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Pollinator-Friendly Farming: Aligning Crop Planning with Insect Ecology

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Insect pollinators support production in a majority of the world's crops, yet their populations are under growing pressure from habitat loss, pesticide misuse, and climate variability. This article explains why pollinators matter for crop yield and farm income, what is threatening them, and how farmers can align crop planning — through diversification, flowering calendars, field margins, and judicious pesticide use — with insect ecology to protect pollination services while improving productivity and farm sustainability.

Introduction

Pollination is one of the most valuable yet underappreciated ecosystem services in agriculture. Bees, butterflies, hoverflies, wasps, beetles, and even some moths and flies move pollen between flowers, enabling fruit set, seed formation, and crop quality in a large share of cultivated plants. Worldwide, around one-third of food production depends to some extent on pollinator-dependent plants, including the majority of leading global food crops *(Bhandari et al., 2025)*. In India, animal pollination contributes a direct value of about ₹1,12,615.73 crores (roughly USD 22.52 billion) to agriculture, with oilseeds such as rapeseed and mustard, along with cotton, fruits, vegetables, and spices, among the biggest beneficiaries *(Gangwar and Charan, 2017)*. Despite this enormous contribution, pollinator populations are declining across agricultural landscapes due to habitat loss, monocropping, and pesticide pressure. For farmers, planning crops with insect ecology in mind is no longer just an ecological ideal — it is fast becoming an economic necessity.

Why Pollinators Matter in Crop Production

Pollinator-dependent crops are not limited to a handful of fruits; they include oilseeds, pulses, vegetables, spices, and plantation crops that form the backbone of Indian farm income. Analysis of more than 200 crops grown in India found that production of over half is dependent on animal pollination to varying degrees, with 14 crops showing 90–100 percent yield reduction in the absence of pollinators *(Gangwar and Charan, 2017)*. Beyond raw yield, adequate pollination also improves fruit size, shape, seed count, and overall produce quality, which directly affects the price farmers receive at the market. Long-term data further shows that since the early 1990s, yields of pollinator-dependent vegetable crops in India have flattened or declined even as non-dependent crops continued to grow, pointing to pollination limitation as a contributing factor *(Basu et al., 2011)*. This makes pollinator health a direct and measurable input into farm productivity, much like irrigation or soil fertility.

Threats to Pollinator Populations

Several interlinked factors are reducing pollinator abundance and diversity in farmland. Large-scale monocultures limit the continuous availability of flowering resources, leaving

pollinators without food during non-flowering periods of the main crop *(Bhandari et al., 2025)*. A field that flowers intensely for two or three weeks and then offers nothing for the rest of the season cannot sustain a resident pollinator population; bees and other insects either starve, move elsewhere, or fail to build up colony strength in time for the next flowering crop. Indiscriminate and poorly timed use of broad-spectrum insecticides compounds this problem by killing pollinators directly or weakening their foraging and reproductive ability through sub-lethal exposure, even at doses too low to cause immediate visible mortality. Loss of natural habitat such as hedgerows, fallow patches, bunds, and wild vegetation removes nesting and shelter sites for ground-nesting and cavity-nesting wild bees, many of which do not live in hives at all and depend entirely on undisturbed soil or plant stems to reproduce. Climate change adds another layer of risk by shifting flowering times out of sync with pollinator activity cycles, so that a crop may bloom before or after its usual pollinators have emerged, reducing effective pollination windows even where pollinator numbers are otherwise stable. Taken together, these pressures explain the global pattern of pollinator decline now being documented even in predominantly agrarian economies like India *(Basu et al., 2011)*.

Pollinator Diversity on Indian Farms

India's pollinator community is far more diverse than a single managed honeybee species. Wild and semi-wild bees such as *Apis cerana indica* (the indigenous hive bee), *Apis dorsata* (the giant rock bee), and *Apis florea* (the dwarf bee) work alongside solitary bees, hoverflies, and butterflies across most cropping systems *(Agriculture Institute, 2026)*. Field studies on crops such as coriander in the Indian Himalayan region have shown that the combined activity of managed honeybees and wild bee genera such as *Andrena* produced a far higher seed yield than flowers excluded from insect visitors, with open-pollinated plots outperforming caged ones by well over 150 percent *(Bhat et al., 2025)*. This finding illustrates an important point for crop planning: relying on a single managed species, typically *Apis mellifera* hives brought in for the season, is rarely as effective as supporting a mixed community of wild and managed pollinators that visit flowers at different times of day and under different weather conditions. A farm that conserves this natural diversity gains a built-in insurance policy against the failure or unavailability of any single pollinator species.

Aligning Crop Planning with Insect Ecology

Agricultural diversification is one of the strongest tools available to farmers for sustaining pollinator populations. Areas that maintain or increase crop diversity tend to better sustain high and stable productivity of pollinator-dependent crops, compared with areas under continuous monoculture *(Bhandari et al., 2025)*. Practical steps include planning a flowering calendar so that some crop or border planting is in bloom across most of the season, intercropping or border-cropping with pollinator-attractive species such as mustard, sesame, or coriander, and retaining or planting hedgerows and field margins with native flowering vegetation. Adjusting sowing dates so that flowering coincides with periods of peak pollinator activity can also meaningfully improve fruit and seed set in pollinator-dependent crops. Where multiple pollinator-dependent crops are grown in the same landscape, staggering their sowing so that flowering periods overlap only partially helps spread pollinator workload more evenly across the season rather than concentrating demand into a single short window. These adjustments require little additional investment but ask farmers to think of pollinators as a recurring biological input that needs to be planned for, not assumed to be freely and permanently available.

