Research Article:

BEE FLORAL CALENDAR OF WILD AND CULTIVATED PLANTS IN PYUTHAN DISTRICT, NEPAL

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ABSTRACT

The availability of floral sources and their flowering duration are crucial for beekeeping, honey production, and crop pollination. This study was conducted to develop a floral calendar for beekeeping, exploring the potential of wild and cultivated bee flora in Pyuthan district. Primary data were collected from direct observation, 20 key informant surveys, and 9 focus group discussions in each municipality involving 227 beekeepers. In this study, a total of 100 plant species from 44 different families were identified and further categorized into nectar (N), Pollen (P), and both nectar and pollen source (NP). The honey flow period was reported to be from March to June and October to November, with the highest number of flowering plants (49) in April. While the winter season (December- February) was identified as a dearth period each having 10 flowering plants. Among the identified plant species, wild plants were found to be the major bee flora with 19 N1P1 plants, followed by fruits with 9 plant species. Based on the floral calendar analysis, the bee flora of the dearth period can be multiplied, and conservation of wild plants can be done to ensure year-round foraging of the honeybee and to minimize foraging disputes among farmers.

सारांश

मौरीपालन, मह उत्पादन र बाली परागसेचनका लागि मौरी चरनका वनस्पति र तिनीहरूको फूल फुल्ने समयावधि महत्त्वपूर्ण छन्। यो अध्ययन प्यूठान जिल्लामा जंगली र खेती गरिएका मौरी चरन वनस्पतिहरूको सम्भाव्यताको अन्वेषण गर्दै मौरीपालनको लागि चरन पात्रो तयार गर्न गरिएको थियो। प्राथमिक सूचना संकलनका लागि प्रत्यक्ष अवलोकन, २० जना प्रमुख सूचनादाताको सर्वेक्षण र हरेक पालिकाको १-१ वटा फोकस समूह छलफलमा २२७ जना मौरीपालकलाई सम्मिलित गराइएको थियो। यस अध्ययनमा ४४ विभिन्न परिवारका जम्मा १०० बोटबिरुवाका प्रजातिहरूलाई मौरीपालनका लागि महत्वपूर्ण बिरुवाका रुपमा पहिचान गरिएको थियो र पहिचान गरिएका बोटबिरुवालाई पुष्परस प्रवाह (एन), पराग प्रवाह (पी) र दुवै प्रवाह (एन पी) का आधारमा समुहबद्ध गरिएको थियो। मौरी चरन वनस्पतिको फूल फुल्ने समयका आधारमा प्यूठान जिल्लाको मह प्रवाह अवधि चैत्रदेखि असार तथा कार्तिकदेखि मङ्सिरसम्म रहेको जानकारी प्राप्त भयो जसमा चैत्र-बैशाख महिनामा सबैभन्दा धेरै फूल फुल्ने बिरुवाहरू (४९) थिए। जाडो मौसम (पुष-माघ) लाई पुष्परस अभाव अवधिको रूपमा पहिचान गरिएको थियो जसमा पुष महिनामा सबैभन्दा कम फूल फुल्ने बिरुवाहरू (१०) थिए। पहिचान गरिएका मौरी चरनका वनस्पतिहरूमध्ये जंगली वनस्पतिहरू र फलफूलका प्रजातिहरू पुष्परस र परागको महत्वपूर्ण स्रोत रहेको पाइयो जसमा पुष्परस र पराग दुवै प्रवाह गर्ने (एन१पी१) बिरुवाहरू क्रमशः १९ वनस्पति प्रजातिहरू र ९ प्रजातिहरू समावेश रहेका थिए। चरनपात्रो विश्लेषणको आधारमा वर्षभरि मौरीको चरन सुनिश्चित गर्न चरन अभावको समयमा फुल्ने बिरुवाको संख्या वृद्धि र जंगली बोटबिरुवाहरूको संरक्षण गर्न सकिन्छ। साथै, किसानहरूबीच चरन विवाद कम गर्न यो अध्ययन उपयोगी हुन सक्छ।

Keywords: Honey flow period, migratory beekeeping, nectar source, pollen source

INTRODUCTION

Beekeeping in the Nepalese community has been practiced since ancient times, starting from traditional beekeeping in locally made log-hives to modern hives with movable frames. Nowadays, migration practice for foraging is becoming an integral part of modern beekeeping. This phenomenon has been supported by our tremendously rich biodiversity, with 7,000 species of flowering plants (Adhikari & Ranabhat, 2011; Aryal et al., 2015; Bista & Shivakoti, 2001; MoFE, 2018). According to Pokhrel et al. (2014), the existing bee forage in the country can support one million honeybee colonies producing 10,000 mt of honey annually.

