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SOCIO ECONOMIC IMPORTANCE OF BEE FLORA OF DISTRICT BAJAUR.

THE SESSIONAL AVAILABILITY AND SOCIO-ECONOMIC IMPORTANCE OF BEE FLORA OF DISTRICT BAJAUR, PAKISTAN

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Abstract
Bees forage plants and honey bees play a significant role in agriculture, environment and economy Pakistan. The Bee Flora Calendar, which outlines the flowering periods of key plants which is crucial for honey production in District Bajaur. Among the major beekeeping hotspots in the region, the natural forests of Tehsil Mamund, Tehsil Barang, and Tehsil Salarzai provide essential forage resources for honeybee populations, supporting sustainable apiculture and local livelihoods. The study was carried out to assess the Bee flora and flowering calendar that produce maximum honey following the flowering period of the local bee flora. The Semi structured questionnaires, participatory Rural Appraising techniques, and field observation were utilized for the collection of data. During the field survey a total of (82) plant species (Table 1) of Bee flora were identified and also enlisted with their flowering period and potential point areas. The field survey shows the socio-economic importance of
beekeeping and Production of Honey and Net Income from Honey of the local Beekeepers. The overall total average production of honey and the net income per beekeeper net cost from honey production were 840kg per year. The results in Table.3 show that the highest average annual production were recorded from Tehsil Salarzai (180 kg) followed by Tehsil Barang (160 kg), Tehsil Mamund (160 kg), Tehsil Chamar kand (140 kg) and Tehsil Utman Kail (80 kg) which is the lowest production were documented in district Bajaur the total average cost on the Honey Bees is (340,000PKR) and the Total annual Net Income from honey sell is (1,334,000 PKR) (700 kg). The total annual cost was observed in this study (70000 Rs.), the highest cost was recorded in Tehsil Salar Zai and Barang followed by (50000 Rs.), while the minimum annual cost of beekeepers was recorded from Tehsil Salar Zai regarding the net Honey Production (7000 Rs.). The total average gross annual income from honey sale was recorded is (1,512,000 PKR). In this regard the Beekeeping industry having a key role in the income of local community.

Keywords: Study Area; Survey plan; Bee Flora and local Beekeeper

Introduction

The Bee forage plants and honey bees having a significant role in agriculture environment and the economy Pakistan. Bee flora refers to the plants that provide nectar and pollen to honey bees, supporting their survival and honey production (Usman *et al.* 2022) In Pakistan, diverse climatic zones and rich floral diversity make the country suitable for beekeeping (Saeed 2022). Some of the major bee flora species in Pakistan include Acacia Spp Zizyphus Spp Eucalyptus Spp Citrus Spp Brassica Spp etc. These plant species not only support bee populations but also enhance agricultural productivity through pollination (Khan and Ghramh 2020). The increasing awareness about the ecological and economic significance of bee flora and honey bees has led to the promotion of beekeeping and conservation efforts in Pakistan (Khan and Khan 2018). The *Apis mellifera,* is introduced and established in Pakistan while the other Honey Bees species ie *Apis florea, Apis cerana, A. dorsata, and A. mellifera* are three indigenous species in Pakistan. Mostly these Honey bee are present in all ecological of the country (Noor *et al.* 2009). The *A. florea, A. mellifera, A. dorsata,* were also investigated in District Bajaur. All over the province Khyber Pakhtun Khawa (The rock bees (*Apis dorsata*) colonies are distributed (Khan 1984). The production of a single colony of *Apis dorsata* (rock bees) may be reach to 22-45 kg per year (Ahmad and Munawar 2013). The (*Apis florea)* is small in size as compare to other honey bees are mostly found in the foot hills and plains of all provinces of Pakistan (Ahmad and Munawar, 1985; Noor *et al.* 2009a, b).The Honey production is not good a single colony may yield in per year (an average 3-4 kg of honey (Ahmad and Munawar 1985). While the quality of honey is very good and mostly like by everyone (Tang and Ran 2024). In 1979 century the A. *mellifera* are introduced from Russia and Australia to Pakistan and are raised up here successfully (Noor *et al.* 2009). Depend upon the good beekeeping methodology the annual Production of honey 45kg to50 kg per year by single productive colony. The Beekeeping has been practices in the Northern Areas of Pakistan start from the start of the human civilization (Noman and Zafar 2023). The Beekeeping is a valuable industry in our country. About 11,000 beekeepers are working in Pakistan and having different Honey bee's species (Ashfaq 2006). Due to unsuccessful mating of queen the (*Apis mellifera*) species were field which was imported from Germany in 1972-73. in 1973 the Pakistan Agriculture and Research Council (PARC), Islamabad, introduced colonies of European Honey bee from Russia and Australia, these honey bees having the ability to produce maximum honey as compare to local honey bees. They collect nectar and pollen from Sarsoon (Brassica campestris), Ber (*Zizyphus mauritiana* Shaftal (*T. alexandrianum*), Barseem, Phulai (*Acacia modesta*) and (*Trifolium resupinatum*) (Ahmad 1981). The mentioned plants species like Shaftal (*T. alexandrianum*), Barseem (*T. resupinatum*) and Sarsoon (*Brassica campestris*) are very common and cultivated in district Bajaur. Ber (*Zizyphus mauritiana*)Eucalyptus and Phulai (*Acacia modesta*), found in tehsil Barang hills,Tehsil Nawagi hills and Tehsil Mamund Chenagai areas. The Beekeepers collected the Honey and then sold in local markets. The price of honey fluctuates during different seasons of the year. It also depends upon the species of bees. The price of honey of small size honey bees is higher than others in the market. It is strongly recommended that the District Bajaur has a great potential for honey bee production industry since the area having great potential of Bee flora and presence of various species of honey bee. During the field survey it is found that most of the beekeepers are very trained and having professional handling of beekeeping methodology. Mostly the beekeepers belong to the tehsil salar zai Village Tangai and Tehsil Mamund.

