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Full Length Research Paper

Economic Study On The Production And Exports Of Egyptian Chamomile

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Abstract
Demand for medicinal and aromatic plants has lately been increasingly growing in international markets due to the economic importance they represent in the manufacturing of many cosmetics, food processing industries, pharmaceutical and pesticides' industries, and perfume industries. Such benefits led the Government of Egypt to devote more attention to medicinal and aromatic plants due to their positive contribution to agricultural exports and to the Balance of Trade. Despite the economic and manufacturing importance of chamomile, more attention from farmers and the Government's are needed at the level of Old and New Lands, where fluctuations and instability in chamomile production and exports have been observed, leading to instability of exports thus the crop's contribution to Egypt's Balance of Agricultural Trade. Therefore, the research attempted to shed light on the degree of instability in chamomile production and its impact on the stability of chamomile exports by measuring instability percentages, studying the geographic distribution and concentration of chamomile exports, measuring the efficiency of chamomile production, identifying the structures of production and exports' costs per ton of chamomile, in addition to identifying the current situation of chamomile production and exports. Findings revealed that average chamomile planted area, yield, and total production for the period 1995-2012 amounted to 9.06 thousand feddans, 0.83 ton/feddan, and 6.71 thousand tons, respectively. On the other hand, average cost, farmgate price, total revenue, and net revenue for the same period amounted to LE 2.7, LE 4.31, LE 3.67, LE 2.73, and LE 0.868 *thousand, respectively. Findings also indicated the concentration of chamomile planted area in New Lands, particularly in Fayoum and Beni Swaif Governorates, with average planted area amounting to 792.5 representing 7.33% of the Country's total area under chamomile, estimated at 10.82 thousand feddans for the period 2009-2012. New Lands planted area in Fayoum and Beni Swaif Governorates represented 64.27% and 43.5% of the total New Lands' planted area. Results also indicated that production and marketing costs per ton of chamomile flowers prepared for exports amounted to 7.79 thousand tons, of which production costs accounted for 84.2%.*

Keywords: *Economic Study, The Production And Exports, Egyptian Chamomile.*

Introduction

Egypt is one of the countries characterized by climate conditions suitable for growing a variety of medicinal and aromatic plants, the cultivations of which have been flourishing in New Lands, in addition to cultivations in Old lands. It is worth mentioning that approximately two thousand varieties of medicinal and aromatic plants are grown in Egypt [(7)]. The importance of Egyptian chamomile comes from the importance it represents in terms of production and export to many countries, especially to the EU market and European countries, where it plays a major role in the manufacturing of cosmetics due to containing volatile oils. Therefore, chamomile is regarded as one of the main medicinal export crops for Egypt [(5)]. It is a well known fact that medicinal and aromatic plants are non-traditional versatile plants for which demand has lately been increasingly growing in international markets for containing plentiful amounts of Alkaloids, glycosides, volatile oils, bitter and colorful substances, and vitamins, in addition to containing vegetable oils in their seeds, stems, leaves, and flower heads. Such contents are used in the manufacturing of many cosmetics, food processing industries, pharmaceutical and pesticides' industries, and perfume industries [(6)].

Materials and methods

Research Problem

Despite the economic and manufacturing importance of chamomile, still it does not receive enough attention, either at the level of farmers, or Governmental agricultural extension services. Hence, fluctuations and instability in chamomile production and exports have been observed, in addition to imbalance between actual production and that economic level of production required to achieve the highest possible rate of exports in order to realize the highest possible revenue from chamomile exports.

Research Objective

The research attempts to shed light on the degree of instability in chamomile production and exports, and to assess the gap between actual and desired level of production that allows reaching the targeted level of exports by studying the geographic distribution of chamomile, measuring efficiency of chamomile production and exports using a number of measures, predicting the desired level of production that allows attaining the desired level of exports, estimating optimum level production for chamomile producers; and identifying problems obstructing farmers' ability to achieve optimum production levels thus the desired level of exports.

Methodology and Sources of Data

The research relied on secondary published and unpublished data collected from the Ministry of Agriculture and Land Reclamation, the Central Agency for Public Mobilization and Statistics, and literature on medicinal and aromatic plants' production and exports. In addition, primary data have been collected from a random sample of 100 individuals representing chamomile producers in Fayoum Governorate during the year 2012. The required data have been collected with the help of a questionnaire that has been designed to serve investigate the research problem and achieve the desired objectives. As regards methodology, the research applied both descriptive and quantitative analysis methods to economic variables in order to estimate production and cost function; estimate optimum level of production; estimate regression equations for the researched economic variables like production, exports, and production costs; in addition to estimating the coefficient of instability in domestic production and exports, and Gini-Hirschman Index to identify the geographic concentration of chamomile exports. The research also measured production and export efficiencies using marginal propensity to export, exports' growth rate, and coefficient of stability/instability of exports.

Results and Discussion

Current Situation and Significance of Egyptian Chamomile

Chamomile crop occupied the third rank in terms of area under medicinal and aromatic plants, with relative importance estimated at 14.84% of the total area under medicinal and aromatic plants during the period 1995-2012. Chamomile grows well in most of the regions in Egypt, but is mostly concentrated in Fayoum, Bani Swaif, Asiout, and Nubaria Governorates. It is an annual, herbal bushy shrub that grows well in clay and good drained yellow soils. Cultivation season starts form late August until the beginning of September, whereas flowering starts in January, and harvesting lasts from February till May. Chamomile flowers are used in preparing tea drinks; as well as medical drug for curing digestive disorders; expanding bronchial tubes; remedy for appetite loss; tonic for blood circulation; and tonic and sedative for coughs. Moreover, chamomile is mainly used in the manufacture of some scents, perfumes and soaps.

Evolution of Planted Area

Data in Table (1) indicate that average chamomile planted area for the period 1995-2012 amounted to 9.06 thousand feddans, ranging between a maximum of 7.19 thousand feddans in 2000 and a minimum of 11.55 thousand feddans in 2012, up by 4.36 thousand feddans representing 60.64%. The estimated regression equation, illustrated in Table (2), revealed that chamomile planted area followed a statistically insignificant increasing trend, indicating that chamomile planted area has been relatively stable over the study period.

