



Science

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

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### 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 melon, *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*, *Pogostemon*, *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*.

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## 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<sup>-1</sup> yr<sup>-1</sup> (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.) Willd. 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

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. Meghauili 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

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*, *Sisoo*, *Uptorium* 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 dominance of wild flora there. The beekeeping enterprises flourished

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 | Ju<br>n | J | A | S | O | N | D |
| <b>Cereal</b>          |                                       |              |        |                |   |   |   |   |         |   |   |   |   |   |   |
| Rice                   | <i>Oryza sativa</i> L.                | Poaceae      | P2     |                |   |   |   | √ | √       |   |   |   | √ | √ |   |
| Maize                  | <i>Zea mays</i> L.                    | Poaceae      | P1     | √              |   |   |   |   | √       | √ | √ | √ | √ | √ |   |
| Finger millet          | <i>Eleusine coracana</i> (L.) Gaertn. | Poaceae      | P2     |                |   | √ | √ |   |         |   |   |   |   |   |   |
| Wheat                  | <i>Triticum aestivum</i> L.           | Poaceae      | P2     | √              | √ | √ |   |   |         |   |   |   |   |   |   |
| Barley                 | <i>Avena sativum</i> L.               | Poaceae      | P2     |                | √ | √ |   |   |         |   |   |   |   |   |   |
| Buckwheat              | <i>Fagopyrum esculentum</i> Moench    | Polygonaceae | N1P1   | √              | √ | √ |   |   |         |   |   |   | √ | √ | √ |
| <b>Pulse crops</b>     |                                       |              |        |                |   |   |   |   |         |   |   |   |   |   |   |
| Pigeon pea             | <i>Cajanus cajan</i> (L) Millsp.      | Fabaceae     | P2     | √              | √ |   |   |   |         |   |   |   |   |   |   |
| Lentil                 | <i>Lens culinaris</i> Medikus         | Fabaceae     | N2     |                |   |   |   |   |         |   |   |   |   | √ | √ |
| Chickpea               | <i>Cicer arietinum</i> L.             | Fabaceae     | N2P2   |                | √ | √ |   |   |         |   |   |   |   |   |   |
| Black gram             | <i>Phaseolus mungo</i> (L.) Hepper    | Fabaceae     | N1     |                |   |   |   |   |         |   | √ | √ | √ |   |   |
| Green gram             | <i>Phaseolus radiates</i> L.          | Fabaceae     | N1P1   |                |   |   |   |   |         |   | √ |   |   |   |   |
| Peas                   | <i>Pisum sativum</i> L.               | Fabaceae     | P2     |                |   | √ |   |   |         |   | √ | √ |   |   |   |
| Cowpea                 | <i>Vigna unguiculata</i> (L.) Walp.   | Fabaceae     | P2     |                |   |   |   | √ | √       | √ | √ | √ |   |   |   |
| Soybean                | <i>Glycine max</i> (L.) Merr.         | Fabaceae     | N2P2   |                |   |   |   |   |         |   | √ | √ |   |   |   |
| Lima beans             | <i>Phaseolus lunatus</i> L.           | Fabaceae     | N2     |                |   |   |   |   |         |   |   |   | √ | √ |   |
| Rice beans             | <i>Vigna umbellata</i> L.             | Fabaceae     | P2     |                |   |   |   | √ | √       |   |   |   |   |   |   |
| Kidneybean (Ghiu simi) | <i>Phaseolus vulgaris</i> L.          | Fabaceae     | N2     |                |   |   |   |   |         |   |   |   | √ | √ |   |