C. Research area

The district Bajaur become under the jurisdiction of Malakand Division of Khyber Pakhtunkhwa since 1973. It remained an Agency of the erstwhile FATA till May 2018.The District Bajaur was a princely state which was run by the Nawab of Bajaur Name Nawab Abdul Subhan till 1990. After eighteen amendments in the constitution of pakistan the FCR was no more due to 25th national constitutional amendment of Pakistan the district Bajaur become the Tribal District of Khyber Pakhtunkhwa. District Bajaur is located at longitude of 71.42° N latitude of 71.52°E with total area of 1,290 km^2. It has boundaries with and Mohmand district on the south-west Malakand district on

the south-east, district Dir (Lower) and Afghanistan on the north-west. Due huge deforestation in the area The mountains of the district Bajaur are barred and severe climatic conditions. About 65 % area of Bajaur is hilly and 35 % is plain. District Bajaur is divided into two sub-divisions (Khar and Nawagai) and eight Tehsils (Loi Mamund, Wara Mamund, Barang, Chamarkand, Kha r, Salarzai,Utman Kheil and Nawagai) (Naz *et al.*2019; Nizami *et al*. 2020a,b). The region experiences a semi-arid climate with notable variations in temperature and precipitation throughout the year, due to the geographical location and topography of the District Bajaur. The minimum and maximum temperature during winter is 7.1 C and Maximum 37.6 C in summer. December and January is the coldest month while July and Jun, July is the hottest month of the year. While The Average annual rainfall is 800mm.

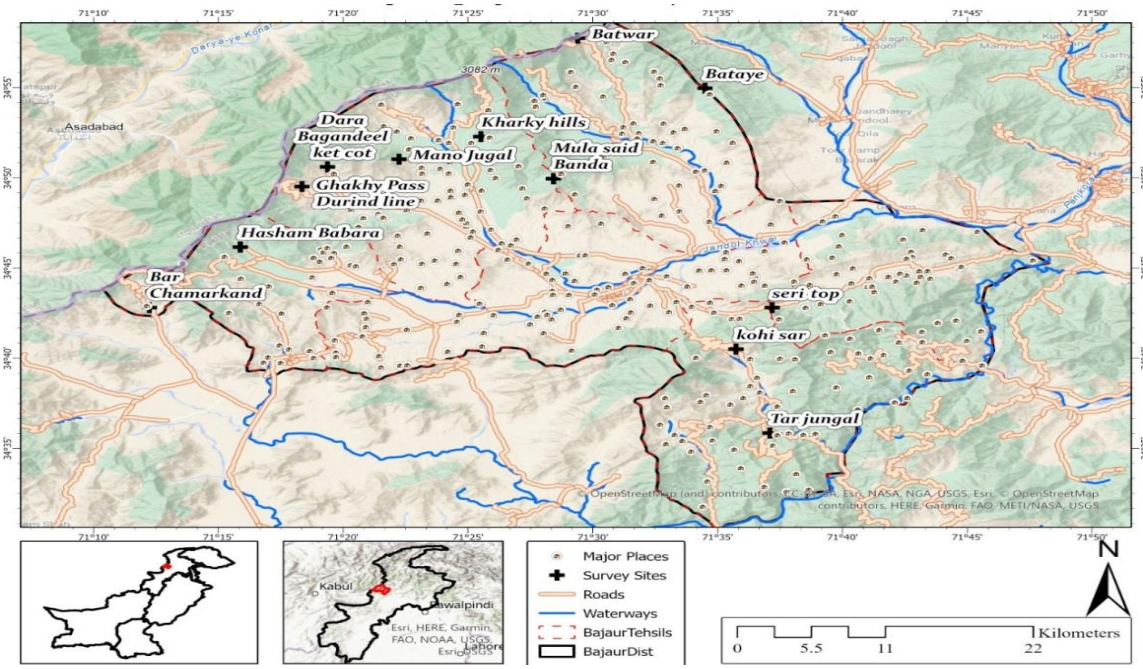

Figure: 1 Map of the Study Area.

