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ORIGINAL RESEARCH ARTICLE

Preparation of floral calendar of bee flora available in Lamjung district, Nepal

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ABSTRACT

Between March and May 2022, researchers conducted a broad survey in the Lamjung district to ascertain the presence and accessibility of bee-friendly flora to compile a floral calendar. In the PMAMP Bee Zone, 62 respondents were chosen for the interview through a simple random sampling approach, from a pool of 382 registered beekeepers. Primary data collection involved using personal interviews, focus group discussions, and key informant surveys. Secondary data were gathered from publications related to the topic from various institutions. The collected data were then analyzed using IBM SPSS V.26 and Microsoft Excel. Nearly all farmers in the study area kept *Apis cerana* bees, but due to insufficient irrigation, the crop fields provided limited forage for the bees during certain periods. The lowest number of frames covers by bees was four during the dearth period. Farmers in the Lamjung district did not practice migratory foraging. The majority of the respondents reported an increase in productivity compared to the previous year. However, only 37.1 percent of them cultivated bee flora. The colony carrying capacity of the forage area was not estimated. Additionally, an increase in deforestation was identified as the major problem affecting bee foraging. To address these issues, it was recommended to plant and cultivate perennial trees such as butter trees *(Vitellaria paradox)*, bottle brush *(Callistemon speciosus)*, litchi *(Litchi chinensis)*, sissoo *(Dalbergia sissoo)*, and sunflower *(Helianthus annus)* with assured irrigation. This approach could ensure year-round forage availability and reduce the need for artificial feeding. The research aimed to explore the current status of honey bee flora and investigate major flora that could be introduced in the study area.

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INTRODUCTION

Lots of diversity, mainly plant, and animal, is available in Nepal (Rijal *et al*., 2018). The wide diversities of crops and other plants benefit from the pollination services of insects, particularly bees, which result in one-third of the total human diet with a pollination value worth 143 times higher than honey production in the world. In Nepal, modern beekeeping was initiated 15 years ago with the introduction of movable frame hives to rear *Apis cerana* (Fabricius). Beekeeping with improved and imported crossbred honeybee *Apis mellifera* (Linnaeus) culture started in 1993–1995 (Pokhrel, 2009) The value of insect pollination for worldwide agricultural production is estimated at 153 billion, which represents 9.5% of the value of the world agricultural production used for human food in 2005 (Gallai, 2009). Bee-keeping is practiced in Nepal primarily for the production of honey (National Agriculture Research Council). Beekeeping has been one of the most important farming activities in Nepal since ancient times. Being a non-land-based enterprise with multipur-pose output, the demand for beekeeping has increased tremen-dously in Nepal. Success in beekeeping depends upon many factors, among them the availability of bee flora. Bees obtain

nectar, pollen, or both from flowers, which are the mainstay of the honey bee's life (Bista and Shivakoti, 2011). The value of flora in beekeeping has been observed in many parts of the world. For instance, the directory of world honey sources (Douthwaite, 1985), the honey plant resources of the Hindu Kush-Himalayan region, and the bee flora of India (Thagunna *et al.*, 2023) are some existing examples of such efforts. It is an important agricultural enterprise that utilizes natural nectar and pollen grains. It contributes to the income of small local farmers, which otherwise would be wasted (Girma *et al.*, 2008).