Evolution of Productivity

It is clear from Table (1) that average chamomile productivity for the period 1995-2012 amounted to 0.83 ton/feddan, ranging between a maximum of 0.74 tons/feddan in 2007 and a minimum of 0.95 tons/feddan in 2004, down 0.21 tons/feddan representing 28.38%. The estimated regression equation, illustrated in Table (2), revealed that chamomile productivity followed a statistically insignificant increasing trend, indicating that chamomile productivity has been relatively stable over the study period.

Evolution of Total Production

Data in Table (1) indicate that average chamomile production for the period 1995-2012 amounted to 6.71 thousand tons, ranging between a minimum of 5.56 thousand tons in 2001 and a maximum of 10 thousand tons in 2012, up 4.44 thousand tons representing 79.86%. The estimated regression equation, illustrated in Table (2), revealed that total chamomile production followed a statistically insignificant increasing trend, indicating that total production has been relatively stable over the study period.

Geographic Distribution of Chamomile Planted Area, Productivity, and Total Production

Table (3) illustrates the distribution of chamomile production over Egyptian Governorates. It is clear that Middle Egypt ranked first in terms of planted area that reached 10.219 thousand feddans representing 9.89% of the average area under chamomile, estimated at 103.3 thousand tons for the period 2010-2012, and in terms of average productivity and total production that reached 2.17 and 8634 tons representing 358.35% and 99.81%, respectively. Upper Egypt ranked second with planted area amounting to 91 thousand feddans representing 0.88% of the average area under chamomile, and in terms of average productivity and total production that reached 0.82 and 58.33 tons representing 97.47% and 0.67%, respectively. Lower Egypt ranked third with planted area amounting to 13 thousand feddans representing 0.13% of the average area under chamomile, and in terms of average productivity and total production that reached 0.75 and 8.67 tons representing 89.58% and 0.10%, respectively.

Table 1: Evolution of Egyptian Chamomile Planted Area, Productivity, and Total Production over the Period 1995-2012

Year	Area (Fed)	Index No.*	Yield (Ton/Fed)	Index No.	Total Production (Tons)	Index No.
1995	7408	100	0.84	100	6184	**100**
1996	9305	125.61	0.85	101.19	7872	**127.30**
1997	10427	140.75	0.83	98.81	8613	**139.28**
1998	11013	148.66	0.83	98.81	9090	**146.99**
1999	7297	98.50	0.83	98.81	6169	**99.76**
2000	7198	97.17	0.80	95.24	5745	**92.90**
2001	7323	98.85	0.76	90.48	5562	**89.94**
2002	7549	101.90	0.79	94.05	5984	**96.77**
2003	7621	102.88	0.83	98.81	6347	**102.64**
2004	9813	132.46	0.95	113.10	9359	**151.34**
2005	9483	128.01	0.84	100.00	7935	**128.32**
2006	7304	98.60	0.83	98.81	6035	**97.59**
2007	8793	118.70	0.74	88.10	7315	**118.29**
2008	9304	125.59	0.82	97.62	7588	**122.70**
2009	11502	155.26	0.84	100.00	9700	**156.86**
2010	10184	137.47	0.87	103.57	8828	**142.76**
2011	10038	135.50	0.86	102.38	8612	**139.26**
2012	11549	155.90	0.87	103.57	10004	**161.77**
Average	**9061.72**	-	**0.83**	-	**6707.89**	-

** 1995 is the base year*

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Agency for Agricultural Economics, Bulletin of Agricultural Economics, Different Issues.

Table 2: Estimated Regression Equations for Evolutions of Chamomile Planted Area, Productivity, and Total Production over the Period 1995-2012

Variable	Estimated Equations	R^2	F	Average	Change (%)	Sig.
Area (Fed)	$\hat{Y}$= 8787 + 124.61 X (11.12) (1.92)	0.19	3.62	9061.72	-	**Insignificant**
Yield (Ton/Fed)	$\hat{Y}$= 0.83 + 0.003 X (32.82) (0.69)	0.48	0.029	0.83	-	**Insignificant**
Total Production (Tons)	**$\hat{Y}$= 6426.16 + 124.39 X (9.53) (1.99)**	**0.082**	**1.25**	**6707.89**	-	**Insignificant**

Where,

$\hat{Y}$ = Estimated Value of the Variable under study , X = Time (1, 2, 3, …. , 18)

R^2 = Coefficient of Determination , F = Model Significance Value

( ) = Value between Brackets indicates calculated T

Source: Calculated from Table (1)

Evolution of Total Production Cost

Data in Table (4) indicate that average cost of chamomile production for the period 1995-2012 amounted to LE 2.73 thousand, ranging between a minimum of LE 2.2 thousand in 2004 and a maximum of LE 3.86 thousand in 2012, up by LE 1.66 thousand representing 75.45%. The estimated regression equation No. 1 in Table (5) indicates that total cost of chamomile production followed a statistically significant increasing trend estimated at LE 48.62, i.e., 1.78% annual rate of increase. Statistical analysis results revealed that R^2 amounted to 0.55.

Evolution of Farm gate Price

Data in Table (4) indicate that average farmgate price for the period 1995-2012 amounted to LE 4.31 thousand/ton, ranging between a minimum of LE 3 thousand/ton in 1995 and a maximum of LE 5.46 thousand/ton in 2012, up by LE 2.46 thousand/ton representing 82%. The estimated regression equation No. 2 in Table (5) indicates that farmgate price per feddan of chamomile followed a statistically significant increasing trend estimated at LE 129.52, i.e., 3.005% annual rate of increase. Statistical analysis results revealed that R^2 amounted to 0.82.

Evolution of Total Revenue

It can be noted from Table (4) that average revenue for the period 1995-2012 amounted to LE 3.67 thousand, ranging between a minimum of LE 2.51 thousand in 1995 and a maximum of LE 4.57 thousand in 2011, up by LE 2.23 thousand representing 88.84%. The estimated regression equation No. 3 in Table (5) indicates that farmgate price followed a statistically significant

increasing trend estimated at LE 117.93, i.e., 3.21% annual rate of increase. Statistical analysis results revealed that R^2 amounted to 0.75.

