استجابة عرض محصول التناع البلدي والبردقوش في مصر

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توضح نتائج التحليل الإحصائي لدالة استجابة عرض محصول التناع البلدي بالأسعار الثابتة خلال فترة الدراسة (2008-2022) أن الصورة الخطية هي أفضل الصور من الناحية الإحصائية، حيث زيادة السعر المزرعي لمحلول التناع البلدي في العام السابق بمقدار جنيه للطن يؤدي ذلك إلى زيادة غير معنوية في مساحة التناع البلدي في العام الحالي بمقدار 5.1 فدان، في حين زيادة المساحة المزروعة من الكمون في العام السابق بمقدار فدان يؤدي ذلك إلى انخفاض معنوي في مساحة التناع البلدي في العام الحالي بمقدار 0.22 فدان، في حين زيادة السعر المزرعي لكل مكرون بالأسعار الثابتة في العام السابق بمقدار جنيه للتدوير يؤدي إلى انخفاض معنوي لمساحة التناع البلدي في العام الحالي بمقدار 0.46 فدان، في حين زيادة تكاليف إنتاج فدان الكمون بالألأسعار الثابتة في العام السابق بمقدار جنيه للتدوير يؤدي إلى زيادة معنوية لمساحة التناع البلدي في العام الحالي بمقدار 1.8 فدان.

كما تبين من دالة استجابة عرض محصول البردقوش بالأسعار الثابتة زيادة السعر المزرعي للبردقوش في العام السابق بمقدار جنيه للطن يؤدي ذلك إلى زيادة معنوية في محصول البردقوش في العام الحالي بمقدار 0.76 فدان، في حين زيادة المساحة المزروعة من البردقوش في العام السابق بمقدار فدان يؤدي ذلك إلى زيادة معنوية في مساحة البردقوش في العام الحالي بمقدار 67.0 فدان.

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Competitiveness Indicators of Egyptian potato and onion crops in their foreign markets

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ABSTRACT

The results of the statistical analysis of the mint supply response function at constant prices during the study period (2008-2022) show that the linear form is the best form from a statistical standpoint, as increasing the farm price of the mint crop in the previous year by one pound per ton leads to a non-significant increase in the area of local mint in the current year increased by 5.1 Feddans, while increasing the cultivated area of cumin in the previous year by an Feddan leads to a significant decrease in the area of local mint in the current year by 0.22 Feddans, while increasing the agricultural price of cumin at fixed prices in the previous year by an amount One pound per Feddan leads to a significant decrease in the area of local mint in the current year by 0.22 Feddans, while increasing the production costs of an Feddan of cumin at fixed prices in the previous year by one pound per Feddan leads to a significant increase in the area of local mint in the current year by 1.8 Feddans

As shown by the response function of the marjoram crop supply at fixed prices, increasing the agricultural price of marjoram in the previous year by one pound per ton leads to a significant increase in the marjoram crop in the current year by 0.76 Feddans, while increasing the cultivated area of marjoram in the previous year by an Feddan leads to A significant increase in the area of marjoram in the current year by 0.67 Feddans.

Keywords: mint, marjoram; supply response; price index; Farm price.

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introduction:

Egyptian medicinal and aromatic plants occupy a distinguished position in the world, despite the small cultivated areas compared to other traditional agricultural crops and varieties. This calls for the need to raise awareness of their importance and their rewarding economic returns, to encourage their expansion, especially since the Ministry of Agriculture aims to expand the areas cultivated with medicinal and aromatic plants To reach 250 thousand Feddans by 2030, as these crops are exported to many countries such as “Italy - Spain - America - Australia - the United Kingdom - Germany - France”, which are used in many industries, including the production and extraction of pharmaceutical compounds to treat various diseases.

The supply response of producers to reduce or increase the cultivated area depends on their price expectations, as it has an impact on the cultivated area, and the expected prices do not depend only on the prices of the previous year but on a series of previous years, and also include the yield of the crop and crops competing for the same. The agricultural area in the same cultivated area, as well as the costs of the crop and competing crops and their prices, and that these factors directly affect the decisions of producers to reduce or increase the cultivated area of the main crop or competing crops, and this is reflected in the production of the crop. The study focuses on the crops of mint (green) and marjoram during the period (2008-2022).

Research problem:

Medicinal and aromatic plants have not received appropriate attention despite the increase in global demand for safe food and medicine, as the medicinal and aromatic plant production sector still suffers from fluctuation in production and its growth at low rates that do not achieve the desired goals, which has been reflected in exports. As a result of the effect of the area cultivated of medicinal and aromatic plants on the farm prices of the previous year, in addition to other variables such as the area planted with the crop in the previous year, the net per-Feddan yield, the
costs per Feddan, the farm price, or competing crops, a change may occur in the farmer’s decisions and he may or may not convert to cultivating another crop. Which affects the crop structure, leading to changes in the amount of medicinal plants available locally and for export. Therefore, the response to the production behavior of the local mint and marjoram crops must be studied.

Search goal:

The research aims to identify the most important factors that can affect the cultivated areas of mint and marjoram crops, determine the response to these variables, and identify the most influential factors that are supposed to affect the cultivated area of these two crops, which allows understanding production behavior, developing correct agricultural policies, and making appropriate decisions, in addition to the possibility of directing agricultural productive resources to achieve increased returns for the farmer.