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

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

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

**Ornamental plants**



|                                    |   |                      |      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------------------------------|---|----------------------|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Callistemon<br>( <i>kalkifol</i> ) | <i>Callistemon<br/>citrinus</i><br>(Curtis)<br>Skeels | Myrtaceae            | N1P1 |   | √ | √ | √ | √ | √ | √ | √ |   |   |   |   |   |   |
| Crysanthim<br>um                   | <i>Chrysanthem<br/>um segetum</i><br>L.               | Asteraceae           | N2P2 |   |   |   |   |   |   |   |   | √ | √ | √ | √ | √ |   |
| Gulmohar                           | <i>Delonix regia</i><br>(Boj. ex<br>Hook.) Raf.       | Fabaceae             | N2P2 |   |   |   |   | √ | √ |   |   |   |   |   |   |   |   |
| Gomphrena                          | <i>Gomphrena<br/>globosa</i> L.                       | Amaranthacea<br>e    | P2   | √ |   |   |   |   |   | √ | √ | √ | √ | √ | √ | √ |   |
| Jasmin                             | <i>Jasminium<br/>sambac</i> (L.)<br>Ait.              | Oleaceae             | N2   |   |   |   |   |   |   |   |   | √ | √ | √ | √ |   |   |
| Rose                               | <i>Rosa indica</i> L                                  | Rosaceae             | N2P2 |   |   |   |   | √ | √ |   |   |   |   |   |   |   |   |
| Marigold                           | <i>Tagetes<br/>patula</i> L.                          | Compositae           | N2P2 |   |   |   |   |   |   |   |   | √ | √ | √ | √ |   |   |
| Zinnia                             | <i>Crassina<br/>elegans</i><br>(Jacq.)<br>Kuntze      | Asteraceae           | N1P2 |   |   |   |   | √ | √ | √ | √ | √ | √ |   |   |   |   |
| Chinese<br>rose                    | <i>Hibiscus<br/>rosa-sinensis</i><br>L.               | Malvaceae            | N2P2 |   |   | √ | √ | √ | √ | √ |   |   |   |   |   |   |   |
| Bottlebrush                        | <i>Grevillea<br/>robusta</i> A.<br>Cunn. ex R.<br>Br. | Proteaceae           | N1P1 |   |   |   | √ | √ |   |   |   |   |   |   |   |   |   |
| Night<br>jasmine                   | <i>Nyctanthes<br/>arbor-tristis</i><br>L.             | Oleaceae             | N1P1 |   |   |   |   | √ | √ | √ | √ | √ | √ |   |   |   |   |
| Garden<br>balsam                   | <i>Impatiens<br/>balsamina</i> L.                     | Balsaminac<br>eae    | N1P2 |   |   |   |   | √ | √ | √ |   |   |   |   |   |   |   |
| Wax<br>mallow                      | <i>Malvaviscus<br/>arboreus</i><br>Cav.               | Malvaceae            | N1P1 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Agava                              | <i>Agave<br/>americana</i> L.                         | Agavaceae            | N2P2 |   |   |   |   |   |   |   |   | √ | √ | √ | √ | √ |   |
| Hollyhook                          | <i>Althaea rosea</i><br>(L.) Cav.                     | Malvaceae            | N2P2 |   |   |   | √ | √ | √ |   |   |   |   |   |   |   |   |
| Calendula                          | <i>Calendula<br/>offisinalis</i> L.                   | Compositae           | N2P2 |   | √ | √ | √ |   |   |   |   |   |   |   |   |   |   |
| Dahlia                             | <i>Dahlia<br/>pinnata</i> Cav.                        | Compositae           | P2   | √ |   |   |   |   |   |   |   | √ | √ | √ | √ | √ |   |
| Dianthus                           | <i>Dianthus<br/>chinensis</i> L.                      | Cariyophyllac<br>eae | P2   |   | √ | √ | √ | √ |   |   |   |   |   |   |   |   |   |
| Euphorbia                          | <i>Euphorbia<br/>pulcherrima</i><br>e                 | Euphorbiacea<br>e    | N2P2 | √ | √ |   |   |   |   |   |   |   |   |   |   |   |   |