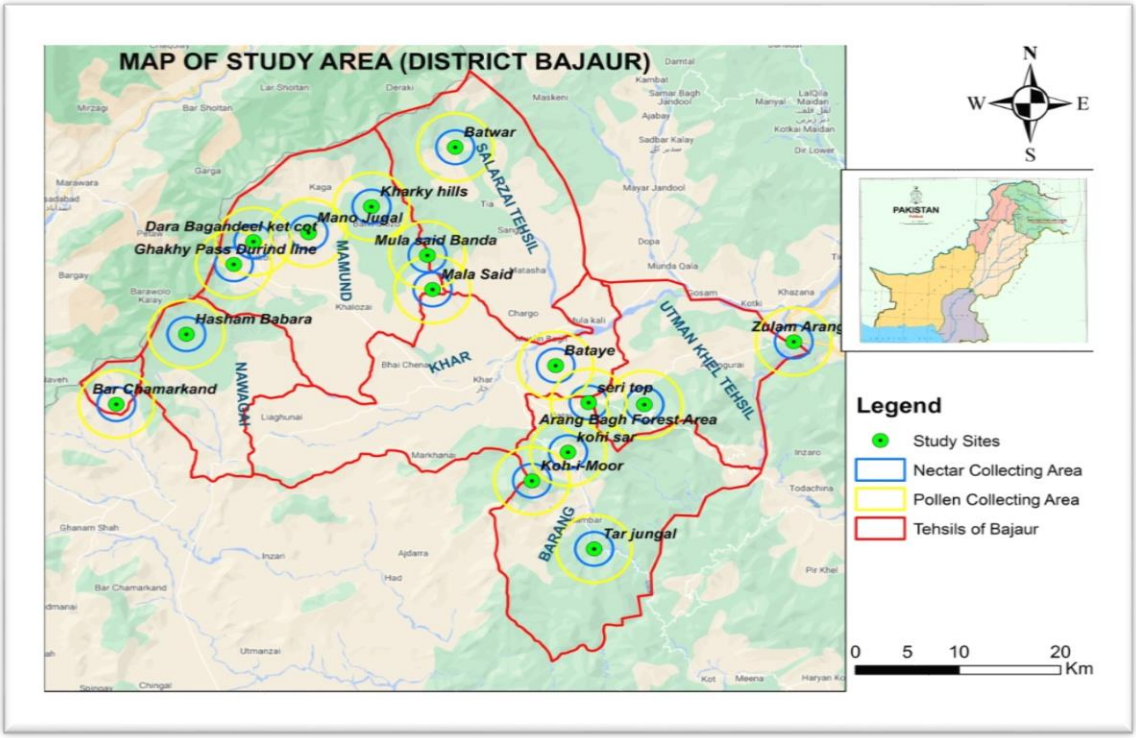

Figure: 2 Map of the Selected study Site in District Bajaur

Materials and Methods

Data collection:

For the collection primary data during the blooming season in District Bajaur with the Primary objective of systematically collecting and documenting bee flora a field survey was undertaken in all Tehsils of District Bajaur, specifically Focusing on identifying nectar and pollen plants showing in (Table.1).The aim of the field survey to provide valuable information regarding the local plant species which is crucial forage for honeybees, particularly *Apis mellifera*. The survey methodology involved careful observation and documentation of flowering species present in the region by using field guides, botanical literature, and referencing various volumes of the flora of Pakistan, such as used by (Ali and Qaiser 2009). The collected plant specimens were identified through visual observation of foraging activities by honeybees. Confirmation of a plant's significance as a bee-friendly plant species of producing nectar or pollen plants (Ali and Qaiser 2009).it was observed in the field survey that the blooming periods of various plant species are started from 22 February to end of April. The data revealed distinctive blooming months for different plants in the study area. The collected plant species were identified as a bee flora into two separate groups, specifying whether a particular plant served as nectar producing plant and pollen producing plant or both nectar and pollen plant. This classification, based on the field survey, contributes valuable information to understanding the ecological dynamics of bee flower interactions in District Bajaur. The results of this survey not only provide a comprehensive inventory of bee flora but also provide practical insights for local beekeepers, conservationists, and policymakers. Understanding the specific plant preferences of honeybees is crucial for promoting sustainable, beekeeping practices and supporting the overall health of pollinator populations in the region (Kumar *et al*. 2021).