Table 3: Distribution of Chamomile Planted Area, Productivity, and Total Production over Egyptian Governorates over the Period 2010-2012

Governorate	Area (Fed)	%*	Yield (Ton/Fed)	%*	Total Production (Tons)	%*
Sharkia	13	0.13	0.75	89.58	8.67	0.10
Lower Egypt	13	0.13	0.75	89.58	8.67	0.10
Giza	0.33	0.00	0.33	39.59	0.33	0.00
Beni Swaif	2394.67	23.18	0.84	99.83	2013.33	23.13
Fayoum	7823.33	75.73	0.84	100.17	6618.33	76.03
Menia	0.67	0.01	1.00	118.76	2.00	0.02
Middle Egypt	10219.00	98.93	2.17	358.35	8634.00	99.18
Assiut	91.00	0.88	0.73	87.21	58.33	0.67
Upper Egypt	91.00	0.88	0.82	97.47	58.33	0.67
Inside the valley	10323.00	99.93	0.84	100.01	8701.00	99.95
Matruh	7.00	0.07	0.62	73.53	4.33	0.05
Outside the Valley	3399.33	32.91	0.62	73.53	2946.00	33.84
Total	103300	100.00	0.84	100.00	8705.33	100.00

** Calculated Figures*
Source of Data: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Agency for Agricultural Economics, Bulletin of Agricultural Economics, Different Issues.

Table 4: Evolution of Total Production Cost, Farmgate Price, Total Revenue, and Net Revenue for Egyptian Chamomile over the Period (1995-2012)

Year	Total Cost (LE/Fed)	Index No.*	Farmgate Price (LE/ton)	Index No.*	Total Revenue (LE/Fed)	Index No.*	Net Revenue (LE/Fed)	Index No.*
1995	2346	100	3000	100	2510	100	164	**100**
1996	2335	99.53	3300	110	2790	111.16	455	**277.44**
1997	2310	98.47	3640	121.33	3010	119.92	700	**426.83**
1998	2624	111.85	3640	121.33	3000	119.52	376	**229.27**
1999	2910	124.04	3822	127.40	3110	123.90	200	**121.95**
2000	2999	127.83	3868	128.93	2920	116.33	-79	**-48.17**
2001	2922	124.55	3840	128.00	3040	121.12	118	**71.95**
2002	2539	108.23	3850	128.33	3450	137.45	911	**555.49**
2003	2619	111.64	4175	139.17	4290	170.92	1671	**1018.90**
2004	2198	93.69	4500	150.00	4293	171.04	2095	**1277.44**
2005	2205	93.99	5188	172.93	4342	172.99	2137	**1303.05**
2006	2569	109.51	5282	176.07	4368	174.02	1799	**1096.95**
2007	2587	110.27	4156	138.53	3458	137.77	871	**531.10**
2008	2815	5119.99	4376	145.87	3571	142.27	756	**460.98**
2009	2836	120.89	4920	164	4148	165.26	757	**461.59**
2010	2965	126.39	5227	174.23	4532	180.56	758	**462.20**
2011	3502	149.28	5326	177.53	4570	182.07	1068	**651.22**
2012	3857	164.41	5462	182.07	4741	188.88	884	**539.02**
Average	**2729.89**	-	**4309.56**	-	**3674.61**	-	**868.94**	-

** Calculated Figures, 1995 is the base year*
Source of Data: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Agency for Agricultural Economics, Bulletin of Agricultural Economics, Different Issues.

Evolution of Net Revenue
Data in Table (4) indicate that net revenue for the period 1995-2012 amounted to LE 868.94, ranging between a minimum of LE 79 in 1995 and a maximum of LE 2137 in 2011, up by LE 2058 representing 2121.65%. The estimated regression equation No. 4 in Table (5) indicates that net revenue followed a statistically significant increasing trend estimated at LE 52.16, i.e., 6% annual rate of increase. Statistical analysis results revealed that R^2 amounted to 0.60.

Current Situation of Chamomile Produced in New Lands

Chamomile is one of the most important medicinal and aromatic plants, where it is exported in the form of dry flowers or extracted oil. It is a winter crop, where chamomile nursery is planted during August to get chamomile seedlings after 45 days. Seedlings are then transported to permanent lands during September till the beginning of October, while harvesting lasts from February till May. New Lands started to actively contribute to export-oriented chamomile production. It is clear from Data in Table (6), which illustrate chamomile planted areas in New Lands, that chamomile is concentrated in Fayoum and Beni Swaif Governorates' Old and New Lands, in addition to Assiut Governorate, with average planted area estimated at 792.5 feddan, representing 7.33% of the average planted area at the level of Old and New Lands for the period 2009-2012, estimated at 10.82 thousand feddans. Fayoum and Beni Swaif represented 64.27% and 43.5% of the total planted area in New Lands, respectively, which calls for devoting more attention to conducting field research in Fayoum for the importance it represents in chamomile production in Old and New Lands. It is clear from the table that average yield and total production of chamomile produced in New Lands over the period 2009-2012 amounted to 0.93 ton/feddan and 816.75 tons, respectively.