Integrating Managed Pollination with Wild Pollinator Conservation

Alongside conserving wild pollinators, many Indian farmers already supplement pollination using managed honeybee colonies, most commonly *Apis cerana indica*, which is favoured for its local adaptation and suitability for small-scale, non-migratory beekeeping *(Farmonaut, 2025)*. Renting or maintaining a few hives near a flowering crop such as mustard, sunflower,

or cucurbits can noticeably improve fruit set, particularly where wild pollinator numbers have already declined due to past habitat loss. However, managed hives work best as a supplement to, not a replacement for, wild pollinator habitat. Conserving natural patches such as forest edges, hedgerows, and wild orchids around farms and apiaries helps sustain diverse bee foraging and builds resilience against climatic fluctuations, while introducing wildflower strips along field boundaries gives both managed and wild bees additional forage outside the main cropping season *(Farmonaut, 2025)*. Ethical management of hive movement, so that colonies are not over-exploited in a single landscape, and provision of clean water sources during hot or dry spells further support colony health. Combining these managed and wild-pollinator strategies gives farmers a more dependable and climate-resilient pollination service than either approach alone.

Farmer-Friendly Pollinator Conservation Practices

Protecting pollinators on-farm does not require giving up plant protection altogether; it requires using it more precisely. Farmers can avoid spraying insecticides during peak flowering hours and instead apply them in the early morning or late evening when pollinator activity is lowest. Choosing selective, pollinator-safer products over broad-spectrum chemicals during the flowering stage reduces direct mortality, and where spraying during flowering cannot be avoided, informing neighbouring beekeepers in advance allows them to temporarily relocate or protect their colonies. Maintaining small patches of native or wild vegetation around field boundaries, avoiding unnecessary tillage of these patches, and where feasible installing simple nesting structures for solitary bees can support wild pollinator populations alongside managed honeybee colonies. Reducing the frequency of mowing or clearing of field bunds during peak flowering periods allows wildflowers growing there to complete their bloom cycle and continue feeding pollinators. Such practices are low-cost, fit easily into existing farm operations, and build long-term resilience into the pollination service that crops depend on.

Benefits of Pollinator-Friendly Farming

The returns from pollinator-friendly planning are both ecological and economic. Crops benefiting from adequate insect pollination typically show improved fruit set, more uniform seed development, and better produce quality, which together support higher and more stable farm income. The economic scale of this service is substantial: globally, declining pollinator populations could translate into an annual net loss of USD 160–191 billion in economic welfare to crop producers and consumers *(Down To Earth, 2024)*, with a further USD 207–497 billion at risk in related non-crop markets such as forestry and food processing. At the same time, diversified, pollinator-friendly systems support broader farm biodiversity, improve natural pest regulation by sustaining populations of predatory and parasitic insects that also benefit from flowering field margins, and reduce dependence on costly chemical inputs over time. Farms that integrate flowering diversity and habitat conservation alongside their main crops also tend to be more resilient to pest outbreaks, climatic stress, and market fluctuations, since they are not relying on a single crop or a single pollinator species for their income. For smallholder farmers in particular, who often cannot absorb a bad season, this added resilience can be as valuable as the direct yield gains from better pollination.

Conclusion

Pollinators are a working part of the farm, not a passive backdrop to it. As pollinator populations continue to face pressure from habitat loss, pesticide exposure, and shifting climate patterns, the productivity of a large share of India's most valuable crops stands at risk. By aligning crop planning with insect ecology — through diversification, flowering calendars, field margins, and judicious, well-timed pesticide use — farmers can protect this essential service while improving their own yields and incomes. To the farming community, the message is simple: a farm that is good for pollinators is, in the long run, also good for the farmer.

References

1. Agriculture Institute (2026). A comparative study of honey bee species: Characteristics and honey production. *Agriculture Notes*, March 17, 2026.
2. Basu, P., Bhattacharya, R. and Ianetta, P. (2011). A decline in pollinator dependent vegetable crop productivity in India indicates pollination limitation and consequent agro-economic crises. *Nature Precedings*. https://doi.org/10.1038/npre.2011.6044.1
3. Bhandari, M., Singh, A. and Rana, K. (2025). Long-term global trends in crop yield and production reveal no current pollination shortage but increasing pollinator dependency. *Frontiers in Ecology and Evolution*. **13**:1–15.
4. Bhat, A., Sharma, P. and Devi, R. (2025). Influence of honeybees and wild pollinators on coriander pollination in the Indian Himalayan region. *Entomologia Experimentalis et Applicata*. **173**(4):1–12.
5. Down To Earth (2024). Pollinator Week: Economic impact of pollination cannot be underestimated. Down To Earth, June 22, 2024.
6. Farmonaut (2025). Honey farming in India: How to start and succeed 2025. *Farmonaut Agricultural Insights*, August 6, 2025.
7. Gangwar, S. and Charan, V.K. (2017). Economic benefits of animal pollination to Indian agriculture. *The Indian Journal of Agricultural Sciences*. **87**(11):1521–1528.
8. Potts, S.G., Biesmeijer, J.C., Kremen, C., Neumann, P., Schweiger, O. and Kunin, W.E. (2010). