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## Public Knowledge, and Perceptions of Honeybees in Punjab, Pakistan

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### ABSTRACT

Honeybees are key pollinators and seed dispersers, and conserving them is critical to maintaining agricultural yields and ecological balance. This study sought to evaluate residents' knowledge, attitudes, and perceptions of honeybees in Pakistan. The present research was conducted in 10 districts of Punjab: Rawalpindi, Gujranwala, Gujrat, Lahore, Sialkot, Kasur, Okara, Narowal, Bahawalpur, Bahawalnagar, Dera Ghazi Khan, and Rahim Yar Khan. A total of 400 closed-ended questionnaires, each containing 33 items, were distributed to randomly selected respondents from communities in each district, with 40 questionnaires per district. During the survey, it was discovered that most people in Punjab valued the honeybee for more than just its beauty. The majority of respondents were familiar with honeybee products such as honey, but many were unaware of propolis, beeswax, bee pollen, and royal jelly. People in Punjab have some scientific understanding of honeybees; for example, they are aware that honeybees aid in research, benefit agriculture, and are employed in traditional and modern medicine. They are also aware that honeybees consume plant parts and help pollinate them. The majority of the population believes that honeybees are not involved in any type of magic and that their venom is not hazardous to humans. The current study improves our understanding of the cultural and economic elements that affect the knowledge, attitudes, and perceptions of beekeepers and the surrounding population. To improve people's present knowledge of honeybees, we support educational programs for specific community groups that highlight ecosystem services and the need to safeguard honeybees.

**KEYWORDS:** Conservation, Honeybee, Pakistan, Human behavior

### INTRODUCTION

Honeybees are beneficial and cosmopolitan insects, excluding the polar regions. Bees possess nearly 24,705 species (Gupta, 2014), but in the aggregate only ten species of honeybees are known to exist worldwide, and 29 subspecies of *A. mellifera* are present in the world. Honeybees, which are native to Europe and Africa, have populated too many parts of the world (Engel, 1999; Sheppard & Meixner, 2003). Pollination behaviour studies indicate that honeybees are effective pollinators of native plants; however, they are less consistent at pollinating alien species. Unlike many other pollinators, honeybees do not engage in distinctive foraging habits. Furthermore, they do not physically injure plants (Hury, 1997).

Honeybees are important for the economy. In Pakistan, 61 important crops are honeybee-pollinated. A drastic decrease in honeybees could mean food scarcity, and therefore it is a matter of extreme importance for food security, especially in developing countries, including Pakistan. A range of constraints affects bee breeding and rearing in the country. Despite the growing need for the products due to the overuse of pesticides, lack of expertise, and deforestation, the demand and economic impact of these products continue to increase. Beekeeping

practices are conducted in the Khyber Pakhtunkhwa and Punjab provinces. Pakistani honey is appreciated across the Middle East for its distinct high quality. Annually, approximately 23 million dollars are generated from the 400 tonnes of honey that are exported to Arab countries from Pakistan. The specific diversity of Pakistan's flora has a positive economic impact and, if properly harnessed, has great potential for sustainable beekeeping, which is beneficial for long-term wildlife. The country's floral diversity, when developed and properly managed, serves as a conservation tool for local wildlife (Altaf & Umair, 2020; Umair & Yaqoob, 2018; Usman *et al.*, 2022).

Every civilization has acknowledged, cherished, and valued honeybees. Their symbolism centers on three key themes: the sweetness of honey, the organization of the beehive, and the impressive majesty of the queen bee. Honey is tasty and used in many products and dishes, also serving as a religious symbol. Its therapeutic advantages have been documented in the oldest medical texts, where it is lauded for its capacity to heal injuries and lower fevers. Moreover, the Quran, the holy book of Islam, refers to honey as the food of Paradise and a means of healing, which was written approximately fourteen

centuries ago (Channa *et al.*, 2018; Papa *et al.*, 2022; Purbafrani *et al.*, 2014).

Loss of habitat, pesticides, climate change and disease are all factors that have caused a decline in the global population of honeybees, which is threatening the ecological balance and agricultural output through pollination. The honeybees are important in cultivation of crops. Meanwhile, their general understanding of their ecological and economic relevance is limited, which gives way to negative interactions. This research assesses public awareness and perceptions of honeybees in Punjab, Pakistan. It evaluates citizens' levels of awareness, analyses their perspectives on honeybees, and examines how factors such as education, profession, and cultural traditions shape these views. Furthermore, it identifies knowledge gaps and misconceptions in order to support the development of more effective awareness and conservation initiatives.

## MATERIALS AND METHODS

**Study area:** With a population of more than 127 million, Punjab is Pakistan's most populated province. Located in Pakistan's central-eastern area, it is the country's largest economy and contributes significantly to the national Gross Domestic Product, or GDP. The capital and largest city is Lahore, with other major cities including Faisalabad, Rawalpindi, Gujranwala, and Multan (Dhavan, 2020; Grewal, 2004; Khan, 2020). Punjab is comprises of desert (Ahmad *et al.*, 2025), terrestrial land (Khan *et al.*, 2024; Khan *et al.*, 2022), wetlands (Batool *et al.*, 2025; Batool *et al.*, 2024; Laraib *et al.*, 2024) and Mountains (Altaf & Umair, 2022; Bashir *et al.*, 2025; Irshad *et al.*, 2025).

According to the latest census of Pakistan in 2023, the population of Punjab province is detailed in a full report. The total population of Punjab is 110 million, with the majority residing in rural areas (70 million) and the density is 536 persons per sq. km (GOP, 2025). The population of Punjab shows that Muslims make up the largest group (97.75 percent), while the minority communities are Christians (1.93 percent) and Hindus (0.20 percent), with additional minorities including Sikhs and Parsis (Malik & Mirza, 2015).