Research method and data sources:

The research relied on descriptive and quantitative analysis methods in describing and analyzing the topics it included, and used some different statistical tools, including estimating percentages, averages, relative importance, and analyzing general trend and multiple regression models by applying the supply response function method, using current and fixed prices. This is due to the difference in the monetary value of the pound. Especially in recent years.

The study also relied on secondary data sources: represented in secondary data published from various sources such as the Economic Affairs Sector - the Central Administration for Agricultural Economics - the Ministry of Agriculture and Land Reclamation - the agricultural departments affiliated with the Ministry of Agriculture - the Central Agency for Public Mobilization and Statistics.

Analysis results:

1- Local mint crop (green):
1-1- Development of the cultivated area of the local mint crop (green):

It is clear from Table (1) that the cultivated area of the local mint crop (green) reached a minimum of 1,308 Feddans in 2008, and a maximum of 5,873 Feddans in 2017, with an average of about 2,675 Feddans during the study period (2007-2022). By studying the general time trend equation in Table (2), it was found that the Linear Form is the best picture from a statistical standpoint, as it was shown that the cultivated area of the local mint crop (green) increased by a statistically significant amount, amounting to about 149.5 Feddans annually, which represents 5.6% of the average period of the study. The significance was proven at the level of 0.01, as was the significance of the model as a whole. The results also showed that about 36% of the changes occurring in the cultivated area of the local mint crop (green) are due to independent variables whose effect reflects the time element.

2-1- The development of production costs, the net return per Feddan, and farm-gate price of the local mint crop (green) at current prices:

A- Development of production costs per Feddan at current prices:

It is clear from Table (1) that the costs of production an Feddan at current prices for the local mint crop (green) reached a minimum of 3,230 pounds/Feddan in 2007, and a maximum of 13,110 pounds/Feddan in 2021, with an average of about 6,454 pounds/Feddan during the study period (2007-2021). By studying the general time trend equation in Table (2), it was found that the linear form is the best form from a statistical standpoint, as it was shown that the costs of production an Feddan at current prices for the local mint crop (green) increase by a statistically significant amount, amounting to about 729.2 pounds/Feddan annually, which represents 11.3% of the average. The study period. The significance was Table (1): Development of production costs, net return per Feddan, and farm price in pounds for the local mint crop (green) at current and real prices in Egypt during the period (2007-2021).
<table>
<thead>
<tr>
<th>Year</th>
<th>Price index*</th>
<th>Area in Feddans</th>
<th>Current prices</th>
<th>Real prices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Costs Net Return</td>
<td>Farm Price</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Costs Net Return</td>
<td>Farm Price</td>
</tr>
<tr>
<td>2007</td>
<td>67.97</td>
<td>1382</td>
<td>3230 2578 287 4752 3793 422</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>80.42</td>
<td>1308</td>
<td>3477 5868 419 4324 7297 521</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>89.88</td>
<td>1977</td>
<td>3576 7230 515 3979 8044 573</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>100.00</td>
<td>1990</td>
<td>3472 8747 593 3472 8747 593</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>110.06</td>
<td>1743</td>
<td>3939 10298 714 3579 9357 649</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>117.89</td>
<td>1844</td>
<td>4286 9572 745 3636 8119 632</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>129.06</td>
<td>1455</td>
<td>4366 8587 759 3383 6653 588</td>
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</tr>
<tr>
<td>2014</td>
<td>142.05</td>
<td>3615</td>
<td>4084 4580 777 2875 3224 547</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>156.78</td>
<td>3733</td>
<td>5091 6197 785 3247 3953 501</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>178.44</td>
<td>3389</td>
<td>6789 5072 790 3805 2842 443</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>231.09</td>
<td>5834</td>
<td>8317 5061 800 3599 2190 346</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>264.38</td>
<td>2156</td>
<td>9739 4068 814 3684 1539 308</td>
<td></td>
</tr>
<tr>
<td>2019</td>
<td>288.57</td>
<td>3066</td>
<td>11012 7877 827 3816 2730 287</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>303.13</td>
<td>2749</td>
<td>12320 8389 847 4064 2767 279</td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td>318.94</td>
<td>2961</td>
<td>13110 6052 874 4110 1898 274</td>
<td></td>
</tr>
</tbody>
</table>
| 2022 | -----        | 3599            | -------------------------- | |}

*Base year 2010 (World Bank). ** Geometric mean.

**Source:** Ministry of Agriculture and Land Reclamation, Central Administration of Agricultural Economics, Agricultural Economics Bulletin, various issues.

proven at the level of 0.01, as was the significance of the model as a whole. The results also showed that about 85% of the changes occurring in production costs per
Feddan at current prices for the local mint crop (green) are due to independent variables whose effect reflects the time element.

**B- The development of the net return per Feddan at current prices:**

It is clear from Table (1) that the net return per Feddan at current prices for the local mint crop (green) reached a minimum of 2578 pounds/Feddan in 2007, and a maximum of 10,298 pounds/Feddan in 2011, with an average of about 6678 pounds/Feddan during the study period (2007-2021). By studying the general time trend equation in Table (2), it was found that the cubic form is the best form from a statistical standpoint, as it was shown that the net return per Feddan at current prices for the local mint crop (green) increases at the beginning of the period until the highest net return per Feddan was reached in 2011, with an estimated value of about 10,298 pounds/Feddan, then it began to decrease until it reached the lowest net return per Feddan in 2018, estimated at about 4068 pounds/Feddan. Then the net return per Feddan began to increase by a statistically significant amount, amounting to about 151.2 pounds/Feddan annually, representing 8.2% of the average period (2019-2021). The significance was proven at the level of 0.01, as was the significance of the model as a whole. The results also showed that about 60% of the changes occurring in the net return per Feddan at current prices for the local mint crop (green) are due to the independent variables whose effect reflects the time element.

**C- Development of agricultural prices at current prices:**

It is clear from Table (1) that farm-gate price at current prices for the local mint crop (green) reached a minimum of about 284 pounds/ton in 2007, and a maximum of about 874 pounds/ton in 2021, with an average of about 703 pounds/ton during the study period (2007-2021). By studying the general time trend equation in Table (2), it was found that the Linear Form is the best Form from a statistical standpoint, as it was shown that farm-gate price at current prices for the local mint crop (green)
increases by a statistically significant amount of about 33.9 pounds/ton, which represents about 4.8% of the average period. The significance was proven at the level of 0.01, as was the significance of the model as a whole. The results also showed that about 78% of the changes occurring in farm-gate price at current prices of the local mint crop (green) are due to independent variables whose effect reflects the time element.

Table (2): General trend equations for the development of production costs, net return per Feddan, and farm price in pounds for the local mint crop (green) at current and real prices in Egypt during the period (2007-2021).

<table>
<thead>
<tr>
<th>variable</th>
<th>The equation</th>
<th>R²</th>
<th>F</th>
<th>% annual change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivated area</td>
<td>( \hat{Y}_i = 1404.05 + 149.5 X_i )</td>
<td>0.36</td>
<td>7.7</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>( (2.7)** ) ( (2.78)** )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current prices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production costs</td>
<td>( \hat{Y}_i = 644.4 + 729.2 X_i )</td>
<td>0.85</td>
<td>75.3</td>
<td>11.3</td>
</tr>
<tr>
<td></td>
<td>( (0.85) ) ( (8.7)** )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \hat{Y}_i = -929.9 + 4523.9 X_i )</td>
<td>0.60</td>
<td>5.5</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>( (-0.43) ) ( (4.1)** )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 638.2 X_i^2 + 25.2 X_i^3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( (-3.98)** ) ( (3.8)** )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>net return</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm price</td>
<td>( \hat{Y}_i = 431.8 + 33.9 X_i )</td>
<td>0.78</td>
<td>45.97</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td>( (9.5)** ) ( (6.8)** )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real prices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production costs</td>
<td>( \hat{Y}_i = 4965 - 389.7 X_i + 23.1 X_i^2 )</td>
<td>0.76</td>
<td>22.9</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>( (24.8)** ) ( (6.6)** )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \hat{Y}_i = 8608.4 - 466.4 X_i )</td>
<td>0.55</td>
<td>16.2</td>
<td>-9.6</td>
</tr>
<tr>
<td></td>
<td>( (8.2) ) ( (-4.02)** )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>net return</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm price</td>
<td>( \hat{Y}_i = 6478 - 22.97 X_i )</td>
<td>0.57</td>
<td>17.2</td>
<td>-4.9</td>
</tr>
<tr>
<td></td>
<td>( (12.8)** ) ( (-4.14)** )</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where: \( Y_i \): the estimated value of the variable.
\( X_i \): time variable for the time period (2007-2022), where \( i = (1,2,3,...,15) \).

The value in parentheses indicates the calculated (T) value, \( R^2 \) the coefficient of determination, \( F \) the significance of the model, \( ** \) indicates the significance of the regression coefficients at a significance level (0.01).

Source: Calculated from Table (1) of the study.

D- Statistical characterization of the linear model of the response of the supply of local mint (green) at current prices:

\( Yi1T = \beta 0 + \beta 1 Yi1 T-1 + \beta 2 Pi1 T-1 + \beta 3 Ci1 T-1 + \beta 4 Ri1 T-1 + \beta 5 Yi2 T-1 \)
+ \beta_6 P_{i2 \ T-1} + \beta_7 C_{i2 \ T-1} + \beta_8 R_{i2 \ T-1}

Y_{i1 \ T}: Mint crop area (green) in Feddans in year T.

Y_{i1 \ T-1}: Mint crop area (green) in Feddans in year T-1.

P_{i1 \ T-1}: The price of a ton of local mint (green) in pounds per year T-1.

C_{i1 \ T-1}: Production costs of an Feddan of local mint (green) in pounds per year T-1.

R_{i1 \ T-1}: Net return on Feddans of local mint (green) in pounds in year T-1.

P_{i2 \ T-1}: Price per ton of cumin (competing crop) in pounds in year T-1.

C_{i2 \ T-1}: Production costs of an Feddan of cumin (the competing crop) in pounds in year T-1.

R_{i2 \ T-1}: The net return of an Feddan of cumin (the competing crop) in pounds per year T-1.