Sampling Method of Scio economic data collection of Beekeeping

The experiment was conducted at the eight different tehsils of district Bajaur The following intents were covered by this experiment; demographic characteristics, beekeeping types, problem facing by beekeepers, season wise problem with beekeepers, cost on management, production of honey bees and Marketable price of honey**.**

Socio-economic data collection

Therefore, an exhaustive questionnaire was designed for this study which contained maximum relevant information regarding the beekeeping sector of the sampled regions. The study was comprised 45 beekeepers; every individual of the recorded population got an equal probability. For exploring the general overview of the subsectors, an initial brief survey was conducted following participatory rural appraisal (PRA) approaches. Consequently, the already designed questionnaire was pretested and adjusted based on the feedback obtained from the group and finally data were collected by interviewing of sample respondents. Descriptive statistics were utilized to investigate the quantitative information. All the picture were drawn of the Bee Flora of the study area and also take the GPS point of the specific area. The data were analysed with help of the statistical software package SPSS version 2016. During the field Survey the local Bee keepers and professional honey collectors were interviewed for the documentation of information about honeybee species and honey present in the study area.

Results

During the blooming session the field data of survey total number of (82) plant species both cultivated and wild plant species were collected from the study area shows that honey bee flora comprises of total number major bee flora ie plant species beri (*Z. numularia*) , (*Zizyphus mauritiana*) (*Accacia Modista.* L),Sarsoon (*Brassica campestris*), Shisham (*Dalbergia sissoo*), Makai (*Zea mays)*, Dania (*Coriandrum sativum* L), Grand (*Carisa opaca),* Ghana*(Silybum marianum),* Kaghzi nimboo (*Citrus aurantifolia*) , Phulai ,(*Acacia modesta*), Khatta (*C. medica*), Malta (*C. sinensis*) Shaftal (*Trifolium alexandrianum*) , ,Behkar *(Justicia adhatoda* L*.) Lady finger (Abelmoschus esculentus L.),*Kowary *(Berberis lycium Royle.),* Zangali Sharsham *(Brassicaca dmea*

Heldr.), Jangali lobia*(Phaseolus vulgaris)* Gum Arabica *(Acacia Senegal),* Masqutees *(Prosopis juliflora),* Tora Bakayan *(Melia azedarach* L.*)* Sufaida *(Eucalyptus camaldulensis*) and Mesquites *(Prosopis juliflora*) were categorise as a major source honey bee forage and produce surplus honey while the other Plant species are the minor Bee flora. The minor bee floras fulfil the flowering session gaps among the major sources in different period of the year and help in constant supply of food.

Table: 1. Sessional availability of common bee flora of district Bajaur

S/N	Scientific name	Local Name	Family	Habit	Yield	Flowering Period
	Coriandrum sativum L.	Danya	Apiaceae	Herb	Nectar Pollen	April- May
	Trachyspermum ammi L	Ajwani	Apiaceae	Herb	Nectar Pollen	April- May
	Carisa opaca	Garinda	Apocynaceae	Shrub	Nectar Pollen	April-June
	Silybum marianum	Ghana/ pashto name	Asteraceae	Herb	Nectar Pollen	Mar-Apr
	Justicia glabra	Khar booty	Acanthaceae	Herb	Nectar Pollen	Mar-Apr
	Cichorium intybus	Chicory	Asteraceae	Herb	Pollen	may-Oct
	Calendula officinalis L.	Dambarguly	Asteraceae	Herb	Nectar Pollen	Sep–January
	Dahlia variabilis	Ornamental Gulab	Asteraceae	Herb	Nectar Pollen	July-October
	Chrysanthemun indicum	Ziar Gully	Asteraceae	Herb	Nectar Pollen	July-October
	Helianthus annuus	Sun flower	Asteraceae	Herb	Nectar Pollen	May-July
	Guizotia abyssinica	Zair Gully	Asteraceae	Herb	Nectar Pollen	May-July
	Tridax procumbens	Speen Gully	Asteraceae	Herb	Nectar Pollen	Jan-Dec
	Silybum marianum	Ghana/pashto name	Asteraceae	Herb	Nectar Pollen	Mar-Apr
	Aster sp.	Unknown	Asteraceae	Herb	Nectar Pollen	Mar-Apr
	Justicia adhatoda L.	Bihkur	Acanthaceae	Shrub	Nectar Pollen	Feb-April
	Hygrophilia auriculata	Unknown	Acanthaceae	Shrub	Nectar Pollen	March-April
	Allium sativum L.	Ooga	Amaryllidacea	Herb	Pollen	May -June
	Tecoma stans	Zair Gully Climber	Bignoniaceae	Climber	Nectar	August-Nov
	Brassica campestris	Sarsoon	Brassicaceae	Herb	Nectar Pollen	Jan-Mar
	Brassicaca dmea Heldr.	Zangali sharsham	Brassicaceae	Herb	Nectar Pollen	March-April
	Berberis lycium Royle.	Kowary (zear largay)	Berberidacea	Shrub	Nectar Pollen	March-July
	Commelina sp.	Sheen Gully	Commelinaceae	Herb	Pollen	March-April
	Ipomea batatas	Perwatai	Covoluvaceae	Herb	Nectar Pollen	March-May
	Ipomea alba	Perwatai	Covoluvaceae	Herb	Nectar Pollen	March-May
	Luffa cylindrica L	Toree	Cucurbitaceae	Herb	Nectar Pollen	Jun-December
	Cucumis sativus L	Keera/Badrang	Cucurbitaceae	Herb	Nectar Pollen	April-December
	Cucumis melo	Khataky	Cucurbitaceae	Herb	Nectar	Jun-