Punjab endures severe weather patterns, marked by fog-laden winters frequently coupled with rainfall. From February, temperatures begin to rise, and spring-like conditions last until mid-April; after that, the heat of summer arrives. The southwest monsoon

normally comes to Punjab around May. The spring monsoon either misses the area or causes heavy rainfall, resulting in floods. June and July are extremely hot months, although official estimates rarely show temperatures reaching 46°C. The rainy season relieves the oppressive heat in August, signaling the end of the most severe summer conditions; nonetheless, cooler weather does not arrive until late October (Abbas *et al.*, 2022; Samie *et al.*, 2020).

**Questionnaire from Study sites:** Structured close-ended questionnaire was first written in English; however, it was later translated into Punjabi and Urdu for local convenience. The initial questionnaire was divided into five sections (respondent background, honeybee understanding, scientific expertise, conserving mindset, and myths and narratives regarding honeybees) that were easily understood by everybody in the region. These questions assessed not only the respondents' perceptions but also their knowledge of honeybees. The authors constructed the questionnaire correctly. All participants were randomly selected, and formal consent was obtained from each of them. All respondents (N=400) were from the 6 divisions of Rawalpindi, Gujranwala, Lahore, Bahawalpur, Dera Ghazi Khan, and Multan in Punjab, Pakistan (Figure 1). Map of the study area was designed with the help of Arc-GIS (Figure 1).

The questionnaire was divided into five sections. The first section included six questions about the participants' backgrounds. The second section contained 14 questions focused on honeybees. The third section assessed participants' scientific literacy (n = 11), while the fourth included two questions related to conservation (n = 2). The final section comprised four questions about honeybee folklore. Data collection for the study took place over six-month period, from April 2023 to October 2024. A total of 400 questionnaires were distributed to the addresses of selected residents. To facilitate the survey, a five-member team fluent in the local language and familiar with the survey area was assembled. Primary data was gathered through direct interviews with the sampled respondents, each of whom received a brief overview of the survey's purpose: to assess and enhance awareness of the relationship between humans and honeybees in Punjab

**Statistical analysis:** The dataset has been examined using Microsoft Excel 2010 and Past Statistical (4.16c) Software for statistical analysis i.e. Chi square.

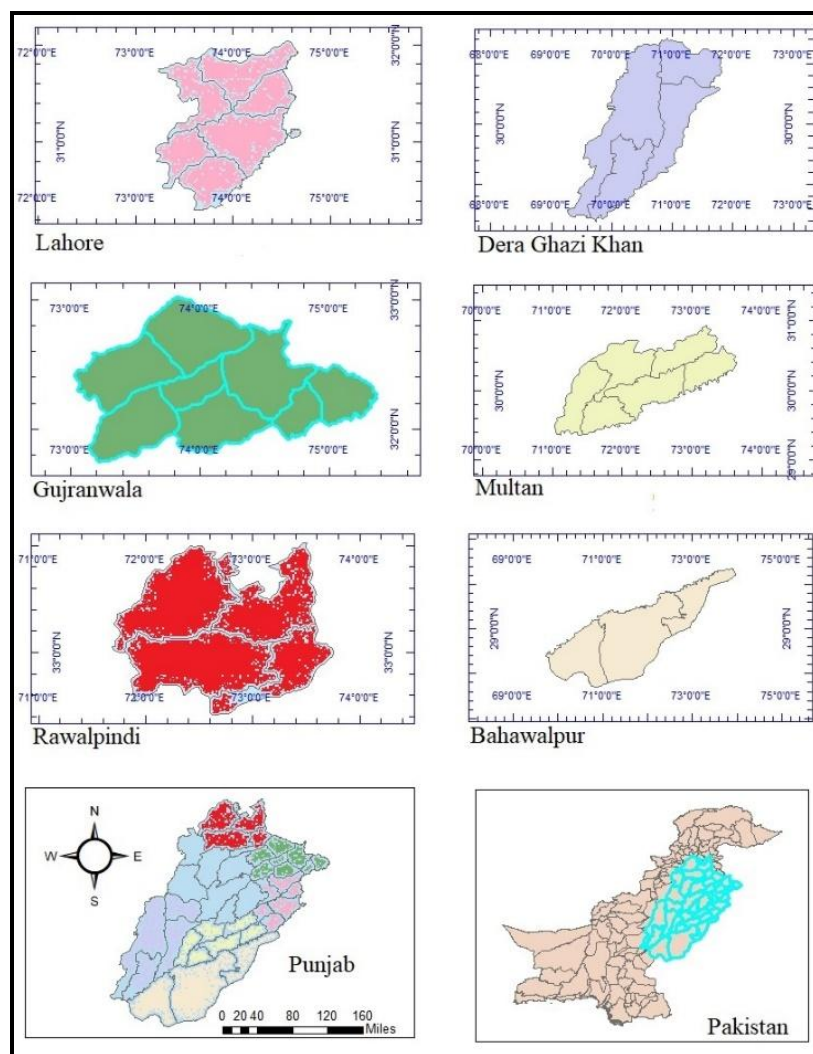


Figure. 1. Map of the study area.

**Relative Frequency of Citation (RFC):** RFC represents the relative importance or level of participant recognition of a certain usage or belief associated with honeybees. The lower the RFC number, the less frequently the data is reported, and the higher the number, the more respondents mentioned or recognized the particular use.

