[Rijal et. al., Vol.6 (Iss.11): November 2018] ISSN- 2350-0530(O), ISSN- 2394-3629(P)
(Received: October 23, 2018 - Accepted: November 25, 2018) DOI: 10.29121/granthaalayah.v6.i11.2018.1121

INTERNATIONAL JOURNAL OF RESEARCH – GRANTHAALAYAH
A knowledge Repository

Science

BEE FLORAL CALENDAR OF CULTIVATED AND WILD PLANTS AVAILABLE IN DIFFERENT AGROECOSYTEMS OF CHITWAN, NEPAL

Shiva P. Rijal[1], Resam B. Thapa[2], Moha D. Sharma[3], Shrawan K. Sah[4], Yubak Dhoj GC[5]
[1] Ph.D. scholar of Institute of Agriculture and Animal Science (IAAS), Tribhuvan University (TU), Nepal
[2] Professor, IAAS, TU, Kathmandu, Nepal
[3, 4] Professor, AFU, Rampur, Nepal
[5] Secretary, Ministry of Agriculture and Livestock Development, Singh Durbar, Kathmandu, Nepal

Abstract

Beekeeping is one of the promising enterprises for economically poor farmers in Nepal but beekeeping farmers lack flora calendar for pollination, bee foraging, and honey production. Therefore, a study was conducted visiting farmers' fields every 15-20 days during 2012-2013 to monitor the common plant species visited by bees, which were considered as bee forage plants categorized as major, and minor sources of pollen and/or nectar. Relevant information was also gathered through key informant interviews and group discussions. During the study period a total of 252 plant species were recorded and their floral calendar prepared. In the study area. The main species identified were: rice, Oryza sativa L.; maize, Zea mays L.; buckwheat, Fagopyrum esculentum Moench.; rapeseed, Brassica campestris L.; sesame, Sesamum orientale L.; litchi, Litchi chinensis Sonner; and cucurbits (bottle gourd, Lagenaria siceraria (Molina) Standl; sponge gourd, Luffa cylindrica (L.) Roem.; bitter gourd, Momordica charantia L.), Leucas (gumpate), Leucas lanata Benth.; Butternut (chiuri), Bassia butyracea Roxb.; Pogostemon (rudilo), Pogostemon glaber Benth.; guava, Pisum sativum L; Sisoo, Dalbergia sissoo Roxb.; Throughwort (Banmara), Eupatorium sp.; silk tree (Padke), Albizia julibrissin Durazz ; Terminalia (Saj) Terminalia bellirica (Geartn.) Roxb. and Murraya (kadipatta) Murraya koenigii (L.) Spreng. Species of Brassica, Pogestemon, Bassia, Citrus, and Artemisia, Pisum, Ipomoea and Eupatorium species were some of the important plants which bloomed during winter. And, Lagerstroemia sp., Impatiens sp, Sesamum indicum L., Zea mays L., Albizia sp. and many cucurbits bloomed during rainy season. Fagopyrum esculentum Moench, Brassica campestral L, Lagerstroemia indica L, Bombax ceiba L, Albizia julibrissin Durazz., Eugenia formosa Wall., Shorea robusta, Guartn. Upatorium grandulosum, Pogostemon glaber Benth. Terminalia alata Heyne ex.Roth, Murraya koenigii (L.) Spreng Sesamum orientale L. Dalbergia sissoo Roxb. were the major bee flora both rich in nectar and pollen.

Keywords: Bee forage; honeybees; buckwheat; rapeseed; Sisoo; Pogostemon.

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
(Received: October 23, 2018 - Accepted: November 25, 2018) DOI: 10.5281/zenodo.1928975

Cite This Article: Shiva P. Rijal, Resam B. Thapa, Moha D. Sharma, Shrawan K. Sah, and Yubak Dhoj GC. (2018). "BEE FLORAL CALENDAR OF CULTIVATED AND WILD PLANTS AVAILABLE IN DIFFERENT AGROECOSYTEMS OF CHITWAN, NEPAL." *International Journal of Research - Granthaalayah*, 6(11), 222-245.

1. Introduction

Nepal is rich in plant and insect diversities. The wide diversities of crops and other plants benefit from pollination services of insects particularly bees, which result in one-third of the total human diet with pollination value worth of 143 times higher than honey production in the world (Mishra, 1997/98). 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 et al., 2009). The average global value of pollination system is $ 117 ha^{-1} yr^{-1} (Costanza *et al*., 1997). Crop pollination yield with enhanced quality in entomophilous orchard fruit crops (Garratt *et al*., 2013), in field crops (Bommarco, 2012), and small fruits and vegetables (Andersson, 2012; Roselino *et al*., 2009; Hogendoorn *et al*., 2014; Roldan, 2006; Isaacs, 2010). Some crops entirely depend on insect pollination for seed and fruit production, whereas others benefit with higher yields, better quality produce and uniform maturation (Breeze *et al*., 2011).

Chitwan district lies in the southern part of Narayani zone in central Nepal. This district enjoys a sub-tropical climate with a unique ecosystem of significant value to the world (i.e. Chitwan National Park). Approximately, 70% of the National Park vegetation is sal (*Shorea robusta) forest*, grassland (20%), riverine forest (7%), and sal with Chirpine (3%). The riverine forests consist mainly of khair (*Acacia catechu* (L.f.) Wilid. sissoo (*Dalbergia sissoo* Roxb.) and simal (*Bombax ceiba* Lin.). The grassland forms a diverse and complex community with over 50 species (Dangol, 2000). This district is well acquainted as granary of Nepal. However, high pressure of migrant from different district of Nepal in Chitwan resulted in negative impact, i.e. change in biodiversity and vegetation composition (Dangol, 2000). Declining of pollinators has been noticed by different researchers (Pokhrel 2005; Biesmeijer et al., 2006; Cameron et al., 2011; Goulson et al., 2008; Englesdorp et al., 2008). Wilson (1988) estimated that 0.2-0.3% of all species are lost every year in globe. Range of 5-10% of the tropical forest species may become extinct within the next 30 years (UNEP, 1993). In the district, there are no in-depth records of bee flora in pollination and beekeeping perspectives, which have long lasting effect on the livelihood of the people living in the area.

To maintain diversity of flora, self-incompatible and cross-pollinated crops require efficient pollination services of honeybees and other pollinators, and also self-pollinated crops benefit from insect 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). Hence, every beekeeper must be familiar with the bee floral resources near/ or around his/her apiary for successful beekeeping and also bee fauna greatly influence crop pollination and reward hive production.

All pollinator species do not respond equally to land use change (Williams *et al*., 2010; Winfree *et al*., 2011). The flowering crop field has been known as an important driver for pollinator community composition, and the landscape context needs to be considered when linking land use

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
(Received: October 23, 2018 - Accepted: November 25, 2018) DOI: 10.5281/zenodo.1928975

to pollination provisioning and benefits to field crops (Bartomeus *et al*., 2014). Delaplane et al. (2010) revealed that in planning a bee pasture, it is important to choose a collection of plants that will produce unbroken succession of bloom throughout the season. Furthermore, seasonal changes in the vegetation patterns, the foraging behavior of bees, and the manner in which the honeybee colonies interact with their floral environment are the major events which determine the best time to carry out bee husbandry practice or prepare for the honey seasons and food shortage periods with feeding management as well. Different studies (Partap and Partap, 2002; Thapa, 2002, Adhikari and Ranabhat, 2003) reveal that level of knowledge about biodiversity conservation, pollination and pollinators in Nepalese farmers are inadequate. Hence, this study was carried out to identify the common bee flora in the study areas, estimate their seasonal abundance and diversity, prepare flowering calendar and identify the nectar and/or pollen producing sources for potential beekeeping by the farmers.

2. Materials and Methods

Study Area

Four study areas with different ecosystems in Chitwan, i.e. Megauli (semi-natural), Fulbari (organic), Jutpani (intensive agriculture) and Siddhi (Hill, semi-natural) Village Development Committees (VDCs) were selected for this study. Meghauli VDC have 25 km long community forest is another Eco-Park and medicinal herbal farming in the buffer zone as attractions of the study area, which is an example of good balance between human settlements and natural environments. Fulbari VDC occupies 1388 ha of land and family households here, chiefly are engaged in agricultural activities, mainly organic agriculture. Jutpani, the other VDC, has 1200 ha land with 767ha cultivable land (Bariland 621 ha, khetland 146 ha.) and 50 ha of forest and others. This site is dominated by intensive agriculture with the use of hybrid seeds, chemical fertilizer and pesticides. Beekeeping is a flourishing business there, however spraying of pesticide in rapeseed and vegetables are threats to beekeeping and environment. Sidhhi VDC occupies 3403ha of land in which the cultivable land is 3291.2 hectares and most of land is undulated and sloppy. This VDC is rich in flora and fauna, since the area other than cultivated is under leasehold forest and community forests' control.

Direct observation of flowering plants was done every 20 days during 2012/013. Each study visit served as pseudo replicates for the site and all observations were made between 7:00-18:00 hours in winter and autumn; and 7:00-18:30 hours in summer season. Honey bee foraging plant were determined with visit of honeybee workers on its flowers for 10 minutes (Silveira, 2004). The observation on nectar and pollen source was based on activities performed by honeybees on different flowers, i.e. honeybees with their activity of extending their proboscis into the flowers were considered as nectar source and bees carrying pollen on their hind legs were determined as pollen source plants ((Mbah and Amao, 2004; Bista and Shivakoti, 2000-2001). Most plants visited by honeybees were identified in the field by comparing with the published reports (Partap, 1997; Polunin and Stainton, 1997; Shrestha, 1998; Thapa, 2006) and those unknown plants were identified with the help of the experts from Tribhuvan University (TU), Agriculture and Forestry University (AFU) and Nepal Agriculture Research Council (NARC). Plants were categorized either rich in pollen (P1, P2) or in nectar (N1, N2) or combination of two in different levels (Partap, 1997). For scaling up beekeeping, the area of agricultural bee forage (in hectare) and potential foraging bee colonies with minimum of two hives per hectare were estimated as potentiality of bee

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
(Received: October 23, 2018 - Accepted: November 25, 2018) DOI: 10.5281/zenodo.1928975

forage supporting honeybee colonies in those areas (Partap and Partap, 1997). Honey potential is the estimated weight (kg) of honey that can be obtained in the course of a season from one hectare of land covered with the plant assuming optimal condition (Crane, 1975), which varies from species to species and also according to climatic and soil condition (Partap, 1997).

Key informant interview and focus group discussion were also organized once in each study area purposively selecting the communities, such as pollination farmer groups, local leaders, buffer zone technicians, bee technician, and other individuals, who are believed to be knowledgeable about bee flora of the study sites. The secondary data included the existing research literature. Related websites of GOs and INGOs, such as, ICIMOD, IAAS, AFU, CBS, CABI, IUCN, and ISSG etc. were consulted to review literature on biological characteristics of the plants. Data were managed in Microsoft Excel and analyzed using descriptive statistics for frequency, density, flowering duration etc.

3. Results and Discussion

Crops and Wild Plants Distributed in The Study Areas

The dominant crops benefited from cross pollination grown in Megauli (semi-natural site) were Chilli, Buckwheat, Broad leaf mustard, Bottle gourd, Mango, Papaya and Rice were crops benefitted by pollination, Coriander, Bitter gourd, Chilli, Sunflower, Litchi, Pumpkin, Sponge gourd, Mustard and Rice in Fulbari (organic site) Bitter gourd, Marigold, Wheat, Okra, Banana, Cowpea, Maize and Rice were the pollination dependent crops in Jutpani (Intensive agriculture site) and Citrus, Maize, Rice and Vegetables in Siddh (hill site). In wild plants Leucas, Murraya (kadipatta), Pogostemon (rudilo) Sisoo, Throughwort (Banmara) available in Megauli ; silk tree (Padke), *Pogestemon, Artemisia, Eupatorium, and Termenelia* in Jutpani Butternut (chiuri), wild *Sesamum Albizia* sp. in Siddhi, *Lagerstroemia indica L, Bombax Albizia,Sissoo, Upatorium* in Fulbari . *The distribution of crops and wild plants in groups is shown in* Table 1.

Table 1: Number of bee forage species available in different land use sites in 2012/013

Particulars	Megauli	Fulbari	Jutpani	Siddhi
Cereals	5 (83.33)	6 (100.00)	5 (83.33)	6 (100.00)
Oilseeds	7 (87.50)	8 (100.00)	4 (50.00)	8 (100.00)
Pulses	10 (90.91)	11 (100.00)	8 (72.73)	9 (81.82)
Vegetables	24 (96.00)	24 (96.00)	24 (96.00)	23 (92.00)
Fruits	19 (90.48)	21 (100.00)	17 (80.95)	18 (85.71)
Ornamentals	23 (88.46)	26 (100.00)	24 (92.31)	15 (57.69)
Wild plants	154 (99.35)	94 (60.65)	139 (89.68)	143 (92.26)
Total	242 (96.03)	190 (75.40)	221 (87.70)	222 (88.10)

Source: Survey, 2012 Parenthesis indicate percentages

Observation shows that Megauli has the richest bee flora (242 species), Siddhi (222 species), followed by Jutpani (221 species), and Fulbari (190 species), respectively (Table 2). The bee flora diversity was higher in the Megauli, iddhi and Jutpani VDCs compared to Fulbari VDC (217 species), mainly due to the dominancy of wild flora there. The beekeeping enterprises flourished

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
(Received: October 23, 2018 - Accepted: November 25, 2018) DOI: 10.5281/zenodo.1928975

there because of availability of greater diversity of wild bee forage resources for the honeybees. The bee forage plants available in different months with their sources is shown in Table 2.

Table 2: Bee floral species with pollen/nectar sources with their flowering time of the study areas in Chitwan

Common Name	Scientific Name	Family	Source	Flowering time											
				J	F	M	A	M	Jun	J	A	S	O	N	D
Cereal															
Rice	*Oryza sativa* L.	Poaceae	P2					√	√			√	√		
Maize	*Zea mays* L.	Poaceae	P1	√					√	√	√	√	√	√	
Finger millet	*Eleusine coracana* (L.) Geartn.	Poaceae	P2			√	√								
Wheat	*Triticum aestivum* L.	Poaceae	P2	√	√	√									
Barley	*Avena sativum* L.	Poaceae	P2		√	√									
Buckwheat	*Fagopyrum esculentum* Moench	Polygonaceae	N1P1	√	√	√							√	√	√
Pulse crops															
Pigeon pea	*Cajanus cajan* (L) Millsp.	Fabaceae	P2	√	√										
Lentil	*Lens culinaris* Medikus	Fabaceae	N2											√	√
Chickpea	*Cicer arietinum* L.	Fabaceae	N2P2		√	√									
Black gram	*Phaseolus mungo* (L.) Hepper	Fabaceae	N1								√	√	√		
Green gram	*Phaseolus radiates* L.	Fabaceae	N1P1								√				
Peas	*Pisum sativum* L.	Fabaceae	P2			√					√	√			
Cowpea	*Vigna unguiculata* (L.) Walp.	Fabaceae	P2					√	√	√	√	√			
Soybean	*Glysine max* (L.) Merr.	Fabaceae	N2P2								√	√			
Lima beans	*Phaseolus lunatus* L.	Fabaceae	N2										√	√	
Rice beans	*Vigna umbellate* L.	Fabaceae	P2					√	√						
Kidneybean (Ghiu simi)	*Phaseolus vulgaris* L.	Fabaceae	N2										√	√	

