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# An Economic Analysis of Bee Honey Production in Egypt (Case study of Beni Suef Governorate)

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**Abstract:** The research aimed to study the economics of honey production in Beni Suef Governorate, Egypt. This can be achieved through; (1) Examining the current status for development of honey beehive numbers, honey production quantity, and beeswax production in Egypt and Beni Suef governorate during (2005-2023), (2) Measuring the beehive density per feddan in Beni Suef governorate and in the selected districts within the research sample in 2024, (3) Analyzing the production costs items per one beehive and the relative importance of each items in apiaries of different production capacities within the research sample in 2024, (4) Measuring certain productive and economic indicators per beehive in apiaries of different production capacities within the research sample, in order to determine the profitability of these projects, (5) Identifying the production and marketing problems facing beekeepers, and proposed solutions from the beekeepers' perspective to overcome them, (6) Identifying the Strengths and Weaknesses of beekeeping projects, and the Opportunities and Threats facing beekeepers in the research sample. The research is based on primary data obtained through a questionnaire survey administered via personal interviews with apiary owners in Beni Suef governorate during 2024, and published secondary data obtained from the Annual Bulletin of Income Estimates from the Agricultural Sector and the Annual Bulletin of Statistics Livestock issued by (CAPMAS), in addition to unpublished secondary data obtained from the directorate of Agriculture in Beni Suef governorate and the selected districts within the research sample, affiliated with the Ministry of Agriculture and Land Reclamation.
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**Key words:** Bee Honey; Productivity Indicators; Economic Indicators; Production and Marketing problems; SWOT Analysis; Egypt.

## Introduction:

Honey bee farming projects are considered important agricultural economic activity characterized by the simplicity of methods and tools used in production, limited capital investment, rapid capital turnover, and consequently quick profit realization[(1)]. Additionally, these projects can significantly contribute to economic development through their role in creating employment opportunities, thereby reducing unemployment on one hand, and increasing individual income in particular and national income in general on the other hand, resulting in a positive impact on the agricultural production value added[(2)].

Egypt's agricultural environment is considered suitable for pursuing apicultural activity as an economic activity, particularly honey bee farming projects, due to its moderate climate and abundant successive crops. this enables producers to increase production of bee products, most notably honey[(3)], Bees play an important role in pollinating agricultural crops, which leads to an increase in crop productivity by approximately 30%[(4)], Apicultural production is considered one of the sources of agricultural income, with the value of apicultural production reaching approximately 275 million Egyptian pounds, representing about 0.03% of the average agricultural production value in Egypt, which amounted to approximately 1,035.675 billion Egyptian pounds during the period (2020-2023)[(5)].

Bees are considered a source for producing numerous products of significant economic, nutritional, and therapeutic value, which their main production includes honey, which is utilized for various nutritional and medical purposes such as skin ointments and cosmetic preparations. Egypt's honey production reached approximately 4.07 thousand tons for the average period (2020-2023)[(6)]. Secondary production includes live bee colonies, with export quantities of live bees reaching approximately 2.4 thousand tons valued at approximately 23.76 million USD for the average of the same period[(7)]. Additionally, bees produce various other products such as beeswax, which is incorporated into certain

pharmaceutical industries; royal jelly, which is considered an energy source with high nutritional value; bee venom, which is utilized in pharmaceutical industries for treating rheumatic diseases; and propolis, which is used as an antimicrobial and anti-inflammatory agent[8].

**Context of the Problem:**

Despite the economic, therapeutic, and nutritional importance of bees and their products, recent years have witnessed a decline in the number of honey beehives in Egypt generally. Beehive numbers decreased from approximately 1,462 thousand beehives in 2005 to approximately 739 thousand beehives in 2023, representing a decline rate estimated at 49.5%. In Beni Suef governorate specifically, the number declined from approximately 167 thousand beehives in 2005 to nearly 53 thousand beehives in 2023, with a decline rate estimated at 68.27%[6]. This has negatively impacted the total production of bee products in general and honey in particular. Consequently, this situation necessitates measuring the most important productive and economic indicators of beekeeping projects to determine their profitability, in addition to identifying the causes of beehive decline and proposing solutions to the problems and constraints facing beekeepers at the research sample level in Beni Suef governorate.

**Objectives:**

The research primarily aims to study the economics of bee honey production in Beni Suef governorate, Egypt. This can be achieved through the following sub-objectives: (1) Examining the current status for development of honey beehive numbers, honey production quantity, and beeswax production in Egypt and Beni Suef governorate during the period (2005-2023), (2) Measuring the beehive density per feddan in Beni Suef governorate and in the selected districts within the research sample in 2024, (3) Analyzing the production costs items per beehive and the relative importance of each items in apiaries of different production capacities within the research sample in 2024, (4) Measuring certain productive and economic indicators per beehive in apiaries of different production capacities within the research sample, in order to determine the profitability of these projects, (5) Identifying the most important production and marketing problems facing beekeepers in the research sample, and proposed solutions from the beekeepers' perspective to overcome them, (6) Identifying the Strengths and Weaknesses of beekeeping projects, and the Opportunities and Threats facing beekeepers in the research sample.

**Methods:**

The research relies on descriptive and quantitative statistical analysis methods to achieve its objectives. Specifically, the following methods were employed: (1) Arithmetic, geometric, and adjusted geometric means, percentages, and annual growth rates for the economic variables under investigation, (2) One-way analysis of variance (One-Way ANOVA, F-test), (3) Certain productive and economic indicators for measuring profitability, (4) Chi-square test ($\chi^2$), (5) SWOT Analysis matrix, which is considered one of the important tools that assists in decision-making and formulating effective strategies for developing and advancing the studied activity. This contributes to increasing investors' income on one hand and national income on the other hand. The analysis evaluates four fundamental categories: Strengths and Weaknesses (internal factors that investors can directly influence), and Opportunities and Threats (external factors facing investors that are beyond their control)[9]. This can be illustrated as follows [10]:

| SWOT Analysis | Positive | Negative |
|---|---|---|
| **Internal Factors** | **S (Strengths)** | **W (weaknesses)** |
| **External Factors** | **O (Opportunities)** | **T (Threats)** |

**Source:** Sharath Kumar C. R. and Praveena K. B. (2023), SWOT Analysis, International Journal of Advanced Research, vol. 11(9):744-748.

**Data Sources:**

The research relies on two main sources of data necessary for its implementation. First, primary data obtained through a questionnaire survey administered via personal interviews with apiary owners in Beni Suef governorate during 2024. Second, published secondary data obtained from the Annual Bulletin of Income Estimates from the Agricultural Sector and the Annual Bulletin of Statistics Livestock issued by the Central Agency for Public Mobilization and Statistics (CAPMAS), in addition to unpublished secondary data obtained from the directorate of Agriculture in Beni Suef governorate and the selected districts within the research sample, affiliated with the Ministry of Agriculture and Land Reclamation (MALR).

**Sample Selection:**

A random sample of apiary owners in Beni Suef governorate was selected for 2024 from three districts: Nasser, Ihnasia, and El-Wasta, based on the relative importance of the number of apiaries and beehives in

each district compared to the remaining districts of Beni Suef governorate. Data presented in Table (1) indicate that the number of apiaries in these three districts reached approximately 102, 89, and 78 apiaries respectively[11], representing about 21.66%, 18.9%, and 16.56% of the total number of apiaries in Beni Suef governorate, which totaled 471 apiaries in 2024. Furthermore, the number of beehives in the three selected districts reached approximately 8.78, 14.74, and 8.2 thousand beehives respectively, representing about 18.30%, 30.72%, and 17.09% of the total number of beehives in the governorate, which amounted to approximately 47.98 thousand beehives during the same year.