Table 5: Estimated Regression Equations for Evolutions of Total Production Cost, Farmgate Price, Total Revenue, and Net Revenue per Feddan of Chamomile over the Period 1995-2012

Variable	Estimated Equation	R^2	F	Average	Rate of Change (%)	Sig.
Total Cost (LE/Fed)	**$\hat{Y}$ = 2268 + 48.62 X** (12.79) (2.97)	0.55	8.81	2729.89	1.78	**Significant**
Farmgate Price (LE/ton)	**$\hat{Y}$ = 3079.11+129.52 X** (18.94) (8.64)	0.82	74.63	4309.56	3.005	**Significant**
Total Revenue (LE/Fed)	**$\hat{Y}$=2554.27+117.93 X** (13.75) (6.87)	0.75	47.25	3647.61	3.21	**Significant**
Net Revenue (LE/Fed)	$\hat{Y}$=373.44+52.16 X (2.22) (2.85)	**0.60**	**8.12**	**868.94**	**6.002**	**Significant**

Where,
$\hat{Y}$ = Estimated Value of the Variable under study , X = Time (1, 2, 3, …. , 18)
R^2 = Coefficient of Determination , F = Model Significance Value
( ) = Value between Brackets indicates calculated T
Source: Calculated from Table (4)

Table 6: Evolution of Planted Area and Productivity of Chamomile at the Level of Governorates and New Land Regions over the Period 2009-2012

Governorate	Area (Fed)	Yield (ton/fed)	Total Production (ton)	Share in Planted Area* %	Share in Yield* %
Beni Swaif	344.75	1.25	462.75	43.50	56.66
Fayoum	509.33	0.76	435	64.27	53.26
Assiut	65	0.37	23.33	8.20	2.86
Total New Lands	792.5	0.93	816.75	100.00	100.00

** Calculated Figures*
Source of Data: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Agency for Agricultural Economics, Bulletin of Agricultural Economics, Different Issues.

Structure of Production and Export Marketing Costs per Ton of Chamomile Grown in New Lands

Data in Table (7) illustrate unit production cost of chamomile flowers prepared for export, and of raw chamomile herb, and productivity, in addition to the relative importance of cost items for the season 2012. As clear, production and marketing costs until reaching the export port amounted to LE 7.794 thousand/ton, of which production cost accounted for 84.2%, including tradable inputs (seeds, chemical fertilizers, pesticides, and fuel for mechanical work), and non-tradable inputs (manure, factors of production and agricultural services represented in wages & labor, agricultural machinery and equipment, land rent, and miscellaneous expenses), which accounted for 41%, 12.6%, 46.6% of the total cost, respectively. At the level of tradable inputs, seeds and fertilizers ranked first in terms of relative importance that represented 21.83% and 13.15% of the total production cost, respectively. Land rent and labor wages followed by representing 19.7% and 16.44% of the total production cost, respectively.

It was found that plastic boxes and transportation cost from the farm gate to sorting stations then to export port represent the main components of export marketing costs, where they accounted for 35.3% and 30.96% of the marketing cost estimated at LE 1.23 thousand/ton, respectively. Data in the table show also that production and marketing costs per average production per feddan, estimated at 0.9 ton of raw chamomile, amounted to LE 4.133 and LE 1.918 thousand, respectively. Data analysis indicates that New Lands, which yield clean agricultural production, especially from medicinal and aromatic plants, are desperately in need for finance to benefit from that advantage due to the high production costs incurred. It is worth mentioning that variable cost per

feddan is estimated at LE 3.317 thousand, whereas only one third of this value is granted to chamomile producers despite the fact that it is granted on the basis of 100% of the variable cost. Therefore, the Principal Bank for Development and Agricultural Credit (PBDAC) should reconsider estimates of variable costs required for planting medicinal and aromatic plants in New Lands so that the granted amount of finance is proportionate to the required production cost, which helps graduate producers and beneficiaries in New Lands avoid being monopolized by exporters and middle agents.

Table 7: Average Production and Marketing Costs per Quantity Produced of Export-oriented Egyptian Chamomile per Feddan during 2011-2012 (LE 1000)

Production and Marketing Cost Items	Chamomile Flowers Prepared for Export (LE 1000/ton)	%	Raw Chamomile (LE 1000/ton)	%	(LE 1000/Fed)	%
Production Cost Items	6.563		5.167	100	4.133	84.2
1. Tradable Inputs	2.691		2.119	41	1.695	
- Seeds	1.433		1.129		0.9032	
- Chemical Fertilizers	0.916		0.721		0.5768	
- Pesticides	0.094		0.74		0.059	
- Fuel and Oil for Mechanical Work	0.248		0.195		0.156	
2. Non-tradable Inputs						
- Manure	0.825		0.65	12.6	0.52	
- Production Factors & Agricultural Services	3.047	2.398	4.6	46.4		
- Labor Wages	1.079		0.85		0.68	
- Machinery & Equipment Rent	0.58		0.455		0.364	
- Land Rent	1.295		1.2		0.816	
- Other Expenses	0.093		0.073		0.0584	
- Export Marketing Costs	1.2305		0.97		0.77	15.8
- Marketing Kits for Export	0.434		0.342		0.274	
- In-farm Drying, Processing and Sorting costs	0.279		0.22		0.176	
- Transportation Cost to Stations	0.381		0.3		0.240	
- Inspection and Custom Clearance Fees	0.127		0.1		0.080	
- Loading Fees	0.0095		0.008		0.006	
Actual Total Cost (Production + Marketing)	7.794		6.137		4.909	100

Average production per feddan for the years 2011-2012 is 0.9 ton of chamomile herb, and about 0.63 ton of chamomile flowers (net for exports in the form of dry chamomile flowers).
Source: Collected and Calculated based on Rapid Rural Appraisal Meetings with Exporters and Farmers.

Study Sample Selection
Based on results of studying the geographic distribution of chamomile planted area and production, Fayoum Governorate has been selected as the largest chamomile producing Governorate, where chamomile planted area reached 7.82 thousand feddans representing 75.73% of the total area under chamomile at the country level during 2010-2012, with productivity amounting to 0.84 ton/feddan, and total production amounting to 6.62 thousand tons, as shown in Table (3). Studying the relative importance of chamomile production Districts in Fayoum revealed that Abshway and Etsa are the two main production Districts, with planted areas representing 50.9% and 45.08% of the total chamomile planted area at the level of Fayoum, and production quantities representing 51.2% and 44.82% of the total quantity of chamomile production at the level of the Governorate in 2012. Therefore, the two Districts were selected for drawing a random sample of chamomile farmers from affiliated villages based on the geometric mean and standard deviation of the area. As such, 60 individuals have been selected from Abshaway, and 40 from Etsa.