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

Oilseed crops															
Rapeseed	*Brassica campestris var toria* L.	Brassicaceae	N1P1	√	√										√
Sarson	*Brassica campestris var. sarson* Prain	Brassicaceae	N1P1	√	√									√	√
Rayo	*Brassica juncea subsp rugosa* (Roxb.) Prain	Brassicaceae	N1P1		√	√	√								
Black mustard	*Brassica nigra* L.	Brassicaceae	N2P2									√	√		
Niger	*Guizotia abyssinica* (L.f.) Cass.	Compositae	N1P1							√	√	√	√		
Sunflower	*Helianthus annuus* L.	Compositae	N1P1							√	√	√			
Linseed	*Linum usitatissimum* L.	Linaceae	N2P2		√	√									
Sesame	*Sesamum orientale* L.	Pedaliaceae	N1P1				√	√	√	√					
Vegetable crops															
Amaranths	*Amaranthus hybridus subsp. cruantus* (L.) Thell.	Amaranthaceae	N2P2							√	√				
Lady's finger	*Abelmoschus esculentus* (L.) Moench	Malvaceae	N2P2			√	√	√	√	√	√				
Chilli	*Capsicum annum* L.	Solanaceae	P1				√	√							
Capcicum	*Capsicum frutescens* L.	Solanaceae	P1		√	√						√	√		
Sweet melon	*Cucumis melo* L.	Cucurbitaceae	N2P2				√	√	√						
Cucumber	*Cucumis sativus* L.	Cucurbitaceae	N2P2			√	√	√	√	√	√	√	√		
Coriander	*Coriandrum sativum* L.	Apiaceae	N1P1		√	√	√								
Squash	*Cucurbita pepo* Duchesne	Cucurbitaceae	P2			√	√								
Pumpkin	*Cucurbita moschata* Duchesne	Cucurbitaceae	P1												

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

Cluster bean	*Cyamopsis tetragonoloba* (L.) Taub.	Fabaceae	N2	√	√	√							√	√	√
Bottle gourd	*Lagenaria siceraria* (Molina) Standl.	Cucurbitaceae	P2					√	√	√					
Ridge gourd	*Luffa acutangula* (L.) Roxb.	Cucurbitaceae	P2					√	√	√				√	√
Sponge gourd	Luffa aegyptiaca Mill.	Cucurbitaceae	P1					√	√	√	√	√			
Snake gourd	*Trichosanthes anguina* L.	Cucurbitaceae	P2					√	√	√	√				
Tomato	*Lycopersicon esculentum* Mill.	Solanaceae	P1	√	√	√	√					√	√	√	√
Bitter gourd	*Momordica charantia* L.	Cucurbitaceae	P2				√	√	√	√	√				
Radish	*Raphanus sativus* L.	Brassicaceae	N1P1		√	√	√								
Brinjal	*Solanum melongena* L.	Solanaceae	N2P2		√	√	√	√	√	√	√	√	√		
Musk gourd	*Benincasa hispida* (Thunb.) Cogn.	Cucurbitacaeae	N2P2						√	√	√	√	√		
Broccoli	*Brassica oleracea var. italica* Plenck	Brassicaceae	N1P1			√	√								
Sweet melon	*Citrullus vulgaris* Schrad	Cucurbitaceae	N2P2			√	√								
Spinach	*Lepidium sativum* L.	Brassicaceae	N2	√	√										
Lettuce	*Spinacea oleracea* L.	Chenopodiaceae	P2		√	√									
Fenugreek	*Trigonella foenum - graecum* L.	Leguminosae	N2P2		√	√	√								
Fababeans	*Vicia feba* L.	Leguminosae	N2P2	√	√	√									
Fruit crops															
Custard apple	*Annona squamosa* L.	Annonoceae	N1P2				√	√	√						
Jack fruit	*Artocarpus integer* (Thunb.) Merr	Moraceae	P2		√	√									

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

Papaya	*Carica papaya* L.	Caricaceae	N2P2				√	√	√						
Lime	*Citrus aurantifolia* (Christm.) Swingle	Rutaceae	N1P1		√	√									
Pumelo	*Citrus grandis* (L.) Osbeck	Rutaceae	N1P1			√	√								
Rough lemon	*Citrus jambhiri* Lush.	Rutaceae	N1P1			√	√								
Indian sweet lime	*Citrus limetttoides* Tanaka	Rutaceae	N1P1			√	√								
Lemon	*Citrus limon* (L.) Osbeck	Rutaceae	N1P1			√	√								
Citron	*Citrus medica* L.	Rutaceae	N1P1			√	√								
Grapefruit	*Citrus paradisi* Macfad.	Rutaceae	N1P1			√	√								
Orange	*Citrus reticulata* Blanco	Rutaceae	N1P1			√	√								
Lichi	*Litchi chinensis* Sonner	Sapindaceae	N1P1			√	√								
Mango	*Mangifera indica* L.	Anacardiaceae	N2P1			√	√								
Banana	*Musa paradisiaca* L.	Musaceae	N2P2	√	√	√	√	√	√						
Guava	*Psidium guajava* L.	Myrtaceae	P2			√	√	√							
Pear	*Pyrus communis* L.	Rosaceae	N1P1												
Pomegranate	*Punica granatum* L.	Lythraceae	N2P1				√	√							
Peach	*Prunus persica* (L.) Batsch	Rosaceae	N1P1		√	√									
Areca nut	*Annona reticulata* L.	Annonaceae	N2P2					√							
Coconut	*Cocos nucifera* L.	Arecaceae	N2	√	√	√	√	√	√	√	√	√	√	√	√
Persimon	*Diospyros virginiana* L.Physalis	Ebenaceae	N2P2			√	√								
Ornamental plants															

Callistemon *(kalkiful)*	*Callistemon citrinus* (Curtis) Skeels	Myrtaceae	N1P1		√	√	√	√	√	√	√				
Crysanthimum	*Chrysanthemum segetum* L.	Asteraceae	N2P2								√	√	√	√	√
Gulmohar	*Delonix regia (*Boj. ex Hook.*)* Raf.	Fabaceae	N2P2					√	√						
Gomphrena	*Gomphrena globosa* L.	Amaranthaceae	P2	√						√	√	√	√	√	√
Jasmin	*Jasminium sambac* (L.) Ait.	Oleaceae	N2									√	√	√	√
Rose	*Rosa indica* L	Rosaceae	N2P2						√	√					
Marigold	*Tagetes patula* L.	Compositae	N2P2									√	√	√	√
Zinnia	*Crassina elegans* (Jacq.) Kuntze	Asteraceae	N1P2						√	√	√	√	√		
Chinese rose	*Hibiscus rosa-sinensis* L.	Malvaceae	N2P2			√	√	√	√	√					
Bottlebrush	*Grevillea robusta* A. Cunn. ex R. Br.	Proteaceae	N1P1				√	√							
Night jasmine	*Nyctanthes arbor-tristis* L.	Oleaceae	N1P1					√	√	√	√	√	√		
Garden balsam	*Impatiens balsamina* L.	Balsamininaceae	N1P2						√	√	√				
Wax mallow	*Malvaviscus arboreus* Cav.	Malvaceae	N1P1	√	√	√	√	√	√	√	√	√	√	√	√
Agava	*Agave americana* L.	Agavaceae	N2P2								√	√	√	√	√
Hollyhook	*Althaea rosea* (L.) Cav.	Malvaceae	N2P2				√	√	√						
Calendula	*Calendula offisinalis* L.	Compositae	N2P2		√	√	√								
Dahlia	*Dahlia pinnata* Cav.	Compositeae	P2	√							√	√	√	√	√
Dianthus	*Dianthus chinensis* L.	Cariyophyllaceae	P2		√	√	√	√							
Euphorbia	*Euphorbia pulcherrima*	Euphorbiaceae	N2P2	√	√										