As mentioned, bee floras are any plants that provide nectar and pollen for the bees, like forest trees, bushes, shrubs, herbs, weeds, medicinal plants, crops, vegetables, fruits, and ornamental plants (Abrol, 1997; Hosamani et al., 2020; Kumar & Bharti, 2015; Pratap, 1997; Thapa, 2006). The success of the beekeeping sector depends upon the availability of bee forage plants. (Rucker et al., 2012). In such a situation, different tools for forage management are in use around the world, among them the bee forage calendar is one of them, which specifies the approximate month and duration of the flowering period of major bee flora in an area (Kumar et al., 2013). Assembling a forage calendar for any particular area needs complete information about seasonal dynamics in the vegetation patterns, bee foraging behavior, and the interaction of the honeybee with its floral environment (Debara et al., 2019).

Despite the huge potential, barely 0.25 million colonies are producing 4,305 metric tons of honey in Nepal (MoALD, 2023). The limited production of honey is significantly impacted by poor forage management, overconcentration of foraging in certain areas and seasons, and underutilization of potential foraging areas (AI-Ghamadi et al., 2016). However, in Pyuthan, the lack of a bee forage calendar results in overcrowding with migratory beekeepers in some municipalities, while some places are still untouched. Also, the trend of bee migration from Chitwan, Kapilvastu, Sarlahi, Kailali, and Kathmandu to Pyuthan during the flowering of *Chiuri (Diploknema butyracea*) has led to conflict between beekeepers (Swargadwari Municipality, 2022). Further, local beekeepers lack the knowledge about important bee flora available on their premises, along with the type of source they provide, i.e., nectar, pollen, or both K. Bhandari (Personal communication, March 8, 2023).

Based on the aforementioned condition, the paper is supposed to develop a location-specific bee forage calendar that can help to plan year-round feeding within the district and migration of bee colonies from other districts (Rijal and Thapa, 2024). The floral calendar of a particular district can also minimize the conflict in bee migration that has been seen in recent years and help to improve the livelihood of people in rural areas (Thapa, 2024). Detailed information about bee flora, their approximate flowering periods, and the foraging behavior of honeybees is essential for maintaining and enhancing the production of honey and other bee products (Dalio, 2013; Kumar et al., 2013). Pyuthan comprises 94.91 square kilometers of *Chiuri* forest with 5,30,820 butter trees (MEDEP, 2010), making it a potential district for migratory beekeeping. Still, the major honeybee floras are not identified, and the floral calendar has not been established to date. In this regard, this paper deals with foraging pattern, foraging calendar, and available plant species in Pyuthan district that would be able to meet the objective of;

a. To identify major wild and cultivated bee flora along with their nectar and pollen supply potential.
b. To develop a forage calendar suggesting the honey flow period and dearth period.

RESEARCH METHODS

The study was carried out during March 2024 covering 9 local bodies of Pyuthan district, based on the annual program of Apiculture Development Center (ADC), Godawari, Lalitpur (Fig. 1). Pyuthan district was purposively selected as a major hub of migratory beekeeping in recent years, having abundance of bee flora, no studies conducted before, and frequent complaints heard about the conflict in bee migration. It extends from an altitude of 305 to 3659 masl with 72,694 ha. of forest area, 42,766 ha of agriculture land, and 12,899 ha. of shrubs consisting of wild and cultivated bee floras.