Through the use of both the Stepwise Regression method and the correlation matrix between the independent variables under study to avoid the problem of multicollinearity, many attempts were made to determine the most important statistical models specific to the response function of the supply of local mint crop (green) at current prices, and the estimation results were as follows:

\[
Y_{i1 \ T} = 0.32656 + 3.26 P_{i1 \ T-1} - 0.28 Y_{i2 \ T-1} - 0.32 P_{i2 \ T-1} + 0.90 C_{i2 \ T-1}
\]

\[
(3.2)^* (2.4)^* (-2.7)^* (-4.7)^* (4.5)^*
\]

\[R^2 = 0.80 \quad \bar{R}^2 = 0.72 \quad F = 9.8\]

The results of the statistical analysis of the supply response function of the local mint crop (green) at current prices during the study period (2008-2022) show that the Linear Form is the best Form from a statistical standpoint, as farm-gate price of the local mint crop (green) increased in the previous year Pi1 T-1 By one pound per ton, this leads to a significant increase in the area of the local mint crop (green) in the current year, Yi1T, by 3.26 Feddans, while increasing the cultivated area of the cumin crop in the previous year, Yi2 T-1, by an Feddan, this leads to a significant decrease in the area of the local mint crop. (green) in the current year, Yi1T, by 0.28
Feddans, while increasing farm-gate price of the cumin crop at current prices in the previous year, $P_{i1}T-1$, by one pound per Feddan, leads to a significant decrease in the area of the local mint crop (green) in the current year, $Y_{i1}T$, by 0.32 Feddans, while Increasing the costs of production an Feddan of cumin crop at current prices in the previous year, $C_{i2}T-1$, by one pound per Feddan, leads to a significant increase in the area of the local mint crop (green) in the current year, $Y_{i1}T$, by 0.90 Feddans. The adjusted coefficient of determination was 0.72, meaning that 72% of the changes occurring in the area of the local mint crop (green) in the current year are due to the aforementioned independent variables. The significance of the model as a whole was proven at the 1% level, which means that the model used fits the nature of the data.

3-1- Development of production costs, net return per Feddan, and agricultural price of the local mint crop (green) at fixed (real) prices:

A- The development of production costs per Feddan at fixed (real) prices:

It is clear from Table (1) that the production costs per Feddan at fixed (real) prices for the local mint crop (green) reached a minimum of 2875 pounds/Feddan in 2014, and a maximum of 4752 pounds/Feddan in 2007, with an average of about 3755 pounds/Feddan during the study period (2007-2021). By studying the general time trend equation in Table (2), it was found that the quadratic image is the best form from a statistical standpoint, as it was shown that the costs of production an Feddan at fixed (real) prices for the local mint crop (green) began to decrease at the beginning of the period until the lowest cost reached in 2014 by an estimated about 4752 pounds/Feddan, then it increased by a statistically significant amount, amounting to about 26.2 pounds/Feddan annually, representing 0.70% of the average for the period (2015-2021), which amounted to about 3761 pounds/Feddan. The significance was proven at the level of 0.01, as was the significance of the model as
a whole. The results also showed that about 76% of the changes occurring in production costs per Feddan at fixed (real) prices for the local mint crop (green) are due to independent variables whose effect reflects the time element.

**B- The development of the net return per Feddan at constant (real) prices:**

It is clear from Table (1) that the net return per Feddan at fixed (real) prices for the local mint crop (green) reached a minimum of 1539 pounds/Feddan in 2018, and a maximum of 9357 pounds/Feddan in 2011, with an average of about 4877 pounds/Feddan during the study period (2007)-2021). By studying the general time trend equation in Table (2), it was found that the linear form is the best form from a statistical standpoint, as it was shown that the net return per Feddan at constant (real) prices for the local mint crop (green) decreases by a statistically significant amount of about 466.4 pounds/Feddan annually, representing 9.6% of the average study period. The significance was proven at the level of 0.01, as was the significance of the model as a whole. The results also showed that about 55% of the changes occurring in the net return per Feddan at constant (real) prices for the local mint crop (green) are due to the independent variables whose effect reflects the time element.

**C- The development of farm-gate price in fixed (real) prices:**

It is clear from Table (1) that the farm price at fixed (real) prices for the local mint crop (green) reached a minimum of about 274 pounds/ton in 2021, and a maximum of about 649 pounds/ton in 2011, with an average of about 464 pounds/ton during the study period (2007-2021). By studying the general time trend equation in Table (2), it was found that the Linear Form is the best Form from a statistical standpoint, as it was shown that farm-gate price at constant (real) prices for the local mint crop (green) decreases by a statistically significant amount of about 22.97 pounds/ton, which represents about 4.9%. Of the average study period. The significance was proven at the level of 0.01, as was the significance of the model as
a whole. The results also showed that about 57% of the changes occurring in farm-gate price at constant (real) prices of the local mint crop (green) are due to independent variables whose effect reflects the time element.

**D- Statistical characterization of the linear model of the response of the supply of local mint (green) at constant (real) prices:**

$$Y_{iT} = \beta_0 + \beta_1 Y_{iT-1} + \beta_2 P_{iT-1} + \beta_3 C_{iT-1} + \beta_4 R_{iT-1} + \beta_5 Y_{iT-2} + \beta_6 P_{iT-2} + \beta_7 C_{iT-2} + \beta_8 R_{iT-2}$$

- $Y_{iT}$: Mint crop area (green) in Feddans in year $T$.
- $Y_{iT-1}$: Mint crop area (green) in Feddans in year $T-1$.
- $P_{iT}$: The price of a ton of local mint (green) in pounds per year $T$.
- $P_{iT-1}$: The price of a ton of local mint (green) in pounds per year $T-1$.
- $C_{iT}$: Production costs of an Feddan of local mint (green) in pounds per year $T$.
- $C_{iT-1}$: Production costs of an Feddan of local mint (green) in pounds per year $T-1$.
- $R_{iT}$: Net return on Feddans of local mint (green) in pounds in year $T$.
- $R_{iT-1}$: Net return on Feddans of local mint (green) in pounds in year $T-1$.
- $P_{iT-2}$: Price per ton of cumin (competing crop) in pounds in year $T$.
- $P_{iT-2}$: Price per ton of cumin (competing crop) in pounds in year $T-1$.
- $C_{iT-2}$: Production costs of an Feddan of cumin (the competing crop) in pounds in year $T$.
- $C_{iT-2}$: Production costs of an Feddan of cumin (the competing crop) in pounds in year $T-1$.
- $R_{iT-2}$: The net return on Feddans of cumin (the competing crop) in pounds in year $T$.
- $R_{iT-2}$: The net return on Feddans of cumin (the competing crop) in pounds in year $T-1$.