The flowering time of each plant differs by time and space. Each local landscape has own honeybee flora and floral dearth for both short and long durations. Local knowledge of bee flora is greatly helpful in the management of bee colonies. To maintain diversity the of flora, self-incompatible and cross-pollinated crops require the efficient pollination services of honeybees and other pollinators, and also self-pollinated crops benefit from insects by showing their hybrid vigor without any desertion in their innate properties of fruits and seeds (Thapa, 2006). The flowering plants of an area having good value as bee pasture are necessary to maintain bee colonies (Baptist and Punchihewa,1980). The beekeeping program is one of the integral parts of governmental policies as well as pursued by INGO/NGOs for upliftment of rural under privileged and marginal people of Nepal. Honeybee is regarded as important high value commodity of Nepal and one of the most important income-generating activities for majority people (Thapa *et al.*, 2000). It helps to enhance agricultural productivity and conserves biological diversity and ecosystem through ensured pollination services (Thapa, 2006). There is tremendous potentiality of bee enterprise in Nepal due to the distribution of diversified bee flora (Partap, 1997; Bista and Shivakoti, 2011; Thapa, 2006; Adhikari and Ranabhat, 2012) and suitable climatic condition for honeybee diversity (Thapa, 2012). One study estimated that Nepal could have as much as one million bee colonies producing more than 10,000 MT of honey annually (Pokhrel *et al.*, 2014).

MATERIALS AND METHODS

Lamjung, located in the western mid-hill region of Gandaki province, ranges in altitude from 793 meters to 8155 meters above sea level. Covering an area of 1692 square kilometers, it constitutes approximately 1.14% of Nepal's total land area. The district has a population of 201,118 people and is renowned for its significant honey and cardamom production in Gandaki Province. Under the PMAMP project, a dedicated bee block was established in the Lamjung to focus on honey production. The research primarily centered on the designated "bee zone" of Lamjug district as identified by the PMAMP. Key sites of the study included Besisahar and Sundar bazar municipalities, as well as Gahate, Chiti, Chisapani, and Duradada. The research study involved collecting both primary and secondary data. Primary data sources included key informant surveys, interviews with local leaders and progressive farmers, focus group discussions, and field observations. These interviews and discussions provided valuable insights into the current policies and functioning of the value chain in the region. To ensure the reliability of the data, the research employed triangulation, involving interviews with individuals from diverse backgrounds, and their responses were carefully compared. Additionally, to verify the results obtained from the questionnaire survey, five focus group discussions (FGDs) were conducted in the final phase of data collection. Moreover, field observations were conducted at different times and locations to witness the situation firsthand, validating the information obtained from the household survey.

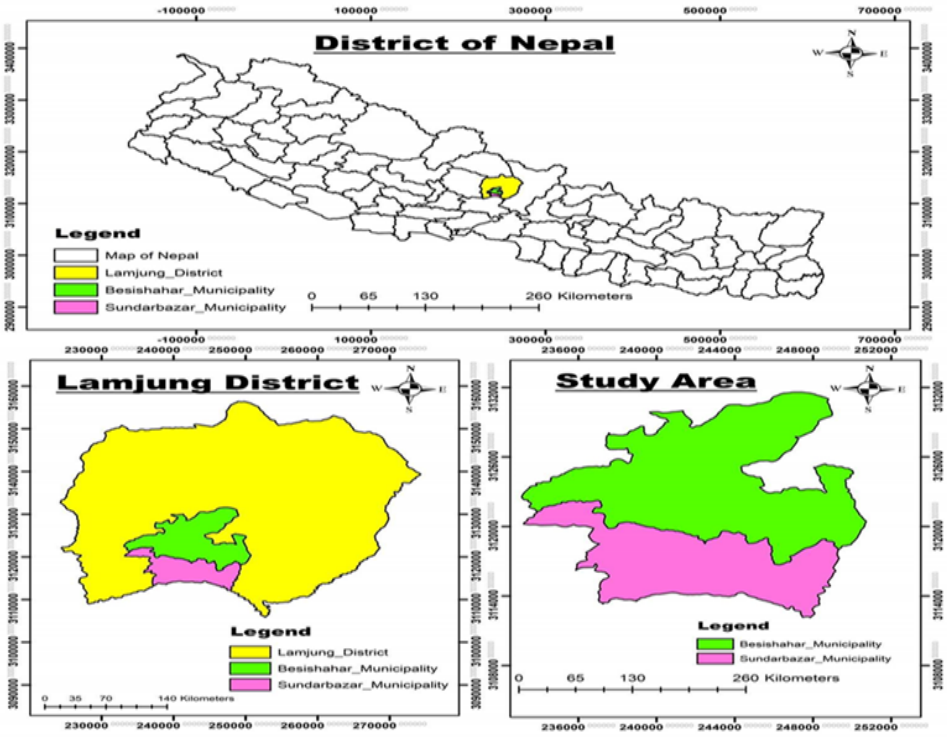

Figure 1. *Map showing a map of Nepal and Besisahar and Sundar bazar municipality.*

