | 95 |

**Source:** Table 1in the statistical appendix.

**Table 3.** Virtual water quantity for the most important commodities within the most important commodity groups for Egyptian agricultural exports as an average for the period 2018-2023.

| **Agricultural commodity** | Agricultural commodity | Exported quantity (A thousand tons) | Virtual water exported (million m3) | Contribution to the total virtual water of the commodity group**(%)** |
|---|---|---|---|---|
| **the fruit** | citrus fruits | 1.25 | 0.7 | 0.2 |
| | grapes | 107.512 | 24.9 | 6.87 |
| | Strawberry | 40.21 | 9.2 | 2.5 |

| **Agricultural commodity** | Agricultural commodity | Exported quantity (A thousand tons) | Virtual water exported (million m3) | Contribution to the total virtual water of the commodity group**(%)** |
|---|---|---|---|---|
| | dates | 56.515 | 6.8 | 1.87 |
| | banana | 1.875 | 1.4 | 0.39 |
| | mango | 7.721 | 12.0 | 3.3 |
| | Other | 140.958 | 340.0 | 93.6 |
| | Total fruit | 425.53 | 363.1 | 100 |
| **Vegetables** | potatoes | 717.97 | 90.7 | 12.9 |
| | onion and garlic | 393.365 | 85.3 | 12.2 |
| | Frozen vegetables | 238.003 | 100.0 | 14.31 |
| | Horny legumes | 16.219 | 7.8 | 1.1 |
| | Other | 372.697 | 117.4 | 16.8 |
| | Total vegetables | 1738.25 | 698.6 | 100 |
| **Medicinal and aromatic plants** | eter | 3.75 | 19.2 | 20.11 |
| | basil | 9.05 | 26.0 | 27.28 |
| | Anise seeds | 6.75 | 14.3 | 14.95 |
| | Roselle | 3.4 | 15.4 | 16.18 |
| | Cumin seeds | 0.712 | 0.7 | 0.7 |
| | Fennel seeds | 5.6 | 5.3 | 5.6 |
| | Caraway | 4.65 | 2.6 | 2.762 |
| | Artemisia chamomile | 5.6 | 3.6 | 3.79 |
| | Marjoram | 7.1 | 8.1 | 8.5 |
| | Other | 2.112 | 1.4 | 1.4 |
| | Total medicinal and aromatic plants | 48.724 | 95.5 | 100 |

**Source:** Table 1 in the statistical appendix.

**Table 4.** Imported quantities and virtual water for the most important Egyptian fresh agricultural imports from commodity groups as an average for the period 2018-2023**.**

| Agricultural commodity | The quantity imported ( thousand tons) | Virtual water source (million m3) |
|---|---|---|
| Total fruit | 24 | 0.02 |
| Total Vegetables | 26 | 10,442,543 |
| Total Cereals | 13910 | 9,027,729,535 |
| Total Oil crops | 96 | 252,623,624 |
| Total Medicinal and aromatic plants | 1 | 1,518,339 |

**Source:** Table 1 in the statistical appendix

**Table 5.** Virtual water quantity for the most important commodities within the most important commodity groups for Egyptian agricultural imports as an average for the period 2018-2023.

| Agricultural commodity | Agricultural commodity | Imported quantity (A thousand tons) | Virtual water exported (million m3) | Contribution to the total virtual water of the commodity group(%) |
|---|---|---|---|---|
| the fruit | citrus fruits | 70 | 40628.7 | 0.2 |
| | grapes | 4425 | 1026600 | 5.0 |