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

	Willd.ex Klotzsch.														
Ixora	*Ixora coccinea* L.	Rubiaceae	N2					√	√	√	√	√	√		
Lagerstromia	*Lagerstromia indica* L.	Lythraceae	N1P1						√	√					
Poppy	*Papaver somniferum* L.	Papavaraceae	P1	√	√										√
Clove flower (big)	*Russelia equisetiformis* Schltdl. & Cham.	Schophulariaceae	N1					√	√	√	√				
Clove flower (small)	*Russelia juncea* Zucc.	Plantaginaceae	N1					√	√	√	√				
Cuphea	*Cuphea micropetala* Kunth	Lythroideae	N1P2			√	√	√	√	√	√	√	√		
Salvia	*Salvia coccinea* Buc'hoz ex Etl.	Labiatae	N2P2	√	√	√	√	√	√	√	√	√	√	√	√
Weeds/wild plants															
Spear mint	*Mentha spicata* L.	Lamiaceae	N2							√	√				
Tulasi	*Ocimum tenuiflorum* L.	Lamiaceae	N2								√	√	√		
Basil (Babari)	*Ocipum basilicum* L.	Lamiaceae	N2	√	√										
Mugwort	*Artemesia indica* Willd.	Asteraceae	N2									√	√	√	
Acacia (khair)	*Acacia catechu* (L.f.) Wilid.	Leguminaceae	N2P2				√	√							
Neem	*Azadirachta indica* A. Juss.	Meliaceae	N2P2				√	√							
Bombox (Simal)	*Bombax ceiba* L.	Bombacaceae	N1P1			√	√								
Chenopodium	*Chenopodium album* L.	Chenopodiaceae	P2	√	√	√									
Sissoo	*Dalbergia sissoo* Roxb.	Fabaceae	N1				√								
Dhatura	*Datura metel* L.	Solanaceae	P2	√	√	√									
Mulberry	*Morus alba* L.	Moraceae	P1			√	√								

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

Parthenium	*Parthenium hysterophorus* L.	Asteraceae	P1			√	√	√	√	√	√	√	√	√	√
Phyllanthus (Amala)	*Phyllanthus emblica* L.	Euphorbiaceae	N1				√	√							
Toona	*Toona ciliata* M.Roem.	Meliaceae	N1P2				√								
Wild Ber	*Zizyphus oxyphylla* Edgew.	Rhamnaceae	N2P2						√	√					
Ber	*Ziziphus mauritiana* Lam.	Rhamnaceae	N2P2									√	√		
Albizia (Padke)	*Albizia julibrissin* Durazz.	Leguminaceae	N1P1						√	√					
Melia (Bakaino)	*Melia azedarach* L.	Meliaceae	P2				√								
Premna	*Premna barbata* (Wall. ex Schauer) Kuntze	Lamiaceae	P2				√								
Butternut tree (Chiuri)	*Bassia butyracea* Roxb.	Sapotaceae	N1P1	√	√									√	√
Clestocalyx	*Cleistocalyx operculatus* (Roxb.) Merr.& L.M Perry	Myrtiaceae	N1P1			√	√								
Eugenia	*Eugenia formosa* Wall.	Myrtiaceae	N1P1		√	√	√								
Syzgium	*Syzgium cumini* (L.) Skeels	Myrtiaceae	N1				√	√	√						
Terminalia (Saj,Asna)	*Terminalia bellirica* (Geartn.) Roxb.	Combretaceae	N1P1				√	√							
Calendula	*Cassia fistula* L.	Leguminaceae	N2P2					√	√	√					
Sal	*Shorea robusta* Guartn.	Dipterocarpaceae	N2P2			√	√								
Epil-epil	*Leucaena tricodes* (Jacq.) Benth	Fabaceae	N2P2									√	√		

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

Bird plum	*Berchemia edgeworthii* Lawson	Rhamnaceae	N2P2				√	√	√						
Siam weed	*Chromolaena odorata* (L.) R.M. King & H. Rob.	Compositae	P2												
Touch-me-not (Lajjabati)	*Mimosa pudica* L.	Leguminaceae	P1				√	√							
Pogostemon (Rudilo)	*Pogostemon glaber* Benth.	Lamiaceae	N1P1	√	√	√	√	√	√						
Callicarpa (Dahikamala)	*Callicarpa macrophylla* Val.	Rubiaceae	P2						√	√	√	√	√		
Ipomoea (Besarum)	*Ipomoea carnea subsp.fistulosa (*Mart. Ex Choisy) D.F.Austin	Convolvulaceae	P2				√	√	√	√	√	√			
Ipomoea	*Ipomoea aquatica* Forssk.	Convolvulaceae	P2							√	√	√			
Bindweed	*Convolvulus arvensis* L.	Convolvulaceae	N2P2												
Knotweed	*Polygonum* spp	Poligonaceae	N2P2					√	√	√	√	√			
Malaysian wild vine (Simali)	*Cissus repens* Lam.	Vitaceae	N1P2					√	√	√	√	√	√		
Bermudagrass (Dubo)	*Cynodon dactylon* (L.) Pers.	Poaceae	N2P2					√	√						
Cassia (tapre)	*Cassia tora* L.	Leguminaceae	N2P2						√	√	√	√	√		
Oxalis (chariamilo)	*Oxalis acetosella* L.	Oxalidaceae	N2		√	√	√								
Crabgrass	*Digitaria cilliaris* (Retz.) Koeler	Oleraceae	N												
Leucas (gumpate)	*Leucas lanata* Benth.	Lamiaceae	N1P1	√	√	√	√								
Clocasia	*Colocasia esculenta* (L.) Schott	Araceae	P1							√	√				
Perilla	*Perilla frutescens* (L.) Brit.	Labiatae	N1P1										√	√	

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

Eupatorium (Banmara)	*Eupatorium adenophorum* Spreng.	Compositae	N1P1			√	√								
Eupatorium (Banmara)	*Eupatorium odoratum* L.	Compositae	N2P2				√	√	√	√	√				
Justicia	*Justicia adhatoda* L.	Acanthaceae	N1P1				√	√							
Black Justiicia	*Justicia gendarussa* Burm.f.	Acanthaceae	N1			√	√	√							
Adina (Karma)	*Adina cordifolia* (Roxb.) Brandis.	Rubiaceae	N1P1						√	√					
Asculus	*Asculus indica* (Wall. ex Camb.) Hook.	Hipocastanaceae	N1P1					√	√						
Ageratum (Gandhe jhar)	*Ageratum conizoides* L.	Compositae	N2P2					√	√						
Amaranths	*Amaranthus spinosus* L.	Amaranthaceae	N2P2						√	√	√				
Anthocephalus (Kadam)	*Anthocephalus chinensis* (Lam.) A.Rich.ex.Walp.	Rubiaceae	N2P1											√	√
Zeranium (Tanki)	*Bauhinia purpurea* L.	Leguminaceae	N1P1									√	√		
Bahunia	*Bahunia vahlii* Wight & Arn.	Leguminaceae	N2P1					√	√						
Orchid tree (Koilalo)	*Bahunia variegata* L.	Leguminaceae	N1P1			√	√								
Bidens	*Bidens pilosa* L.	Compositae	P2						√	√	√				
Breea	*Breea arvensis* (L.) Less.	Compositae	N2P2				√	√	√						
Casalpinia	*Casalpinia decapetala* (Roth) Alston	Leguminaceae	P1							√	√	√			
Trumpet vine	*Campsis grandiflora* (Thunb.) K. Schum.	Bignoniaceae	N1P2					√	√	√	√				
Cannabis (Ghanja)	*Cannabis sativa* L.	Cannabaceae	N2P2						√	√					