**Table (1):** Relative importance of the number of apiaries and beehives in the districts of Beni Suef governorate in 2024.

| Districts | Apiaries | | Beehives | |
|---|---|---|---|---|
| | No. of apiaries | (%) | No. of thousand hives | (%) |
| Nasser | 102 | 21.66 | 8.78 | 18.30 |
| Ihnasia | 89 | 18.90 | 14.74 | 30.72 |
| El- Wasta | 78 | 16.56 | 8.20 | 17.09 |
| Beni Suef | 75 | 15.92 | 6.55 | 13.65 |
| El- Fashn | 48 | 10.19 | 3.19 | 6.65 |
| Biba | 45 | 9.55 | 4.23 | 8.82 |
| Sumusta | 34 | 7.22 | 2.29 | 4.77 |
| Total | 471 | 100.00 | 47.98 | 100.00 |

**Source:** Compiled and calculated from data of the Ministry of Agriculture and Land Reclamation, directorate of Agriculture in Beni Suef governorate, Food Security administration records, unpublished data.

Data presented in Table (2) indicate that the total number of apiaries in the three districts selected for the research sample (Nasser, Ihnasia, and El-Wasta) reached approximately 269 apiaries, representing about 57.12% of the total number of apiaries in Beni Suef governorate. Additionally, the number of beehives in the same districts reached approximately 31.72 thousand beehives, representing about 66.11% of the total number of beehives in Beni Suef governorate.

**Table (2):** Relative importance of the number of apiaries and beehives in the three selected districts of the research sample in Beni Suef governorate in 2024.

| Statement / Districts | Apiaries | | Beehives | |
|---|---|---|---|---|
| | No. of apiaries | **(%)** | No. of thousand hives | **(%)** |
| Nasser | 102 | 21.66 | 8.78 | 18.30 |
| Ihnasia | 89 | 18.90 | 14.74 | 30.72 |
| El- Wasta | 78 | 16.56 | 8.20 | 17.09 |
| Total districts | 269 | 57.12 | 31.72 | 66.11 |
| Total of Governorate | 471 | - | 47.98 | - |

**Source:** Compiled and calculated from the data contained in Table (1).

The two largest villages in each of the selected districts were chosen based on the relative importance of the number of apiaries and beehives according to data from the Food Security administration records at the Agricultural directorate in each district of the research sample. The villages of Ashmant and Beni Adi were selected from Nasser District; Qay and Nanna from Ihnasia District; and Wena El-Qess and Atwab from El-Wasta District. Data presented in Table (3) indicate that the number of apiaries in the villages of Ashmant and Beni Adi in Nasser District reached approximately 12 and 10 apiaries respectively[12], representing about 13.79% and 11.49% of the total number of apiaries in the selected villages of the research sample, which totaled 87 apiaries. The number of beehives in each village reached approximately 4.29 and 1.6 thousand beehives respectively, representing about 26.83% and 10.01% of the total number of beehives in the selected villages of the research sample, which amounted to approximately 16 thousand beehives. Furthermore, the number of apiaries in the villages of Qay and Nanna in Ihnasia District reached approximately 25 and 12 apiaries respectively, representing about 28.74% and 13.79% of the total number of apiaries in the selected villages of the

research sample. The number of beehives in each village reached approximately 4.58 and 1.83 thousand beehives respectively, representing about 28.61% and 11.41% of the total number of beehives in the selected villages of the research sample. Meanwhile, the number of apiaries in the villages of Wena El-Qess and Atwab in El-Wasta District reached approximately 17 and 11 apiaries respectively, representing about 19.54% and 12.64% of the total number of apiaries in the selected villages of the research sample. The number of beehives in each village reached approximately 2.15 and 1.56 thousand beehives respectively, representing about 13.41% and 9.72% of the total number of beehives in the selected villages of the research sample.

**Table (3):** Number of selected surveyed beekeepers in the study villages in Beni Suef governorate during 2024

| District | Villages | Apiaries | | Beehives | | Geometric mean(1) | Adjusted geometric mean(2) | No. of sample units(3) |
|---|---|---|---|---|---|---|---|---|
| | | No. of apiaries | (%) | No. of thousand hives | (%) | | | |
| Nasser | Ashmant | 12 | 13.79 | 4.29 | 26.83 | 19.24 | 19.54 | 10 |
| | Beni- Adi | 10 | 11.49 | 1.60 | 10.01 | 10.72 | 10.89 | 5 |
| | Total | 22 | 25.29 | 5.89 | 36.84 | - | - | 15 |
| Ihnasia | Qay | 25 | 28.74 | 4.58 | 28.61 | 28.67 | 29.12 | 15 |
| | Nanna | 12 | 13.79 | 1.83 | 11.41 | 12.54 | 12.74 | 6 |
| | Total | 37 | 42.53 | 6.40 | 40.03 | - | - | 21 |
| El-Wasta | Wena El-Qess | 17 | 19.54 | 2.15 | 13.41 | 16.19 | 16.44 | 8 |
| | Atwab | 11 | 12.64 | 1.56 | 9.72 | 11.09 | 11.26 | 6 |
| | Total | 28 | 32.18 | 3.70 | 23.14 | - | - | 14 |
| Total of districts selected of sample | | 87 | 100 | 15.99 | 100 | 98.45 | 99.99 | 50 |

(1) Geometric mean= $\sqrt{(\text{Relative importance of hive no.})(\text{Relative importance of apiary no.})}$

(2) Adjusted geometric mean = (Geometric mean / Total geometric mean) × 100

(3) Number of sample units = (Adjusted geometric mean × Total sample size) / 100

**Source:** Collected and calculated from data of the Ministry of Agriculture and Land Reclamation, Agriculture Directorate in Beni Suef governorate, Food Security records at the Agricultural administration in each district of the research sample districts, unpublished data.

Following the selection of the research sample villages, the stratified sample units totaling 50 apiary owners were distributed across these villages based on the adjusted geometric mean. The share of the villages of Ashmant and Beni Adi in Nasser District was 10 and 5 units respectively, totaling 15 units out of the total research sample of 50 units. The share of the villages of Qay and Nanna in Ihnasia District was 15 and 6 units respectively, totaling 21 units out of the total sample units. Finally, the share of the villages of Wena El-Qess and Atwab in El-Wasta District was 8 and 6 units respectively, totaling 14 units out of the total sample units—Table (3).

After distributing the stratified sample units across the research sample villages, the selected sample from each village was distributed across three production capacities according to the number of hives in the apiary. The first capacity includes (less than 100 hives), the second capacity includes (100 - less than 200 hives), while the third capacity includes (200 hives or more). The data presented in Table (4) shows that the sample units were distributed across these capacities in each village according to the adjusted geometric mean, with 1, 2, and 7 units in Ashmant village in Nasser district for the three production capacities respectively out of the research sample size of 50 beekeepers, and 1, 1, and 3 units in Beni Adi village in Nasser district in the same order out of the research sample size. Furthermore, the sample units were distributed across the three production capacities in the two villages of Ihnasya district, represented by Qai village with 2, 5, and 8 units, and Nanna village with 1, 2, and 3 units in the same order out of the research sample size. Additionally, the sample units were distributed across the three production capacities in the two villages of El-Wasta district, represented by Wana El-Qess village with 1, 5, and 2 units out of the research sample size, and Atwab village with 2, 3, and 1 units in the same order out of the research sample size.