| Agricultural commodity | Agricultural commodity | Imported quantity (A thousand tons) | Virtual water exported (million m3) | Contribution to the total virtual water of the commodity group(%) |
|---|---|---|---|---|
| | Strawberry | 1420 | 323760 | 1.6 |
| | dates | 219 | 26280 | 0.1 |
| | banana | 4132 | 3119660 | 15.1 |
| | mango | 8728 | 14357560 | 69.7 |
| | Other fruit | 5161 | 12448332 | 60.4 |
| | Total fruit | 24155 | 20609080.51 | 100.0 |
| Vegetables | potatoes | 222927 | 28155680.1 | 269.6 |
| | onion and garlic | 2717 | 589045.6 | 5.6 |
| | Frozen vegetables | 553 | 232260 | 2.2 |
| | Horny legumes | 1 | 480 | 0.0 |
| | Other vegetables | 200214 | 63067410 | 0.3 |
| | Total vegetables | 25984 | 10442542.72 | 100.0 |
| Cereals | the rice | 48259 | 64618710 | 0.7 |
| | Wheat | 6579701 | 4428138773 | 49.1 |
| | Levantine maize | 7238004 | 2547777408 | 28.2 |
| | Other | 44215 | 10302095 | 0.1 |
| | Total grains | 13910215 | 9027729535 | 100.0 |
| Oil crops | Peanuts | 3512 | 7887952 | 3.1 |
| | Sesame | 26642 | 115572996 | 45.7 |
| | sunflower | 55391 | 145955285 | 57.8 |
| | soybean | 4585 | 2709735 | 1.1 |
| | Other oil crops | 5416 | 18468560 | 7.3 |
| | Total oil crops | 95546 | 252623624 | 100.0 |
| Medicinal and aromatic plants | eter | 210 | 1075200 | 70.8 |
| | basil | 10.9 | 31370.2 | 2.1 |
| | Anise seeds | 78 | 164892 | 10.9 |
| | Roselle | 12 | 54528 | 3.6 |
| | Cumin seeds | 9 | 8829 | 0.6 |
| | Fennel seeds | 166 | 158530 | 10.4 |
| | Caraway | 9 | 5103 | 0.3 |
| | Artemisia chamomile | 80 | 51760 | 3.4 |
| | Marjoram | 12 | 13716 | 0.9 |
| | Other medicinal and aromatic plants | 188 | 121260 | 8.0 |
| | Total medicinal and aromatic plants | 774.9 | 1518339.06 | 100.0 |

**Source:** Table No. 1 in the statistical appendix.

**Table 6.** Water footprint indicators for the fruit group, average for the period 2018-2023**.**

| Agricultural commodity | Agricultural commodity | Virtual water exported, million m3 | Virtual water imported, million m3 | Total water footprint, million m3 | % self-sufficiency from domestic water resources |
|---|---|---|---|---|---|
| the fruit | citrus fruits | 0.73 | 0.04 | 0.77 | 94.7 |
| | grapes | 24.94 | 1.03 | 25.97 | 96.05 |
| | Strawberry | 9.17 | 0.32 | 9.49 | 96.59 |
| | dates | 6.78 | 0.03 | 6.81 | 99.61 |
| | banana | 1.42 | 3.12 | 4.54 | 31.21 |
| | mango | 127.01 | 14.36 | 141.37 | 89.84 |
| | Other fruit | 339.99 | 12.45 | 352.44 | 96.47 |
| | Total fruit | 363.06 | 20.61 | 383.67 | 94.63 |
| Vegetables | potatoes | 90.68 | 28.16 | 118.84 | 76.31 |
| | onion and garlic | 85.28 | 0.59 | 85.87 | 99.31 |
| | Frozen vegetables | 99.96 | 0.23 | 100.19 | 99.77 |
| | Horny legumes | 7.79 | 0.00 | 7.79 | 99.99 |
| | Other vegetables | 117.40 | -63.07 | 54.33 | 216.08 |
| | Total vegetables | 698.58 | 10.44 | 709.02 | 98.53 |
| Cereals | the rice | 1.79 | 64.62 | 66.40 | 2.69 |
| | Wheat | 0.20 | 4428.14 | 4428.34 | 0 |
| | Levantine maize | 2.36 | 2547.78 | 2550.14 | 0.09 |
| | Other | 0.03 | 10.30 | 10.33 | 0.28 |
| | Total grains | 5.50 | 9027.73 | 9033.23 | 0.06 |
| Medicinal and aromatic plants | eter | 19.20 | 1.08 | 20.28 | 94.7 |
| | basil | 26.05 | 0.03 | 26.08 | 99.88 |
| | Anise seeds | 14.27 | 0.16 | 14.43 | 98.86 |
| | Roselle | 15.45 | 0.05 | 15.50 | 99.65 |
| | Cumin seeds | 0.70 | 0.01 | 0.71 | 98.75 |
| | Fennel seeds | 5.35 | 0.16 | 5.51 | 97.12 |
| | Caraway | 2.64 | 0.01 | 2.64 | 99.81 |
| | Artemisia chamomile | 3.62 | 0.05 | 3.67 | 98.59 |
| | Marjoram | 8.12 | 0.01 | 8.13 | 99.83 |
| | Other medicinal and | 1.36 | 0.12 | 1.48 | 91.83 |
| | Total medicinal and | 95.47 | 1.52 | 96.99 | 98.43 |
| Oil crops | Peanuts | 59.33 | 7.89 | 67.22 | 88.26 |
| | Sesame | 51.10 | 115.57 | 166.67 | 30.66 |
| | sunflower | 17.56 | 145.96 | 163.52 | 10.74 |
| | soybean | 0.03 | 2.71 | 2.74 | 1.01 |
| | Other oil crops | 0.34 | 18.47 | 18.81 | 1.8 |
| | Total oil crops | 119.00 | 252.62 | 371.62 | 32.02 |