RESULTS AND DISCUSSION

Honey bee species, honey, and beekeeping practices

The species mainly cultivated was *Apis cerana*, and modern beehives were preferred by most of the farmers for beekeeping. Deforestation and diverse pollution sources have hindered the satisfactory production of honey. Up until now, farmers have not embraced any management practices. The yearly honey extraction per colony averaged around 4-5kg. In the last two years, total honey production has experienced growth, attributed to the increase in the number of beehives. To handle weak colonies, the most common management practice involves adding frames, and subsequently, a colony union is employed. During the management of a weak colony, it was observed that no one opted to reduce the space in the hives. Beekeepers were observed providing sugar syrup and candy to support the bee population in the colony during the dearth period, and no farmers provided pollen supplements for bees. A large portion of the respondents ventured into beekeeping due to its relative ease compared to other occupations, and the majority of farmers viewed it as more profitable compared to other crops. Roughly 50% of the beekeepers commenced their beekeeping endeavors following training provided by government organizations and other international non-governmental organizations.

Bee flora

The majority of respondents in the study area reported that bee flora was only sufficient for a few months. Farmers intentionally cultivated bee flora as they understood its significance. Forest areas, grasslands, rain-fed cultivated land (bari), and irrigated cultivated land (khet) were identified as the major sources of bee flora. Among these land-use types, forest areas and rain-fed cultivated land were identified as the major sources of bee flora. Pastures were exclusively used for bee foraging. The forest area provided bee flora primarily during April when *Castanopsis hystrix* (Katus) was the major available flora, and during March-April when Sisoo was the main flora available. Rain-fed cultivated land served as a source of bee flora during October, July, and August with mustard and maize as the major available flora, respectively. Irrigated cultivated land was a major source of bee flora during January-February, with Berseem being the main flora available. However, grassland was reported to have very low availability of bee flora. Novel bee forages refer to bee forages that can be introduced in a district with a similar climate and topography from different places. These forages hold high importance since they attract most bees for foraging. Among the most potential novel bee forages, Chiuri *(Diploknema butyracea)* was found to be the most promising followed by Bottle Brush and Dhaturo (*Datura stramonium)*. The major bee flora from crop fields was available for only a few months. Perennial flowering trees served as bee flora available for more extended periods, but they were limited to a small area in the floral calendar. Mustard was the primary flower available from September to October. During extreme rainy and cold seasons, the flora was insufficient, necessitating artificial feeding. Notably, no major flora was reported during the rainy season. Bee flora from forest areas was available from October to the first week of December and March to April, from rain-fed cultivated land during October to November, and from irrigated cultivated land from February to March, while grassland was very rare. Problems of bee foraging, as identified by key informants' interviews and focused group discussions were used for ranking the respondents in the study area. The most serious problem ranked by respondents was the increase in deforestation, with many people excessively cutting plants. Meanwhile, diseases that attack bees were ranked as the least serious problem, having a less severe effect. Respondents considered plants with good pollen sources and bee forage to be the most important, whereas forage that has a long flowering period was ranked as least important according to respondents.