**Table (4):** Distribution of the research sample of beekeepers across selected villages according to different production capacities in Beni Suef governorate during 2024

| District | Village | capacity | Beekeepers | | Hives | | Geometric mean | Adjusted geometric mean | No.of sample units |
|---|---|---|---|---|---|---|---|---|---|
| | | | No. | (%) bee keepers | No. | (%) from total | | | |
| Nasser | Ashmant | 1 | 2 | 16.67 | 150 | 3.50 | 7.63 | 7.98 | 1 |
| | | 2 | 3 | 25 | 590 | 13.75 | 18.54 | 19.38 | 2 |
| | | 3 | 7 | 58.33 | 3550 | 82.75 | 69.48 | 72.64 | 7 |
| | | Total | 12 | 100 | 4290 | 100 | 95.65 | - | 10 |
| | Bani Adi | 1 | 3 | 30 | 140 | 8.75 | 16.20 | 16.87 | 1 |
| | | 2 | 2 | 20 | 350 | 21.88 | 20.92 | 21.79 | 1 |
| | | 3 | 5 | 50 | 1110 | 69.38 | 58.90 | 61.34 | 3 |
| | | Total | 10 | 100 | 1600 | 100 | 96.02 | - | 5 |
| Ihnasia | Qay | 1 | 5 | 20 | 375 | 8.20 | 12.80 | 13.16 | 2 |
| | | 2 | 9 | 36 | 1200 | 26.23 | 30.73 | 31.60 | 5 |
| | | 3 | 11 | 44 | 3000 | 65.57 | 53.71 | 53.18 | 8 |
| | | Total | 25 | 100 | 4575 | 100 | 97.24 | - | 15 |
| | Nanna | 1 | 3 | 25 | 125 | 6.85 | 13.09 | 13.69 | 1 |
| | | 2 | 4 | 33.33 | 500 | 27.40 | 30.22 | 31.59 | 2 |
| | | 3 | 5 | 41.67 | 1200 | 65.75 | 52.34 | 54.72 | 3 |
| | | Total | 12 | 100 | 1825 | 100 | 95.65 | - | 6 |
| El-Wasta | Wena El- Qess | 1 | 3 | 17.65 | 170 | 7.93 | 11.83 | 12.06 | 1 |
| | | 2 | 10 | 58.82 | 1155 | 53.85 | 56.28 | 57.37 | 5 |
| | | 3 | 4 | 23.53 | 820 | 38.23 | 29.99 | 30.57 | 2 |
| | | Total | 17 | 100 | 2145 | 100 | 98.1 | - | 8 |
| | Atwab | 1 | 4 | 36.36 | 375 | 24.12 | 29.61 | 29.95 | 2 |
| | | 2 | 5 | 45.45 | 750 | 48.23 | 46.82 | 47.36 | 3 |
| | | 3 | 2 | 18.18 | 430 | 27.65 | 22.42 | 23.12 | 1 |
| | | Total | 11 | 100 | 1555 | 100 | 98.85 | - | 6 |

- Capacity (1): Refers to apiary capacity (less than 100 hives).
- Capacity (2): Refers to apiary capacity (100 - less than 200 hives).
- Capacity (3): Refers to apiary capacity (200 hives or more).

**Source:** Collected and calculated from data of the Ministry of Agriculture and Land Reclamation, Agriculture directorate in Beni Suef governorate, Food Security records at the Agricultural administration in each district of the research sample districts, unpublished data.

**Results and Discussion:**

**First: Development of honey beehive numbers and honey and wax production quantities in Egypt and Beni Suef governorate during (2005-2023).**

The data presented in Tables (5, 6) indicate the following:

**(1) Number of honey beehives:**

The number of honey beehives in Egypt during the period (2005-2023) ranged between a minimum of approximately 729.19 thousand hives in 2022 and a maximum of approximately 1,461.9 thousand hives in 2005. The number of honey beehives in Egypt trended toward a decrease during the research period at a decreasing rate estimated at approximately 3.9% at the 0.01 probability level from the average of approximately 1,028.38 thousand hives, with a decrease amount of approximately 40.11 thousand hives - Equation No. (1), Table (6).

The number of honey bee hives in Beni Suef governorate during the research period ranged between a minimum of approximately 44.55 thousand hives in 2018 and a maximum of approximately 166.90 thousand hives in 2005 and 2006. The number of honey beehives in Beni Suef governorate trended toward a decrease during the study period at a decreasing rate estimated at approximately 8.1% at the 0.01 probability level from the average of approximately 96.61 thousand hives, with a decrease amount of approximately 7.83 thousand hives - Equation (2), Table (6).

**Table (5):** Development of beehive numbers and honey and wax production quantities in Egypt and Beni Suef governorate during (2005-2023).

| Year | No. of hives | | | Production of honey | | | Production of wax | | |
|---|---|---|---|---|---|---|---|---|---|
| | Egypt | Beni Suef | (%) | Egypt | Beni Suef | (%) | Egypt | Beni Suef | (%) |
| | Thousand Hives | | | (1000 Ton) | | | (1000 Ton) | | |
| 2005 | 1461.90 | 166.90 | 11.42 | 8.52 | 1.29 | 15.14 | 0.10 | 0.009 | 9.00 |
| 2006 | 1417.47 | 166.90 | 11.77 | 7.92 | 1.01 | 12.75 | 0.10 | 0.010 | 10.00 |
| 2007 | 1352.11 | 155.18 | 11.48 | 7.60 | 0.93 | 12.24 | 0.11 | 0.010 | 9.09 |
| 2008 | 1277.32 | 155.79 | 12.20 | 6.96 | 0.88 | 12.64 | 0.08 | 0.012 | 15.00 |
| 2009 | 1253.23 | 143.29 | 11.43 | 7.04 | 0.67 | 9.52 | 0.17 | 0.013 | 7.65 |
| 2010 | 1139.41 | 117.56 | 10.32 | 6.03 | 0.54 | 8.96 | 0.17 | 0.013 | 7.65 |
| 2011 | 1090.96 | 113.79 | 10.43 | 5.68 | 0.47 | 8.27 | 0.18 | 0.014 | 7.78 |
| 2012 | 983.04 | 105.36 | 10.72 | 5.07 | 0.48 | 9.47 | 0.18 | 0.013 | 7.22 |
| 2013 | 965.26 | 112.23 | 11.63 | 5.41 | 0.60 | 11.09 | 0.15 | 0.012 | 8.00 |
| 2014 | 929.63 | 116.70 | 12.55 | 5.44 | 0.65 | 11.95 | 0.12 | 0.014 | 11.67 |
| 2015 | 879.98 | 67.41 | 7.66 | 4.95 | 0.33 | 6.67 | 0.09 | 0.003 | 3.33 |
| 2016 | 828.90 | 48.97 | 5.91 | 4.38 | 0.23 | 5.25 | 0.10 | 0.002 | 2.00 |
| 2017 | 820.52 | 49.24 | 6.00 | 4.15 | 0.22 | 5.30 | 0.13 | 0.002 | 1.54 |
| 2018 | 934.52 | 44.55 | 4.77 | 5.49 | 0.20 | 3.64 | 0.12 | 0.002 | 1.67 |
| 2019 | 819.56 | 48.53 | 5.92 | 4.50 | 0.21 | 4.67 | 0.11 | 0.002 | 1.82 |
| 2020 | 788.90 | 58.58 | 7.43 | 4.57 | 0.27 | 5.91 | 0.13 | 0.003 | 2.31 |
| 2021 | 838.85 | 58.30 | 6.95 | 4.17 | 0.29 | 6.95 | 0.11 | 0.003 | 2.73 |
| 2022 | 729.19 | 53.11 | 7.28 | 3.71 | 0.27 | 7.28 | 0.10 | 0.003 | 3.00 |
| 2023 | 738.65 | 53.19 | 7.20 | 3.81 | 0.28 | 7.35 | 0.09 | 0.003 | 3.33 |
| Avg. | 1028.38 | 96.61 | 9.39 | 5.55 | 0.52 | 9.37 | 0.12 | 0.008 | 6.67 |
| Min. | 729.19 | 44.55 | - | 3.71 | 0.20 | - | 0.08 | 0.002 | - |
| Max. | 1461.90 | 166.9 | | 8.52 | 1.29 | | 0.18 | 0.014 | |

**Source:** Central Agency for Public Mobilization and Statistics (CAPMAS), Annual Bulletin of statistics Livestock, (2005-2023) .