S/N	Scientific name	Local Name	Family	Habit	Yield	Flowering Period
					Pollen	December
	Cucurbita pepo	Dobi Kado	Cucurbitaceae	Herb	Nectar Pollen	Jun-December
	Lagenaria leucantha	Kado	Cucurbitaceae	Herb	Nectar Pollen	April-September
	Cucurbita maxima	Sor Kado	Cucurbitaceae	Herb	Nectar Pollen	April-September
	Capparis decidua	Karir	Capparaceae	bushy shrub	Nectar Pollen	Mar-April
	Acacia modesta	Palosa,Phulai	Fabaceae	Tree	Nectar Pollen	Mar-May
	Bohinia verigata	Kachnar nectar	Fabaceae	Tree	Nectar Pollen	Mar-April
	Phaseolus vulgaris	Jangali Lobia	Fabaceae	Herb	Nectar	April-June
	Medicago sativa	Alfalfa	Fabaceae	Herb	Nectar Pollen	March-April
	Acacia Senegal	gum arabic tree	Fabaceae	Tree	Nectar Pollen	March-May
	Albizia lebbeck	Sarrs	Fabaceae	Tree	Nectar Pollen	March-May
	Prosopis juliflora	Mesquites	Fabaceae	small tree	Nectar Pollen	March-May
	Dalbergia sisoo	Shawa	Fabaceae	small tree	Nectar Pollen	March-May
	Punica granatum	Anar	Lythraceae	Tree	Nectar Pollen	May-July
	Isodon rugosus (Wall.exBenth).	Spairkiy	Lamiaceae	Shrub	Nectar Pollen	April–August
	Ajuga bracteosa Wall Buch. Ham.exD.Don.	Gute	Lamiaceae	Herb	Nectar Pollen	November-May
	Leucas aspera	Speen gully	Lamiaceae	Herb	Nectar Pollen	March-May
	Allium cepa	Piaz	Liliaceae	Herb	Pollen	April-May
	Alcea rosea	Common hollyhock	Malvaceae	Herb	Nectar Pollen	April–August
	Abelmoschus esculentus L.	Lady Finger/Bendi	Malvaceae	Herb	Nectar Pollen	April–August
	Hibiscus sutrattensis L.	Unknown	Malvaceae	Herb	Nectar Pollen	April–August
	Sida acuta	Unknown	Malvaceae	Herb	Pollen	*August-October*
	Melia azedarach L.	Tura Bakyan	Meliaceae	Tree	Nectar Pollen	April-May
	Morus alba	Toth	Moraceae	Tree	Nectar	April–July
	Acacia modesta	Palosa, Phulai	Mimosaceae	Tree	Nectar Pollen	March-May
	Myrtus communis L.	Mano	Myrtaceae	Shrub	Nectar Pollen	April–August
	Callistemon linearis	Battol Brush	Myrtaceae	Tree	Nectar Pollen	March-May
	Eucalyptus camaldulensis	Sufaida	Myrtaceae	Tree	Nectar Pollen	April –July
	Olea ferruginous	Kao/Olive tree	Oleaceae	Tree	Pollen	April-June
	Oxalis corniculata	Trewakai	Oxalidaceae	Herb	Pollen	March-April
	Portulaca oleracea	Warkhary	Portulaceae	Herb	Nectar	July-September
	Dalbergia sissoo	Shishum	Papilionaceae	Tree	Nectar Pollen	April