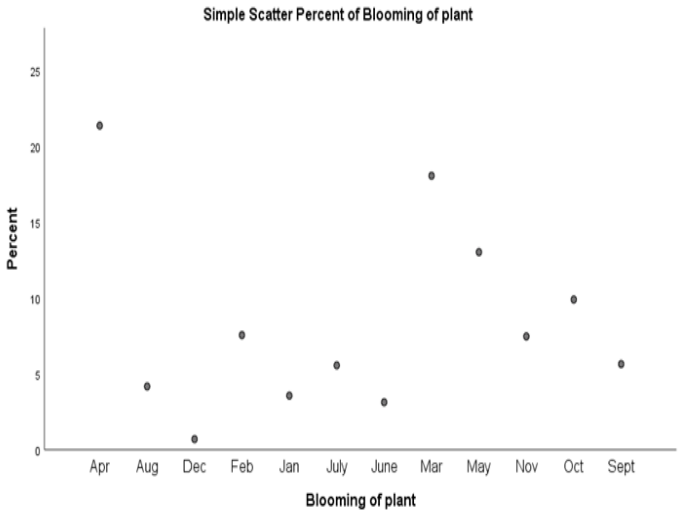

Figure 2. *Blooming month of plants.*

Bee floral calendar

Honey was collected from the available flora during the months of October and November in the study area. Respondents did not engage in migratory foraging for honey harvest when bee flora is not accessible. To maximize honey harvest, it was crucial to have large and populous colonies during the major honey flow period. Achieving this required beekeeper to be well-informed about the timing of honey flows. Therefore, they had to carefully observe, and identify the main nectar- and pollen-producing plants, and record their flowering periods, and understand their impact on colony growth. The availability of bee plant and the occurrence of honey flows or dearth had to be closely monitored. Artificial feeding was predominantly practiced during the rainy season and in December when extremely cold weather prevailed. There were many months when major flora, was not available, leading to critical shortages during that period.

Table 1. Integrated floral calendar.

Months Forages	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Schima wallichii												
Mustard												
Lemon												
Maize												
Buckwheat												
Orange												
Rhododendron												
Pear												
Bottle brush												
Shorea robusta												
Castanopsis indica												
Banana												
Alnus nepalensis												

Table 2. List of bee flora mostly available in Lamjung.

Flora	Nectar	Pollen	Blooming time
Buckwheat	Yes	Yes	Oct-Nov
Maize	No	Yes	Apr-May
Mustard	Yes	Yes	Sept-Nov
Sesame	Yes	Yes	Apr-May
Sunflower	Yes	Yes	July-Sept
Capsicum	No	Yes	Mar-Apr
Chilli	No	Yes	Apr-May
Corriander	Yes	Yes	Feb-Mar
Lemon	Yes	Yes	Mar-Apr
Orange	Yes	Yes	Mar-Apr
Pear	Yes	Yes	March
Litchi	Yes	Yes	March
Mango	Yes	No	Mar-Apr
Bottlebrush	Yes	Yes	Apr-May
Zinnia	No	Yes	July-Oct
Sisoo	Yes	No	Apr-May
Mulberry	No	Yes	Feb-Mar
Bombax	Yes	Yes	Mar-Apr
Katus (*Castanopsis indica)*	Yes	Yes	Sept-Oct
Rudilo (*Pogostemon benghalensis)*	Yes	Yes	Jan-Feb
Chilaune (*Schima wallichil)*	Yes	Yes	May-June
Paiyu (*Prunus cerasoides)*	Yes	Yes	Oct-Nov
Rhododendron	Yes	Yes	Feb-Mar

Table 3. Crops and wild plants distributed in the study areas.