**Table (6):** General trend equations for honey beehive numbers and honey and wax production in Egypt and Beni Suef governorate during (2005-2023).

| No. of model | Dependent variable | Unit | General trend equations | | $\bar{R}^2$ | F | Change rate (%) | Trend value |
|---|---|---|---|---|---|---|---|---|
| 1 | No. of hives | (1000 hives) | Egypt | $\hat{Y}i = 7.29 - 0.039\ T$ $(13.62)^{**}$ | 0.92 | $185.40^{**}$ | -3.9 | 40.11 |
| 2 | | | Beni suef | $\hat{Y}i = 5.27 - 0.081\ T$ $(9.40)^{**}$ | 0.84 | $88.28^{**}$ | -8.1 | 7.83 |
| 3 | Production of honey | (1000 ton) | Egypt | $\hat{Y}i = 2.10 - 0.042\ T$ $(11.57)^{**}$ | 0.89 | $133.89^{**}$ | -4.2 | 0.233 |
| 4 | | | Beni suef | $\hat{Y}i = 0.11 - 0.094\ T$ $(8.07)^{**}$ | 0.79 | $65.08^{**}$ | -9.4 | 0.049 |
| 5 | Production of wax | | Egypt | $\hat{Y}i = 2.05 - 0.007\ T$ $(0.71)^{n.s}$ | 0.03 | $0.50^{n.s}$ | - | |
| 6 | | | Beni suef | $\hat{Y}i = 4.05 - 0.112\ T$ $(5.03)^{**}$ | 0.60 | $25.27^{**}$ | -11.2 | 0.0001 |

(**) Indicates statistical significant at 0.01 level. (n.s) Indicates non-significant.

**Source:** compiled and calculated from the data contained in Table (5).

**(2) Honey production:**

Honey production in Egypt during the period (2005-2023) ranged between a minimum of approximately 3.71 thousand tons in 2022 and a maximum of approximately 8.52 thousand tons in 2005. Honey production in Egypt trended toward a decrease during the research period at a decreasing rate estimated at approximately 4.2% at the 0.01 probability level from the average of approximately 5.55 thousand tons, with a decrease amount of approximately 233 tons - Equation No. (3), Table (6).

Honey production in Beni Suef governorate ranged between a minimum of approximately 0.20 thousand tons in 2018 and a maximum of approximately 1.29 thousand tons in 2005. Honey production in Beni Suef governorate trended toward a decrease during the research period at a decreasing rate estimated at approximately 9.4% at the 0.01 probability level from the average of approximately 0.52 thousand tons, with a change amount of approximately 49 tons - Equation No. (4), Table (6).

**(3) Beeswax production:**

Beeswax production in Egypt during the period (2005-2023) ranged between a minimum of approximately 0.08 thousand tons in 2008 and a maximum of approximately 0.18 thousand tons in 2011 and 2012, with an annual average estimated at approximately 0.12 thousand tons. However, the statistical significance of the annual change rate for beeswax production in Egypt was not confirmed due to the fluctuation of its values between increase and decrease around the average during the research period - Equation (5), Table (6).

Beeswax production in Beni Suef governorate during the study period ranged between a minimum 0.002 thousand tons over the period (2016-2019), and a maximum 0.014 thousand tons in 2011 and 2014. Beeswax production in Beni Suef governorate trended toward a decrease during the study period at a decreasing rate estimated at approximately 11.2% at the 0.01 probability level from the average of approximately 0.008 thousand tons, with a change amount of approximately 0.1 tons - Equation (6), Table (6).

From the above, it is evident that the number of honey beehives in Beni Suef governorate decreased at a rate greater than the rate of decrease in Egypt, reaching approximately double, which led to a decline in production at a higher rate for both the main production of honey and the secondary production of beeswax. This necessitates measuring some productive and economic indicators to determine the profitability or lack thereof of honey bee breeding projects.

**Second: Bee load per-feddan in Beni Suef governorate and in the selected districts of the research sample**

Bee load per-feddan is defined as the number of beehives required for honey production per feddan of cultivated area with flowering crops from which bees extract nectar and pollen[13]. The most important flowering crops on which bees feed and which are most widespread in Beni Suef governorate are clover, cotton, medicinal and aromatic plants, and citrus crops. The data presented in Table (7) shows that the bee load per-feddan of hives for the four crops in Beni Suef governorate was approximately 0.87, 3.87, 3.56, and 13.34 hives/feddan respectively, where the number of beehives reached approximately 47.98 thousand hives, and the cultivated area with clover, cotton, medicinal and aromatic plants, and citrus crops reached approximately 55.19, 12.40, 13.47, and 3.60 thousand feddan respectively [14].

The bee load per-feddan of hives for the four crops in Nasser district was approximately 0.96, 3.39, 45.04, and 13.72 hives/ feddan respectively, where the number of beehives reached approximately 8.78 thousand hives, and the area cultivated with clover, cotton, medicinal and aromatic plants, and citrus crops reached approximately 9,161, 2,592, 195, and 640 feddan respectively.

The bee load per- feddan of hives for the four crops in Ihnasia district was approximately 2.31, 3.85, 14.88, and 988.24 hives/ feddan respectively, where the number of beehives reached approximately 16.80 thousand hives, and the area cultivated with clover, cotton, medicinal and aromatic plants, and citrus crops reached approximately 7,284, 4,366, 1,129, and 17 feddan respectively.

The bee load per- feddan of hives for the four crops in El-Wasta district was approximately 1.6, 6.1, 5.25, and 36.58 hives/ feddan respectively, where the number of beehives reached approximately 8.20 thousand hives, and the area cultivated with clover, cotton, medicinal and aromatic plants, and citrus crops reached approximately 5,127, 1,344, 1,561, and 244 feddan respectively.

From the above, it is evident that the bee load per- feddan is generally low, particularly for the two largest crops in terms of cultivated area (clover and cotton) in the districts of the research sample in Beni Suef governorate. This necessitates encouraging an increase in the number of beehives to maximize benefit from the flowering cultivated area in these districts and consequently increase honey production.

**Table (7):** Bee load Per-feddan in Beni Suef governorate and in the selected districts of the research sample in 2024.

| Statement / Crop | Governorate | | | Nasser | | | Ihnasia | | | El- Wasta | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. of hives | Cultivated area | Bee load(*) | No. of hives | Cultivated area | Bee load(*) | No. of hives | Cultivated area | Bee load(*) | No. of hives | Cultivated area | Bee load(*) |
| | (Hiv) | (Feddan) | (Hive/fedda) | (Hiv) | (Feddan) | (Hive/fedda) | (Hiv) | (Feddan) | (Hive/fedda) | (Hiv) | (Feddan) | (Hive/fedda) |
| Clover | 47976 | 55192 | 0.87 | 8782 | 9161 | 0.96 | 16800 | 7284 | 2.31 | 8195 | 5127 | 1.60 |
| Cotton | 47976 | 12397 | 3.87 | 8782 | 2592 | 3.39 | 16800 | 4366 | 3.85 | 8195 | 1344 | 6.10 |
| Medical and Aromatic pl. | 47976 | 13465 | 3.56 | 8782 | 195 | 45.04 | 16800 | 1129 | 14.88 | 8195 | 1561 | 5.25 |
| Citrus | 47976 | 3597 | 13.34 | 8782 | 640 | 13.72 | 16800 | 17 | 988.24 | 8195 | 224 | 36.58 |
| Total | 47976 | 84651 | 0.57 | 8782 | 12588 | 0.70 | 16800 | 12796 | 1.31 | 8195 | 8256 | 0.99 |

(*) Bee load = Number of hives in the geographical area / Total cultivated area in feddan in this area.