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

Clotoria	*Clitoria ternatea* L.	Leguminaceae	N2P2							√					
Coffee	*Coffea arabica* L.	Rubiaceae	N2P2			√	√								
Mayan leaf	*Coleus blumei* Benth.	Lamiaceae	N2						√	√	√				
Duranta	*Duranta erecta* L.	Verbenaceae.	P2			√	√								
Rudraksha	*Elaeocarpus sphericus* (Gsertn) K. Schum.	Elaeocarpaceae	N1P2					√							
Eucalyptus	*Eucalyptus citriodora* Hook	Myrtaceae	N2P2						√	√					
Euphorbia	*Euphorbia hirta* L.	Euphorbiaceae	P2					√	√	√					
Milkweed	*Launaea asplenifolia* (Willd.) Hook f.	Compositae	P1					√	√	√					
Ficus	*Ficus benghalensis* L.	Moraceae	N2			√									
Ficus (Kabro)	*Ficus lacor* Buch.-Ham.	Moraceae	N2			√									
Cluster fig tree (Dumri)	*Ficus racemosa* L.	Moraceae	N2			√									
Pipal	*Ficus religiosa* L.	Moraceae	N1			√									
Cotton	*Gossypium hirsutum* L.	Malbaceae	N1P2									√	√		
Jacanranda	*Jacanranda mimosifolia* D. Don.	Bignoniaceae	N1P1					√	√						
Jatropha	*Jatropha curcas* L.	Euphorbiaceae	N2					√	√						
Pumello	*Maesa macrophylla* Wall.	Myrsinaceae	N1P1		√	√	√								
Momordica	*Momordica balsamina* L.	Cucurbitaceae	P2		√	√									
Moringa	*Moringa oleifera* Lam.	Moringaceae	N1P1		√	√									
Poison ivy (Bhalayo)	*Rhus wallichii* Hook.f.	Anacardiaceae	N2P2						√	√	√	√	√	√	
Richinus (Aadir)	*Richinus communis* L.	Euphorbiaceae	N2P2					√	√	√	√				

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

Sapium	*Sapium insigne* (Royale) Benth.ex. Hook.f.	Euphorbiaceae	N1						√	√					
Schima	*Schima wallichii* (DC) Korth.	Theaceae	N2P2					√	√						
Broomweed (Chini Jhar)	*Scoparia dulcis* L.	Plantaginaceae	P2				√	√	√						
Sechium	*Sechium edule* (Jacq.) Sw.	Cucurbitaceae	N2P2								√	√	√	√	√
Tik	*Tectona grandis* L.f.	Lamiaceae	N2P2			√									
Black mayobalan (Barro)	*Terminalia chebula* Retz.	Combretaceae	N1P1				√	√							
Vitex	*Vitex negunod L.*	Lamiaceae	N1P2				√	√							
Woodfordia (Dhangero)	*Woodfordia fruticosa* (L.)Kurz.	Lythraceae	N1P1			√	√								
Adina (Karam)	*Adina cardifolia* (Willd. ex Roxb.) Benth. and Hook.f. ex Brandis	Rubiaceae	N2P2			√	√								
Litsea (Kutmiro)	*Litsea monopetala* (Roxb.) Pers.	Lauraceae	N2P2	√	√	√	√	√	√						
Wild eggplant	*Solanum torvum* Swartz.	Solanaceae	P2	√	√	√	√	√	√	√	√	√	√	√	√
Love apple	*Solanum aculeatissimum* Jacq.	Solanaceae	P2							√	√	√	√		
Chaff-flower (Apamarga)	*Achyranthes aspera* L.	Amaranthaceae	N2									√	√	√	√
Dwarf copperleaf (Bhirangi jhar)	*Alternanthera sessilis (*L.) R.Br.ex DC.	Amaranthaceae	N2P2									√	√		
Cacia tora (small)	*Cassia tora* L.	Leguminaceae	P2							√	√				
Hydrocotyle	*Hydrocotyle nepalensis* Hooker.	Araliaceae	N2P2							√	√				

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

Digitaria	*Digitaria ciliaris* (Retz.) Koeler.	Poaceae	N2						√						
Cyperus	*Cyperus rotundus* L.	Cyperaceae	P2								√	√	√		
Prickly poppy	*Argemone mexicana* L.	Papavaraceae	N1P1								√	√	√		
Lotus	*Nelumbo nucifera* Gaertn.	Nelumbonaceae	P1							√	√	√			
Thatch grass	*Saccharum spontaneum* L.	Poaceae.	P2								√	√	√		
Whip grass	*Hemarthria compressa* (L.f.) R.Br.	Poaceae	P1	√	√	√	√	√	√	√	√	√	√	√	√
Imperata	*Imperata cylindrica* (L.) P.Beauv.	Poaceae	P2									√	√	√	
Saccharum	*Saccharum bengalense* Retz.	Poaceae	P2		√										
Calicarpa	*Calicarpa macrophylla* Vahl.	Verbenaceae	N2P1												
Dhursil	*Colebrookea oppositifolia* Smith	Labiatceae	P2	√	√										√
Kadipatta	*Murraya koenigii* (L.) Spreng.	Rutaceae	N1P1						√						
Lantana (Yellow)	*Lantana camara* L.	Verbenaceae	N2P2	√	√	√	√	√	√	√					
Coccinea	*Coccinea grandis* (L.) Voigt	Cucurbitaceae	N1P2						√	√					
Wild radish	*Blumea lacera* (Burn. f.) DC	Asteraceae	N2P2	√	√	√									√
Calotropis	*Calotropis gigantea* (L.) W.T.Alton	Apocynaceae	P	√	√										
Dhaincha	*Sesbania grandiflora* (L.) Poiret.	Fabaceae	P1										√	√	
Wild bean	*Ceropegia pubescens* Wall.	Asclepiadaceae	N2P2	√	√										