Through the use of both the stepwise regression method and the correlation matrix between the independent variables under study to avoid the problem of multicollinearity, many attempts were made to determine the most important statistical models specific to the response function of the supply of the local mint crop (green) at constant (real) prices, and the estimation results were as follows:

<table>
<thead>
<tr>
<th>$\hat{Y}_{iT}$</th>
<th>$P_{iT-1}$</th>
<th>$Y_{iT-2}$</th>
<th>$P_{iT-2}$</th>
<th>$C_{iT-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1608.5 + 5.1</td>
<td>-0.22 Y_{iT-1} - 0.46</td>
<td>1.8 C_{iT-1}</td>
<td>(0.36) (1.2) (-2.2)* (-5.1)** (1.8)*</td>
<td></td>
</tr>
</tbody>
</table>

| $R^2 = 0.78$ | $R^2 = 0.69$ | $F = 8.9$ |
The results of the statistical analysis of the supply response function of the local mint crop (green) at constant (real) prices during the study period (2008-2022) show that the Linear Form is the best Form from a statistical standpoint, as farm-gate price of the local mint crop (green) increased in the previous year \( P_{1T-1} \) by one pound per ton. This leads to a non-significant increase in the area of the mint crop (green) in the current year, \( Y_{1T} \), by 5.1 Feddans, while increasing the cultivated area of the cumin crop in the previous year, \( Y_{2T-1} \), by an Feddan, this leads to a significant decrease in The area of the mint crop (green) in the current year is \( Y_{1T} \) by 0.22 Feddans, while increasing the farm price of the cumin crop at fixed (real) prices in the previous year \( P_{1T-1} \) by one pound per Feddan leads to a significant decrease in the area of the mint crop (green) in the current year. \( Y_{1T} \) by 0.46 Feddans, while increasing the costs of production an Feddan of cumin crop at constant (real) prices in the previous year, \( C_{2T-1} \), by one pound per Feddan leads to a significant increase in the area of the local mint crop (green) in the current year, \( Y_{1T} \), by 1.8 Feddans. The adjusted coefficient of determination was 0.69, meaning that 69% of the changes occurring in the area of the local mint crop (green) in the current year are due to the aforementioned independent variables. The significance of the model as a whole was proven at the 1% level, which means that the model used fits the nature of the data.

2- Marjoram crop:
1-2- Development of the cultivated area of the marjoram crop:
It is clear from Table (3) that the cultivated area of the marjoram crop reached a minimum of 1,935 Feddans in 2017, and a maximum of 5,403 Feddans in 2018, with an average of about 3,400 Feddans during the study period (2007-2022).

Table (3): Development of production costs, net return per Feddan, and agricultural price in pounds for the marjoram crop at current and real prices in Egypt during the period (2007-2021).
<table>
<thead>
<tr>
<th>Year</th>
<th>Price index*</th>
<th>Area in Feddans</th>
<th>Current prices</th>
<th>Real prices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Costs</td>
<td>Net Return</td>
</tr>
<tr>
<td>2007</td>
<td>67.97</td>
<td>4056</td>
<td>2495</td>
<td>1779</td>
</tr>
<tr>
<td>2008</td>
<td>80.42</td>
<td>5403</td>
<td>2757</td>
<td>1804</td>
</tr>
<tr>
<td>2009</td>
<td>89.88</td>
<td>4691</td>
<td>2793</td>
<td>2885</td>
</tr>
<tr>
<td>2010</td>
<td>100.00</td>
<td>4128</td>
<td>2993</td>
<td>1534</td>
</tr>
<tr>
<td>2011</td>
<td>110.06</td>
<td>4113</td>
<td>3594</td>
<td>6921</td>
</tr>
<tr>
<td>2012</td>
<td>117.89</td>
<td>3474</td>
<td>3259</td>
<td>2412</td>
</tr>
<tr>
<td>2013</td>
<td>129.06</td>
<td>2520</td>
<td>3432</td>
<td>3037</td>
</tr>
<tr>
<td>2014</td>
<td>142.05</td>
<td>2681</td>
<td>3608</td>
<td>1010</td>
</tr>
<tr>
<td>2015</td>
<td>156.78</td>
<td>3361</td>
<td>3801</td>
<td>959</td>
</tr>
<tr>
<td>2016</td>
<td>178.44</td>
<td>3594</td>
<td>6298</td>
<td>-658</td>
</tr>
<tr>
<td>2017</td>
<td>231.09</td>
<td>1935</td>
<td>9199</td>
<td>3959</td>
</tr>
<tr>
<td>2018</td>
<td>264.38</td>
<td>2049</td>
<td>10702</td>
<td>2155</td>
</tr>
<tr>
<td>2019</td>
<td>288.57</td>
<td>3788</td>
<td>12156</td>
<td>5185</td>
</tr>
<tr>
<td>2020</td>
<td>303.13</td>
<td>2889</td>
<td>11478</td>
<td>5022</td>
</tr>
<tr>
<td>2021</td>
<td>318.94</td>
<td>2973</td>
<td>13260</td>
<td>2310</td>
</tr>
<tr>
<td>2022</td>
<td>-----</td>
<td>2740</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

المتوسط **152.43**

3400 6122 2688 5828 3371 1863 3540

*Base year 2010 (World Bank). ** Geometric mean.