The study involved collecting both primary and secondary data. The primary data was collected by focus group discussion, key informant survey, and direct observation. Focus group discussions were conducted in each local body involving an average of 25 beekeepers. In total, 227 beekeepers (185 male and 42 female) actively participated in the focus group discussion. The structured questionnaire was pre-tested by bee experts and experienced beekeepers. In every local body, a day-long workshop was conducted to discuss and collect primary data. Focus group discussions were mainly focused on the availability of wild and cultivated bee flora, their flowering time, flowering duration, and the type of source (nectar, pollen or both) they provide. Based on the focus group discussion, a list of bee flora was prepared. The Focus group discussion was followed by direct observation of available forage resources during survey time for verification and confirmation. The observation on nectar and pollen sources was based on activities performed by honeybees on different flowers. Flowers in which honeybees collect pollen in their pollen basket were recognized as pollen sources and the activities of extending their proboscis into the flowers were considered as nectar sources.

In order to reconfirm the list prepared by focus group discussion 20 key informant surveys were conducted involving experienced beekeepers, representatives of the Federation of Nepal Beekeepers (FNBK), the head of Integrated Agriculture and Livestock Development Office, Pyuthan, the head of National Agriculture Modernization Program, Program Implementation Unit, Pyuthan, the representative of the Division Forest Office Pyuthan, the head of the agriculture section of each municipality, and local leaders. The prepared list was further processed by including the scientific name of each species, family and the source they supply through secondary articles review.

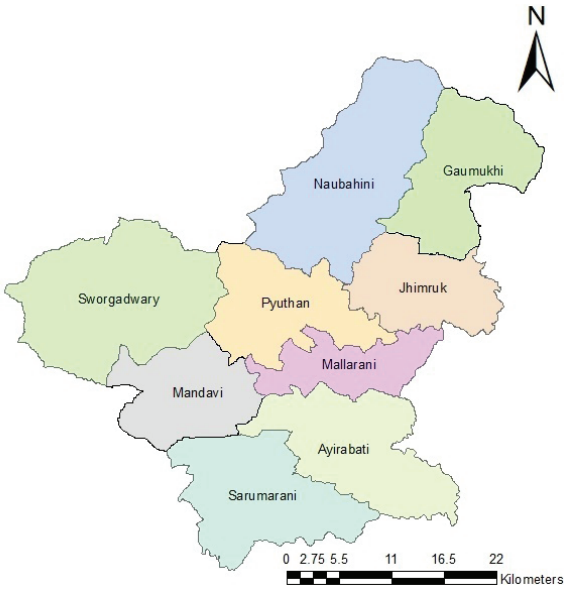

Fig. 1. Map of Pyuthan district. All the nine local bodies were the study sites
Source: GoN, 2025

Descriptive analysis tool was used to analyze the data by plant types (Wild, cereals, oilseeds, vegetables, pulse, fruits and ornamental plants), by plant families and by the supply of nectar, pollen or both. The identified plant species were categorized into 8 categories based on the source they supply as N1 for high nectar supply, N2 for low nectar supply, P1 for high pollen supply, P2 for low pollen supply, N1P1 for both high nectar and pollen, N2P1 for low nectar and high pollen, N1P2 for high nectar and low pollen and N2P2 for low pollen and low nectar. The list of bee flora under the category of plant type were placed into a chart presentation based on their flowering period to develop a bee floral calendar. According to the floral calendar the months with higher number and area of N1P1 plants were considered as honey flow period and the months with least flowering plants were referred as dearth period. Result findings and their reliability were discussed including pertinent articles from national and international publications. This research work complies with relevant ethical standards and legal requirements.

RESULTS AND DISCUSSION

Bee flora available in Pyuthan district

From the focus group discussion, direct observation and key informant survey 100 potential bee forage plants were recorded in Pyuthan district. Among them, 52 species were wild bee flora and 48 were cultivated species. In cultivated species, 3 oilseeds crops, 7 cereals, 6 pulse crops, 12 vegetables, 12 fruits and 8 ornamental plants were listed in the district (Fig. 2).