**Source:** Compiled and calculated from data of:

- Ministry of Agriculture and Land Reclamation, Directorate of Agriculture in Beni Suef Governorate, Food Security Administration Records, unpublished data.
- Ministry of Agriculture and Land Reclamation, Agriculture Directorate in Beni Suef Governorate, Statistics Department records, unpublished data.

**Table (8):** Results of One-Way ANOVA test according to production capacities of apiaries in the research sample in Beni Suef governorate in 2024.

| Variable | Unit | F-test |
|---|---|---|
| Hive productivity of honey | Ton | 29.1** |
| Total costs per hive | EGP | 84.03** |
| Total revenue | EGP | 47.33** |
| Net return | EGP | 799.9** |

(**) indicates statistical significant at 0.01 level.

**Source:** Complied and calculated from the questionnaire data for the research sample.

**Third: Variance analysis between the averages of the most important productive and economic variables for different production capacities of apiaries in the research sample**

One-way analysis of variance (ANOVA) (F-test) was conducted between the averages of the most important productive and economic variables for different production capacities of apiaries in the research sample in Beni Suef governorate in 2024, with the aim of determining the extent of significant differences between these production capacities, and to determine whether to study the sample aggregated at the level of apiary production capacities or to study each production capacity separately [15].

These variables include hive productivity of honey (tons), total costs per hive (pounds), total revenue (pounds), and net return (pounds). The results of the analysis presented in Table (8) show a statistically significant effect of differences at the 0.01 probability level based on the significance of the calculated (F) value among all variables under investigation. Therefore, the null hypothesis that there are no differences between the averages of hive productivity of honey, total costs per hive, total revenue, and net return for the three production capacities is rejected, and the alternative hypothesis that there are differences between the averages of hive productivity of honey, total costs per hive, total revenue, and net return for the three production capacities under investigation is accepted. This requires the necessity of studying each production capacity of apiaries in the research sample separately.

**Fourth: Items of production costs for one hive and the relative importance of each in apiaries with different production capacities in the research sample.**

The data presented in Table (9) shows that the total production costs for the first production capacity of apiaries (less than 100 hives) in the research sample amounted to approximately 1,344 pounds/hive, which exceeds those of the second production capacity (100 - less than 200 hives) and third production capacity (200 hives or more) by approximately 125 and 199 pounds/hive respectively, representing an increase of approximately 10.25% and 17.38% respectively. Production costs include both fixed costs and variable costs as follows:

**(1) Fixed Costs:**

Fixed costs are defined as costs that do not change with changes in production volume[16]. The fixed costs for the first production capacity of apiaries amounted to approximately 1,048 pounds/hive, which exceed those of the second and third capacities by approximately 118 and 177

pounds/hive, representing an increase of approximately 12.69% and 20.23%. The items of these costs in beekeeping projects include: apiary land rent, hive costs (frames and sealed brood + queen + bees), maintenance costs of beekeeping tools and equipment, beekeeper and permanent labor wages, burlap and stands costs, depreciation value of fixed assets. This can be clarified for each production capacity as follows:

- **Apiary land rent:** The average apiary land rent for the three production capacities amounted to approximately 33, 20, and 18 pounds/hive respectively, representing approximately 2.46%, 1.64%, and 1.57% in the same order of the average total production costs.

**Table (9):** Average of production costs items for one beehive in pounds and the relative importance of each in apiaries with different production capacities in the research sample in 2024.

| Statement \ Capacity | First production capacity (less than 100 hives) | | Second production capacity (100 - less than 200 hives) | | Third production capacity (200 hives or more) | |
|---|---|---|---|---|---|---|
| | Value | (%) | Value | (%) | Value | (%) |
| Apiary land rent | 33 | 2.46 | 20 | 1.64 | 18 | 1.57 |
| Hive cost(*) | 550 | 40.92 | 500 | 41.02 | 500 | 43.67 |
| Maintenance cost of beekeeping tools and equipment | 250 | 18.60 | 220 | 18.05 | 195 | 17.03 |
| Beekeeper and permanent labor wages | 100 | 7.44 | 90 | 7.38 | 75 | 6.55 |
| Burlap and stands cost | 75 | 5.58 | 70 | 5.74 | 65 | 5.68 |
| Depreciation value of fixed assets | 40 | 2.98 | 30 | 2.46 | 18 | 1.57 |
| Total fixed costs | 1048 | 77.98 | 930 | 76.29 | 871 | 76.07 |
| Feeding sugar price | 70 | 5.21 | 65 | 5.33 | 60 | 5.24 |
| Medicinal materials price | 40 | 2.98 | 33 | 2.71 | 25 | 2.18 |
| Medicinal materials price | 0 | 0.00 | 25 | 2.05 | 18 | 1.57 |
| Feeders price | 6 | 0.45 | 6 | 0.49 | 6 | 0.52 |
| Masks price | 30 | 2.23 | 60 | 4.92 | 90 | 7.86 |
| Transportation cost | 150 | 11.15 | 100 | 8.21 | 75 | 6.56 |
| Total Variable costs | 296 | 22.02 | 289 | 23.71 | 274 | 23.93 |
| Total production costs | 1344 | 100 | 1219 | 100 | 1145 | 100 |

(*) Includes (frames and sealed brood + queen + bees).

**Source:** Complied and calculated from the questionnaire data for the research sample.

- **Hive Cost:** The average hive cost for the three production capacities amounted to approximately 550, 500, and 500 pounds/hive respectively, representing approximately 40.92%, 41.02%, and 43.67% in the same order of the average total production costs.

- **Maintenance cost of beekeeping tools and equipment:** The average maintenance cost of tools and equipment for the three production capacities amounted to approximately 250, 220, and 195 pounds/hive respectively, representing approximately 18.60%, 18.05%, and 17.03% in the same order of the average total production costs.

- **Beekeeper and permanent labor wages:** The average cost of beekeeper and permanent labor wages for the three production capacities amounted to approximately 100, 90, and 75 pounds/hive respectively, representing approximately 7.44%, 7.38%, and 6.55% in the same order of the average total production costs.

- **Burlap and stands cost:** The average cost of burlap and stands for the three production capacities amounted to approximately 75, 70, and 65 pounds/hive respectively, representing approximately 5.58%, 5.74%, and 5.68% in the same order of the average total production costs.

- **Depreciation value of fixed assets:** The average depreciation value of fixed assets for the three production capacities amounted to approximately 40, 30, and 18 pounds/hive respectively, representing approximately 2.98%, 2.46%, and 1.57% in the same order of the average total production costs.

