

## Bees and Agriculture: The alliance for better sustainability and farming practices

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### Introduction:

The term 'bees' is not just restricted to honey bees. There are bees other than honey bees that are still being overlooked. Mother earth is bestowed with around 20,000 species of bees categorized under seven families and many others are yet to be described (Ascher and Pickering, 2014). These include social bees and also solitary bees that offer valuable ecosystem services (pollination) other than honey and various hive products. But the value of additional yield obtained due to bee pollination alone is 15-20 times more than the value of all the hive products put together. This fact emphasizes the role of bees as pollinators of plants.

Pollination is the transfer of pollen grains from anthers to the stigma of the flowers on the same or different plants. The coevolution of plants with bees (Cappellari *et al.*, 2013) has paved the way for the bees to serve as crucial pollinators of various plant species around the globe. Bees are the dominant group of pollinators while, butterflies and moths are the most diverse groups (Ollerton *et al.*, 2017). Bees have branched hairs that enable them to collect and carry pollen grains (loose pollen grains), they are social and semi-social in existence, with fidelity to floral resources. All these features make them efficient pollinators of a wide number of plant species (Ollerton *et al.*, 2017; Klein *et al.*, 2018).

For centuries together the association between human beings and bees is found to be concrete and mutualistic. In recent years this is being jeopardized by the loss of both the managed bee colonies (Potts *et al.*, 2010) and wild bee populations in Europe and North America, thereby resulting in a decline in pollination (Biesmeijer *et al.*, 2006; Koh *et al.*, 2016). This can also be the case throughout our planet, which has to be further investigated.

### The farmer's friends:



In agriculture, bees are the most important input other than fertilizers, agrochemicals and organic amendments put together. Of the fifty managed bee species, 12 species of bees are managed for crop pollination (Potts *et al.*, 2016a). Wind and self-pollinated crops account for 60percent of the global food consumption and do not require external agencies for pollination, but 90per cent of the 107 major food crops are visited by bees (Klein *et al.*, 2007). Wild bees on average contribute USD\$3251/ha towards the production of insect-pollinated crops (Kleijn *et al.*, 2015). Bees improve the yield of some crops (Klein *et al.*, 2007, 2018; Stein *et al.*, 2017), and also contribute to enhanced nutritional value, improved quality of the produce even up to 62percent (Stein *et al.*, 2017) and increased shelf life of many fruits and vegetables (Klatt *et al.*, 2014). While the exclusion of pollinators caused an average yield gap of 37percent in cotton and 59percent in sesame (Stein *et al.*, 2017) which further backs the fact that bees are crucial for plant pollination.

Crops benefited by bee pollination include fruits and nuts like almond, apple, apricot, and peach, strawberry, citrus and litchi. In apples, there was a yield increase of 44percent due to bee pollination. Vegetables and seed crops like cabbage, cauliflower, carrot, coriander, cucumber, melon, onion, pumpkin, radish and turnip are also dependent on bee pollination. Bees also have a crucial role to play in the pollination of forage seed crops like Lucerne and clover. Lucerne in turn serves as an offseason floral resource in temperate regions like Jammu and Kashmir. This mutualistic interaction between bees and crop plants benefits agriculture and its allied sectors like animal husbandry and finally the human beings, both in health and economic aspects.

Albeit agricultural crops, the contribution of bees towards the pollination of biofuel crops is also significant. Even though self-pollinated, oilseed crops like Jatropha (Romero and Quezada-Euan,2013) and Canola (Halinski *et al.*, 2018) had pollination success rates when supported with bees. Sunflower, niger, rapeseed, mustard and safflower, also depend on bees for pollination. They have also found a positive correlation between yield and bee diversity. This implies that in addition to the want of bees there is also an emphasis on diversity.

#### **Pollinators in protected cultivation:**

Protected cultivation offers crops relief from various biotic and abiotic stress factors. One should also consider the fact that they also deter the entry of pollinators. Pollinators are

indispensable even in poly houses. These artificial structures where plants are grown under a roof also demand the farmers to manage pollinators. There are even bees that are well suited for this task. Farmers have successfully deployed various domestic and wild bee species for pollination under protected cultivation.

Stingless bees, *Tetragonula iridipenis* S. have immense potential as pollinators of crops under protected cultivation in India. Pollination of eggplant (*Solanum melongena* L.) by a stingless bee (*Melipona fasciculata* S.) was found to increase the yield by 29.20percent (Silva *et al.*, 2013). In Sweet pepper (*Capsicum annuum* L.) both the quality and quantity of fruits and number of seeds per fruit were also found to increase significantly when pollinated by *Melipona subnitida* D.(Cruz *et al.*,2005), *Austroplebia australis* F. and *Tetragonula carbonaria* S.(Greco *et al.*,2011). Bumblebees are potential pollinators of crops cultivated in green/poly houses in the temperate regions of the world.

#### **Management of bees for pollination:**

Pollination of crops by bees is called mellitophily. Farmers and policymakers should consider bees as one of the most essential inputs for crop production. The efficiency of bee pollination depends on the colony strength, number of colonies placed in the field (which depends on individual crops) along with the distribution, the stage of the crop and weather conditions. Knowledge about the flowering pattern, availability of alternate resources during the offseason to sustain the life of colonies and suitable agricultural practices like avoidance/judicious application of insecticide are all essential to fetch the services of these valuable pollinators. It is essential for the farmers to get skill training on managing bees for at least pollination, if not for honey, even though, bees provide both simultaneously.

#### **Sustainable alliance:**

Life on earth is designed in such a way that there is a link between all the biotic and abiotic components in one way or the other. This is not necessarily only mutualistic as it can also be harmful to one while beneficial to the other. However, life goes on with a balance created and supported by nature. Agriculture is not just science or art it is a way of life close to nature and can never be against it. Sustainable crop management practices are the need of the hour. Billions of hungry stomachs are to be fed daily and this promotes intensified farming practices, monocultures and indiscriminate use of agrochemicals. Polycultures and integrated farming practices will be conducive for the diversity of bees, flora and fauna. The

alliance between bees and crops can only feed the exploding population. This is not just the concern of bees and agriculture alone but the survival of life on earth as a whole.



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