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

Piper	*Piper longum* L.	Piperaceae	P2								√	√			
Wild temeric	*Curcuma aromatica* Salisb.	Zingiberaceae	N2P2												
Mikania	*Mikania micarantha* Kunth	Asteraceae	N2P2		√										
Paspalum	*Paspalum distichum* L.	Poaceae	P2								√	√			
Cynoglossum	*Cynoglossum glochidiatum* Wall.ex Benth	Boraginaceae	P2						√	√					
Croton	*Croton sparciflora* Morong	Euphorbiaceae	N2 P2	√	√										
Achyranthes	*Achyranthes aspera* L.	Amaranthaceae.	N2P2						√	√					
Datura	*Datura stramonium* L.	Solanaceae	P2					√	√						
Clerodendrum	*Clerodendrum infortunatum* L.	Lamiaceae	N1				√	√							
pignut Wild (sesame	*Hyptis suaveolens* (L.) Poit.	Lamiaceae	N2								√	√			
Vicia	*Vicia angustifolia* (L.) ex Reich.	Leguminaceae	P2	√	√										
Urtica	*Urtica dioica* L.	Urticaceae	N2P2		√	√									
Oxalis	*Oxalis corniculata* L.	Oxalidaceae	N2					√	√	√	√	√	√	√	
Mallotus	*Mallotus phillipensis* (Lam.) Muell. Arg.	Euphorbiaceae	N2P2		√	√									
Grewia	*Grewia helicterifolia* Wall.ex G. Don.	Tiliaceae	P2				√	√							
Calotropis	*Calotropis gigantea* (L.) W.T.Aiton	Asclepiadaceae	P1	√	√										
Lime grass	*Cympopogon flexuosus*	Poaceae	N2P2	√	√										

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

	(Nees ex Steud.) W. Atson														
Common mallow	*Thespesia lampas* (Cav.) Dalz. & A. Gibson	Malvaceae	P1N2		√	√									
Chaklatewe ed (Bankuro)	*Melochia corchorifolia* L.	Malvaceae	P2												
Potentilla	*Potentilla supina* L.	Rosaceae	N2					√	√						
Eclipta	*Eclipta prostrata* (L.) L.	Asteraceae	P2N2	√	√										
Ixeris	*Ixeris polycephala* Cass.	Asteraceae	P2						√	√					
Xanthium	*Xanthium strumarium* L.	Asteraceae	P2						√	√					
Garuga (Dabdabe)	*Garuga pinnata* Roxb.	Burseraceae	N2P2					√	√						
Cyperus	*Cyperus* spp.	Cyperaceae	P2				√	√							
Eleocharis	*Eleocharis pellucida* J. Presl. & C. Presl.	Cyperaceae	N2						√	√					
Dillenia	*Dillenia pentagyna* Roxb.	Dilleniaceae	N1P2			√	√								
Desmodium	*Ocimum basilicum* L.	Labiateae	N2P2	√	√										
Phaseolus	*Desmodium oojeinese* (Roxb.) H. Ohashi	Leguminosae	N1P2				√	√							
Fragaria	*Flemingia macrophylla* (Willd.) Merr.	Leguminosae	N2P2								√	√			
Xeromphis	*Phaseolus mungo* L.	Leguminosae	N2P2						√	√					
Schleichera	*Fragaria nubicola* Lindi.ex. Lacaita	Rosaceae	N1					√	√						
Typha	*Xeromphis uliginosa*	Rubiaceae	N2P2						√	√					

	(Retz.) Maheshw.														
Phyla	*Schleichera oleosa* (Lour.) Oken	Sapindaceae	N2P1	√	√										
Wild okra	*Typha angustifolia* L.	Typhaceae	P1							√	√				
Sawtooth fogfruit (Paadke Siris)	*Phyla nodiflora* (L.) Greene	Verbenaceae	N1				√	√	√	√	√	√	√	√	√
Aegle	*Flemingia strobilifera* (L.) W.T. Aiton	Fabaceae	N2P1	√	√										
Native rosella (Mulapate)	*Abelmoschus ficulneus* (L.) Wight & Arn.	Malvaceae	N2P2		√				√	√					
Pink sisis	*Albizia julibrissin* (Var.)	Fabaceae	N1P1										√	√	
Wood apple (Mirchaiya)	*Aegle marmelos* (L.) Correa	Rutaceae	N1P2					√							
Batoko plum	*Diplacus inermis* Wall ex Roxb.	Lamiaceae	N2P2							√	√	√			

* H= Herb,T= Tree, S= Shrub

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

Rice, *Oryza sativa* L.; maize, *Zea mays* L.; buckwheat, *Fagopyrum esculentum* Moench.; rapeseed, *Brassica campestris* L.; sesame, *Sesamum orientale* L.; litchi, *Litchi chinensis* Sonner; .; guava, *Pisum sativum* L ; cucurbits (bottle gourd, *Lagenaria siceraria* (Molina) Standl; sponge gourd, *Luffa cylindrica* (L.) Roem.; bitter gourd, *Momordica charantia* L.; Leucas (gumpate), *Leucas lanata* Benth.; Butternut (chiuri), *Bassia butyracea* Roxb: Pogostemon (rudilo), *Pogostemon glaber* BenthSisoo, *Dalbergia sissoo* Roxb.; Throughwort (Banmara), *Eupatorium* sp. and silk tree (Padke), *Albizia julibrissin* Durazz; Murraya (kadipatta) Murraya koenigii (L.) Spreng. are the major bee forage species of the district. *Fagopyrum esculentum Moench, Brassica campestral L, Lagerstroemia indica L, Bombax ceiba L, Albizia julibrissin Durazz., Eugenia fprmosa Wall., Shorea robusta, Guartn. Upatorium grandulosum, Pogostemon glaber Benth.* Terminalia alata Heyne ex.Roth, *Murraya koenigii (L.) Spreng Sesamum orientale L. Dalbergia sissoo Roxb.* were the major bee flora both rich in nectar and pollen.

Table 3: Distribution of crops and wild bee forage plant in different months in Chitwan, during 2012-2013

Particulars	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Cereal	3	2	2	0	2	2	1	5	4	3	3	1

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
(Received: October 23, 2018 - Accepted: November 25, 2018) DOI: 10.5281/zenodo.1928975

Pulses	1	2	2	0	2	2	1	5	4	3	3	1
Oilseed	2	4	2	2	1	1	3	2	3	2	1	2
Vegetable	4	10	14	13	10	10	7	8	6	6	3	3
Fruits	1	5	16	16	7	4	1	1	1	1	1	1
Ornamental	6	7	7	9	13	15	14	14	12	12	8	8
Wild	22	33	35	45	48	53	48	36	33	25	15	9
Total	39	63	78	85	83	87	75	71	63	52	34	25

Table 3 summaries the crops and wild bee forage with their flowering months, which indicated that majority of bee forage available in Feb-September. Though rainy season is drought period in Chitwan condition, many wild plant species found flowering in the season. Migration of bee colony in different places within Chitwan can lower the feeding to the bees in winter and rainy seasons.

Table 4: Bee forage plants with nectar and pollen sources found in Chitwan, Nepal during 2012-2013

Particuclars	**P1**	**P2**	**N1**	**N2**	**N1P1**	**N2P1**	**N1P2**	**N2P2**	**Total**
Cereals	1	4	0	0	1	0	0	0	6
Wild plants	11	32	10	16	23	6	10	47	155
Ornamentals	1	3	2	2	5	0	3	10	26
Fruits	0	2	0	1	11	2	1	4	21
Vegetables	5	6	0	2	3	0	0	9	25
Pulses	0	4	1	3	1	0	0	2	11
Oilseeds	0	0	0	0	6	0	0	2	8
Total	18	51	13	24	50	8	14	74	252

Plants identified as bee forage are categorized as source of pollen (P1, P2) or nectar (N1, N2) and their combinations with their status in the study areas of Chitwan (Table 2). This includes 50 plant species rich in both nectar and pollen (N1P1), 14 species N1P2, 8 species N2P1, 74 species N2P2, 18 species rich in pollen only(P10, and 51 species as minor source of pollen (P2), 13 species rich in nectar (N1) and 24 species low nectar(N2). Pollen is necessary for brood development which were found to a greater amount in wild plants compared to crops. However, most of the wild plants which had low content of nectar and pollen.