Study Sample Characterization
Characterization of the study sample variables is presented in Table (9). Total sample individuals amounted to 100. Statistical analysis revealed no differences between farm holding categories, and therefore total sample individuals have been used in estimating production and cost functions. Descriptive analysis revealed that average chamomile production and productivity at the sample level during 2012 amounted to 1.99 and 0.81 ton/feddan, respectively. Average quantities of other inputs amounted to: seedlings (3320), manure (630 m^3), phosphate fertilizer (350 kg/fed), potash fertilizer (790 kg/fed), Azote fertilizer (690 kg/fed). Finally, average number of labor amounted to 90 man/day.

Table 8: Relative Importance of Chamomile Planted Area, Total Production, and Productivity at the Level of Fayoum Districts in 2012

District	Area (1000 Fed)	%	Total Production (1000 tons)	%	Productivity (ton/fed)	%
Abshaway	3.5	50.9	2.905	51.20	0.83	101.47
Etsa	3.1	45.08	2.542	44.82	0.82	100.2
Fayoum	0.228	3.31	0.187	3.29	0.819	100.1
Sinorus	0.048	0.11	0.031	0.67	0.804	98.29
Total	6.876	100	5.672	100	0.818	-

Source: Calculated based on data collected from the Central Agency for Agricultural Economics, Administration of Agriculture in Fayoum.

Table 9: Characterization of the Study Sample Drawn From Fayoum Governorate in 2012

Variable	Total Sample
Number of Observations	100
Average Area Under Chamomile (1000 feddan)	4.69
Average Productivity (ton)	0.81
Average Production (ton/fed)	1.99
Average Number of Seedlings	3320
Average Amount of Manure (m^3/fed)	630
Average Quantity of Phosphate Fertilizer (kg/fed)	530
Average Quantity of Potash Fertilizer (kg/fed)	790
Average Quantity of Azote Fertilizer (kg/fed)	680
Average Number of Labor per Feddan (man/day)	**90**

Source: Study Sample Data (2012)

Chamomile Production and Cost Functions

Production Functions

Relationship between total production and factors of production has been estimated under several statistical forms. Logarithmic form proved the best in terms of statistical and economic criteria, where results revealed a positive relationship between total production and each of the following variables: labor, mechanical work in hours, quantity of seeds in kilograms, and pesticides. Based on the estimated equation, a 10% increase in the mentioned variables leads to increasing total production by 3.8%, 2.4%, 3.7%, and 5.4%, respectively; whereas a 10% increase in Azote fertilizer leads to reducing total production by 4.8%. It is worth mentioning that all of the estimated parameters proved statistically significant. Total elasticity reached 1.15, and coefficient of determination amounted to 0.78.

$$\ln Y = 0.089 + 0.38 \ln X_1 + 0.24 \ln X_2 + 0.037 \ln X_3 - 0.048 \ln X_4 + 0.54 \ln X_5$$
$$(2.12) \quad (3.59) \quad (2.71) \quad (7.81) \quad (2.62) \quad (2.23)$$
$$R^{-2} = 0.78 \qquad F = 62.32$$

Where

ln Y = estimated value of production quantity (tons),
ln X_1 = labor (man/day),
ln X_2 = mechanical work (kg)
ln X_3 = amount of seeds (kg)
ln X_4 = Azote fertilizer (kg)
ln X_4 = Pesticides (kg)

Source: Calculated using field data collected from Fayoum in 2012.

Cost Functions

Cost functions have also been estimated in different forms. Cubic form proved the best in terms of economic and statistical criteria, where the estimated relationship between production costs and total production proved statistically significant at 1% level. Coefficient of determination indicates that 65% of the changes in production costs are due to changes in total chamomile production. The estimated equation was used to find that volume of production that minimizes the cost, which can be attained at the point where marginal cost equals total cost. Findings revealed that it reached 0.94 ton/fed. As for the volume that maximizes profit, which can be attained at the point where marginal cost equals marginal revenue (price), findings revealed that it amounted to 1.05 ton. Comparing these figures with the actual productivity at the level of the study sample indicate that none of the farmers reached that volume. Therefore, inputs must be intensified in order to reach that optimum volume that maximizes production and minimizes cost. The estimated elasticity reached 0.23.

TC =2.67 + 56.8 y - 0.12 y2 + 0.0068 y3
(2.31) (2.78) (-2.89) (2.97) R^{-2} =0.65 F =32.8

Source: Calculated using field data collected from Fayoum in 2012.

Economic Stability of Egyptian Chamomile Production and Exports

Economic stability of chamomile crop can be studied on two parts, the first of which focuses on economic stability of production, whereas the second focuses on exports. Data in table (10) indicate that economic factors responsible for chamomile production include planted area, productivity, and farmgate price, where different degrees of economic stability between them have observed, which affected the economic stability of chamomile production. Productivity proved more stable than price and planted area, where the calculated geometric mean of the instability coefficient for productivity amounted to 12.91 over the period 1995-2012, whereas geometric mean of the instability coefficient for farmgate price and planted area amounted to 49.91 and 67.67 over the same period, respectively. Accordingly, geometric mean of the instability coefficient for domestic production amounted to 45.67 over the mentioned period. Instability in planted area and productivity, and their impact on production instability proved statistically insignificant, where equation (1) in Table (11) indicate that instabilities in planted area and productivity have positive impacts on production instability, hence a unit increase in instability of the two mentioned variables is expected to lead to instability in chamomile production amounting to 1.02 and 0.84 units, respectively. However, instability in farmgate price proved statistically insignificant in terms of influencing chamomile production, where farmgate price proved to have higher economic stability than that of planted area. Applying stepwise regression to instability coefficients of the study variables revealed instability in domestic production due to instability in planted area and productivity, as clear from equation (2) in Table (11).

It is natural that economic stability in the volume and value of Egyptian chamomile exports is influenced by stability in total domestic production and export price. It is clear from Table (10) that export prices are more stable than domestic production, where the geometric mean of instability coefficients for export and domestic production amounted to 73.29 and 45.67 over the period 1995-2012, leading to expectations regarding the stability/instability of domestic production, where it is influenced by productivity and planted area that have more impact on the stability of export quantity and price.