Source: Ministry of Agriculture and Land Reclamation, Central Administration of Agricultural Economics, Agricultural Economics Bulletin, various issues.

By studying the general time trend equation in Table (4), it was found that the Linear Form is the best Form from a statistical standpoint, as it was shown that the cultivated area of the marjoram crop decreased by a statistically significant amount,
amounting to about 136 Feddans annually, which represents 4.0% of the average period of the study. The significance was proven at the level of 0.01, as was the significance of the model as a whole. The results also showed that about 47% of the changes occurring in the cultivated area of the marjoram crop are due to independent variables whose effect reflects the element of time.

2-2- The development of production costs, the net return per Feddan, and farm-gate price of the marjoram crop at current prices:

A- Development of production costs per Feddan at current prices:

It is clear from Table (3) that the costs of production per Feddan at current prices for the marjoram crop reached a minimum of 2,495 pounds/Feddan in 2007, and a maximum of 13,260 pounds/Feddan in 2021, with an average of about 6,122 pounds/Feddan during the study period (2007-2021). By studying the general time trend equation in Table (4), it was found that the linear form is the best form from a statistical standpoint, as it was shown that the costs of production per Feddan at current prices for the marjoram crop increase by a statistically significant amount, amounting to about 816.4 pounds/Feddan annually, which represents 13.3% of the average period of the study. The significance was proven at the level of 0.01, as was the significance of the model as a whole. The results also showed that about 83% of the changes occurring in the costs of production per Feddan at current prices for the marjoram crop are due to independent variables whose effect reflects the time element.

B- The development of the net return per Feddan at current prices:

It is clear from Table (3) that the net return per Feddan at current prices for the marjoram crop reached a minimum of -658 pounds/Feddan in 2016, and a maximum of 6921 pounds/Feddan in 2011, with an average of about 2688 pounds/Feddan during the study period (2007-2021). By examining the general time trend equation in Table (4), none of the commonly accepted statistical forms were found to be
significant, as there is fluctuation in the data, which means that the net yield per Feddan data at current prices for the marjoram crop revolves around its arithmetic average of about 2688 pounds/Feddan.

Table (4): General trend equations for the development of production costs, net return per Feddan, and farm-gate price in pounds for the marjoram crop at current and real prices in Egypt during the period (2007-2021).

<table>
<thead>
<tr>
<th>variable</th>
<th>The equation</th>
<th>$R^2$</th>
<th>F</th>
<th>% annual change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivated area</td>
<td>$\hat{Y}_i = 4555.4 - 136.0 X_i$</td>
<td>0.47</td>
<td>12.2</td>
<td>-4.0</td>
</tr>
<tr>
<td>Production costs</td>
<td>$\hat{Y}_i = -409.6 + 816.4 X_i$</td>
<td>0.83</td>
<td>62.6</td>
<td>13.3</td>
</tr>
<tr>
<td>net return</td>
<td>None of the common statistical forms were significant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm price</td>
<td>$\hat{Y}_i = 1618.05 + 526.3 X_i$</td>
<td>0.65</td>
<td>24.2</td>
<td>9.0</td>
</tr>
<tr>
<td>Real prices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production costs</td>
<td>$\hat{Y}_i = 3830.4 - 284.2 X_i + 21.9 X_i^2$</td>
<td>0.63</td>
<td>10.3</td>
<td>—</td>
</tr>
<tr>
<td>net return</td>
<td>$\hat{Y}_i = 3206.5 - 167.9 X_i$</td>
<td>0.24</td>
<td>4.1</td>
<td>-9.0</td>
</tr>
<tr>
<td>Farm price</td>
<td>$\hat{Y}_i = 4386.6 - 105.8 X_i$</td>
<td>0.22</td>
<td>3.7</td>
<td>-3.0</td>
</tr>
</tbody>
</table>

Where: $Y_i$: the estimated value of the variable.
$X_i$: time variable for the time period (2007-2022), where $i = (1,2,3,...,15)$.
The value in parentheses indicates the calculated (T) value, ($R^2$) the coefficient of determination, (F) the significance of the model, (**) indicates the significance of the regression coefficients at a significance level (0.01).
Source: Calculated from Table (3) of the study.

C- Development of agricultural prices at current prices:

It is clear from Table (3) that farm-gate price at current prices for the marjoram crop reached a minimum of about 3042 pounds/ton in 2007, and a maximum of about 9731 pounds/ton in 2021, with an average of about 5828 pounds/ton during the study period (2007-2021). By studying the general time trend equation in Table (4), it was found that the linear form is the best form from a statistical standpoint, as it was found that farm-gate price at current prices of the marjoram crop increases by a
statistically significant amount of about 526.3 pounds/ton, which represents about 9% of the average period of the study. The significance was proven at the level of 0.01, as was the significance of the model as a whole. The results also showed that about 65% of the changes occurring in farm-gate price at current prices of the marjoram crop are due to independent variables whose effect reflects the time element.