**Tendency Index (TI)**

TI = Yes (%) – No (%)

While

A positive value shows more people agree with the question, and

A negative value shows more people disagree with the question.

**Clarity Index (CI)**

CI = Yes (%) + No (%) - I don't know (%)

While

A positive value shows more people know about the species, and

A negative value shows fewer people know or do not know about the species.

**RESULTS**

**Demographic information:** A total of 400 Muslim males (n=277) and females (n=123) respondents in Punjab were surveyed. The data were collected through questions (Figure 2); they belong to different professions, such as government employees (n=108), housewives (n=34), students (n=142), farmers (n=38), laborers (n=64), and traditional healers (n=14). In terms of age groups, the largest section consisted of informants aged 37–56 years (n=61), followed by various age groups: 18–36 years (n=198), 57–70 years (n=51), and above 70 years (n=30). Most of the informants were educated (n=389), while some were illiterate (n=11).

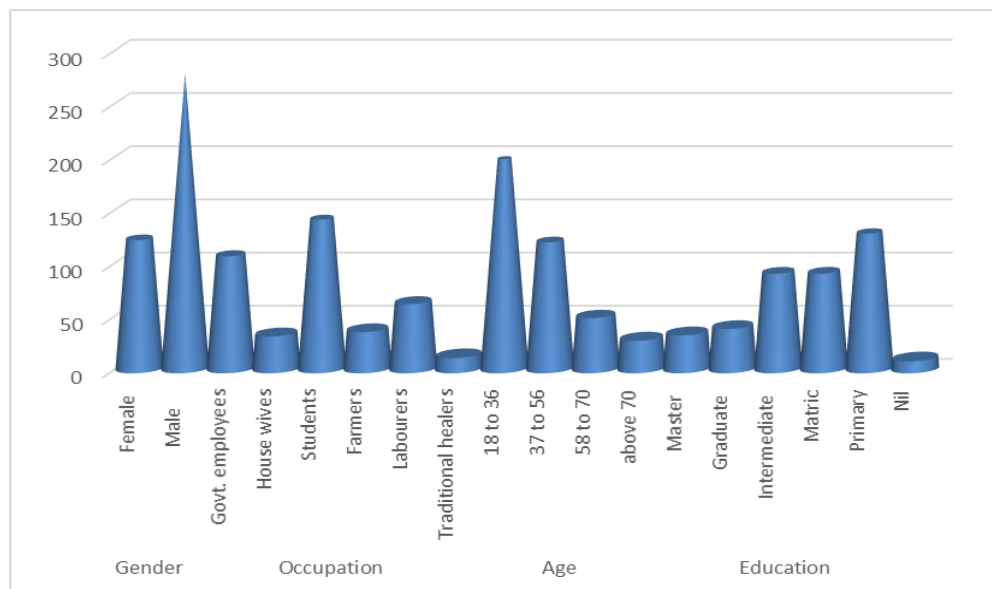


Figure 2. Data of selected informants of Punjab, Pakistan.

**Basic knowledge:** During the study, it was noted that most people in Punjab not only appreciated the beauty of the honeybee (informants say yes = 364) but also liked this species (yes = 335). Most people have seen the hives (yes = 359) and are familiar with the products of honeybees, such as honey (informants say yes = 335), while many people don't know about other products like propolis (informants say no = 240), bee wax (no = 344), bee pollen (no = 364), and royal jelly (no = 367). While all the respondents are Muslims, most of them to know about the importance of honey in Islam. Further majority of the informants are not entomologists and don't attend any seminars or workshops regarding honeybees or apiculture, they don't have much knowledge about apiculture (informants say no = 324), and they don't know whether the status of honeybees is decreasing or increasing (informants say don't know = 208) (Figure

3 Table 1). The output indicates that the variables have a significant association, with a Chi-square of 4888.2 and a p-value of less than 0.000001. This is supported by a Monte Carlo p-value of 0.001. The association strength is high, as shown by a Cramer V of 0.686. ). During the study, it was noted that the tendency index of basic knowledge ranged from -96 to 100. The highest TI (100) shows that people used honeybee products, while most of them are not entomologists/apiologists (TI = -96). On the other hand, it was noted that the CI ranged from -4 to 100. The clarity index (100) shows that people are sure these species are honeybees and are beautiful. They know they have attended workshops/seminars about honeybee keeping, Royal Jelly, and honeybee pollen. The negative value (CI = -4) shows that the people of Punjab are very uncertain about the honeybee population (Table 1).

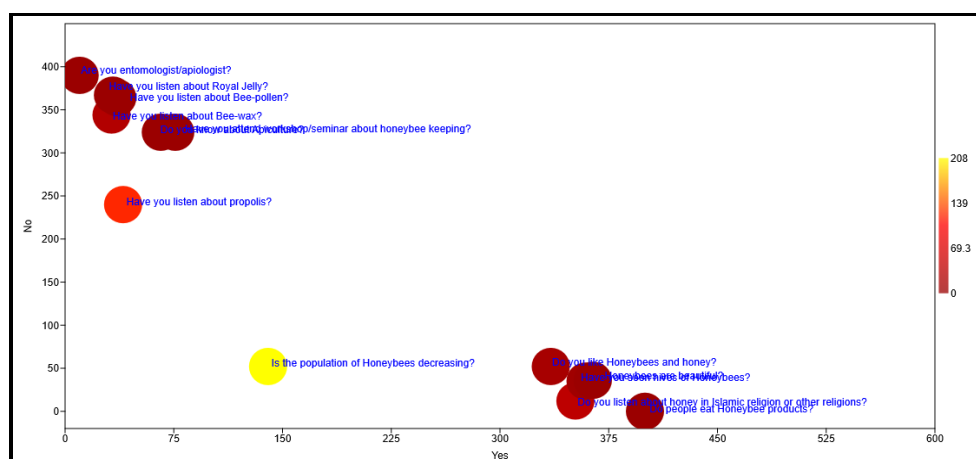


Figure 3. This figure shows the human knowledge about honeybees on x-axis and y-axis, while color variation shows the respondents ratio unaware about the questions of honeybees (1-400).