S/N	Scientific name	Local Name	Family	Habit	Yield	Flowering Period
	Trifolium Alexandrianum	Shaftal	Papilionaceae	Herb	Nectar Pollen	May-Jun
	T. resupinatum	Barseem/Arabi shaftal	Papilionaceae	Herb	Nectar Pollen	May-Jun
	Zea mays	Jawar/Makai	Poaceae	Herb	pollen	Jul-Oct
	Pyrus pashia	Nashpati	*Pyrus pashia*	Tree	Nectar Pollen	March-April
	Borreria sp.	Speen Gully	Rubiaceae	Herb	Nectar Pollen	March-April
	Citrus aurantifolia	Nimboo	Rutaceae	Shrub	Nectar Pollen	Jan–April
	Citrus sinensis	Malta	Rutaceae	Small tree	Nectar Pollen	Mar-Apr
	Citrus medica	Khatta	Rutaceae	Small tree	Nectar Pollen	Mar-Apr
	Zizyphus jujube	Beer	Rhamnaceae	Tree	Nectar Pollen	Jul-Oct
	Zizyphus Mauritiana	Karkanra/jangale Beer	Rhamnaceae	Tree	Nectar Pollen	Jul-Oct
	Z. numularia	Malla,Jheri beri,	Rhamnaceae	Small tree	Nectar Pollen	Jul-Oct
	Nigella sativa L.	Klonje	Ranunculaceae	Herb	Nectar Pollen	July-August
	Pyrus pashia	Jungali Apple	Rosaceae	Tree	Nectar Pollen	Mar-April
	Rosa cymosa	Rose	Rosaceae	Shrub	Pollen	March-May
	Rosa indica	Gulab	Rosaceae	Shrub	Pollen	March-May
	Solanum virginianum L.	Markody	Solanaceae	shrub	Nectar Pollen	November-May
	Solanum indicum	Markondai Ghana	Solanaceae	Herb	Nectar Pollen	Sep-Jan
	Solanum nigrum	Kach macho	Solanaceae	Herb	Nectar Pollen	Jun-Dec
	Solanum melongena	Bengun	Solanaceae	Herb	Nectar Pollen	April-Oct
	Lycopercicon esculentum	Tomato	Solanaceae	Herb	Nectar Pollen	April-Oct
	Solanum tuberosum	Alo	Solanaceae	Herb	Nectar Pollen	Mar-Jun
	Tamarix aphylla	Farash	Tamaricaceae	Tree	Nectar Pollen	March-May
	Vitis vinifera	Angoor	Vitaceae	Climber	Nectar Pollen	April–August
	Vitex negundo	Marvandai	Verbenaceae	shrub	Nectar Pollen	Sep-Nov

Discussion

The research areas were expansively surveyed to categorize present plant species visited by workers of honeybees for pollen and nectar collection. A detailed list of 82 plant species Plant Chick List Show Bothe cultivated and wild Bee Flora of the study area. In which 14 plant species, were found as major bee forage for the production of surplus honey showing in Table 1. *(Phulai) Acacia modesta* provide sufficient amount of nectar to the honey bees. The honey of *Acacia modesta* is white or very lightly marked. (Masterd - Sarsoon) *Brassica campestris* is a good source of nectar and pollen. The Honey of (Mastered - Sarsoon) yellow in colour and becomes grainy in a few days after harvesting. The Malta (*Citrus sinensis)* species provide both pollen and nectar for honeybees. Their pollens are especially very useful for early brood tending after flooded. The colour of the

Citrus sinensis honey is light amber. (Shisham): *Dalbergia sissoo* are also important sourece of nector and pollen wich provide nector and pollen to the honeybees the colour of sheshum honey is amber to dark-amber and having strong flavor. *Zizyphus jujube* (Beer) is also one of the best sources of nectar and pollen which provide nectar for honey. *Trifolium alexandrianum* and *T. resupinatum* (Clovers) are best source of nectar and pollen. The bulk of honey in the irrigated plains comes from this source. *Zea mays* (Maize- Makai) supplies larger quantities of pollen than other plants the comprehensive chick list of minor sources (bee flora species) of pollen and nectar has been listed in (table 2). These Minor Bee floras full fill the flowering period among the major sources in different session of the year which help in continuous supply of forage to honey bees (Shahid and Qayyum 1977). The overall total average production of honey and the net income per beekeeper net cost from honey production were 840kg per year. The results in Table 4.8 show that the highest average annual production were recorded from Tehsil Salarzai (180 kg) followed by Tehsil Barang (160 kg), Tehsil Mamund (160 kg), Tehsil Chamar kand (140 kg) and Tehsil Utman Kail (80 kg) which is the lowest production were documented in district Bajaur the total average cost on the Honey Bees is (340,000PKR) and the Total annual Net Income from honey sell is (1,334,000 PKR) (700 kg). The total annual cost was observed in this study (70000 Rs.), the highest cost was recorded in Tehsil Salar Zai and Barang followed by (50000 Rs.), while the minimum annual cost of beekeepers was recorded from Tehsil Salar zai regarding the net Honey Production (7000 Rs.). The total average gross annual income from honey sale was recorded is (1,512,000 PKR). In this regard the Beekeeping industry having a key role in the income of local community.