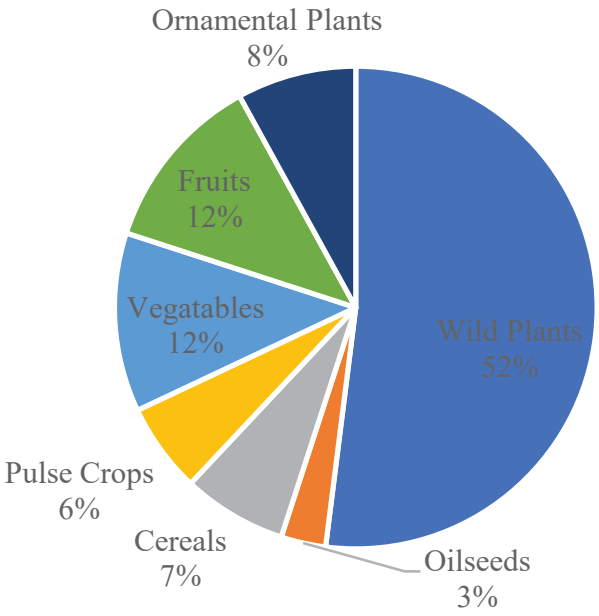

Fig. 2. Bee flora of Pyuthan district

The recorded plants were categorized under 44 different families (Table 1). The highest number of plant species (13) was recorded under Fabaceae, followed by Rosaceae (6), Poaceae (6), Cucurbitaceae (5), Malvaceae (5) and Rutaceae (5). Similarly, the lowest number of plant species (1) was recorded under 23 different families. Neupane et al. (2024) listed 50 plant families having potential bee flora, among which the Fabaceae family is the most important one as observed in this study. Among 13 bee flora of Fabaceae, *Trifloium repens* and *Dalbergia sissoo* are plants providing high nectar and pollen (N1P1). *Trifloium repens* is a perennial herb that can be easily sown in barren open fields, and its flowering period is 5 to 6 months making it appropriate for bees. Similarly, *Dalbergia sisso* is primarily found growing along river banks utilizing uncultivated and degraded land simultaneously benefitting honeybees.

Table 1. Bee flora of Pyuthan district categorized under plant families

SN	Families	Species
1	Acanthaceae	2
2	Anacardiaceae	1
3	Apiaceae	1
4	Asparagaceae	1
5	Asteraceae	2
6	Berberidaceae	1
7	Bignoniaceae	1
8	Boraginaceae	1
9	Brassicaceae	4
10	Combretaceae	1
11	Compositae	4
12	Cucurbitaceae	5
13	Dipterocarpaceae	1
14	Ebenaceae	1
15	Ericaceae	1
16	Euphorbiaceae	1
17	Fabaceae	13
18	Fagaceae	1
19	Juglandaceae	1
20	Lamiaceae	3
21	Lauraceae	2
22	Linaceae	2
23	Lythraceae	2
24	Malvaceae	5
25	Meliaceae	2
26	Moraceae	2
27	Musaceae	1
28	Myricaceae	1
29	Myrtaceae	3
30	Oleaceae	2
31	Pinaceae	1
32	Poaceae	6
33	Polygonaceae	2
34	Primulaceae	1
35	Proteaceae	1
36	Rhamnaceae	1
37	Rosaceae	6
38	Rubiaceae	1
39	Rutaceae	5
40	Salicaceae	1
41	Sapindaceae	2
42	Sapotaceae	1
43	Solanaceae	3
44	Theaceae	1

Bee forage calendar

Table 2 presents the bee forage calendar of Pyuthan district, which are arranged according to available forage source and their flowering month.

Table 2. Bee flora with their flowering time and available sources in Pyuthan district

