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Statistical study to investigate the effect of climate fluctuations and contamination of bee products with pesticides on the change in beekeeping in Gharbia Governorate, Egypt

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Abstract:

The most severe concerns influencing the global marketing of bee goods are pesticide pollution of bee products and climate change. As a result, diagnostic questionnaires, formal interviews, and field notes were used to gather data on beekeepers' understanding of pesticide product contamination and safety measures for this questionnaire, as well as their knowledge of the effects of climate variability and change on beekeeping productivity. From April to September 2019, a survey of 100 beekeepers was undertaken in Egypt's Gharbia Governorate. According to the findings on pesticide pollution of bee products, 85 percent of the beekeepers in the survey were not informed of the dates of pesticide applications to crops near the hives. Only 3% of the beekeepers in the research are interested in learning the names of pesticides used in the areas around their apiaries. Similarly, 70% of them have no idea whether their items are pesticide-contaminated or not. On the other hand, almost 92 percent of beekeepers report a drop in the number of workers, which they ascribe to a variety of factors, including the use of pesticides. Only 8% of beekeepers tested for pesticide residues in their products before exporting them. The findings revealed that 80% of the beekeepers in the study had never heard of climate change. Only 20% of the beekeepers who took part in the study were interested in learning more about climate change. While only 6% of people are aware of the term "climate change," they predict problems for bees such as decreasing nectar, honey, and pollen, as well as a reduction in hive population in the autumn and early winter. Bee movement causes colony destruction. However, 14% of them do not believe there is a connection between beekeeping and climate change.

Introduction:

Approximately 9000 years ago, humans began harvesting honey from bees. A man gathering honey is depicted in a 7000 B.C. rock painting discovered near Valencia, Spain. Beekeeping and honey processing is seen in drawings of Egyptian temples from around 2400 B.C. There are hints that honey was used to cure wounds in Egypt's oldest medical papyri, which dates from 1553-1550 BC. Honey and bee pollen grains were commended as a source of youthfulness and health in

ancient literature such as the Talmud, the Bible, scrolls from the East, ancient Greece, and Rome. Grease-honey-lint may be employed as a wound dressing on the Smith papyrus (c. 2,600–2,200 B.C.). “Honey is helpful for all rotten and hollow ulcers,” wrote Discords (About 50 A.D.). Aristotle (350 B.C.) used honey to cure wounds. The first hives in Egypt were cylinders made of clay that could be stacked. "Honey and pollen grains create warmth, clean wounds, and ulcers, soften stubborn ulcers of the lips, heal carbuncles and weeping sores," Hippocrates stated. Galen, the renowned Roman physician, who prescribed it for a variety of poisonings and intestinal disorders, including gangrenous stomatitis, considered honey. Honey is a "Medicine for men," according to the Koran's "The Bee" passage. As a poultice in the East, a mixture of honey and pollen grains was utilized (Hassan *et al.*, 2015).

Honey's sensory, chemical, physical, and microbiological qualities all have a role in determining its quality. Honey and other bee products are widely eaten as food and medicine, and contamination could pose major health risks (Eissa *et al.*, 2014). Pesticide and antibiotic contamination in agriculture is a difficult issue to solve. Honey and other bee products are widely eaten as food and medicine, and contamination could pose major health risks. Pesticides pollute honey and other bee-derived goods. Pesticide residues cause genetic changes and cellular disintegration, and antibiotics may increase the number of diseases that are resistant in humans and animals. Contaminated honey has been blamed for a number of cases of baby botulism. When honey is made from some plants, it can be hazardous. It is possible that ingesting honey without knowing where it comes from or how safe it is could be harmful (Noori *et al.*, 2012).

Pesticide residue in honeybee colonies has only been studied in cross-sectional research to date. Honey, beebread/pollen, wax, propolis, and bees have all been used to test residues. Most of them have only looked into a small number of pesticide residues, mostly those associated with honey bee pest control. Analytical methods capable of detecting a wide variety of pesticide residues found in the foraging habitat as well as those employed in colony management were used in several of the investigations.

On the other hand, estimates of climate change forecast upheavals in certain parts of the world a few decades from now, including advancing deserts, retreating ice caps, melting snow, shifting rainfall patterns, and a greater frequency of catastrophic climate events in general (Le Conte and Navajas, 2008).