Socio-economic information

The local knowledge and socio-economic information for beekeeping was collected from locals of different age groups (25-35 years; 36-45 years; 46-55 years and 56-65 years) by interviewing them in the study area. A purposive sampling strategy was used in selecting the participants for discussion, questionnaires and interviews (Kinati *et al.* 2012).

Table:2 Demographic profile of beekeepers from different Tehsil of district Bajaur

Age group	Tehsil Mamund		Tehsil Chamar kand		Tehsil Nawagai		Tehsil Salar zai		Tehsil Barang		Tehsil Utman Khail	
	F	%	F	%	F	%	F	%	F	%	F	%
20-30 years	5	31	4	40	1	16.66	6	37	2	33.33	1	16.66
31-40 years	6	37.5	3	30	2	33.33	3	18.75	3	50	2	33.33
41-50 years	3	18.75	2	20	1	16.66	4	25	1	16.66	3	50
Above50 years	2	12.5	1	10	2	33.33	3	18.75	0	0	0	0
Total	16	100	10	100	6	100	16	100	6	100	6	100
Status of Education of the local Beekeepers												
Graduate	1	6.25	1	10	0	0	0	0	0	0	0	0
Secondary Literate	2	12.5	3	30	0	0	1	6.25	1	16.66	3	50
Middle Literate	8	50	2	20	2	33.33	2	12.5	1	16.66	2	33.33
Primary Literate	2	12.5	2	20	3	50	4	25	3	50	1	16.66
Illiterate	3	18.75	2	20	3	50	9	56.25	1	16.66	0	0
Total	16	100	10	100	6	100	16	100	6	100	6	100
Size of the Family Member												
1-5	2	12.5	3	30	1	16.66	4	25	2	33.33	1	16.66
6-10	10	62.5	6	60	3	50	8	50	4	66.66	3	50
Above 10	4	25	1	10	2	33.33	4	25	0	0	2	33.33
Total	16	100	10	100	6	100	16	100	6	100	6	100

Table: 3 Total annual in (kg) total annual cost and total net income from honey sell.

Tehsil	Total annual production (kg)	Total annual cost C	Gross annual income from honey sale D	Annual net income from honey sell DC
Tehsil Mamund	160	60,000	288,000	228,000
Tehsil Chamar kand	140	50,000	252000	202,000
Tehsil Nawagai	120	50,000	216,000	166,000
Tehsil Salar zai	180	70,000	324,000	317,000
Tehsil Barang	160	70,000	288,000	281,000
Tehsil Utman Khail	80	40,000	144,000	140,000
Total average	840	340,000	1,512,000	1,334,000