Table 10: Evolution of Instability Coefficients of Chamomile Planted Area, Productivity, Domestic Production, Farmgate Price, Export Quantity, and Export Price over the Period 1995-2012

Year	Planted Area	Yield	Domestic Production	Farmgate Price	Export Quantity	Export Price
1995	16.87	0.84	5.60	6.50	5.57	43.37
1996	47.79	48.98	39.91	48.58	33.90	32.20
1997	61.00	66.79	56.17	62.19	49.24	57.92
1998	69.10	75.09	65.31	71.64	69.75	75.76
1999	83.62	80.07	81.16	76.18	73.28	82.12
2000	86.54	83.99	85.38	79.91	81.00	83.87
2001	88.26	86.97	87.87	82.90	86.59	88.56
2002	89.41	88.15	88.58	85.00	85.99	89.52
2003	90.50	88.93	89.23	85.54	88.11	81.61
2004	88.99	88.60	85.71	85.98	83.88	81.16
2005	90.33	90.83	88.99	85.30	87.73	88.92
2006	93.17	91.70	92.32	86.28	87.74	88.92
2007	92.41	93.17	91.41	90.04	87.75	88.91
2008	92.54	92.97	91.73	90.26	87.72	88.92
2009	91.40	93.28	90.13	89.78	87.73	88.92
2010	92.86	93.47	91.58	89.82	87.74	88.91
2011	93.37	93.93	92.27	90.24	87.74	88.92
2012	92.80	94.20	91.52	90.54	87.72	89.52
Average	81.16	80.66	78.60	77.59	75.51	79.34
Geometric Mean	67.67	12.91	45.67	49.03	44.20	73.29

Source: Calculated based on data in Tables (1), (11), and (4)

Instability Coefficient Equation

This equation can be calculated based on percentages of average deviations as follows:

1. Estimate the regression equations for chamomile quantity, value, or export price over the time period for which export stability is to be measured;
2. Calculate the estimated value of crop quantity, value, or export price over the same time period;
3. Calculate deviations between actual and estimated values ÷ Actual Value × 100 , as follows:

Instability Coefficient = $\frac{|y - \hat{y}|}{\hat{y}}$ x 100

Where y is the actual value of the dependent variable, ŷ is the estimated value. Optimum state of export stability is obtained when instability coefficient is zero.

Equations (1) and (2) in Table (13), which explain the impacts of factors affecting exports instability, indicate that instability in production has no significant impact on the instability of chamomile exports, where a 10% increase in production instability from primary sources leads to 7.9% units of instability in exports, which proved statistically significant. Instability of export price proved to have statistically insignificant impact on the instability of exports quantity. However, findings indicate stability of export prices.

Table 11: Factors Affecting Instability of Egyptian Chamomile Production over the Period 1995-2012

No.	Analysis Method	Equation	F	$\bar{R}^2$
1	Linear Regression	$Y= -1.483+1.02\ X_1+ 0.84\ X_2 + 0.0077\ X_3$ (3.56) (9.79) (4.49) (0.18)	35.08	0.89
2	Stepwise	$Y= -1.238 - 1.015\ X_1+ 0.827\ X_2$ (5.46) (10.61) (4.69)	58.19	0.91

Source: Calculated based on data in Tables (10)
Where,
Y = Instability in total production (1000 tons)
X_1 = Instability in planted area (1000 feddans)
X_2 = Instability in productivity (ton/feddan)
X_3 = Instability in farmgate price (LE 100/ton)

Required Level of Production for Achieving Efficiency in Chamomile Exports
Deficiencies exist in a large number of factors affecting production of medicinal and aromatic plants. And to estimate the required level of chamomile production, lagged influencing factors have been used like production in thousand tons (x_{t-1}), planted area in thousand feddans (x_1), composite actual farmgate price [1] in LE thousand/ton (x_2). The following proved the best estimated model:

$\hat{Y}= -0.737- 0.0223\ X_{t-1}+ 0.93X_1+0.04\ X_2$
(1.91) (-0.19) (8.28) (0.129) $R^{-2}=0.85$ F = 24.92

Where,
$\hat{Y}$= Level of production required to reach the targeted level of exports (in thousand tons),
X_{t-1} = Lagged production quantity (in thousand tons),
X_1 = Actual planted area,
X_2 = Composite Farmgate Price

Findings revealed that the required level of production is estimated at 6.77 thousand tons. Test results indicated that difference between the required and actual level of production is not statistically significant, where only a gap of 0.0014 thousand tons existed due to convergence of actual and required levels of average production. Accordingly, total production is considered quite suitable for exports, unless expansion in unlimited export quotas is taken into account, which can be achieved by expanding chamomile cultivations in New Lands, especially in Fayoum and Beni Swaif Governorates. Therefore, a higher level of production that improves the efficiency of resources used can be achieved, especially that producers are still in the first stage of the production function.

Geographic Distribution and Concentration of Egyptian Chamomile Exports
Findings illustrated in Tables (14) and (15) reveal that EU countries represent the major markets for Egyptian chamomile, where it absorbed 72.18% of Egyptian chamomile exports volume during the study period 1995-2012. Markets of the two Americas, Asian countries, Arab countries, Australian countries, and African countries followed with relative importance amounting to 14.5%, 3.2%, 2.43%, 0.14%, and 0.05% of Egyptian chamomile exports during the same period. Other irregular markets absorbed 7.531% during the mentioned period.
Geographic concentration, which has been measured using Gini-Hirschman Index, amounted to 72.188% for the EU Market. According to Michaely et al., a value that equals to or higher than 40% indicates concentration of exports. It can therefore be said that exports volume and value concentrated in the EU Markets, especially Germany, for which the calculated coefficient of concentration for the volume and value of exports amounted to 41.9% and 40.3%, respectively.
Coefficient of concentration for total exports quantity and value to the EU countries amounted to 72.18% and 69.68%, respectively. And despite finding that price concentration for other countries exceeds that of the EU counties, the large quantities led to higher export values despite the lower prices compared to other countries and economic blocs. Besides, concentration of the

[1] *Composite Farmgate Price has been calculated using "Arbitrary Weights Method"*
$Xp= 0.3\ X_1p- 0.7X_{t-1}p$, where Xp = Composite Farmgate Price on the basis of year t, X_1P = farmgate price in the current year , $7X_{t-1}$ P = farmgate price lagged one year.

highest percentages of prices in the two Americas, which occupied the second rank in terms of exports quantity and value, is incomparable to quantities exported to the EU market. The opening of African, Australian, and Arab market for Egyptian Exports calls for devoting more attention to opening new market windows while keeping the old ones. The estimated equations indicated instability and non-significance for most of the markets, even the major ones, and for economic blocs and countries that recorded the highest geographic concentration indices. Therefore, it was important to study stability of Egyptian exports, and the causes of instability.