Due to its effects on honeybees and their diseases, as well as the floral environment, climate is particularly crucial for the honey bee, *Apis mellifera* Linnaeus (Hymenoptera: Apidae), colonies' activity and productivity (Le Conte and Navajas, 2008). Climate change is currently seen as the greatest future concern because of its effects on all living organisms, including plants and their pollinators. However, few studies on the effects of climate change have been conducted. As evidenced by the review article (Abou-Shaara, 2016). Climate change is likely to have an impact on plant and bee distribution, for example (Le Conte and Navajas, 2008).

As a result, the goal of the research reported in this study is to determine the levels of beekeepers' knowledge, attitudes, and behaviours regarding pesticide product contamination and safety practices, as well as to understand the effects of climate change on bee products in Egypt. We want to find out how much

beekeeper knows about climate change and how bees affect it.

Materials and methods

1. Sample and targeted group:

A survey was conducted from April 2019 to September 2019 for 100 beekeepers in Gharbia Governorate – Egypt.

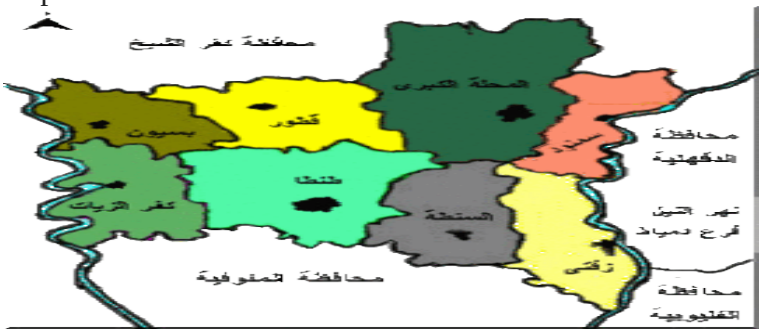

Figure (1): Map shows the included Gharbia Governorate – Egypt in the study.

2. Questionnaire development and delivery:

Diagnostic surveys, formal interviews, and information on beekeepers knowledge of pesticides as well as exposure of bees to pesticides, the effects of bee poisoning and the problem of contamination of bee's products, and knowledge about impacts of climate variability and change on beekeeping productivity. Data were collected through face-to-face interviews with 100 beekeepers in Egypt's major agricultural region (Gharbia Governorate) (Figure 1) (Jallow *et al*., 2017).

The questionnaire contained three main sections. 1st section is designed to collect information on the personal characteristics of the beekeepers. 2nd section focused on collecting information on apiary production, types of strains used in breeding in apiaries, sources of nutrition, and seasons of sorting and production. 3rd section included questions regarding the most important diseases and pests that threaten bees and their products and methods of disease and pest control in the apiaries studied, types of pollutants beehive and bee products, whether natural or chemical Information about the time to apply pesticides is available near the apiaries studied. Follow observing the disappearance of workers. Samples that analysis pesticide residues.4th section included questions regarding knowledge about the impacts of climate variability and change on beekeeping productivity.

3. Data Analysis:

All data were coded, entered, and then analyzed using SPSS version 20 (SPSS Inc., Chicago, IL, USA).

Results and discussion

3.1. Demographic characteristics and profile of the beekeepers:

The study's beekeepers were all male. The participants ranged in age from 35 to 61, with an average of 48. Above half of the beekeepers were over the age of 50. A large percentage of beekeepers (64%) had a high level of education, (28% had an intermediate level of education), and 8% were illiterate or had not completed elementary school. The majority of responders (48%) had 5–10 years of beekeeping experience, with 36% having more than 10 years and 16% having fewer than 5 years. The owners of apiaries made up the bulk of those who received the survey. Where it reached (44%) while 28% are in charge of apiaries and the lowest number

(12%) represents merchants, while employees are represented by (11%) and the other (5 percent) (Table 1). The findings are consistent with those published by Al-Ghamdi *et al*. (2016), who stated that 138 people from 14 Arabian countries took part in the study. The majority of those who took part in the survey were between the ages of 31 and 45. (42.8 percent of the total). Most of them were also with a high educational level with a B.Sc. or higher degree (81.2% of the total) and 58.7% of them with experience of less than 10 years in beekeeping.

Table (1): Categories of different characteristics of respondents from beekeepers.

Criteria	Categories	%
Age	Less 30	0
	From 31-49	81
	From 50-60	15
	More than 60	4
Education level	Illiterate	8
	Intermediate education	28
	High qualified	64
Experience in beekeeping	Less than 5	16
	5–10	36
	More than 10	48
Relationship with beekeeping	Owner	44
	Responsible for apiaries	28
	Merchants	12
	Workers	11
	Others	5

3.2. Apiary types and production:

Production of bees and apiary type: All of the apiaries surveyed in the Governorate of Gharbia produce honey for local consumption. The number of apiary hives ranged from 50 to 500, with an average of 125. The study area's hives range in age from 1 to 20 years old. The average annual bee honey production in the research was 5 tons.