**(2) Variable costs:**

Variable costs are defined as costs that change with changes in production volume[16]. The variable costs for the first production capacity of apiaries amounted to approximately 296 pounds/hive, which

exceed those of the second and third production capacities by approximately 7 and 22 pounds/hive, representing an increase of approximately 2.42% and 8.03%. The items of these costs in beekeeping projects include: feeding sugar price, medicinal materials price, seasonal labor wages, feeders price, masks price, and transportation cost. This can be clarified for each production capacity as follows:

- **Feeding sugar price:** The average feeding sugar price for the three production capacities amounted to approximately 70, 65, and 60 pounds/hive respectively, representing approximately 5.21%, 5.33%, and 5.24% in the same order of the average total production costs.
- **Medicinal materials price:** The average medicinal materials price for the three production capacities amounted to approximately 40, 33, and 25 pounds/hive respectively, representing approximately 2.98%, 2.71%, and 2.18% in the same order of the average total production costs.
- **Seasonal labor wages:** The average seasonal labor wages for the second and third production capacities amounted to approximately 25 and 18 pounds/hive respectively, representing approximately 2.05% and 1.57% in the same order of the average total production costs, while the first production capacity does not require seasonal labor.
- **Feeders price:** The average feeders price for the three production capacities amounted to approximately 6 pounds/hive, representing approximately 0.45%, 0.49%, and 0.52% respectively of the average total production costs.
- **Masks price:** The average masks price for the three production capacities amounted to approximately 30, 60, and 90 pounds/hive respectively, representing approximately 2.23%, 4.92%, and 7.86% in the same order of the average total production costs.
- **Transportation cost:** The average transportation cost for the three production capacities amounted to approximately 150, 100, and 75 pounds/hive respectively, representing approximately 11.15%, 8.21%, and 6.56% in the same order of the average total production costs.

From the above, it is evident that the third production capacity (200 hives or more) has lower total costs than the second production capacity (100 - less than 200 hives) and the first production capacity (less than 100 hives). This means that the larger the production capacity of the apiary, the lower its total costs, which reflects the positive impact of economies of scale.

**Fifth: Productive and economic indicators per hive in apiaries with different production capacities in the research sample**

By measuring some productive and economic indicators per hive in apiaries with different production capacities in the research sample in Beni Suef governorate in 2024, the following is evident:

**(1) Productive indicators:**

The productive indicators are represented by the average productivity of one beehive from bee products for different production capacities in the research sample. The data presented in Table (10) shows the following:

- **Honey production:** The average hive production of honey for the third production capacity (200 hives or more) amounted to approximately 10.75 kg/hive, which exceeds that of the second capacity (100 - less than 200 hives) and first capacity (less than 100 hives) by approximately 1.15 and 1.75 kg/hive respectively, representing an increase of approximately 11.98% and 19.44% in the same order.
- **Beeswax production:** The average hive production of wax for the third production capacity amounted to approximately 0.36 kg/hive, which exceeds that of the second and first capacities by approximately 0.01 and 0.11 kg/hive respectively, representing an increase of approximately 2.86% and 44% in the same order.
- **Bee package production:** The average hive production of bee packages for the third production capacity amounted to approximately 1.5 packages/hive, which exceeds that of the second and first production capacities by approximately 0.25 and 0.5 packages/hive respectively, representing an increase of approximately 20% and 50% in the same order.
- **Royal jelly production:** The average hive production of royal jelly for the third production capacity amounted to approximately 35 g/hive, which exceeds that of the second and first production capacities by approximately 7 and 10 g/hive respectively, representing an increase of approximately 25% and 40% in the same order.
- **Pollen production:** The average hive production of pollen for the third production capacity amounted to approximately 2 kg/hive, which exceeds that of the second and first capacities by approximately 0.25 and 0.5 kg/hive respectively, representing an increase of approximately 14.29% and 33.33% in the same order.

**Table (10):** Productive and economic indicators per hive in apiaries with different production capacities in the research sample in 2024.

| Indicators \ Production capacities | | Unit | Third production capacity (less than 100 hives) | | | Second production capacity (100 - less than 200 hives) | | | First production capacity (200 hives or more) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Average production | price | Value | Average production | price | value | Average production | price | value |
| Productivity | Honey production | Kg | 9 | 90 | 810 | 9.6 | 95 | 912 | 10.75 | 102 | 1096.5 |
| | Beeswax production | Kg | 0.25 | 75 | 18.75 | 0.35 | 78 | 27.3 | 0.36 | 80 | 28.8 |
| | Bee Package production | No. | 1 | 550 | 550 | 1.25 | 550 | 687.5 | 1.5 | 550 | 825 |
| | Royal Jelly production | gm. | 25 | 10 | 250 | 28 | 12 | 336 | 35 | 15 | 525 |
| | Pollen production | Kg | 1.5 | 300 | 450 | 1.75 | 305 | 533.75 | 2 | 315 | 630 |
| Economics | Total return | EGP | 2078.75 | | | 2496.55 | | | 3105.3 | | |
| | Net return(1) | EGP | 734.75 | | | 1277.55 | | | 1960.3 | | |
| | Relative profitability(2) | (%) | 248.23 | | | 442.06 | | | 715.44 | | |
| | Benefit-cost ratio (3) | - | 1.55 | | | 2.05 | | | 2.71 | | |
| | Marginal surplus(4) | EGP | 1782.75 | | | 2207.55 | | | 2831.3 | | |
| | Return on the invested pound(5) | EGP | 0.55 | | | 1.05 | | | 1.71 | | |
| | Profit margin ratio(6) | (%) | 35.35 | | | 51.17 | | | 63.13 | | |

(1) Net return= Total return- Total costs. (2) Relative profitability = (Net return/ Variable costs) ×100.
(3) Benefit- cost ratio= Total return/ Total costs. (4) Marginal Surplus = Total return- Variable costs
(5) Return on the invested pound= Net return/ Total costs. (6) Profit Margin Ratio= (Net return/ Total return) ×100
**Source:** Complied and calculated from the questionnaire data for the research sample.

**(2) Economic indicators**

The economic indicators per hive in apiaries with different production capacities in the research sample are illustrated by the data presented in Table (10) as follows:

- **Total return:** The average total return per hive for the third production capacity (200 hives or more) amounted to approximately 3,105.3 pounds/hive, which exceeds that of the second production capacity (100 - less than 200 hives) and first production capacity (less than 100 hives) by approximately 608.75 and 1,026.55 pounds/hive respectively, representing an increase of approximately 24.38% and 49.38% in the same order.
- **Net return:** The average net return per hive for the third production capacity amounted to approximately 1,960.3 pounds/hive, which exceeds that of the second and first capacities by approximately 682.75 and 1,225.55 pounds/hive respectively, representing an increase of approximately 53.44% and 166.80% in the same order.
- **Relative profitability:** The relative profitability per hive for the third production capacity amounted to approximately 715.44%, which exceeds that of the second and first capacities by approximately 273.38% and 467.21% respectively, representing an increase of approximately 61.84% and 188.22% in the same order.
- **Benefit- cost ratio:** The benefit -cost ratio per hive for the third production capacity amounted to approximately 2.71, which exceeds that of the second and first categories by approximately 0.66 and 1.16 respectively, representing an increase of approximately 32.19% and 74.84% in the same order.
- **Marginal surplus:** The marginal surplus per hive for the third production capacity amounted to approximately 2,831.3 pounds/hive, which exceeds that of the second and first capacities by approximately 623.75 and 1,048.55 pounds/hive respectively, representing an increase of approximately 28.25% and 58.82% in the same order.
- **Return on invested pound:** The return on invested pound per hive for the third production capacity amounted to approximately 1.71 pounds/hive, which exceeds that of the second and first capacities by approximately 0.66 and 1.16 pounds/hive respectively, representing an increase of approximately 62.86% and 210.90% in the same order.
- **Profit margin ratio:** The profit margin ratio per hive for the third production capacity amounted to approximately 63.13%, which exceeds that of the second and first categories by approximately 11.96% and 27.78% respectively, representing an increase of approximately 23.37% and 78.58% in the same order.

From the above, it is evident that the productive and economic indicators for the third production capacity (200 hives or more) of apiaries in the research sample are higher than those of the second production capacity (100 - less than 200 hives) and first production capacity (less than 100 hives). In addition, the total costs for the third production capacity are lower than those of the second and first capacities, reflecting economies of scale by increasing apiary size in light of decreasing average

of costs per hive and increasing average of net return per hive. Furthermore, the higher marginal surplus for the third production capacity compared to the second and first categories is an indicator of faster capital recovery as production capacity increases.