Table 12: Volume and Value of Chamomile Exports, and Export Price Per Ton over the Period 1995-2012

Year	Export Quantity (1000 tons)	Export Value (LE Million)	Export Price (LE 1000)
1995	2.26	16.27	7.2
1996	2.83	19.27	6.81
1997	3.26	20.67	6.34
1998	2.59	12.61	4.87
1999	2.86	12.84	4.49
2000	2.44	11.86	4.86
2001	2.01	8.08	4.02
2002	2.4	10.10	4.21
2003	2.29	19.03	8.31
2004	3.45	32.64	9.46
2005	2.89	17.69	6.12
2006	3.15	21.04	6.68
2007	3.41	24.69	7.24
2008	3.68	28.67	7.79
2009	3.94	32.90	8.35
2010	4.2	37.42	8.91
2011	4.46	42.19	9.46
2012	4.73	44.79	9.47
Average	**3.16**	**21.87**	**6.92**

Source: Central Agency for Public Mobilization and Statistics, Foreign Trade Yearbook, Different Issues.

Table 13: Factors Affecting Instability of Egyptian Chamomile Exports over the Period 1995-2012

No.	Equation	Analysis Method	F	$\bar{R}^2$
1	**Linear Regression**	Y=7.83 - 0.229X1 + 0.78X2 (1.31) (1.13) (2.61)	4.17	0.35
2	**Stepwise**	Y= 2.596 + 0.79 X2 (2.31) (2.63)	6.9	0.33

Source: Calculated based on data in Tables (12)
Where,
Y = Instability in Export Quantity (1000 tons)
X_1 = Instability in Export Prices (LE 1000)
X_2 = Instability in Domestic Production (1000 tons)

Table 14: Gini-Hirschman Index for Concentration of Chamomile Exports Quantity, Value, and Export Price at the Level of Main Economic Blocs and Import Countries over the Period 1995-2012

Economic Blocs	Coefficient of Geographic Concentration		
	Quantity	**Value**	**Price**
European Union	72.188	69.68	97.18
Germany	41.63	40.3	96.8
Americas' Countries	14.5	18.3	126.16
Asian Countries	3.2	4.37	136
Arab Countries	2.43	1.68	69.15
Australian Markets	0.14	0.15	106.6
African Countries	0.05	0.045	85.67

Source: Calculated based on data collected from the Central Agency for Public Mobilization and Statistics, Foreign Trade Database, the Internet.

Table 15: Statistical Parameters of the Quantity and Value of Egyptian Chamomile Exports to Main Blocs and Countries over the Period 1995-2012

Variable/Economic Bloc	$\bar{Y}$	A	B	R^2	T	Annual Rate of Change	Coefficient of Variation
Export Volume (ton)							
EU Markets	1.81	1.764	-0.109	0.109	0.146	-6.02	0.5723
Americas markets	0.364	0.362	0.00036	0.114	0.034	0.10	0.1044
Asian Markets	0.081	0.065	0.024	0.471	3.14	29.63	0.1110
Arab Countries Markets	0.061	0.021	0.0066	0.28	2.21	10.82	0.0372
Australia's Markets	0.004	0.0018	0.0004	0.053	1.2	10.00	0.0037
African Countries Markets	0.0024	-0.0014	0.0005	0.215	0.0539	20.83	0.0024
Others	0.258	0.262	-0.000656	0.167	0.023	-0.25	0.228
Total Exports Volume (ton)	2.51	2.15	0.0603	0.25	0.87	2.40	0.718
Value (LE 1000)							
EU Markets	11155.7	9386.55	294.85	0.078	0.53	2.64	5643.9
Americas markets	2960.4	1818.86	185.3	0.28	2.2	6.26	1039.17
Asian Markets	701.15	-699.8	233.99	0.41	2.83	33.37	1128.2
Arab Countries Markets	268.72	82.05	31.11	0.39	2.7	11.58	153.54
Australia's Markets	29.47	37.7	-1.458	0.056	0.76	-4.95	19.05
African Countries Markets	13.37	-21.89	4.701	0.66	3.26	35.16	15.89
World Total Value	16008.8	11152.9	809.32	0.033	1.16	5.06	7463.1
Export Price (LE/ton)							
EU Markets	6026.6	5562.6	77.34	0.084	0.47	1.28	1656.08
Americas markets	8298.3	4842.06	575.05	0.301	2.33	6.93	3116.7
Asian Markets	7575.7	8550.9	-162.52	0.068	0.601	-2.15	2743.7
Arab Countries Markets	4970.16	564.9	-112.29	0.067	0.613	-2.26	1861.13
Australia's Markets	7938.12	13887	-1049.9	0.74	4.75	-13.23	4311.5
African Countries Markets	5457.03	6503.14	1594.2	0.32	189	29.21	67789
Total	6276.4	5594.6	113.64	0.057	0.68	1.81	1712.5

Source: Calculated based on data collected from the Central Agency for Public Mobilization and Statistics, Foreign Trade Database, the Internet.