SN	Scientific name	English name	Nepali name	Family	Source	Flowering month											
						J	F	M	A	M	J	J	A	S	O	N	D
Wild Plants																	
1	*Acacia catechu*	Cutch tree	Khayer	Fabaceae	N2P2						■	■	■	■			
2	*Agave americana*	Century plant	Ketuki	Asparagaceae	N2P2								■	■			
3	*Ageratum conizoides*	Common weed	Gandhe Jhar	Compositae	N2P2						■	■					
4	*Albizia lebbeck*	Albizia	Siris	Fabaceae	N2P1					■	■						
5	*Azarirachta indica*	Margosa	Neem	Meliaceae	N1P2				■	■							
6	*Berberis aristata*	Barberry	Chutro	Berberidaceae	N1P2			■	■								
7	*Bombax ceiba*	Silk cotton	Simal	Malvaceae	N1P1			■	■								
8	*Bahunia purpurea*	Geranium tree	Tanki	Leguminaceae	N2P2				■	■							
9	*Bahunia variegate*	Orchid tree	Koiralo	Lgumniaceae	N2P2				■	■							
10	*Campis grandiflora*	Chinese trumpet vine	Ghata Puspalata	Bignoniaceae	N1P2					■	■	■					
11	*Castanopsis indica*	Chestnut	Katush	Fagaceae	N1P1								■	■			
12	*Cinnamomum tamala*	Indian bay leaf	Tejpatta	Lauraceae	N1P1			■	■	■							
13	*Clerodendrum infortunatum*	Clerodendrum	Rajbeli	Lamiaceae	N1				■	■							
14	*Cordia dichotoma*	Glue berry	Bohori	Boraginaceae	N1P2					■	■	■					
15	*Dalbergia sissoo*	Sissoo	Sissoo	Fabaceae	N1P1			■	■								
16	*Diploknema butyracea*	Butter tree	Chiuri	Sapotaceae	N1P2	■									■	■	■
17	*Engelhardia spicata*	Great malay beam	Mauwa	Juglandaceae	N1P1			■	■								
18	*Eriobetrya* spp.		Teju	Ebenaceae	N1P1			■	■	■							
19	*Eupatorium adenophorum*	Eupatorium	Banmara	Compositae	N1P1			■	■								
20	*Euphorbia* spp.	Euphorbia		Euphorbiaceae	N2P2				■								
21	*Frayinus floribunda*	Ash tree	Lankuri	Oleaceae	N1P2				■	■							
22	*Ficus religoisa*	Sacred fig	Peepal	Moraceae	N1			■									

23	*Grevillea robusta*	Silver oak	Kaiyo plant	Proteaceae	N1P1													
24	*Grewia optiva*		Bhimal	Malvaceae	N1P1													
25	*Justicia adhatoda*	Malabar nut	Asuro	Acanthaceae	N1P2													
26	*Lagerstroemia indica*	Crape myrtle	Asare Phul	Lythraceae	N1P1													
27	*Leucaena leucocephala*	Epil-epil	Epil-epil	Fabaceae	N2P1													
28	*Litsea monopetala*	Litsea	Kutmiro	Lauraceae	N2P2													
29	*Maesa chisia*	Chisia wild berry	Bilaune	Primulaceae	N1P2													
30	*Morus alba*	Mulberry	Kimbu	Moraceae	P1													
31	*Melia azedarach*	China berry	Bakaino	Meliaceae	N2P2													
32	*Myrica esculenta*	Bay-berry	Kafal	Myraceae	N1P1													
33	*Parthenium hysterophoru*	Parthenium	Gajar jhar	Asteraceae	P1													
34	*Pogostemon glaber*	Pogostemon	Rudilo	Lamiaceae	N1P2													
35	*Pinus ruxburghii*	Pinus	Sallo	Pinaceae	P1													
36	*Prunus cerasoides*	Wild cherry	Paiyun	Rosaceae	N1P1													
37	*Reinwardtia indica*	Yellow flax	Pyauli	Linaceae	N2P2													
38	*Rhododendron arboreum*	Rhododendron	Laliguras	Ericaceae	N1P2													
39	*Rosa brunonii*	Wild rose		Rosaceae	N1P1													
40	*Rubus ellipticus*	Golden himalayan raspberry	Aiselu	Rosaceae	N1P2													
41	*Rumex scutatus*	Buckler sorrel	Kapu	Polygonaceae	P1													
42	*Sapindus mukorossi*	Soapberry	Rithha	Sapindaceae	N1P1													
43	*Schima wallichii*	Needlewood	Chilaune	Theaceae	N1P2													
44	*Shorea robusta*	Sal	Sal	Dipterocarpaceae	N1P2													
45	*Syzigium cumini*	Java plum	Jamun	Myrtaceae	N1P1													
46	*Terminalia bellirica*	Myrobalan	Barro	Combretaceae	N1P1													
47	*Thunbergia coccinea*	Thunbergia	Kagchuchhe	Acanthaceae	N1P1													
48	*Trifolium repens*	White clover	Tinpate	Fabaceae	N1P1													
49	*Vitex negundo*	Chinese chaste tree	Sewli	Lamiaceae.	N1P2													
50	*Wendlandia* spp.		Tilko	Rubiaceae	N1P2													
51	*Xylosma* spp.		Raju	Salicaceae	N1P1													
52	*Zizyphus* spp.	Jujube	Bayer	Rhamnaceae	N1P2													