**Table 1.** Informants number (n) and percentage (%) of the responses (P value= 0.000001) for questions about basic knowledge about Honeybees.

| Questions                                                         | Yes (%)     | No (%)   | Don't know (%) | TI    | CI   |
|-------------------------------------------------------------------|-------------|----------|----------------|-------|------|
| Do you like Honeybees and honey?                                  | 335 (83.75) | 52 (13)  | 13 (3.25)      | 71    | 93   |
| Honeybees are beautiful?                                          | 364 (91)    | 36 (9)   | 0 (0)          | 82    | 100  |
| Have you seen hives of Honeybees?                                 | 359 (89.75) | 35 (8.8) | 6 (1.5)        | 81    | 97   |
| Have you attend workshop/seminar about honeybee keeping?          | 76 (19)     | 324 (81) | 0 (0)          | -62   | 100  |
| Are you entomologist/apiologist?                                  | 10 (2.5)    | 390 (98) | 0 (0)          | -96   | 100  |
| Do you know about Apiculture?                                     | 66 (16.5)   | 324 (81) | 0 (0)          | -64.5 | 97.5 |
| Do people eat Honeybee products?                                  | 400 (100)   | 0 (0)    | 0 (0)          | 100   | 100  |
| Is the population of Honeybees decreasing?                        | 140 (35)    | 52 (13)  | 208 (52)       | 22    | -4   |
| Have you listen about propolis?                                   | 40 (10)     | 240 (60) | 120 (30)       | -50   | 40   |
| Have you listen about Bee-wax?                                    | 32 (8)      | 344 (86) | 24 (6)         | -78   | 88   |
| Have you listen about Royal Jelly?                                | 33 (8.25)   | 367 (92) | 0 (0)          | -84   | 100  |
| Have you listen about Bee-pollen?                                 | 36 (9)      | 364 (91) | 0 (0)          | -82   | 100  |
| Do you listen about honey in Islamic religion or other religions? | 352 (88)    | 12 (3)   | 36 (9)         | 85    | 82   |

**Scientific Knowledge:** People of Punjab have some scientific knowledge about honeybees; for example, they know that honeybees are helpful in research (informants say yes = 384), positively impact agriculture (informants say yes = 324), and are used in traditional (informants say yes = 272) and modern medicine (informants say yes = 300). They are also aware that honeybees eat parts of plants (informants say yes = 348) and are helpful for pollination (informants say yes = 348). They have information that honeybees don't impact our environment and don't contaminate water. However, they have no information about zoonotic diseases and the transfer of diseases (Figure 4, Table 2). With a Chi-square of 2511.2 and a p-value of less than 0.000001, the results

show that the variables have a strong and significant correlation. A Monte Carlo p-value of 0.001 supports this. A Cramer V of 0.53419 indicates a high connection strength. During the study, it was noted that the TI ranged from -70 to 93. The highest tendency index (93) shows that people believe these species are "helpful for pollination" and "useful in research," and that they are not harmful to our environment (TI = -70). On the other hand, it was noted that the CI ranged from -22 to 98. The clarity index (98) shows that people know these species are "useful in research," and the negative value (CI = -22) shows that the people of Punjab are uncertain about zoonotic diseases (Table 2).

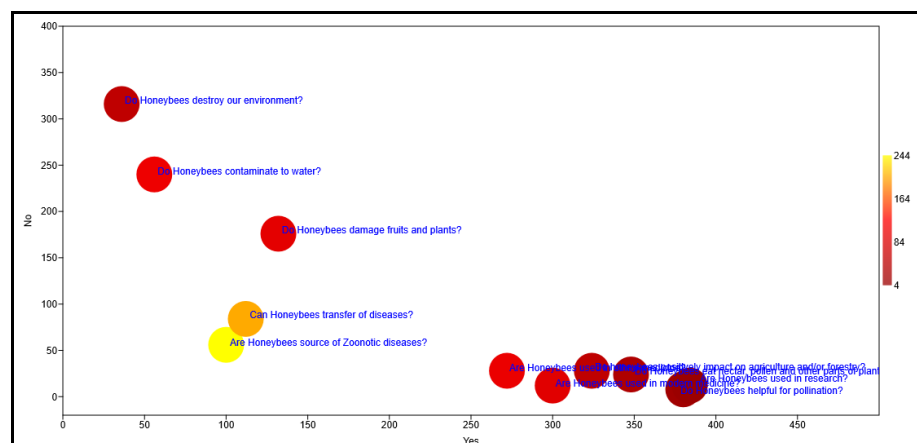


**Figure 4.** This figure shows the human scientific knowledge about honeybees on x-axis and y-axis, and color variation shows the respondents ratio unaware of questions about honeybees.