Total water footprint = the amount of virtual water imported from abroad + the amount of virtual water exported
Percentage of self-sufficiency in local water resources = (amount of virtual water exported ÷ total water footprint**)** x 100.
**Source:** Table 6 in the statistical appendix

**Table 7.** The most important government policies to rationalize irrigation water use during the period 2002-2022

| Years | Policies related to rationalizing irrigation water use | | Production policies | Trade policies |
|---|---|---|---|---|
| | Number of government decisions regulating the area of land irrigated by modern irrigation methods | The length of canals that have been cleared and developed with modern systems to rationalize water use (thousand meters) | Number of government decisions regulating the production of water-intensive crops | Number of government decisions related to exports of water-intensive agricultural commodities |
| 2002 | 8 | 59998 | 14 | 5 |
| 2003 | 7 | 56168 | 15 | 8 |
| 2004 | 7 | 63827 | 15 | 8 |
| 2005 | 8 | 59998 | 16 | 9 |
| 2006 | 8 | 56168 | 17 | 9 |
| 2007 | 8 | 63827 | 18 | 10 |
| 2008 | 8 | 59998 | 17 | 9 |
| 2009 | 12 | 56168 | 26 | 14 |
| 2010 | 19 | 63827 | 40 | 21 |
| 2011 | 20 | 59998 | 42 | 23 |
| 2012 | 23 | 56168 | 49 | 27 |
| 2013 | 30 | 63827 | 63 | 34 |
| 2014 | 29 | 59998 | 62 | 34 |
| 2015 | 29 | 56168 | 61 | 33 |
| 2016 | 30 | 63827 | 63 | 34 |
| 2017 | 28 | 59998 | 59 | 32 |
| 2018 | 27 | 56168 | 56 | 30 |
| 2019 | 27 | 63827 | 58 | 31 |
| 2020 | 31 | 59998 | 65 | 35 |
| 2021 | 34 | 56168 | 71 | 39 |
| 2022 | 30 | 63827 | 63 | 34 |

**Source:**
- ITC Database https://www.trademap.org
- Ministry of Trade and Industry, General Authority for EL-Ameria Printing Press, Egyptian Gazette website, various issues

**Table 8.** Agricultural exports and the most important government policies related to water resources for the period 2002-2022.