The crinoline bee strain has the highest percentage of bee strains in the research area's apiaries, with 58 percent, followed by the Italian bee strain at 24 percent and the Egyptian bee strain at 18 percent. Over the course of one season, I discovered that alfalfa was the most common source of nectar, accounting for 88%, followed by camphor (36%), citrus (28%), and miscellaneous sources (6%).

Selling honeybees, which accounted for 60% of the income, was followed by selling parcels, which accounted for 56%, selling pollen and bee quarters, which accounted for 8%, and finally selling beeswax, which accounted for 7%, with the percentage of apiaries with all income streams being 12% (Table 2).

According to FAO (2016), the average honeybee output in the examined bees is consistent with the Arab Republic of Egypt's overall average. According to reports, natural honey comes in over 35 different varieties, with some of the more well-known being: Sunflower Honey - Hijazi Honey Alfalfa - Sweet Alfalfa Honey - Apple Honey - Citrus Honey - Cotton Honey - Mint Honey (Alfalfa Honey).

In addition to bee production, which is considered the most important investment in the field of beekeeping in Egypt, bees produce six main products (Honey, pollen, wax, bee venom, royal jelly, and propolis). It wasn't until 2011 that Egypt began importing honey bees (Mostafa *et al.*, 2018).

Table (2): Bees production and apiary type of respondents from beekeepers.

Question	Variable	%
Is your apiary exported honeybee products?	No.	100
Apiary hives	Less 100	40
	From 101-500	48
	More than 500	12
Bee strain	The crinoline bee	58
	The Italian bee	24
	The Egyptian bee	18
Age of apiary	Less 1	20
	From 1-5	35
	More than 5	49
Nectar sources	Alfalfa source	88
	Camphor	36
	Citrus	28
	Other sources	6
Income sources	Selling honeybees	60
	Selling parcels	56
	Selling pollen	8
	Selling bee quarters,	8
	Selling beeswax	7
	All income sources	12

3.3. Types of beehive and bee products pollutants:

Diseases and pests that harm bees: The results in the apiaries analysed revealed that beekeepers reported the emergence of Nosema in all apiaries, with brood diseases accounting for 88 percent of the apiaries studied, and other diseases accounting for 20%. Varroa mites were found in

80% of apiaries, with hornets accounting for 60% of the infestations (Table 3). Bee wolves and other pests infested 25% of the apiaries investigated, whereas wax moths infested 7% of the apiaries. The findings also revealed that treatment with formic acid and beta-cross against illnesses and pests, in general, had a positive effect on the majority of apiaries, with more than 85 percent losing nearly half of their colony.

Pesticides and threaten bees: The study showed that the percentage of 52% of beekeepers under study do not recognize contamination of the beekeeper or its products with cross pollutants such as pesticides, while 48% of beekeepers know that there is a problem of contamination of the products of the bees. About 68% of the beekeepers in question believe that the cause of contamination of bee products is due to chemical contamination. Referring to beekeepers acknowledge the possibility of chemical contamination due to several reasons, including contamination by residual direct pesticides during the application, of 25%, while 32% of beekeepers refer to the reason for feeding bees on a general flower treatment with pesticides. Some beekeepers refer to the treatment of beehives with some pesticides. Refer 33% of beekeepers to all the above and 10% of beekeepers refer for other reasons. About 92% of the beekeepers concerned observed the phenomenon of deficiency in workers, while 8% of the beekeepers concerned did not notice this phenomenon, and 20% of the beekeepers attributed the phenomenon to the use of pesticides in the areas surrounding the bees. While 80 % of the beekeepers attributed the phenomenon to different reasons.

About 85% of the beekeepers under study indicated that beekeepers are not notified of the date of application of pesticides in areas close to the beekeepers, while 15% of beekeepers indicated that they could be notified of the date of application. Of some beekeepers 3% mentioned some trade names of pesticides used in the areas close to the beekeepers under study (Table 4).

Review the life history and foraging behavior of bumblebees and honeybees and discuss how these traits may influence routes and levels of exposure. Overall, the major pesticide exposure routes for bumblebees and honeybees are similar. Furthermore, bumblebees may receive comparatively higher pesticide doses via contact or oral exposure (Spivak and Sheppard, 2019).

Table (3): Potential diseases and pests that threaten bees.