Average market rate Honey sale in District Bajaur (1800 PKR) per kg

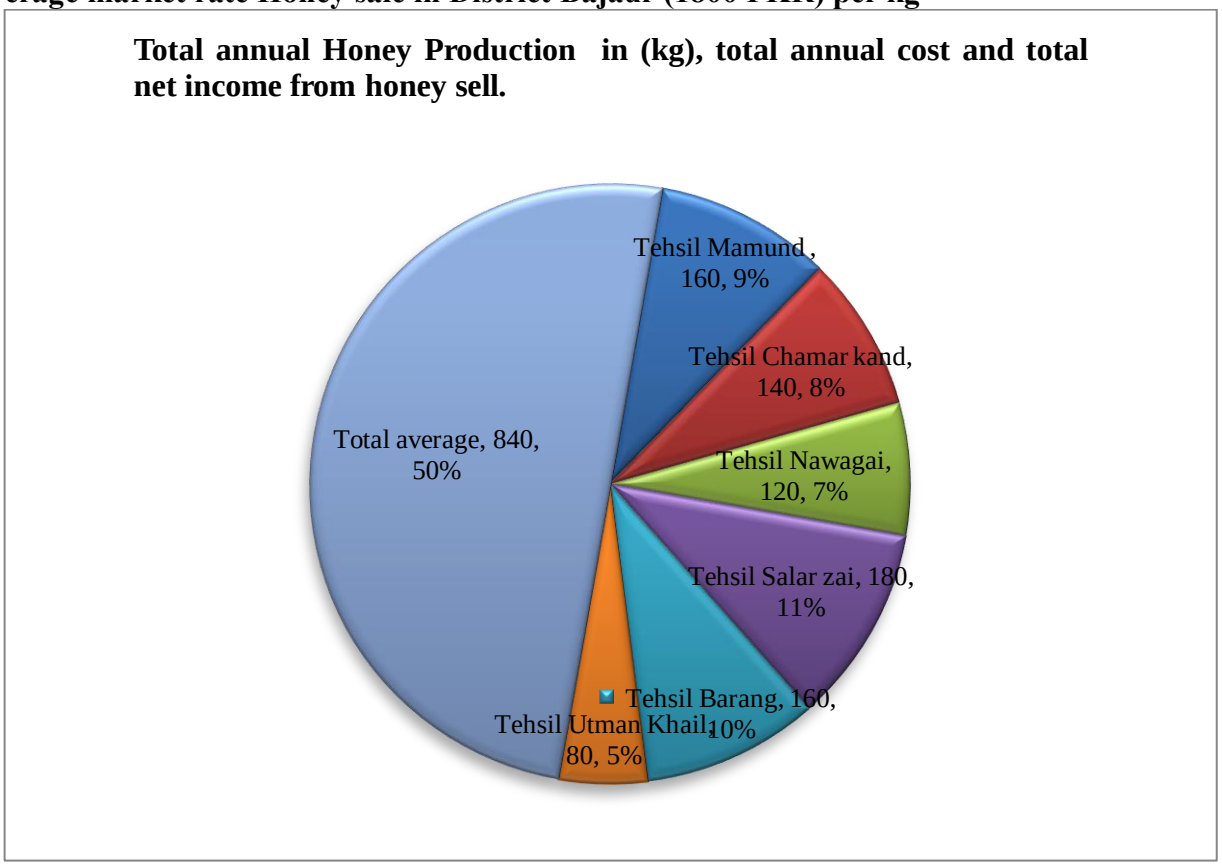

Figure: 3

Conclusion

From mid-March to May 2023 during the field survey in District Bajaur, a total of 82 bee flora plant species were identified, highlighting the region's rich floral diversity supporting pollinators. The distribution of bee flora varied across different land use types, with closed forest areas exhibiting the highest species diversity, while rain-fed lands had relatively fewer species. Key bee forage plants such as (*Trifolium alexandrinum)* (*Zea may),* (*Luffa cylindrical),* (*Coriandrum sativum*), (*Allium sativum*), and (*Brassica campestris*) played a crucial role in providing essential pollenand nectar resources. These findings underscore the ecological significance of bee flora in sustaining pollinator populations and highlight the need for conservation efforts to maintain and enhance floral diversity in Bajaur. Future studies should focus on seasonal variations in floral availability and the influence of land use changes on pollinator health and productivity. The peak honeybee foraging period was from March to April, coinciding with strong colony strength and peak honey harvest. However, from January to early March, forage scarcity weakened colonies.

Recommendations

Beekeepers must make sure proper feeding and colony management from the start of January to early March when natural forage is not available. Supplementary feeding with sugar sweet liquid and protein alternates could preserve colony strength during this period. When the peak foraging period occurs from 12 March to end of April, beekeepers should align their hive management practices, such as honey sparing and swarm control, to maximize honey production during this critical period. Beekeepers should collaborate with local farmers and authorities to promote bee-friendly flora, particularly for the dry season For the Inspiring the plantation of key bee forage species, especially nectar-rich plants, can help sustain honeybee colonies throughout the year. Given the positive impact of the rainy season on bee flora diversity, efforts should be made to conserve natural habitats and implement rainwater harvesting techniques to support floral growth during dry session. Since honey production directly impacts the socio-economic conditions of the community, cooperative initiatives among beekeepers, farmers, and environmental agencies can enhance sustainable beekeeping practices and improve local livelihoods. Local beekeepers should participate in training programs on modern beekeeping techniques, colony health management, and honey processing to improve productivity and sustainability.

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Conflict of Interest

All authors declare no conflict of interest

Data Availability

Data which presented in this research study will be available on a fair request to the Corresponding author

Ethics Approval

Not applicable to this research paper

Novelty statement

This study research provided the first comprehensive assessment of bee flora in Bajaur, an ecologically significant yet understudied region of Pakistan. By Authenticating floral diversity, blooming time period, and plant-pollinator interactions, this research offers novel insights into the district's pollination ecology. The findings contribute to biodiversity conservation, sustainable beekeeping practices, and climate change strategies, providing a critical information gap in the floristic composition supporting native and managed bee populations in Bajaur.

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