Flora	Scientific name	Family	Source	Flowering months											
				May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Cereal															
Rice	*Oryza sativa*	Poaceae	P_2		√				√						
Maize	*Zea mays*	Poaceae	P_1	√	√										
Wheat	*Triticum aestivum*	Poaceae	P_2										√	√	
Barley	*Avena sativum*	Poaceae	P_2											√	
Buckwheat	*Fagopyrum esculentum*	Polygonaceae	N_1P_1					√	√						
Fingermillet	*Eleusine coracana*	Poaceae	P_2										√	√	
Pulse crops															
Pigeonpea	*Cajanus cajan*	Fabaceae	P_2										√		
Lentil	*Lens culinaris*	Fabaceae	N_2								√				
Cowpea	*Vigna unguiculata*	Fabaceae	P_2	√	√										
Soybean	*Glysine max*	Fabaceae	N_2P_2					√	√						
Kidneybean	*Phaseolus vulgaris*	Fabaceae	N_2						√	√					
Peas	*Pisum sativum*	Fabaceae	P_2					√	√					√	
Oilseed crops															
Mustard	*Brassica campestris var toria*	Brassicaceae	N_1P_1							√	√				
Rayo	*Brassica juncea subsp rugosa*	Brassicaceae	N_1P_1										√	√	
Sesame	*Sesamum orientale*	Pedaliaceae	N_1P_1	√	√										
Sunflower	*Helianthus annuus*	Compositae	N_1P_1					√	√						
Sarson	*Brassica campestris var. sarson*	Brassicaceae	N_1P_1								√	√	√		
Vegetable crops															
Cucumber	*Cucumis sativus*	Cucurbitaceae	N_2P_2					√							
Capsicum	*Capsicum frutescens*	Solanaceae	P1	√											√
Chilli	*Capsicum annum*	Solanaceae	P_1	√	√										
Pumpkin	*Cucurbita moschata*	Cucurbitaceae	P_1												
Squash	*Cucurbita pepo*	Cucurbitaceae	P_2											√	√
Tomato	*Lycopersicon esculentum*	Solanaceae	P_1	√	√					√	√	√			
Bottle gourd	*Lagenaria siceraria*	Cucurbitaceae	P_2	√	√	√									
Ridge gourd	*Luffa acutangula*	Cucurbitaceae	P_2	√	√										
Sponge gourd	*Luffa aegyptiaca*	Cucurbitaceae	P_1	√	√	√									
Snake gourd	*Trichosanthes anguina*	Cucurbitaceae	P_2	√	√	√	√								
Fruit crops															
Lime	*Citrus aurantifolia*	Rutacea	N_1P_1										√	√	
Lemon	*Citrus limon*	Rutacea	N_1P_1											√	√
Orange	*Citrus reticulata*	Rutacea	N_1P_1											√	√
Litchi	*Litchi chinensis*	Sapindaceae	N_1P_1												√
Mango	*Mangifera indica*	Anacardiaceae	N_2P_1	√											√
Banana	*Musa paradisiaca*	Musaceae	N_2P_2	√	√	√	√	√	√	√	√	√	√	√	√
Peach	*Prunus persica*	Rosaceae	N_1P_1											√	√
Plum	*Prunus domestica*	Rosaceae	N_1P_1												√
Mulberry	*Morus alba*	Moraceae	N_2P_1											√	
Aiselu	*Rubus ellipticus*	Rosaceae	N_2P_1											√	
Gauva	*Psidium guajava*	Myrtaceae	P_2	√										√	√
Ornamental plants															
Crysanthimum	Chrysanthemum segetum	Asteraceae	N_2P_2					√	√	√	√				
Zinnia	Crassina elegans	Asteraceae	N_1P_2					√	√						
Bottle brush	Grevillea robusta	Proteaceae	N_1P_1	√											√
Kufiya	Cuphea hyssopifolia	Lythraceae	N_2P_2	√	√	√	√	√	√	√	√	√	√	√	√
Others															
Cotton	Gossypium hirsutum	Malbaceae	N_1P_2						√	√					
Chilaune	Schima wallichi	Theaceae		√											√
Katus	Castanopsis hystrix	Fagaceae						√	√						
Rudilo	Pogostemon glaber	Lamiaceae N_1P_2		√											√