D- Statistical characterization of the linear model of the marjoram supply response at current prices:

\[ Yi1T = \beta_0 + \beta_1 Yi1 T-1 + \beta_2 Pi1 T-1 + \beta_3 Ci1 T-1 + \beta_4 Ri1 T-1 + \beta_5 Yi2 T-1 \]
\[ + \beta_6 Pi2 T-1 + \beta_7 Ci2 T-1 + \beta_8 Ri2 T-1 \]

\( Yi1T \): marjoram crop area in Feddans in year T.
\( Yi1 T-1 \): Marjoram crop area in Feddans in year T-1.
\( Pi1 T-1 \): The price of a ton of marjoram in pounds in year T-1.
\( Ci1 T-1 \): The costs of production an Feddan of marjoram in pounds in year T-1.
\( Ri1 T-1 \): Net return on marjoram Feddans in pounds in year T-1.
\( Pi2 T-1 \): Price per ton of cumin (competing crop) in pounds in year T-1.
\( Ci2 T-1 \): Production costs of an Feddan of cumin (the competing crop) in pounds in year T-1.
\( Ri2 T-1 \): The net return of an Feddan of cumin (the competing crop) in pounds per year. T-1

Through the use of both the stepwise regression method and the correlation matrix between the independent variables under study to avoid the problem of multicollinearity, many attempts were made to determine the most important statistical models specific to the marjoram crop supply response function at current prices, and the estimation results were as follows:
The results of the statistical analysis of the marjoram crop supply response function at current prices during the study period (2008-2022) show that the Linear Form is the best form from a statistical standpoint, as increasing farm-gate price of the marjoram crop in the previous year \( P_{i1 \, T-1} \) by one pound per ton leads to a significant increase. The area of the marjoram crop in the current year \( Y_{i1 \, T} \) increased by 0.36 Feddans, while increasing the cultivated area of the marjoram crop in the previous year \( Y_{i1 \, T-1} \) by an Feddan. This leads to a significant decrease in the area of the marjoram crop in the current year \( Y_{i1 \, T} \) by 0.42 Feddans. The green mint crop in the previous year \( Y_{i2 \, T-1} \), by an Feddan. This leads to a significant decrease in the area of the marjoram crop in the current year \( Y_{i1 \, T} \) by 0.42 Feddans. It also increases the cost of producing a green mint crop per Feddan at current prices in the previous year \( C_{i2 \, T-1} \), by an amount One pound per Feddan leads to a significant increase in the area of the marjoram crop in the current year \( Y_{i1 \, T} \) by 0.26 Feddans, while increasing the net yield per Feddan from the green mint crop in the previous year \( R_{i2 \, T-1} \), by an Feddan, leads to a significant decrease in the area of the marjoram crop in the current year \( Y_{i1 \, T} \), by 0.25. Feddan. The adjusted coefficient of determination was 0.74, meaning that 74% of the changes occurring in the area of the marjoram crop in the current year are due to the aforementioned independent variables. The significance of the model as a

\[
\hat{Y}_{i1 \, T} = 4196.02 + 0.36 \, P_{i1 \, T-1} + 0.42 \, Y_{i1 \, T-1} - 0.42 \, Y_{i2 \, T-1} + 0.26 \, C_{i2 \, T-1} - 0.25 \, R_{i2 \, T-1}
\]

\[\begin{align*}
(4.1)** & \quad (2.8)** & \quad (2.3)* & \quad (-3.1)** & \quad (2.9)** \\
(-4.0)**
\end{align*}\]

\[
R^2 = 0.83 \quad \bar{R}^2 = 0.74 \quad F = 8.9
\]
whole was proven at the 1% level, which means that the model used fits the nature of the data.

3-2- The development of production costs, the net return per Feddan, and farm-gate price of the marjoram crop at fixed (real) prices:

A- The development of production costs per Feddan at fixed (real) prices:

It is clear from Table (3) that the costs of production per Feddan at fixed (real) prices for the marjoram crop reached a minimum of 2424 pounds/Feddan in 2015, and a maximum of 4158 pounds/Feddan in 2021, with an average of about 3371 pounds/Feddan during the study period (2007-2021). By studying the general time trend equation in Table (4), it was found that the quadratic Form is the best Form from a statistical standpoint, as it was shown that the costs of production per Feddan at constant (real) prices for the marjoram crop began to decrease at the beginning of the period until the lowest cost reached in 2015, estimated at about 2424 pounds/Feddans and then increased by a statistically significant amount amounting to about 43.8 pounds/Feddan annually, representing 0.65% of the average period (2016-2021), which amounted to about 6712 pounds/Feddan. The significance was proven at the level of 0.01, as was the significance of the model as a whole. The results also showed that about 63% of the changes occurring in the costs of production per Feddan at constant (real) prices for the marjoram crop are due to independent variables whose effect reflects the time element.

B- The development of the net return per Feddan at constant (real) prices:

It is clear from Table (3) that the net return per Feddan at fixed (real) prices for the marjoram crop reached a minimum of -369 pounds/Feddan in 2016, and a maximum of 6288 pounds/Feddan in 2011, with an average of about 1863 pounds/Feddan during the study period (2007-2021). By studying the general time trend equation in Table (4), it was found that the linear form is the best form from a statistical standpoint, as it was shown that the net return per Feddan at constant (real)
prices for the marjoram crop decreases by a statistically significant amount of about 167.9 pounds/Feddan annually, which represents 9% of the average period. The significance was proven at the level of 0.05, as was the significance of the model as a whole. The results also showed that about 24% of the changes occurring in the net return per Feddan at constant (real) prices for the marjoram crop are due to the independent variables whose effect reflects the time element.