| Years | Agricultural exports in millions of dollars (1) | Production policies | Trade policies | Policies related to rationalizing irrigation water use | |
|---|---|---|---|---|---|
| | | Number of government decisions regulating the production of water-intensive crops (2) | Number of governmental decisions related to exports of water-intensive agricultural commodities | Number of government decisions regulating the area of land irrigated by modern irrigation methods | The length of canals that have been cleared and developed with modern systems to rationalize water use (thousand meters) |
| | y | X1 | X2 | X3 | X4 |
| 2002 | 732.6 | 14 | 5 | 8 | 59998 |

| | | | | | |
|---|---|---|---|---|---|
| 2003 | 779.3 | 15 | 8 | 7 | 56168 |
| 2004 | 811.8 | 15 | 8 | 7 | 63827 |
| 2005 | 854.5 | 16 | 9 | 8 | 59998 |
| 2006 | 918.8 | 17 | 9 | 8 | 56168 |
| 2007 | 1009.70 | 18 | 10 | 8 | 63827 |
| 2008 | 954.74 | 17 | 9 | 8 | 59998 |
| 2009 | 1310.10 | 26 | 14 | 12 | 56168 |
| 2010 | 2140.00 | 40 | 21 | 19 | 63827 |
| 2011 | 2955.80 | 42 | 23 | 20 | 59998 |
| 2012 | 3164.30 | 49 | 27 | 23 | 56168 |
| 2013 | 3109.50 | 63 | 34 | 30 | 63827 |
| 2014 | 2786.30 | 62 | 34 | 29 | 59998 |
| 2015 | 3188.50 | 61 | 33 | 29 | 56168 |
| 2016 | 3238.00 | 63 | 34 | 30 | 63827 |
| 2017 | 3199.20 | 28 | 32 | 28 | 59998 |
| 2018 | 3125.80 | 27 | 30 | 27 | 56168 |
| 2019 | 3223.30 | 58 | 31 | 27 | 63827 |
| 2020 | 3185.90 | 65 | 35 | 31 | 59998 |
| 2021 | 3405.60 | 71 | 39 | 34 | 56168 |
| 2022 | 3286.00 | 63 | 34 | 30 | 63827 |

**Source:**
1. ITC Database https://www.trademap.org/
2. Ministry of Trade and Industry, General Authority for EL-Ameria Printing Press previous reference

**Table 9.** Unit root test (Expanded Dickey-Fuller) for the most important government policies related to water resources affecting agricultural exports in Egypt during the period 2002-2022.

| Variable | Symbol | The test value at the original data level | | Appropriate conversion | The value of the test after taking appropriate variances | |
|---|---|---|---|---|---|---|
| | | value (t) | p-value (Prob.) | | value (t) | p-value (Prob.) |
| Egyptian agricultural exports | **Y** | -1.58 | 0.56 Insignificant | first difference | -3.46 | Significant at 0.01 |
| Governmental decisions regulating the production of water-intensive crops | **X1** | -1.04 | 0.73 Insignificant | first difference | -3.81 | Significant at 0.01 |
| Government decisions related to exports of water-intensive agricultural commodities | **X2** | -1.25 | 0.64 Insignificant | first difference | -3.59 | Significant at 0.01 |
| Government decisions regulating the area of land irrigated by modern irrigation methods | **X3** | -0.9 | 0.77 Insignificant | First difference | -3.85 | Significant at 0.01 |
| The length of canals that have been cleaned and developed with modern systems to rationalize water use | **X4** | -0.92 | 0.87 Insignificant | First difference | -3.72 | Significant at 0.01 |