Cereals																	
53	*Eleusine coracana*	Finger millet	Kodo	Poaceae	P2												
54	*Fagopyrum esculentum*	Buckwheat	Phapar	Polygonaceae	N1P2												
55	*Oryza sativa*	Rice	Dhan	Poaceae	P2												
56	*Oryza sativa*	Rice (Spring)	Chaite Dhan	Poaceae	P2												
57	*Triticum aestivum*	Wheat	Gauh	Poaceae	P2												
58	*Zea mays*	Maize (Rainy season)	Makai	Poaceae	P1												
59	*Zea mays*	Maize (Winter season)	Hiunde makai	Poaceae	P1												
Oilseeds																	
60	*Brassica campestris var toria*	Rapeseed	Tori	Brassicaceae	N1P1												
61	*Brassica campestris var sarson*	Sarson	Sarsyun	Brassicaceae	N1P1												
62	*Linum usitatissimum*	Linseed	Aalas	Linaceae	N2P2												
Vegetables																	
63	*Abelmoschus esculentus*	Lady's finger	Bhindi	Malvaceae	N2P2												
64	*Brassica oleracea var. italica*	Broccoli	Brocauli	Brassicaceae	N2P2												
65	*Capsicum annum*	Chilli	Khursani	Solanaceae	N2P2												
66	*Coriandrum sativum*	Coriander	Dhaniya	Apiaceae	N2P2												
67	*Cucumis sativus*	Cucumber	Kakro	Cucurbitaceae	N1P1												
68	*Cucurbita moschata*	Pumpkin	Pharsi	Cucurbitaceae	N1P1												
69	*Lagenaria siceraria*	Bottle gourd	Lauka	Cucurbitaceae	N2P2												
70	*Luffa aegyptiaca*	Sponge gourd	Ghirunla	Cucurbitaceae	N2P2												
71	*Lycopersicon esculentum*	Tomato	Tamatar	Solanaceae	N2P2												
72	*Momordica charantia*	Bitter gourd	Karela	Cucurbitaceae	N2P2												
73	*Raphanus sativus*	Radish	Mula	Brassicaceae	N1P1												
74	*Solanum melongena*	Brinjal	Bhanta	Solanaceae	N2P2												
Pulse crops																	
75	*Cicer arietinum*	Chickpea	Chana	Fabaceae	N2P2												
76	*Glysine max*	Soybean	Bhatmash	Fabaceae	N2P2												
77	*Lens culinaris*	Lentil	Masuro	Fabaceae	N1P2												

78	*Phaseolus vulgaris*	Kidney bean	Rajma	Fabaceae	P2												
79	*Pisum sativum*	Peas	Kerau	Fabaceae	N2P2												
80	*Vigna unguiculate*	Cowpea	Bodi	Fabaceae	N2P2												
Fruits																	
81	*Citrus aurantifolia*	Lime	Kagati	Rutaceae	N1P1												
82	*Citrus grandis*	Pumelo	Bhogate	Rutaceae	N1P1												
83	*Citrus limon*	Lemon	Nibuwa	Rutaceae	N1P1												
84	*Citrus reticulata*	Mandarin orange	Suntala	Rutaceae	N1P1												
85	*Citrus sinensis*	Sweet orange	Mausam	Rutaceae	N1P1												
86	*Litchi chinensis*	Litchi	Litchi	Sapindaceae	N1P1												
87	*Mangifera indica*	Mango	Aanp	Anacardiaceae	N2P1												
88	*Musa paradisiaca*	Banana	Kera	Musaceae	N2P2												
89	*Psidium guajava*	Guava	Amba	Myrtaceae	N1P1												
90	*Pyrus communis*	Pear	Naspati	Rosaceae	N1P1												
91	*Pyrus persica*	Peach	Aaru	Rosaceae	N1P1												
92	*Punica granatum*	Pomegranate	Anar	Lythraceae	N2P1												
Ornamental Plants																	
93	*Callistemon citrinus*	Bottlebrush	Kalkiphool	Myrtaceae	N1P1												
94	*Chrysanthemum segetum*	Chrysanthemum	Godawari	Asteraceae	N2P2												
95	*Dahlia pinata*	Dahlia	Lahurephool	Compositae	N2P2												
96	*Hibiscus rosa-sinensis*	Chinese rose	Ghantiphool	Malvaceae	N1P2												
97	*Malvaviscus abrorues*	Wax mallow	Khursaniphool	Malvaceae	N2P2												
98	*Nyctanthes arbor-tristis*	Night Jasmine	Parijat	Oleaceae	N1P1												
99	*Rosa indica*	Rose	Gulab	Rosaceae	N2P1												
100	*Tagetes patula*	Marigold	Sayapatri	Compositae	N2P2												