N1 = high nectar,
N2= low nectar,
P1 = High pollen,
P2 = low pollen

Problems in bee foraging

Problems of bee foraging identified by key informants' interview and focused group discussions were used for forced ranking to the respondents in the study area. A large number of hives on a single forage location was ranked the most serious problem with an index value of 0.75. Many beekeepers take their hives in a single location. Appropriate estimation of the colony carrying capacity of the forage location was not estimated. Meanwhile, no road linkage to the forage area was ranked as the least serious problem with an index value of 0.45. Lamjung is rich in bee flora. Most of these species were included in plant species lists in several other studies (Thapa, 2006), and (Pokhrel, 2005). Litchi, buckwheat, rapeseed, mustard, cowpea, radish, broccoli, sponge gourd, cucumber, red gram, okra, mango, citrus, squash, bottlebrush, sesame, and bottle gourd, as reported by many workers (Dhakal, 2003; Neupane, 2002; Devkota, 2000). The cropland showed potential for increasing production and productivity by placing supplemental honeybee colonies on crop fields during the flowering period, as reported by (Garratt *et al.*, 2014). Many crops and wild plants visited by bees in Lamjung include: litchi, buckwheat, rapeseed, mustard, cowpea, radish, broccoli, sponge gourd, cucumber, brinjal, red gram, okra, mango, citrus, squash, bottlebrush, sesame, and bottle gourd, as reported by many workers in Chitwan (Dhakal, 2003). The availability of major honey-potential flora has led to great scope for beekeeping in the district. This is further supported by the availability of minor flora, which mainly consists of wild flora and supports bees even in dearth periods. This study was in concurrence with the floral studies of Kabre, Dolakha (Bista and Shivakoti, 2011). Bista and Shivakoti (2011) at Kabre, Dolakha district, indicated that the peak periods of honeybee foraging activity and abundant bee floral plants were recorded during mid-February and the spring season, whereas the winter season is a dearth period and the colony strength can be weak. The flowering plants of an area with good value as bee pasture are necessary to maintain bee colonies. Honeybees visited these plants extensively for honey production and colony multiplication (Hosamani *et al.*, 2020).

Conclusion

The availability of forage in Lamjung is insufficient for bees. However, beekeepers in the area cultivate bee-friendly flora to a limited extent. To enhance forage availability, it is recommended to plant perennial flowering trees in community forests, along roadsides, and on unused land. Moreover, cultivating mustard and sunflower with assured irrigation can increase the availability of bee flora in crop fields. Beekeeping serves as the primary occupation for the majority of beekeepers in the region. The overall honey productivity from *Apis cerana* was found to be 5kg per hive, with variations observed among different categories of beekeepers. Currently, the major problem affecting beekeeping is the escalating deforestation. The shortage of bee-friendly flora poses a significant challenge to the expansion of beekeeping enterprises. In light of research findings, it is advised to plant bee flora to reduce the cost of honey production. The majority of bee flora blooms between March and April.

Conflict of interest

The authors declare that there is no conflict of interest with the present publication.

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REFERENCES

Adhikari, S., & Ranabhat, N. B. (2012). Bee flora in mid hills of Central Nepal. *Botanica Orientalis: Journal of Plant Science*, *8*, 45-56, https://doi.org/10.3126/botor.v8i0.5558

Baptist, B. A. & Punchihewa, R. W. K. (1980). A preliminary analysis of the principal factors which will affect apiary honey production in Sri Lanka. Proceedings of the 2nd Conference of Apiculture in Tropical Climates, New Delhi: 75-81.

Bista, S., & Shivakoti, G. P. (2011). Honeybee Flora at Kabre, Dolakha District. *Nepal Agriculture Research Journal*, *4*, 18–25, https://doi.org/10.3126/narj.v4i0.4859

Douthwaite, R. J. (1985). Directory of Important World Honey Sources. By E. Crane, P. Walker and R. Day. London: International Bee Research Association (1984), pp. 384, £27.50. *Experimental Agriculture*, 21(3), 298. https://doi.org/10.1017/s0014479700012680

Devkota, F. (2000.). Comparative Pollination Behavior of *Apis cerana* F. and *Apis mellifera* L. on Broccoli and Their Impact on Seed Production. Master Thesis Tribhuvan University. Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal.