Growth Rate of Chamomile Exports

Growth rate of chamomile exports has been calculated by dividing the rate of change in exports value over the study period 1995-2012 over the average quantity of chamomile exports over the same period, multiplied by 100. Results indicate that growth rate amounted to 5.055%, which is a modest rate of growth in exports value. On the other hand, the rate of growth in quantity amounted to 2.4%, whereas the rate of growth in prices amounted to 1.81%, both of which are the references for growth rate in exports value. It is worth noting that growth rates in exports value varied between economic blocs, where findings revealed that growth in exports value, quantity, and prices at the level of old markets followed a slower pace compared to new markets. However, new markets absorbed far less quantities than old markets, where findings revealed that traditional markets, i.e., EU markets, absorbed 71% of Egypt's chamomile exports despite the slower pace of growth rate in chamomile exports compared to other markets that absorbed only the remaining percent (African, Asian, etc.). Therefore, besides continuing to open new chamomile markets, it is vital to keep the old markets and create more marketing opportunities inside them.

Summary and Conclusion

Demand for medicinal and aromatic plants has lately been increasingly growing in international markets due to the economic importance they represent in the manufacturing of many cosmetics, food processing industries, pharmaceutical and pesticides' industries, and perfume industries. Such benefits led the Government of Egypt to devote more attention to medicinal and aromatic plants due to their positive contribution to agricultural exports and to the Balance of Trade.

Despite the economic and manufacturing importance of chamomile, more attention from farmers and the Government's are needed at the level of Old and New Lands, where fluctuations and instability in chamomile production and exports have been observed, leading to instability of exports thus the crop's contribution to Egypt's Balance of Agricultural Trade. Therefore, the research attempted to shed light on the degree of instability in chamomile production and its impact on the stability of chamomile exports by measuring instability percentages, studying the geographic distribution and concentration of chamomile exports, measuring the efficiency of chamomile production, identifying the structures of production and exports' costs per ton of chamomile, in addition to identifying the current situation of chamomile production and exports. Findings revealed that average chamomile planted area, yield, and total production for the period 1995-2012 amounted to 9.06 thousand feddans, 0.83 ton/feddan, and 6.71 thousand tons, respectively. On the other hand, average cost, farmgate price, total revenue, and net revenue for the same period amounted to LE 2.7, LE 4.31, LE 3.67, LE 2.73, and LE 0.868 thousand, respectively. Findings also indicated the concentration of chamomile planted area in New Lands, particularly in Fayoum and Beni Swaif Governorates, with average planted area amounting to 792.5

representing 7.33% of the Country's total area under chamomile, estimated at 10.82 thousand feddans for the period 2009-2012. New Lands planted area in Fayoum and Beni Swaif Governorates represented 64.27% and 43.5% of the total New Lands' planted area. Results also indicated that production and marketing costs per ton of chamomile flowers prepared for exports amounted to 7.79 thousand tons, of which production costs accounted for 84.2%.

The highest variable cost items have been recorded by seeds and labor wages, which represented 37.3% and 20.48% of the total variable cost, respectively. Production and cost functions have been estimated at the level of the study sample. Findings revealed that chamomile production and exports have been experiencing instabilities, and that economic factors responsible for chamomile production are behind this situation, including planted area, yield, and farmgate price, where differences have been observed in the degrees on instability between them, leading to negative impacts on the stability of chamomile production. Results indicated that yield has been more stable than farmgate price and planted area, where the calculated geometric mean of production instability for the period 1995-2012 amounted to 12.91, whereas that calculated for farmgate price and planted area amounted to 67.67 and 49.03, respectively, leading to a geometric mean of domestic production amounting to 45.67%. Instability in planted area and yield and their impacts on chamomile production instability proved statistically significant, where a unit increase in the stability of the two mentioned variables leads to increasing economic instability in production by 1.02 and 0.84, respectively. However, instability in farmgate price showed non-significant impact on the stability of production, where farmgate price proved more economically stable than planted area. It is natural that economic stability in the volume and value of Egyptian chamomile exports is influenced by stability in total domestic production and export price. Results indicated that export prices are more stable that domestic production, where the geometric mean of instability coefficients for export and domestic production amounted to 73.29 and 45.67 over the period 1995-2012, leading to expectations regarding stability/instability of domestic production, where it is influenced by productivity and planted area that have more impact on the stability of export quantity and price. Findings regarding geographic distribution reveal that EU countries represent the major markets for Egyptian chamomile, where it absorbed 72.18% of Egyptian chamomile exports during the study period 1995-2012. Markets of the two Americas, Asian countries, Arab countries, Australian countries, and African countries followed with relative importance amounting to 14.5%, 3.2%, 2.43%, 0.139%, and 0.052% of Egyptian chamomile exports during the same period. Other irregular markets absorbed 7.531% during the mentioned period. As for the geographic concentration, measured using Gini-Hirschman Index, findings revealed that it amounted to 72.188% for the EU Market, especially Germany, for which the calculated coefficient of concentration for the volume and value of exports amounted to 41.9% and 40.3%, respectively.

Results of calculating the growth rate of chamomile exports showed that it amounted 5.055%. Growth rate of quantity amounted to 2.4%, whereas that of prices amounted to 1.81%. Average propensity to export Egyptian chamomile accounted for 0.0054 of Egypt's Gross National Product, and about 0.0033 of Egypt's National Agricultural Product. Based on the achieved results, the research offered the following recommendations:

1. Devoting more attention to developing high yielding varieties that can help achieve production efficiency for farmers, especially in New Lands.
2. It is vital to keep old markets and create more marketing opportunities inside them, in addition to opening new market windows characterized by stability and high export prices in order for chamomile farmers and Egypt's economy to achieve higher profitability.
3. Raising awareness of clean agriculture, its importance to chamomile crop production, and the increasing demand for clean agriculture products, especially by the EU markets.
4. Devoting more attention to financing chamomile producers, where the finance offered to producers is low relative the incurred variable cost, and goes lower when the marketing cost is taken into consideration. The actually offered finance does not exceed on third of the variable cost per feddan, leaving producers under the mercy and monopoly of exporters.
5. Designing a technical, economic, marketing bulletin for chamomile producers, especially those in New Lands.

Ethics

All the authors read and approved the manuscript and no ethical issues involved.

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