**Sixth: The most important productive and marketing problems facing beekeepers in the research sample and proposed solutions from the beekeepers' perspective to overcome them**

Through the questionnaire survey of beekeepers in the research sample in Beni Suef governorate in Egypt for the 2024 season, the productive and marketing problems and obstacles they faced were identified, along with proposed solutions from their perspective to overcome them, as follows:

**(1) Productive problems and proposed solutions:**

The data in Table (11) shows that the productive problems faced by beekeepers in the research sample consisted of six problems ranked according to their relative importance as follows: the problem of high rental value, where the relative importance of this problem reached approximately 84% of the total sample of 50 units, followed by the problem of farmers' lack of awareness of the most appropriate timing for pesticide spraying, which leads to bee deaths, where the relative importance of this problem reached approximately 80%, followed by the problem of high worker wages due to the scarcity of specialized labor in beekeeping, with a relative importance of approximately 74%, followed by the problem of rising prices of production inputs, where its relative importance reached approximately 72%, followed by the problem of beekeepers' lack of experience in performing the wintering process, where the relative importance of this problem reached approximately 70%, and finally the problem of bee congestion in certain areas, especially during transportation from one governorate to another, with a relative importance of approximately 66% of the total number of apiaries in the research sample. The statistical significance of all six problems was confirmed through the estimated ($\lambda^2$) values.

**Table (11):** Relative importance of productive problems faced by Beekeepers and proposed solutions from their perspective in the research sample in 2024.

| No. | Problems | Frequency | (%) | ($\lambda^2$) |
|---|---|---|---|---|
| **First: Productive problems** | | | | |
| 1 | High rental value | 42 | 84 | $23.12^{**}$ |
| 2 | Farmers' lack of awareness of the most appropriate timing for pesticide spraying | 40 | 80 | $18^{**}$ |
| 3 | High worker wages | 37 | 74 | $11.25^{**}$ |
| 4 | Rising prices of production inputs | 36 | 72 | $9.68^{**}$ |
| 5 | Beekeepers' lack of experience in performing the wintering process | 35 | 70 | $8^{**}$ |
| 6 | Bee congestion in certain areas, especially during transportation from one governorate to another | 33 | 66 | $5.12^{*}$ |
| Total | | 50 | | |
| **Second: Proposals of beekeepers** | | | | |
| 1 | Necessity of offering soft loans to beekeepers | 40 | 80 | $18^{**}$ |
| 2 | Necessity of activating the role of agricultural extension in educating farmers about the most appropriate spraying times | 39 | 78 | $15.68^{**}$ |
| 3 | Necessity of providing intensive training courses to increase skilled labor | 34 | 68 | $6.48^{**}$ |
| 4 | Necessity of state subsidies for production inputs | 32 | 64 | $3.92^{*}$ |
| 5 | Necessity of educating beekeepers about appropriate methods for the wintering process | 32 | 64 | $3.92^{*}$ |
| 6 | Proposal to disseminate varietal maps of different crops and their concentration areas, especially in governorates to which beehives are transported during flowering time | 29 | 58 | $1.28^{n.s}$ |
| Total | | 50 | | |

$\lambda^2 = \Sigma [(O_i - E_i)^2 / E_i]$., (*) Indicates statistical significant at 0.05 level.
(**) Indicates statistical significant at 0.01 level. , (n.s) Indicates non-significant.
**Source:** Complied and calculated from the questionnaire data for the research sample.

It was found that the proposals of beekeepers in the research sample to overcome these problems they faced, as shown in Table (11), amounted to six proposals ranked according to their relative importance as follows: the proposal for the necessity of offering soft loans to beekeepers, where the relative importance of this proposal reached approximately 80%, followed by the proposal for the

necessity of activating the role of agricultural extension in educating farmers about the most appropriate spraying times to avoid harming bee insects, with a relative importance of approximately 78%, followed by the proposal for the necessity of providing intensive training courses to increase skilled labor, where the relative importance of this proposal reached approximately 68%, followed by two proposals: the necessity of state subsidies for production inputs, and the necessity of educating beekeepers about appropriate methods for the wintering process, with a relative importance of approximately 64% for each, and finally the proposal to disseminate varietal maps of different crops and their concentration areas, especially in governorates to which beehives are transported during flowering time, with a relative importance of approximately 58%. The statistical significance of only five proposals among the proposed solutions was confirmed through the estimated ($\chi^2$) values.

**(2) Marketing problems and proposed solutions**

The data in Table (12) shows that the marketing problems faced by beekeepers in the research sample consisted of only three problems ranked according to their relative importance as follows: the problem of bureaucracy faced by beekeepers when obtaining apiary licenses, which limits marketing capability if they cannot obtain these licenses, with a relative importance of approximately 88%, followed by the problem of low product prices with a relative importance of approximately 82%, and finally the problem of commercial fraud, where the relative importance of this problem reached approximately 56%. The statistical significance of only two problems was confirmed through the estimated ($\chi^2$) values.

**Table (12):** Relative importance of marketing problems faced by beekeepers and proposed solutions from their perspective in the research sample in 2024

| No. | Problems | Frequency | (%) | ($\lambda^2$) |
|---|---|---|---|---|
| **First: Marketing problems** | | | | |
| 1 | Bureaucracy faced by beekeepers when obtaining apiary licenses | 44 | 88 | $28.88^{**}$ |
| 2 | Low product prices | 41 | 82 | $20.48^{**}$ |
| 3 | Commercial fraud | 28 | 56 | $0.72^{n.s}$ |
| Total | | 50 | | |
| **Second: Proposals of beekeepers** | | | | |
| 1 | Direct the concerned authorities regarding license issuance to facilitate the necessary procedures for establishing apiaries | 40 | 80 | $18^{**}$ |
| 2 | Necessity of including honey among the products priced on the stock exchange | 39 | 78 | $15.68^{**}$ |
| 3 | Necessity of tightening supply control over bee products offered in markets | 27 | 54 | $0.32^{n.s}$ |
| Total | | 50 | | |

(**) Indicates statistical significant at 0.01 level, (n.s) Indicates non-significant.
**Source:** Complied and calculated from the questionnaire data for the research sample.

It was found that the proposals of beekeepers in the research sample to overcome these problems they faced, as shown in Table (12), amounted to three proposals ranked according to their relative importance as follows: the proposal to direct the concerned authorities regarding license issuance to facilitate the necessary procedures for establishing apiaries, with a relative importance of approximately 80%, followed by the proposal for the necessity of including honey among the products priced on the stock exchange so that beekeepers can obtain a fair price, with a relative importance of approximately 78%, and finally the proposal for the necessity of tightening supply control over bee products offered in markets, with a relative importance of approximately 54%. The statistical significance of only two of the proposed solutions was confirmed through the estimated ($\chi^2$) values.

From the above, according to the results of the ($\chi^2$) test, all productive problems facing beekeepers in the research sample are statistically significant, meaning they are influential problems for honey producers. Despite the profitability of the honey bee project, which is evident from the net return and return on invested pound indicators, and the rapid capital turnover, which is evident through the marginal surplus indicator, as shown by the research sample data, if these obstacles facing beekeepers are not addressed and overcome, they will be forced to abandon beekeeping projects. This will lead to an increasing decline in the number of apiaries and hives and consequently negatively affect honey production, as evidenced during the period (2005-2023), during which the statistically significant rate of decrease in honey production reached approximately 4.2% at the national level and 9.4% at the level of Beni Suef governorate, which is considered a significant rate of decrease. Therefore, the proposed solutions from the beekeepers' perspective were reviewed in the hope that they may serve as a lifeline to address these

problems and encourage the adoption of beekeeping projects in a way that benefits beekeepers and consequently consumers in particular, and the national income in general.