Table 5: Bee forage crops and wild plants having different sources available in different months during 2012-2013

Sources	**Jan**	**Feb**	**Mar**	**Apl**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**No. of flora**
N1P1	7	15	26	27	12	12	8	7	6	8	6	5	50
N1	1	0	2	6	8	6	5	5	3	2	1	1	13
N2	4	5	6	2	4	6	3	5	5	8	7	4	24
P1	6	6	3	4	5	4	8	7	7	6	4	3	18
P2	9	14	14	13	16	15	14	15	15	9	9	5	51
N1P2	0	0	2	5	7	6	6	5	4	4	0	0	14

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

N2P1	2	2	1	2	2	2	1	1	0	0	1	1	8
N2P2	22	33	35	45	48	53	48	36	33	25	15	9	74
Total	51	75	89	104	102	104	93	81	73	62	43	28	252

Table 5 shows that bee forage were find well distributed throughout the year, however most of the species got flowering from Feb to September. Less number of plants were got flowering in November- January.

4. Discussions

Chitwan is rich in bee flora, i.e. 252 bee forage species were found during study. Most of these species were included in plant species lists in several other studies of Dangol and Shivakoti (2001), Thapa (2006) and Pokhrel, (2005) . Many crop and wild plants visited by bees in Chitwan include: litchi, buckwheat, rapeseed, Indian mustard, cowpea, radish, broccoli, sponge gourd, cucumber, brinjal, red gram, okra, mango, citrus, squash, bottlebrush, sesame and bottle gourd as reported by many workers (Thapa, 2002; Dhakal, 2003; Neupane, 2000; Devkota, 2000). 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 which supports bee even in the dearth periods. This study was concurrence with the floral study of Kavre and Dolakha (Bista and Shivakoti, 2001) and Pokhrel (2005), respectively. Bista and Shivakoti (2001) at Kabre, Dolakha district indicated that the peak periods of honeybee foraging activity and abundant bee floral plants were recorded during mid-February and May (spring season); whereas from mid-November to February (winter season) is dearth period and the colony strength can be weak However, availability of honey potential bee flora is shown comparatively lacking in summer, which was also similar to the study of Mishra (1997/1998). Less honey potential floral sources are available to bees from June to September, so these months are very harsh for bees.
Higher numbers of bee flora recorded in Megauli under semi- natural, shrub land and watershed areas found positive impact in biodiversity conservation as indicated by Emiru *et al.* (2006), in eastern zone of Tigray, Ethiopia. Jacobs *et al.* (2006) emphasized on bee flora species and other multipurpose species for rehabilitation of degraded and watershed areas, which were seen in Megauli. Akratanakul (1990) also lists guidelines for the exploration and evaluation of potential area for beekeeping with honeybee plants having relatively long blossoming periods, generally in terms of several weeks or months.

Knowledge about bee flora with their flowering time is very crucial for the farmers. Figure 2 shows that cultivated and wild bee forage plants bloomed in different months, however, the potential source of nectar and pollen were found in November to April, known as honey flow seasons in Chitwan condition. Honey flow is primarily due to the sufficiency of bee flora rapeseed, buckwheat and *Bassia butyracea* (Nov-Feb), *Pogostemon* sp. (Nov-Feb), *Dalbergia* sp. (April-May). *Albizia* sp. (July-Aug) *Morraya* sp (June), *Eupatorium* sp. (May-July), *Bombax* sp. (March-April), *Termenalia* sp(June-July), in different parts of Chitwan district. Several wild flora with minor honey sources were also found in rainy months (June-September) too, however, it was not sufficient for honeybee growth and development hence these period was taken as dearth period to bees in Chitwan condition. The cropland showed potentiality of increasing production and productivity by placing supplemental honeybee colonies on crop fields during flowering period as repoted by Garratt et al. (2013) in orchard fruit crops (Bommarco, Marini and Vaissi`ere, (2012)

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
(Received: October 23, 2018 - Accepted: November 25, 2018) DOI: 10.5281/zenodo.1928975

in small fruits and vegetables (Andersson, Rundlof and Smith, 2012) and Partap C (1997) in fruit and seed production. However, this practice was not followed by the farmers resulting in low crop productivity there. Studies done by Partap and Partap (2002) and Thapa (2002) reveals that level of knowledge about biodiversity conservation, pollination and pollinators in Nepalese farmers are inadequate.

5. Conclusion and Recommendation

A total of 252 common bee flora species were identified in four study areas of Chitwan. The common bee forage species identified included: rice, maize, buckwheat, cowpea, black gram, rapeseed, mustard, and cucurbits, Lichi, citrus, *Eupatorium*, Pogostemon, Sissoo, Acacia, Termenalia, Albizia Morraya (kadipatta), Leucas. Most of the important bee flora was blooming from November to March, and this was peak period for honeybee foraging activity as well as peak time of honey harvest. There was shortage of bee forage in winter (Nov –January) and rainy period (June- Aug). There was variation in bee flora species diversity and abundance in different land use system, i.e. somewhat fewer floral species were recorded in organic site, i.e. Fulbari VDC, which was far from natural forests. In the study areas, there was good availability of bee forage in the summer season also. This was one of the positive impact of conservation of National Park, community forests, watershed and fallow lands. Though the sufficient bee flora was available in intensive agriculture practiced area, farmer kept away their hives in other places for foraging due to heavy use of pesticide in their crop fields. Hence, awareness raising program should be organized to educate them about importance of bee flora in pollinators and honey production. However, in the dry season only few bee flora plants were in bloom and this affected the colony performance. Therefore, to solve this problem beekeeping based agro-forestry practices on cultivated land, and selection of plant species that can tolerate drought and set flower for a long period should be introduced. Introduction of similar major honey producing plants in other countries or regions with similar vegetation patterns, agro-ecosystems, climate, and edaphic conditions also seemed necessary. Emphasis must be given honey potential plant which blooms longer period rather than covering large area. The large-scale planting of honeybee forages should be integrated with other agricultural activities, such as reforestation, roadside plantings, and animal pasture.

Acknowledgements

My sincere thanks goes to the Dean Prof. Dr. Keshav Raj Adhikari and Asst. Dean (Academic), Prof. Dr. Gopal Bahadur K.C. of IAAS, Tribhuvan University, Nepal for their valuable suggestions and support. I express my gratitude to Mr. Milan Subedi, Assistant Professor of IAAS, TU, Nepal for his regular support and motivation. I am thankful to all the farmers' groups and key informants of the research areas without their help the research will not be completed.

References

[1] Adhikari, S. and N.B. Ranabhat. 2003. Bee flora in mid hills of central Nepal. Botanica orientalis-J. Plant Sci. 8: 45–56.
[2] Akratanakul, P. 1990. Beekeeping in Asia. Food and Agriculture Organization of the United Nations, Agricultural Services. Bulletin 68/4. Rome, Italy.