**Conservation Attitude of People:** The majority of individuals are ignorant of the current state of honeybees and their protection, according to collected data. In particular, 250 interviewees stated they were unsure of the value of honeybees. However, many people recognize the worth of honeybees. Consequently, 268 respondents said that honeybees not be eliminated for any reason, and 356 informants said that they not be killed (Figure 5). The results show that the variables are significantly and strongly

associated, with a Chi-square of 522.62 and a p-value of less than 0.000001. This is corroborated by a Monte Carlo p-value of 0.001. The relationship is strong, as evidenced by a Cramer V of 0.45906. During the study, it was noted that the TI ranged from -84 to -14. The people in the area think that these species not be killed (TI=-84) or removed (TI=-34) from our environment, and most people think these species do not need conservation (TI=-14). On the other hand, it was noted that the CI ranged from -15 to

78. The clarity index (78) shows that people are sure these species are not to be removed from our ecosystem, while they are unsure about the honeybee conservation perspective (Table 3).

**Table 2.** Informants number (n) and percentage (%) of the answers (P value= 0.000001) for questions about the scientific information and impacts of honeybees.

| Questions                                                      | Yes (%)  | No (%)   | Don't know (%) | TI  | CI  |
|----------------------------------------------------------------|----------|----------|----------------|-----|-----|
| Are Honeybees source of Zoonotic diseases?                     | 100 (25) | 56 (14)  | 244 (61)       | 11  | -22 |
| Can Honeybees transfer diseases?                               | 112 (28) | 84 (21)  | 204 (51)       | 7   | -2  |
| Are Honeybees used in research?                                | 384 (96) | 12 (3)   | 4 (1)          | 93  | 98  |
| Do Honeybees eat nectar, pollen and other parts of plants?     | 348 (87) | 24 (6)   | 28 (7)         | 81  | 86  |
| Do Honeybees damage fruits and plants?                         | 132 (33) | 176 (44) | 92 (23)        | -11 | 54  |
| Are Honeybees used in ethno-medicine?                          | 272 (68) | 28 (7)   | 100 (25)       | 61  | 50  |
| Are Honeybees used in modern medicine?                         | 300 (75) | 12 (3)   | 88 (22)        | 72  | 56  |
| Do honeybees positively impact on agriculture and/or forestry? | 324 (81) | 28 (7)   | 48 (12)        | 74  | 76  |
| Do Honeybees destroy our environment?                          | 36 (9)   | 316 (79) | 48 (12)        | -70 | 76  |
| Do Honeybees contaminate water?                                | 240 (60) | 56 (14)  | 104 (26)       | 46  | 48  |
| Are Honeybees helpful for pollination?                         | 380 (95) | 8 (2)    | 12 (3)         | 93  | 94  |

**Table 3.** Informants number (n) and percentage (%) of the answers (P value= 0.000001) for questions about the conservation of honeybees.

| Questions                                                   | Yes (%)  | No (%)   | Don't know (%) | TI  | CI  |
|-------------------------------------------------------------|----------|----------|----------------|-----|-----|
| Is killing of Honeybees good?                               | 20 (5)   | 356 (89) | 24 (6)         | -84 | 70  |
| Do you support the removal of honeybees from the ecosystem? | 114 (29) | 268 (67) | 18 (4.5)       | -38 | 78  |
| Do you support the efforts for conservation of Honeybees?   | 66 (17)  | 124 (31) | 250 (63)       | -14 | -15 |

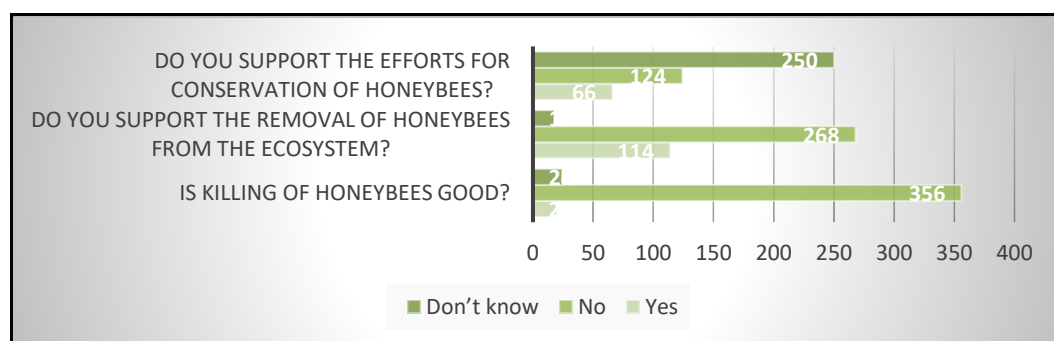


**Figure 5.** Human attitude toward of Honeybees regarding conservation perspectives?

**Superstitious and Narratives:** Most Punjabis do not have superstitions and misconceptions related to bees. The majority of the populace considers that honeybees are not involved in any form of magic and that honeybee venom is not toxic to human beings (Figure 6, Table 4). The results show that the variables are significantly linked, with a Chi-square of 77.691 and a p-value of less than 0.000001. This is corroborated by a Monte Carlo p-value of 0.001. The association strength is high, which is indicated by a Cramer V of 0.31163. While the Certainty Index (CI) shows the level of certainty with which these judgments were expressed, the Tendency Index (TI)

values show the general direction of respondents' perceptions. The TI value for the statement, "Honeybees' venom can kill humans," was -49, showing a definite trend toward disagreement, while the CI value of 54 indicates a comparatively high degree of conviction among respondents. In a similar vein, the question, "Do people use honeybee products in black magic?" had a CI of 10, indicating a relatively low degree of certainty, and a TI of -9, indicating a slight tendency toward disagreement or uncertainty (Table 4).