C- The development of farm-gate price in fixed (real) prices:

It is clear from Table (3) that the farm price at fixed (real) prices for the marjoram crop reached a minimum of about 2149 pounds/ton in 2016, and a maximum of about 6229 pounds/ton in 2010, with an average of about 3540 pounds/ton during the study period (2007-2021). By studying the general time trend equation in Table (4), it was found that the linear form is the best form from a statistical standpoint, as it was shown that farm-gate price at fixed (real) prices for the marjoram crop decreases by a statistically significant amount of about 105.8 pounds/ton, which represents about 3% of the average period of the study. The significance was proven at the level of 0.05, as was the significance of the model as a whole. The results also showed that about 22% of the changes occurring in farm-gate price at constant (real) prices of the marjoram crop are due to independent variables whose effect reflects the time element.

D- Statistical characterization of the linear model of the marjoram supply response at constant (real) prices:

\[ Y_{i1T} = \beta_0 + \beta_1 Y_{i1T-1} + \beta_2 P_{i1T-1} + \beta_3 C_{i1T-1} + \beta_4 R_{i1T-1} + \beta_5 Y_{i2T-1} + \beta_6 P_{i2T-1} + \beta_7 C_{i2T-1} + \beta_8 R_{i2T-1} \]

\[ Y_{i1T} \]: marjoram crop area in Feddans in year T.
\[ Y_{i1T-1} \]: Marjoram crop area in Feddans in year T-1.
\[ P_{i1T-1} \]: The price of a ton of marjoram in pounds in year T-1.
\[ C_{i1T-1} \]: The costs of production an Feddan of marjoram in pounds in year T-1.
Through the use of both the stepwise regression method and the correlation matrix between the independent variables under study to avoid the problem of multicollinearity, many attempts were made to identify the most important statistical models specific to the marjoram crop supply response function at constant (real) prices, and the estimation results were as follows:

\[
Y_{i1T} = 6527.9 + 0.76 P_{i1 \text{T-1}} + 0.67 Y_{i1 \text{T-1}} - 0.46 Y_{i2 \text{T-1}} + 1.45 C_{i1 \text{T-1}} \\
+ 0.42 R_{i1 \text{T-1}} - 0.59 R_{i2 \text{T-1}} \\
+ 4.76 (6.7)** + 6.9)** + 5.2)** - 4.8)** (5.8)** \\
+ 0.42 RT_{i1 \text{T-1}} - 0.59 RT_{i2 \text{T-1}} \\
(4.5)** (-6.8)** \\
\]

\[R^2 = 0.94 \quad R^2 = 0.89 \quad F = 19.4\]

The results of the statistical analysis of the marjoram crop supply response function at constant (real) prices during the study period (2008-2022) show that the Linear Form is the best Form from a statistical standpoint, as increasing farm-gate price of the marjoram crop in the previous year Pi1 T-1 by one pound per ton leads to this. This leads to a significant increase in the area of the marjoram crop in the current year (Yi1T) by 0.76 Feddans, while increasing the cultivated area of the marjoram crop in the previous year (Yi1 T-1) by an Feddan. This leads to a significant increase in the area of the marjoram crop in the current year (Yi1T) by 0.67 Feddans, with an increase in net returns. This leads to a significant increase in the area of the marjoram crop in the current year (Yi1T) by 0.42 Feddans, while increasing the cultivated area of the green mint crop in the previous year (Yi1 T-1) by an Feddan leads to A significant decrease in the area of the marjoram crop in the
current year, Yi2 T-1, by 0.46 Feddans. Also, increasing the cost of producing green mint crop per Feddan at fixed (real) prices in the previous year, Ci2 T-1, by one pound per Feddan, leads to a significant increase in the area of the marjoram crop in the year. The current Yi1 T is 1.45 Feddans, while increasing the net yield per Feddan from the green mint crop in the previous year RTi2 T -1 by an Feddan leads to a significant decrease in the area of the marjoram crop in the current year, Yi1, by 0.59 Feddans. The adjusted coefficient of determination was 0.89, meaning that 89% of the changes occurring in the area of the marjoram crop in the current year are due to the aforementioned independent variables. The significance of the model as a whole was proven at the 1% level, which means that the model used fits the nature of the data.

**Recommendations:**

1- Working through the competent authorities, such as the Ministry of Agriculture and Land Reclamation and the Horticultural Research Institute, to increase the cultivated area and acreage productivity of mint and marjoram crops, and to provide assistance in solving production problems.

2- Working through the competent authorities, such as the Ministry of Agriculture and Land Reclamation and the Horticulture Research Institute, to increase the agricultural price and reduce the cost of production, which leads to an increase in the cultivated area of mint and marjoram crops.

3- Conducting workshops and seminars through the Agricultural Extension Institute to encourage the importance of cultivating medicinal and aromatic plants, which improve the general health of the agricultural worker and thus work to increase his productivity.

4- Providing government support and aid to farmers to work on increasing the cultivated areas of medicinal and aromatic plants, because of their health and economic benefits and increasing export opportunities for these crops.
the reviewer:

1- Sanaa Gamal El-Din Jaber (Doctor) (2015): An economic study of the response to the supply of the most important export medicinal plants, Alexandria Journal of Agricultural Sciences, Volume (60), Issue (3).

2- Adel Muhammad Mostafa (Doctor), et al. (2012): External demand functions for the most important global markets for Egyptian medicinal and aromatic crops, Egyptian Journal of Agricultural Economics, Volume (22), Issue (2).


6- Ministry of Agriculture and Land Reclamation, Central Administration for Agricultural Economics, Agricultural Economics Bulletin, various issues.