Note: Initial letter of month, J= January to D= December; N1= High Nectar, N2= Low Nectar, P1= High Pollen, P2= Low Pollen

Bee flora in relation to the month

In this study 100 bee forage species were recorded and studied such as *Diploknema butyracea, Pogostemon benghalensis, Castanopsis indica, Prunus cerasoides, Schima wallichii, Rubus ellipticus, Xylosma spp., Maesa macrophylla, Thunbergia coccinea, Bombax ceiba, Dalbergia sissoo, Terminalia bellirica, Leucaena tricodes, Diospyros malabarica, Wendlandia spp., Rumex scutatus, Brassica campestris* var *toria, Fagopyrum esculentum, Coriandrum sativum, Citrus* spp.*, Pyrus* spp.*, Litchi chinensis, Nyctanthes arbor-tristis,* and *Callistemon citrinus.* Most of the flowering plants and their flowering months are similar to flora calendar prepared by Rijal et al. (2018) in Chitwan and Bhattarai et al. (2023) in Lamjung districts.

Based on the prepared floral calendar the honey flow and dearth periods were determined, and the results are summarized in Table 3 and 4. This table indicates that the majority of bee forages are available from March to June. During March, April, May and June, 46, 49, 38 and 34 blooming plants are available. Major forage plants of this season are; *Syzigium cumini, Trifolium repens, Dalbergia sisso, Citrus* spp.*, Xylosma* spp.*, Thunbergia coccinea, Engelhardia spicata, Eriobetrya* spp.*, Litichi sinensis, Myrica ecsulenta, Pyrus* spp.*, Bombax ceiba, and Pyrus persica.*

Table 3. Distribution of crops and wild forage plants with their flowering month

Plants	J	F	M	A	M	J	J	A	S	O	N	D
Wild plants	2	6	26	32	25	16	13	6	5	3	3	3
Oilseeds	2			1	1	1	1			1	2	2
Cereals	2	2	1			2	2	2	2	3	1	
Pulse crops	1	2	1		1	1	1	2	1	1	1	
Vegetables	1	2	4	4	3	8	6	6	2	1	1	1
Fruits	1	6	11	7	2	1	1	1	1	1	1	1
Ornamental plants	1	1	3	5	6	5	2	1	3	3	3	3
Total	10	19	46	49	38	34	26	18	14	13	12	10

Note: Initial letter of month, J= January to D= December

In table 4, the number of plants with different nectar and pollen supply in relation to month are presented that shows that the number of plant species having N1P1 source are higher in the month of March to May with highest number in April making these months a honey flow period of Pyuthan district. On the other hand, from October to November, the major bee flora of Pyuthan, such as *Chiuri, Paiyun, and* mustard flowers provide a higher supply of nectar and pollen. Even though fewer plant species serve as bee flora in autumn, honey flow is better due to their larger area coverage and familiarity with beekeepers. There are over 5 lakh plants of chiuri (MEDEP, 2010), and mustard is cultivated in 860 ha of land (MOALD, 2024), ensuring nectar supply to honeybees. As we can see, spring season is equally potential for beekeeping with a higher number of bee floras; their importance and ability to raise honey yield are undermined among beekeepers, leading to underutilization of forages during this season and overconcentration during autumn. Over the past few years, migratory beekeepers have only focused on the autumn to the butter tree source, causing overcrowding and conflict. In this context, migration in the spring season can be a good option with less competition.