**Table 4.** Informants number (n) and percentage (%) of the answers (P value= 0.000001) for questions about the folklores of honeybees.

| Questions                                        | Yes (%) | No (%)   | Don't know (%) | TI  | CI |
|--------------------------------------------------|---------|----------|----------------|-----|----|
| Honeybees' venom can kill the human.             | 56 (14) | 252 (63) | 92 (23)        | -49 | 54 |
| Do people use Honeybees products in Black Magic? | 92 (23) | 128 (32) | 180 (45)       | -9  | 10 |

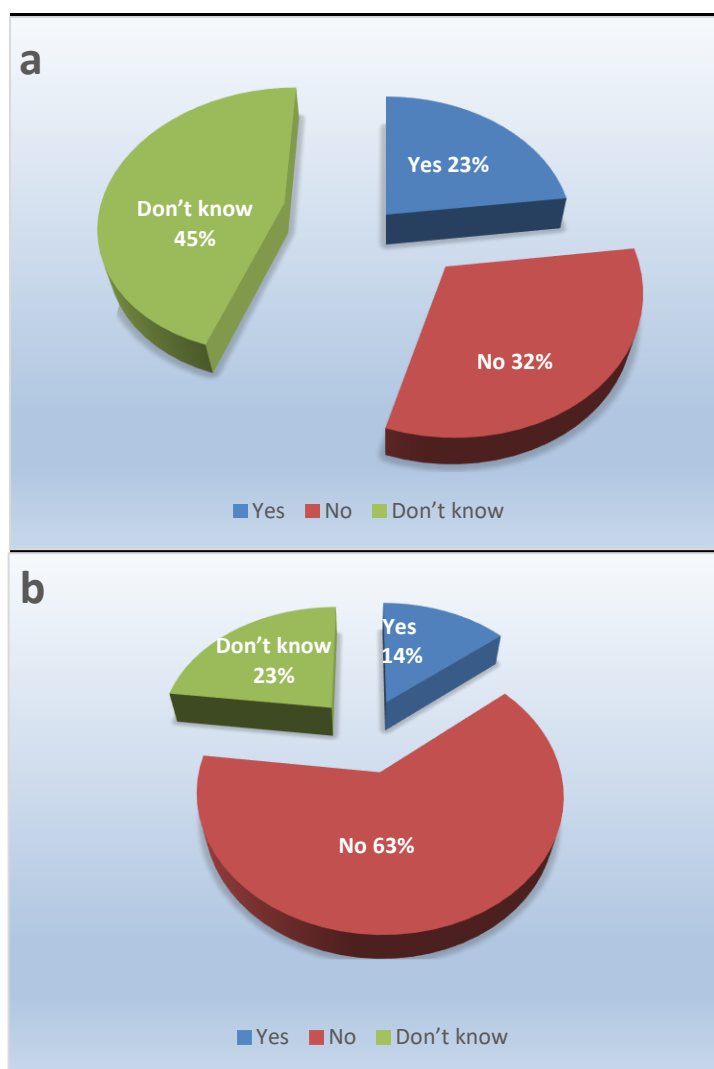


**Figure 6.** Superstitious about honeybee i.e. (A). Do people use Honeybees products in Black Magic? (B). Honeybees' venom can kill the human.

## DISCUSSION

In Pakistan, most researchers focused on the diversity, conservation, and habitat preferences of fauna (Ejaz & Rasheed, 2024; Faiz & Altaf, 2024; Jahangeer & Awan, 2024; Mansha & Nawaz, 2023). Honeybees are often overlooked, despite their vital contributions to the environment and agriculture. Many people view them as irritating pests, failing to recognize their essential role in pollination, which enables plants to thrive and produce vegetables, fruits, and other products. This lack of awareness leads to an underestimation of their importance in farming and ecological balance. Like other neglected species, honeybees face numerous threats, including habitat loss, pesticide exposure, and climate change, yet they do not receive the care they need. Protecting and conserving honeybees is crucial not only for the ecosystem but also for human survival, as our food supply relies heavily on their pollination efforts. It is time to extend the respect and protection that honeybees deserve as a fundamental part of life on Earth.

**Diversity:** According to respondents' information, most people like honeybees and their beauty, and are also aware of the products of honeybees. Most of the informants have no information about the status of honeybees. According to literature, total 20,000 species of bees, while ten species of honeybees are reported from the world (Ahmad F, 2000; Arias *et al.*, 1996; Batra, 1995; Deowanish *et al.*, 2001; Engel, 1999; GBIF, 2017; Gupta, 2014; Hadisoosilo, 1997; Hadisoosilo *et al.*, 2008; Han *et al.*, 2012; Hepburn & Radloff, 2011; Hepburn *et al.*, 2005; Khan *et al.*, 2014; Koeniger, 1976; Koetz, 2013; Maa, 1953; Mortensen *et al.*, 2013; Paar *et al.*, 2004; Radloff *et al.*, 2010; Radloff *et al.*, 2011; Rattanawanee *et al.*, 2007; Roubik *et al.*, 2005; Sheppard & Meixner, 2003; Summers, 1990; Tingek, 1996; Whitfield *et al.*, 2006; Winston *et al.*, 1981). i.e. 1. *Apis mellifera* (found in South America, North America, Europe, Asia, Africa, and Australia). 2. *Apis cerana* (located in Pakistan, India, Myanmar, Thailand, China, the Philippines, New Guinea, Malaysia, Australia, Indonesia, and Korea). 3. *Apis koschevnikovi* (native to Malaysia, Indonesia, Borneo, the Malay Peninsula,

Sabah, Sumatra, and Java). 4. *Apis nuluensis* (found in Borneo). 5. *Apis dorsata* (which inhabits India, Pakistan, Indonesia, Sri Lanka, the Philippines, Borneo, and Thailand). 6. *Apis laboriosa* (located in the western Chinese province of Yunnan, Bhutan, India, and Nepal). 7. *Apis binghami* (found in Indonesia and Thailand). 8. *Apis nigrocincta* (located in the Philippines, China, and Indonesia). 9. *Apis florea* (which can be found in Oman, Iran, China, Myanmar, Pakistan, Sri Lanka, Indonesia, the Persian Gulf, Vietnam, Thailand, Malaysia, the Philippines, Cambodia, and Nepal) and 10. *Apis andreniformis*, (present in India, Burma, China, Laos, Malaysia, Vietnam, Indonesia, and the Philippines).