Dhakal, G. (2003). Efficiency of *Apis mellifera* L. and *Apis cerana* F. for Pollinating Mustard. Institute of Agriculture and Animal Sciences, Rampur, Chitwan, Nepal.

Gallai, N. (2009). Economic Valuation of the Vulnerability of World Agriculture Confronted with Pollinator Decline. Ecological Economics, 810-821.

Garratt, M. P., Breeze, T. D., Jenner, N., Polce, C., Biesmeijer, J. C., & Potts, S. G. (2014). Avoiding a bad apple: Insect pollination enhances fruit quality and economic value. *Agriculture, Ecosystems & Environment*, *184*, 34–40, https://doi.org/10.1016/j.agee.2013.10.032

Girma, M., Ballo, S., Tegegne, A., Alemayehu, N., & Belayhun, L. (2008). Approaches, methods and processes for innovative apiculture development: experiences from Ada'a-Liben Woreda Oromia Regional State, Ethiopia. IPMS Working Paper 8. Nairobi, Kenya: ILRI.

Hosamani, V., Venkateshalu, Jagadeesha, N., Ms, R., Pm, G., & Kr, L. (2020). Bee Flora and floral calendar of honey bees in dry land regions of northern Karnataka. *International Journal of Chemical Studies*, https://doi.org/10.22271/chemi.2020.v8.i1ad.8559

Nepal Agricultural Research Council (NARC). (n.d.). https://narc.gov.np/

Neupane, K. R. (2002). Foraging preference of honey bee species to selected horticultural crops.

Pokhrel, S. (2005). Behavior and Management of Domesticated and Wild honeybees (Apis spp.) in Chitwan, Nepal. Ph.D. dissertation. Tribhuvan University, 240 p.

Pokhrel, S. (2009). Comparative benefits of beekeeping enterprise in Chitwan, Nepal. *Journal of Agriculture and Environment*, *10*, 46–59, https://doi.org/10.3126/aej.v10i0.2129

Pokhrel, S., Shrestha, J. B., & Joshi, S. R. (2014). Suggested National Apiculture Policy, Strategy and Action Plan Nepal. 35p

Partap, U. (1997). Bee flora of the Hindu Kush-Himalayas - Inventory and management. https://doi.org/10.53055/icimod.251

Rijal, S. P., Thapa, R. B., Sharma, M., Sah, S. K., & Dhoj, Y. (2018). Bee floral calendar of cultivated and wild plants available in different agroecosystems of Chitwan, Nepal. *International Journal of Research - Granthaalayah*, *6*(11), 222–245, https://doi.org/10.29121/granthaalayah.v6.i11.2018.1121

Thagunna, K. S., Raut, S., & Baniya, C. B. (2023). Bee flora of Khumaltar agroecosystem, Lalitpur, Nepal. *Our Nature*, *21*(1), 29–42. https://doi.org/10.3126/on.v21i1.50762

Thapa, R. B. (2006). Honeybees and other insect pollinators of cultivated plants: a review. *Journal of the Institute of Agriculture and Animal Science*, 27: 1-23.

Thapa, R., Shrestha, R., Manandhar, D. N., Bista, S., & Kafle, B. (2000). Beekeeping in Nepal. 7th international bee research and 4th Asian apiculture association conference. Proceeding of 7th international conference. Tropical bee management and Diversity. 409-413 pp.

Thapa, R. B. (2006). Honeybees and other insect pollinators of cultivated plants: a review. *Journal of the Institute of Agriculture and Animal Science*, 27: 1-23.

Thapa, R. (2012). Honeybees of Nepal: diversity, beekeeping, and medical applications of bee products. *Sonsik Journal*, 4: 1-9