**Source:** Collected and calculated from Table 8**.**

**Table 10.** Granger test results for studying the causal relationship among model variables related to the most important government policies related to water resources affecting Egyptian agricultural exports during the period 2002-2022

| VAR Granger Causality/Block Exogeneity Wald Tests | | | |
|---|---|---|---|
| Sample: 1 21 | | | |
| Included observations: 19 | | | |
| Dependent variable: Y | | | |
| Excluded | Chi-sq | ddf | Prob. |
| X1 | 7.887582 | 22 | 0.0194 |
| X2 | 4.106915 | 22 | 0.1283 |
| X3 | 3.962099 | 22 | 0.1379 |
| X4 | 6.213102 | 22 | 0.0448 |
| All | 13.22935 | 88 | .00.12 |

**Source:** Collected and calculated from data in Table 8.

**Table 11.** Results of the Akaike test to determine the optimal lag period for the model variables associated with the most important variables affecting Egyptian agricultural exports in Egypt for the period 2002-2022

| VAR Lag Order Selection Criteria | | | | | | |
|---|---|---|---|---|---|---|
| Endogenous variables: Y X1 X2 X3 X4 | | | | | | |
| Exogenous variables: C | | | | | | |
| Sample: 1 21 | | | | | | |
| Included observations: 19 | | | | | | |
| Lag | LLogL | LR | FPE | AAIC | SC | HQ |
| 00 | -401.4381 | NA | 2.62e+12 | 42.78296 | 43.03150 | 42.82502 |
| 11 | -357.8863 | 59.59723 | 4.15e+11 | 40.83014 | 42.32136 | 41.08251 |
| 22 | 1 178.3698 | 451.5841* | 3.58e-12* | -12.98629* | -10.25239* | -12.52361* |

**Source:** Collected and calculated from data in Table 8.

**Table 12.** Results of estimating the VAR model on the impact of the most important government policies related to water resources affecting Egyptian agricultural exports during the period 2002-2022.

| | Y | X1 | X2 | X3 | X4 |
|---|---|---|---|---|---|
| Y(-1) | 1.136929 | 0.007159 | 0.004002 | 0.003393 | 8.86E-15 |
| | (0.23528) | (0.00307) | (0.00160) | (0.00156) | (1.8E-12) |
| | [ 4.83218] | [ 2.32855] | [ 2.49733] | [ 2.18110] | [ 0.00489] |
| | | | | | |
| Y(-2) | -0.592364 | 0.007736 | 0.004145 | 0.003483 | -1.13E-16 |
| | (0.29145) | (0.00381) | (0.00199) | (0.00193) | (2.2E-12) |
| | [-2.03248] | [ 2.03119] | [ 2.08824] | [ 1.80744] | [-5.0e-05] |
| | | | | | |
| X1(-1) | 448.0791 | 9.144864 | 4.856064 | 4.387487 | -1.73E-12 |
| | (162.060) | (2.11768) | (1.10383) | (1.07159) | (1.2E-09) |
| | [ 2.76489] | [ 4.31835] | [ 4.39929] | [ 4.09438] | [-0.00139] |
| | | | | | |
| X1(-2) | 70.79373 | 4.476008 | 2.362468 | 2.433619 | -1.02E-11 |
| | (208.922) | (2.73003) | (1.42302) | (1.38145) | (1.6E-09) |
| | [ 0.33885] | [ 1.63954] | [ 1.66018] | [ 1.76164] | [-0.00636] |
| | | | | | |
| X2(-1) | -393.2628 | -5.561932 | -3.057937 | -2.448309 | 3.24E-12 |
| | (197.495) | (2.58072) | (1.34519) | (1.30590) | (1.5E-09) |
| | [-1.99125] | [-2.15519] | [-2.27325] | [-1.87481] | [ 0.00213] |
| | | | | | |
| X2(-2) | -6.542932 | -2.052741 | -1.106744 | -1.213809 | 8.57E-12 |
| | (158.141) | (2.06646) | (1.07713) | (1.04567) | (1.2E-09) |
| | [-0.04137] | [-0.99336] | [-1.02749] | [-1.16079] | [ 0.00703] |