**Honeybee products:** Honey bee products are honey, royal jelly, bee venom, bee wax and propolis (Figure 7). Honey consists of approximately 75% sugars, 10–15% disaccharides, and contains water (Figure 8). Its protein content ranges from 0.1% to 3.3%, including

enzymes. Additionally, honey contains about 1% amino acids. It also includes organic acids, vitamins (such as pantothenic acid, folic acid, nicotinic acid, pyridoxine, biotin, vitamin C, riboflavin, and thiamine), and minerals (including arsenic, barium, chromium, cobalt, cadmium, calcium, copper, iodine, iron, lithium, magnesium, phosphorus, selenium, silver, manganese, nickel, potassium, sodium, and zinc). Honey contains pigments, phenolic compounds (such as anthocyanidins, phenolic acids, flavones, flavanones, flavonols, flavanols, isoflavones, and chalcones), as well as more than 400 volatile compounds and solid particles (Alqarni et al., 2014; Andersen & Markham, 2005; Bonté & Desmoulière, 2013; Castro-Vázquez et al., 2007; da Silva et al., 2016; Hermosín et al., 2003; Iglesias et al., 2006; Kamal & Klein, 2011; Moreira et al., 2007; Sak-Bosnar & Sakač, 2012; Won et al., 2009).

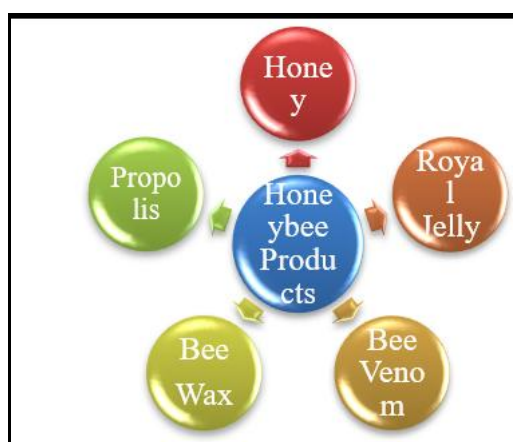


Figure 7. Products of the honeybee.

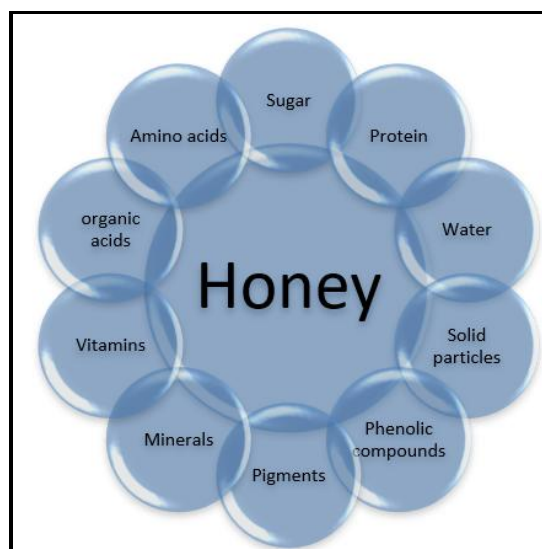


Figure 8. Chemical Composition of Honey.

The Holy Quran contains a complete surah titled Al-Nahl (the Honey Bee), which highlights the significance and benefits of honey. Over fourteen hundred years ago, in the Holy Quran written, that

honey possesses healing properties for a variety of medicinal issues. The Quran describes honey as a source of nourishment that is safe and pure for human consumption (Kamarulzaidi et al., 2014). In the Christian community (Kelhoffer, 2005), in Hinduism

(Kumar, 2024), and in *Buddhism* (Carter & Palihawardena, 2000) also mentioned that honey is important and useful for humans (Antonio, 2003).

**Ethnomedicinal uses of the honeybee:** Across cultures, honey has been valued not only for its sweetness but also for its medicinal properties. Honey was a part of religious ceremonies in ancient Egypt (Boukraâ, 2023; Kumar, 2024). In Ayurveda, honey is an essential ingredient for curative purposes and is prescribed in a herbal mix as well (Pandit). Traditional Chinese medicine also highly regards honey for its balancing properties and prescribes it for digestive and respiratory ailments (Dai *et al.*, 2021). Importance is given to honey in Greek, Roman (Kumar, 2024), African and American cultures (Boukraâ, 2023).

It is noted that honeybee products are used to cure various diseases like eye disease, expectorant, cold, body ache, gastritis, snakebite, erupting of teeth in child, stomach, spleen, dark spots, skin, diarrhea, allergy, burn, wounds in mouth, influenza, toothache, diabetes mellitus, hypertension, cancer, expectorant, cold, body ache, gastritis, snakebite, stomach, spleen, dark spots, skin, diarrhea, allergy, burn, wounds in mouth, influenza, toothache, diabetes mellitus, hypertension, athero-sclerosis, cancer, Alzheimer's disease, joint pain, tonsils, urinary system, throat pain, cough, asthma, cold, cough, acidity and obesity (Abbasi *et al.*, 2011; Altaf *et al.*, 2018; Barros *et al.*, 2012; Benítez, 2011; Betloch Mas *et al.*, 2014; Chinlapianga *et al.*, 2013; Deb & Haque, 2011; Dixit *et al.*, 2010; Erejuwa *et al.*, 2012; Haileselassie, 2012; Jaroli *et al.*, 2010; Lev, 2003; Lohani, 2011; Mahawar & Jaroli, 2006; Mootoosamy & Mahomoodally, 2014; Oliveira *et al.*, 2010; Padmanabhan & Sujana, 2008; Sreekeesoon & Mahomoodally, 2014; Vallejo & González, 2014; Vijayakumar *et al.*, 2015; Waykar & Alqadhi, 2016; Yeshi *et al.*, 2017; Yirga *et al.*, 2011).