Meanwhile, the winter season (December to January) was found to be a dearth month, each having only 10 blooming plants. This is the major time of the year during which artificial feeding should be planned. Some important forage plants that flower during dearth periods

are *Thunbergia coccinea*, *Castanopsis indica*, *Cucumis sativus, Cucurbita moschata,* and *Parthenium hysterophorum.* Similarly, Neupane et. al (2024) reported winter season as a dearth period in mid-hill with low temperature, short sunshine duration, and low availability of bee flora.

Table 4. Bee forage plants with different sources available in Pyuthan district

Sources	J	F	M	A	M	J	J	A	S	O	N	D
N1			1	1	1							
P1	1	2	5	4	2	3	2	2	1	1	1	1
P2	1	1				1	1	1	1	3	2	
N1P1	3	9	21	18	10	7	7	3	2	2	3	3
N1P2	2	3	9	11	10	5	5	1	1	1	1	1
N2P1			1	3	3	1	1	1	1			
N2P2	3	4	9	12	12	10	10	10	8	5	5	5
Total	10	19	45	48	37	27	26	18	14	12	12	10

Note: Initial letter of month, J= January to D= December; N1= High Nectar, N2= Low Nectar, P1= High Pollen, P2= Low Pollen.

Bee flora in relation to the available source

The bee forage plants are categorized according to the source of nectar (N1, N2) or pollen (P1, P2) and their combinations are presented in Table 5. Among them, 35 plants are rich in both nectar and pollen (N1P1) along with 19, 5, 28 species falling in the N1P2, N2P1, and N2P2 categories, respectively. Two species are rich in nectar only (N1), whereas 9 species are rich in pollen (P1), and 10 species are minor sources of pollen (P2).

The major bee forages are wild plants with a greater number of plants providing both nectar and pollen (N1P1) compared to cultivated crops. Besides, wild plants, fruit species are rich in both nectar and pollen. Therefore, planting of fruits, such as citrus, peach, pear and litchi seems to be effective for beekeeping which is similar to the study carried out by Adhikari & Ranabhat (2011). Neupane et al. (2024) indicated major wild plants flowering during March-June and fruit trees flowering during the spring season (March and April) which are major bee flora in the district. Cereals are a good source of pollen (P1 and P2). Oilseeds, vegetables, pulses, and ornamental plants are minor sources and beneficial during the dearth period.

Table 5. Bee forage plants as nectar and pollen sources in Pyuthan district

Particulars	N1	P1	P2	N1P1	N1P2	N2P1	N2P2	Total
Wild Plants	2	4		19	16	2	9	52
Oilseeds				2			1	3
Cereals		2	4		1			7
Pulse			1		1		4	6
Vegetables				3			9	12
Fruits				9		2	1	12
Ornamental Plants				2	1	1	4	8
Grand Total	2	6	5	35	19	5	28	100

Note: N1= High Nectar, N1= High Nectar, N2= Low Nectar, P1= High Pollen, P2= Low Pollen

CONCLUSION

Pyuthan has tremendous potential in beekeeping, given the country's availability of major bee flora. But, because of poor forage management, it is not performing to its potential. In this study, 100 plants were identified and categorized according to their source supply to develop a floral calendar suggesting the honey flow period, dearth period, and potential flora with both nectar and pollen supply. Based on the results of this study, we conclude that it is essential to identify and raise the area coverage of wild bee flora in the spring season to increase honey yield and to minimize conflict in the autumn season. Similarly, it is critical to manage the dearth period to ensure a year-round supply.

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AUTHOR CONTRIBUTIONS

Author A: Conceptualization, Methodology, Writing-Original Draft
Author B: Visualization, Validation, Supervision, Review, and Editing
Author C: Supervision, Review, and Editing

CONFLICT OF INTEREST

The author declares no conflict of interest regarding this publication.

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