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

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

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

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

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

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

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



|                         |   |                    |          |   |   |   |  |   |   |   |   |   |   |   |   |   |
|-------------------------|---|--------------------|----------|---|---|---|--|---|---|---|---|---|---|---|---|---|
| Piper                   | <i>Piper longum</i><br>L.                                 | Piperaceae         | P2       |   |   |   |  |   |   |   |   | √ | √ |   |   |   |
| Wild<br>temeric         | <i>Curcuma<br/>aromatica</i><br>Salisb.                   | Zingiberaceae      | N2P2     |   |   |   |  |   |   |   |   |   |   |   |   |   |
| Mikania                 | <i>Mikania<br/>micarantha</i><br>Kunth                    | Asteraceae         | N2P2     |   | √ |   |  |   |   |   |   |   |   |   |   |   |
| Paspalum                | <i>Paspalum<br/>distichum</i> L.                          | Poaceae            | P2       |   |   |   |  |   |   |   |   | √ | √ |   |   |   |
| Cynoglossu<br>m         | <i>Cynoglossum<br/>glochidiatum</i><br>Wall.ex<br>Benth   | Boraginaceae       | P2       |   |   |   |  |   | √ | √ |   |   |   |   |   |   |
| Croton                  | <i>Croton<br/>sparciflora</i><br>Morong                   | Euphorbiacea<br>e  | N2<br>P2 | √ | √ |   |  |   |   |   |   |   |   |   |   |   |
| Achyranthe<br>s         | <i>Achyranthes<br/>aspera</i> L.                          | Amaranthacea<br>e. | N2P2     |   |   |   |  |   | √ | √ |   |   |   |   |   |   |
| Datura                  | <i>Datura<br/>stramonium</i><br>L.                        | Solanaceae         | P2       |   |   |   |  |   | √ | √ |   |   |   |   |   |   |
| Clerodendru<br>m        | <i>Clerodendru<br/>m<br/>infortunatum</i><br>L.           | Lamiaceae          | N1       |   |   |   |  | √ | √ |   |   |   |   |   |   |   |
| pignut Wild<br>( sesame | <i>Hyptis<br/>suaveolens</i><br>(L.) Poit.                | Lamiaceae          | N2       |   |   |   |  |   |   |   |   | √ | √ |   |   |   |
| Vicia                   | <i>Vicia<br/>angustifolia</i><br>(L.) ex Reich.           | Leguminaceae       | P2       | √ | √ |   |  |   |   |   |   |   |   |   |   |   |
| Urtica                  | <i>Urtica dioica</i><br>L.                                | Urticaceae         | N2P2     |   | √ | √ |  |   |   |   |   |   |   |   |   |   |
| Oxalis                  | <i>Oxalis<br/>corniculata</i><br>L.                       | Oxalidaceae        | N2       |   |   |   |  | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Mallotus                | <i>Mallotus<br/>phillipensis</i><br>(Lam.) Muell.<br>Arg. | Euphorbiacea<br>e  | N2P2     |   | √ | √ |  |   |   |   |   |   |   |   |   |   |
| Grewia                  | <i>Grewia<br/>helicterifolia</i><br>Wall.ex G.<br>Don.    | Tiliaceae          | P2       |   |   |   |  | √ | √ |   |   |   |   |   |   |   |
| Calotropis              | <i>Calotropis<br/>gigantea</i> (L.)<br>W.T.Aiton          | Asclepiadacea<br>e | P1       | √ | √ |   |  |   |   |   |   |   |   |   |   |   |
| Lime grass              | <i>Cympopogon<br/>flexuosus</i>                           | Poaceae            | N2P2     | √ | √ |   |  |   |   |   |   |   |   |   |   |   |

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

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

|            |    |    |    |    |    |    |    |    |    |    |    |    |
|------------|----|----|----|----|----|----|----|----|----|----|----|----|
| 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           |

|       |    |    |    |     |     |     |    |    |    |    |    |    |     |
|-------|----|----|----|-----|-----|-----|----|----|----|----|----|----|-----|
| 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. Akwatanakul (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 reported by Garratt et al. (2013) in orchard fruit crops (Bommarco, Marini and Vaissi`ere, (2012)

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.

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