**Modern medicinal uses of the honeybee:** Natural honey has been utilized as a therapeutic ingredient since antiquity. It comprises compounds called phenolic acids along with flavonoids, both of which contribute significantly to human health. Honey has been shown to treat cancers, diabetes, digestive problems, cardiac issues, support of apoptosis, possesses immune-boosting, enhance its immune-modulatory function (Li *et al.*, 2010; Mandal & Mandal, 2011; Oršolić, 2009; Vallianou *et al.*, 2014), injured corneas, minimize infection in inflammatory condition (Salehi *et al.*, 2014), potential antibacterial (Estevinho *et al.*, 2008; Silici *et al.*, 2010), serve as antioxidants (Rhone & Basu, 2008), ability to regulate both diastolic and systolic blood pressure (Aluko *et al.*, 2014), to maintain heart, blood vessels (Al-Waili *et al.*, 2013), and cures hepatic damage (Zhao *et al.*, 2018).

**Role of honeybees in Pollination:** Pollinators play a crucial role in both nature and agriculture. Approximately 90 percent of wild flowering plants

and 75 percent of food crops rely on animal pollination. Over 200,000 species contribute to this essential process, with many being various types of bees. Among them, the western honeybee (*Apis mellifera*) is the most recognized and extensively utilized by humans. However, the world is facing a decline in insect populations, posing a significant threat to food security, as most crops depend on insects for pollination. While honeybees are well-known pollinators, it is important to note that all pollinators are under threat from factors such as habitat loss and pesticide use (Halvorson *et al.*, 2021).

**Zoonotic disease from the honeybee:** Rarely, zoonotic diseases and health hazards of honeybees can be contracted by individuals due to direct and indirect interactions with the honeybees and their products (Belluco *et al.*, 2023; Daszak *et al.*, 2000; Morris, 2020). Bee-related anaphylaxis stings are life-threatening, as well as causing death and acute allergic reactions (Smallheer, 2013; Rayamane *et al.*, 2014). Honeybee-associated zoonoses are confirmed to occur less frequently compared to other animal-associated ones (Rayamane *et al.*, 2014; Smallheer, 2013). The global rise in beekeeping shows the growing significance of adequate treatment and understanding regarding bee products (Ali *et al.*, 2020; Hogue, 2009).

**Conservation Attitude of People toward honeybee worldwide:** World perspective on honeybees in the context of conservation has transformed remarkably, primarily due to the rise of awareness of the importance of honeybees in pollination and ecosystem well-being. In the recent past, bees have come to dominate the farming industry, as they do most of the work in the pollination of different crops, as well as wild plants. Among the environmental benefits are that the activity of the bees results in an increase in the number of plant species and the provision of human food. Global warming has led to conservation measures that have been established and accelerated by the alarming rate of the loss of bee numbers, which has been ascribed to various factors, including the loss of natural habitats, the use of harmful chemicals, global warming, and diseases. The most ardent champions of protection measures, which involve but are not confined to the establishment of conducive habitats for bees, curbing the use of chemicals harmful to bees, and indulging in green farming methods, have become governments, environmental organizations, and beekeepers. Among the key means through which the importance of bees has been brought to the limelight are publicity, education, and the participation of citizens in scientific research. Furthermore, improved international collaboration and increased efficiency of honeybee protection measures remain essential since not all people are aware of the consequences that threats to these important pollinators entail. The conservation perspective has been brightened mostly because of the constantly increasing understanding of the ecological

and economic significance of honeybees; nevertheless, the issue of the absence of holistic methods of defense remains a challenge that is difficult to resolve (Iwasaki & Hogendoorn, 2021; Panziera et al., 2022).

**Superstitious and Narratives:** Honeybees are significant in the cultural and superstitious traditions of many countries and often symbolize care, prosperity, and heavenly power. In most cultures, honeybees are considered to be the messengers of the supernatural or good luck. This concept can be traced back to ancient Egypt when both oxen and bees were perceived as gods. Even the name "folklore" originates from a Greek expression, which translates to "ox progeny," as an extension of the common folklore that a swarm of honeybees might naturally develop out of the rotting body of an ox (Hogue, 2009; Ransome, 2004).

## CONCLUSION

The information indicates that individuals in Punjab generally hold a positive view of honeybees and their essential role in pollination and agriculture. However, there is a notable knowledge gap concerning beekeeping practices, honeybee products, and honeybee health. While respondents expressed a favorable attitude toward honeybee conservation, the limited scientific knowledge and low participation in training programs highlight the need for specialized educational initiatives and awareness training. Understanding the ecology and management of honeybees is crucial for developing effective strategies to protect and conserve these pollinators, which are vital for maintaining ecosystem balance and enhancing agricultural productivity.

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## CONFLICTS OF INTEREST

All authors declared that they have no competing interests in the manuscript.

## AUTHOR CONTRIBUTIONS:

Data was collected by MA, and A; while project was supervised by AMK and critically review MI.

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