| | | | | | |
|---|---|---|---|---|---|
| X3(-1) | -438.8955 | -11.40421 | -5.885951 | -5.729179 | -1.49E-12 |
| | (221.742) | (2.89755) | (1.51033) | (1.46622) | (1.7E-09) |
| | [-1.97931] | [-3.93581] | [-3.89712] | [-3.90745] | [-0.00087] |
| | | | | | |
| X3(-2) | -154.7898 | -8.202322 | -4.361074 | -4.241938 | 1.21E-11 |
| | (274.165) | (3.58258) | (1.86740) | (1.81286) | (2.1E-09) |
| | [-0.56459] | [-2.28950] | [-2.33537] | [-2.33992] | [ 0.00575] |
| | | | | | |
| X4(-1) | -0.016027 | -0.000901 | -0.000433 | -0.000416 | -1.000000 |
| | (0.02357) | (0.00031) | (0.00016) | (0.00016) | (1.8E-13) |
| | [-0.67995] | [-2.92415] | [-2.69960] | [-2.67038] | [-5.5e+12] |
| | | | | | |
| X4(-2) | 0.047060 | 0.000379 | 0.000236 | 0.000170 | -1.000000 |
| | (0.02807) | (0.00037) | (0.00019) | (0.00019) | (2.2E-13) |
| | [ 1.67668] | [ 1.03425] | [ 1.23230] | [ 0.91580] | [-4.6e+12] |
| | | | | | |
| C | -1702.019 | 32.83915 | 12.64147 | 15.26576 | 179993.0 |
| | (2708.28) | (35.3897) | (18.4467) | (17.9079) | (2.1E-08) |
| | [-0.62845] | [ 0.92793] | [ 0.68530] | [ 0.85246] | [ 8.6e+12] |
| R-squared | 0.977599 | 0.990087 | 0.990856 | 0.988885 | 1.000000 |
| Adj. R-squared | 0.949598 | 0.977695 | 0.979425 | 0.974991 | 1.000000 |
| Sum sq. resids | 436936.8 | 74.60813 | 20.27074 | 19.10388 | 2.60E-17 |
| S.E. equation | 233.7030 | 3.053853 | 1.591805 | 1.545310 | 1.80E-09 |
| F-statistic | 34.91259 | 79.90011 | 86.68519 | 71.17437 | 5.85E+24 |
| Log likelihood | -122.3693 | -39.95403 | -27.57486 | -27.01163 | 363.8206 |
| Akaike AIC | 14.03888 | 5.363582 | 4.060511 | 4.001224 | -37.13901 |
| Schwarz SC | 14.58566 | 5.910363 | 4.607292 | 4.548005 | -36.59223 |
| Mean dependent | 2414.097 | 45.31579 | 24.52632 | 21.47368 | 60199.21 |
| S.D. dependent | 1040.971 | 20.44791 | 11.09739 | 9.771662 | 3247.844 |

**Source:** Collected and calculated from data in Table 8.

**Table 13.** Results of the inverse roots test for variables in the VAR model related to water resources affecting the agricultural trade balance in Egypt for the period 2002-2022

| Roots of Characteristic Polynomial | |
|---|---|
| Endogenous variables: Y X1 X2 X3 X4 | |
| Exogenous variables: C | |
| Lag specification: 1 2 | |
| Root | Modulus |
| -0.500000 - 0.866025i | 1.000000 |
| -0.500000 + 0.866025i | 1.000000 |
| 0.217675 - 0.871256i | 0.898036 |
| 0.217675 + 0.871256i | 0.898036 |
| 0.706607 - 0.064751i | 0.709568 |
| 0.706607 + 0.064751i | 0.709568 |
| -0.371642 - 0.373685i | 0.527028 |
| -0.371642 + 0.373685i | 0.527028 |
| 0.194698 - 0.476071i | 0.514346 |
| 0.194698 + 0.476071i | 0.514346 |
| No root lies outside the unit circle. | |
| VAR satisfies the stability condition | |

**Source:** Results of statistical analysis for Table 8.