**Seventh: Strengths and Weaknesses of the beekeeping project, and Opportunities and Threats facing beekeepers in the research sample**

The results of the SWOT Analysis presented in Table (13) show that the most important Strengths and Weaknesses of the beekeeping project, and the Opportunities and Threats facing beekeepers in the research sample, are as follows:

**- Strengths:**

The available strengths for beekeeping projects were as follows: (1) Beekeeping projects do not require large investment capital, (2) Beekeeping projects have a rapid capital turnover rate, (3) The possibility of establishing the apiary within the farm, which reduces fixed costs of the project for the farmer and increases crop productivity due to the role of bees in plant pollination, meaning that farmers' adoption of this type of project will diversify their income sources, (4) The reproduction rate of the bee insect is rapid, and therefore a beekeeping project can be started with a small number of hives, and with the increase in the number of bees in a short period, the number of hives increases, and consequently the apiary capacity, (5) Ease of acquiring beekeeping skills, (6) Diversity of products that can be obtained from the bee insect (honey, wax, pollen, propolis, bee venom, in addition to bee packages).

**- Weaknesses:**

The weaknesses suffered by beekeeping projects were as follows: (1) Lack of experience for new breeders in technical operations related to beekeeping such as wintering, which sometimes leads to complete hive loss, as well as how to deal with diseases, (2) Lack of full awareness of the most appropriate times for spraying pesticides to preserve bee life, which leads to bee poisoning like other harmful insects, (3) High worker wages, (4) High rental value.

**- Opportunities:**

The available opportunities for beekeeping projects were as follows: (1) Climate diversity that led to the availability of a large number of crops and different flowering times, which helps provide natural pasture for bees throughout the year, (2) The possibility of using the apiary in educational courses to increase beekeepers' income.

**Table (13):** Results of SWOT Analysis for Strengths and Weaknesses of beekeeping projects and Opportunities and Threats facing apiary owners in the research sample in Beni Suef governorate in 2024.

| Strength | Weakness |
|---|---|
| Beekeeping projects do not require large investment capital. | Lack of experience for new breeders in technical operations related to beekeeping, as well as how to deal with diseases. |
| Beekeeping projects have a rapid capital turnover rate. | Lack of full awareness of the most appropriate times for spraying pesticides. |
| The possibility of establishing the apiary within the farm. | High worker wages. |
| The reproduction rate of the bee insect is rapid. | |
| Ease of acquiring beekeeping skills. | High rental value. |
| Diversity of products that can be obtained from the bee insect. | |
| **Opportunities** | **Threats** |
| Climate diversity that led to the availability of a large number of crops and different flowering times, which helps provide natural pasture for bees throughout the year. | Inadequate role of agricultural extension in providing technical information that helps new beekeepers succeed in their project. |
| | Lack of institutional or governmental support for beekeepers. |
| | Presence of pests and diseases that attack bees. |
| The possibility of using the apiary in educational courses to increase beekeepers' income. | Climate changes that negatively affect bee work and colonies. |
| | Use of pesticides in surrounding areas may lead to bee poisoning. |
| | Continuous increase in production input prices. |
| | Commercial fraud of honey by competitors. |

**Source:** Compiled from the questionnaire data for the research sample.

**- Threats:**

The threats suffered by beekeeping projects were as follows: (1) Inadequate role of agricultural extension in providing technical information that helps new beekeepers succeed in their project, (2) Lack of institutional or governmental support for beekeepers, making them face production and marketing risks without protection from hazards, (3)

Presence of pests and diseases that attack bees such as Varroa, brood rot, wasps, and others, (4) Climate changes such as drought or heavy rains that negatively affect bee work and colonies, (5) Use of pesticides in surrounding areas may lead to bee poisoning, (6) Continuous increase in production input prices, (7) Commercial fraud of honey by competitors, which causes consumers to lose confidence in the product in general.

**Conclusion:**

The research had come to some important results can be a summarized a; (1) The number of honey beehives in Beni Suef governorate trended toward a decrease during (2005-2023) at a decreasing rate estimated at approximately 8.1% at the 0.01 probability level from the average of approximately 96.61 thousand hives, (2) Honey production in Beni Suef governorate trended toward a decrease during the research period at a decreasing rate estimated at approximately 9.4% at the 0.01 level from the average of approximately 0.52 thousand tons, (3) Beeswax production in Beni Suef governorate trended toward a decrease during the study period at a decreasing rate estimated at approximately 11.2% at the 0.01 level from the average of approximately 0.008 thousand tons, (4) the number of honey beehives in Beni Suef governorate decreased at a rate greater than the rate of decrease in Egypt, reaching approximately double, which led to a decline in production at a higher rate for both the main production of honey and the secondary production of beeswax, (5) The bee load per- feddan is generally low, particularly for the two largest crops in terms of cultivated area (clover and cotton) in the districts of the research sample in Beni Suef governorate, where the bee load per-feddan of hives for the four crops (clover, cotton, medicinal and aromatic plants, and citrus crops) in Nasser district was approximately 0.96, 3.39, 45.04, and 13.72 hives/ feddan respectively, and in Ihnasia district was approximately 2.31, 3.85, 14.88, and 988.24 hives/ feddan respectively, finally in El-Wasta district was approximately 1.6, 6.1, 5.25, and 36.58 hives/ feddan respectively, (6) The total production costs for the first production capacity of apiaries (less than 100 hives) in the research sample amounted to approximately 1,344 pounds/hive, which exceeds those of the second production capacity (100 - less than 200 hives) and third production capacity (200 hives or more) by approximately 125 and 199 pounds/hive respectively, it is evident that the third production capacity has lower total costs than the second production capacity and the first production capacity. This means that the larger the production capacity of the apiary, the lower its total costs, which reflects the positive impact of economies of scale, (7) The economic indicators for the third production capacity of apiaries in the research sample are higher than those of the second and first production capacity, where the return on invested pound per hive for the third production capacity amounted to approximately 1.71 pound/hive, which exceeds that of the second and first capacities by approximately 0.66 and 1.16 pound/hive respectively, and the higher marginal surplus for the third production capacity compared to the second and first categories is an indicator of faster capital recovery as production capacity increases, where the marginal surplus per hive for the third production capacity amounted to approximately 2,831.3 pound/hive, which exceeds that of the second and first capacities by approximately 623.75 and 1,048.55 pounds/hive respectively, (8) The productive problems faced by beekeepers consisted of six problems, top of one is the problem of high rental value, and the marketing problems faced by beekeepers consisted of only three problems, and top of one is the problem of bureaucracy faced by beekeepers when obtaining apiary licenses, (9) According to SWOT analysis show that the most important Strengths and Weaknesses of the beekeeping project, and the Opportunities and Threats facing beekeepers in the research sample.

In light of the findings of the research, it recommends the necessity of the following: (1) Activating the role of agricultural extension to train new beekeepers on various technical operations, especially the wintering process, and on how to deal with pests and diseases that attack bees, in addition to climate changes, as well as educating them about appropriate times for spraying pesticides, (2) Working to provide government support for beekeepers through subsidizing production inputs and facilitating apiary licensing procedures, (3) Tightening control over the quality of honey varieties offered in markets, (4) Pricing honey products through the stock exchange like many products to ensure beekeepers obtain a fair price, (5) Disseminating varietal maps and flowering times for various crops at the national level through agricultural directorates in different governorates and other specialized entities to facilitate beekeepers' access to them, which helps them identify areas with the highest crop density during flowering time to transport bees there and prevent the bee congestion problem that affects productivity.

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