Diseases and pests	**%**
Nosema	100
Brood diseases	88
Bee paralysis Virus	5
Other diseases	20
Bee wolf	25
Varroa	80
Hornets	60
Wax moths	7
Other pests	25

Table (4): Pesticides and threaten bees.

Question	Variable	%
Did you know that there is a problem with contamination with bee products?	Yes	48
	No	52
The kind of contamination with bee products	Chemical	68
	Natural	32
Reasons of chemical contamination	Pesticide residues during application.	25
	Feeding bees on general flowers treatment with pesticides	32
	The treatment of beehives with some pesticides	33
	The other reasons	10
Note the phenomenon of the disappearance of worker bees	Yes	92
	No	8
Notification of the date of application of pesticides in the areas close to the bees under study	Yes	15
	No	85

Table (5) shows that six pesticide active ingredients were used in different farms in the areas close to the beekeepers under study. About 83.33% of the pesticides used belonged to the (WHO) toxicity class II (Moderately hazardous), with a few classes U (Unlikely to pose an acute hazard in normal use) recoded (16.66%). Insecticides were used by 66.66% of the farmers, followed by fungicides (16.66%), and acaricides (16.66 %), respectively.

About 50% of the pesticides used belonged to the neonicotinoid group, followed by the organophosphate group, amitraz, and dithiocarbamates group receded 16.66 %. 5 active ingredients were registered in the state of Egypt, with a percentage value of 83.33%, unclouded 4 active ingredients Restricted use pesticides were 66.66%. In addition, the percentage of Not registered pesticides was 16.66%.

Only 8% of beekeepers were found to analyze pesticide residues in their products for export, while 92% of beekeepers do not analyze pesticide residues in their products.

Table (5): Classification of pesticides, toxicological class used in the fields close to the beekeepers under study.

Active Ingredient	WHO Toxicity Class (a *)	Classification	Registration Situation (b**)
Mancozeb	U	Dithiocarbamates	R
Amitraz	II	Amitraz	NR
Imidacloprid	II	Neonicotinoid	RUP
Acetamiprid	II	Neonicotinoid	RUP
Thiamethoxam	II	Neonicotinoid	RUP
Chlorpyrifos	II	Organophosphate	RUP

(a *): II: Moderately hazardous U: Unlikely to pose an acute hazard in normal use
(b): R: Registered NR: Not registered RUP : Restricted use of pesticides**

3.4. The effect of climate change on bees and their products:

Climate change can influence honeybees at different levels. It can have a direct influence on honeybee behaviour and physiology. It can alter the quality of the floral environment and increase or reduce colony harvesting capacity and development. It can define new honeybee distribution

ranges and give rise to new competitive relationships among species and races, as well as among their parasites and pathogens. Beekeepers will also be obliged to change their apiculture methods. (Le Conte and Navajas, 2008).

The results showed that 80% of beekeepers under study did not know about the term climate change. While only 20% of beekeepers under study are interested in, knowing about climate change. 20% of beekeepers are divided into two parts, that 6% of beekeepers who know the term climate change refer to some phenomena that affect bees and the result of climate changes, they expect problems for bees, such as reducing nectar, honey, and pollen besides decreasing of hive population during Autumn and early Winter. Migration of bees, damages colonies. On the other hand, 14% of beekeepers believe that there is no direct relationship between bees and their production with surrounding or expected climatic changes. All beekeepers under study have no vision or expectation of possible measures to address the effects of bees exposed to these climate changes (Table 6).

Table (6): The effect of climate change on bees and their products.

Question	Variable	%
The term climate change	Yes	20
	No	80
know the term climate change refers to some phenomena that affect bees	Yes	6
	No	14
vision or expectation of possible measures to address the effects of bees exposed to these climate changes	Yes	0
	No	100

It is recommended that use (IPM) system to minimize the use of pesticides, prevention of neonicotinoid group treatment near apiaries, thinking carefully about the use of pesticides, especially where plants are in flower. Ministry of Agriculture should help beekeepers to find a good strain that survives climatic changes, growing more flowers, and shrubs that provide nectar and pollen as food for bees and other pollinators (Eucalyptus is very useful). Providing a clean source of water for bees to take back to the hive, thinking carefully about the use of pesticides, especially where plants are in flower, the establishment of windbreaks and shelter around apiaries, ensuring sun shades in early summer, ensuring pollen substitute and sugar feeding during starvation. Beekeepers must learn and train on artificial insemination and molecular biology is a useful tool for measuring the genetic diversity of honey bee populations and liking their adaptability to climatic changes and to different pathogens.

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