[3] Andersson, G.K.S., M. Rundlöf and H.G. Smith. 2012. Organic farming improves pollination success in strawberries. PLoS ONE 7: (2) e31599.
[4] Baptist, B.A. and R.W.K. Punchihewa .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
[5] Bartomeus, I., S.G. Potts, I. Steffan-Dewenter, B.E. Vaissière, M. Woyciechowski, K.M. Krewenka, T. Tscheulin, S.P.M. Roberts, H. Szentgyörgyi, C. Westphal and R. Bommarco. 2014. Contribution of insect pollinators to crop yield and quality varies with agricultural intensification. PeerJ 2: e328.
[6] Biesmeijer, J.C., S.P. Roberts, R. Reemer, M, Ohlemüller , M. Edwards , T. Peeters , A.P. Schaffers, S.G. Potts , R . Kleukers , C.D. Thomas , J. Settele and W.E. Kunin . 2006. Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands. Science 313:351–354.
[7] Bedru, B., B. Muys and E. Mathiji. 2006. Economic valuation methods of forest rehabilitation in exclosures. J. Drylands 1(2):165-170.
[8] Bista S. and P. G. Shivakoti. 2001. Honeybee flora at Kabre Dolakha District, Nepal. Journal of Nepal Agric. Res. (4 & 5): 16-25.
[9] Bommarco, R., L. Marini and B.E. Vaissiere. 2012. Insect pollination enhances seed yield, quality, and market value in oilseed rape. Oecologia 169: 1025–1035.
[10] Breeze, T.D., A.P. Bailey, K.G. Balcombe and S.G. Potts. 2010. Pollination services in the UK: How important are honeybees? Agri.Eco.Environ. 142 (3–4):137–143.
[11] Cameron, S. A., J. D. Lozier, J. P. Strange, J. B. Koch, N. Cordes, L. F. Solter, T. L. Griswold, and G. E. Robinson. 2011. Patterns of widespread decline in North American bumble bees. Proc. Natl. Acad. Sci. USA 108: 662–667.
[12] Costanza, R.; R. D'Arge, R. De Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O'Neil, J. Paruelo, P. Raskin, and M.van der Belt, 1997. The value of the world's ecosystem services. Nature 387: 253–260.
[13] Dangol, D. R. 2000. Studies on ethnobotany of weeds in Chitwan. pp. 123-135. Shrestha, S. M. and N. R.
[14] Devkota (eds.), IAAS Research Reports (1995-2000). Institute of Agriculture and Animal Science, Rampur.
[15] Dangol, D. R. and G.P. Shivakoti. 2001. Plant diversity of western Chitwan: A floristic approach. J. Nat.Hist. Mus. 20: 129–147
[16] Dhakal, G. 2003. Efficciency of Apis mellifera L. and Apis cerana F. for pollinating mustard and buckwheat. M.Sc. Thesis, Institute of Agriculture and Animal Sciences, Rampur, Chitwan, Nepal
[17] Devkota, F.P. 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.
[18] Emiru, B. 2002. Actual and Potential Contributions of Enclosure of Enhance Biodiversity in Dry Lands of Eastern Tigray with Particular Emphasis on Woody Plants, M.Sc. Thesis. ISSN 1402-201 X 2002; 70 (SlU), Sweden.
[19] Gallai, N., J. M. Salles, J. Settele, and B. E. Vaissiere. 2009. Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecol. Econ. 68: 810–821.
[20] Garratt, M.P.D., T. Breeze, N. Jenner, C. Polce, J.C. Biesmeijer and S.G. Potts. 2013. Avoiding a bad apple: insect pollination enhances fruit quality and economic value. Agric., Ecosys. Environ 84:4–40.
[21] Gulson, D., G.C. Lye, and B.Darvill. 2008. Decline and conservation of bumble bee, Ann.Rev.Entomol. 53:181-208
[22] Hogendoorn, K., F. Bartholomaeus and M.A. Keller. 2010. Chemical and sensory comparison of tomatoes pollinated by bees and by a pollination. J. Econ. Ent. 103:1286–1292.
[23] Isaacs, R. and A.K. Kirk. 2010. Pollination services provided to small and large highbush blueberry fields by wild and managed bees. J. of Appl. Eco. 47:841–849.

ISSN- 2350-0530(O), ISSN- 2394-3629(P)
DOI: 10.5281/zenodo.1928975

[24] Jacobs, F., C. Simoens, D. Graaf and J. Deckers, 2006. Scope for non-wood forest products income generation from rehabilitation areas: focus on beekeeping. J. Drylands 1(2): 171-185.
[25] Mishra, R.C. 1997/1998. Perspectives in Indian apiculture. Agro. Botanica, HS Offset Printers, New Delhi, India.
[26] Neupane, K. R. 2001. Foraging preference of honeybee species to selected horticultural crops. M. Sc. Thesis submitted to IAAS, Rampur, Chitwan, Nepal.
[27] Partap, U. 1997. Bee flora of the Hindu-Kush-Himalayas: Inventory and management. ICIMOD, Kathmandu, Nepal.
[28] Partap, U. and T. Partap. 1997. Managed crop pollination. The missing dimension of mountain agriculture productivity. Discussion Paper No. MES 97/1. ICIMOD, Kathmandu, Nepal. pp 1-22.
[29] Partap, U. and T. Partap. 2002. Warning signal from the apple valley of the HKH: Productivity concerns and pollination problems. ICIMOD, Kathmandu, Nepal.
[30] Pokhrel, S. 2005. Behavior and Management of Domesticated and Wild honeybees (Apis spp.) in Chitwan, Nepal. Ph.D. dissertation. Tribhuvan University. 240 p.
[31] Pokhrel, S. 2006. Behavior and management of domesticated and wild honeybees (Apis spp.) in Chitwan, Nepal. Ph. D. dissertation, Department of Entomology, IAAS, Rampur, Chitwan, Nepal. 240
[32] Polumin, O. and A. Station. 1997. Flowers of Himalaya. Oxford University Press, ISBN 10: 0195641876
[33] Roldán, S. and S. Guerra. 2006. Quality fruit improvement in sweet pepper culture by bumble bee pollination. Scientia Horticulturae 110:160–166.
[34] Roselino, A. C., S.B. Santos, M. Hrncir and L.R. Bego. 2009. Differences between the quality of strawberries (Fragaria x ananassa) pollinated by the stingless bees Scaptotrigona aff. depilis and Nannotrigona testaceicornis. Genetics and Molecular Research 8:539–545.
[35] Shreshtha, K. 1998. Dictionary of Nepalese plant names. Mandala Book Point, Kathmandu, Nepal.
[36] Silveira F.A. (2004) Monitoring pollinating wildbees, In: Freitas B.M., Pereira J.O.P. (Eds.), Solitary bees: conservation, rearing and management for pollination, Imprensa Universitária UFC, Fortaleza.
[37] Thapa, R. B. 2006. Honeybees and other insect pollinators of cultivated crops: J. Inst. Agric. Anim. Sci. 27:1-23.
[38] Pokhrel, S, R., Thapa, F. P. Neupane, S. M. Shrestha. 2006. Absconding behavior and management of Apis cerana F. honeybee in Chitwan, Nepal. Journal of the Institute of Agriculture and Animal Science. 27: 77-86
[39] Thapa, R. B. 2002. Insect pollinators of some crop plants in Chitwan. NAHSON Bull.12/13:19-21.
[40] Winfree, R., I. Bartomeus and D. Cariveau. 2011. Native pollinators in anthropogenic habitats. Annual Review of Ecology, Evolution and Systematics 42:1-22.
[41] van-Engelsdorp, D., J.R.. Hayes., J., R.M. Underwood and J. Pettis. 2008. A Survey of Honey Bee Colony Losses in the U.S., Available: Spring 2008. PLoS ONE 3, e4071 in Jan12, 2015.
[42] UNEP. 1993. Global biodiversity. UNEP, Nerobi, Kenya.
[43] Williams, I.H. 1994. The dependence of crop production within the European Union on pollination by honey bees. Agric. Zool. Review. 6:229-257.
[44] Wilson, E. O. 1988. The current state of biodiversity. In : E. O Wilson and F. M. Peter (eds.) Biodiversity, National Academic Press, Washington DC, USA. 3-18 pp

*Corresponding author.
E-mail address: rijal_sp@ yahoo.com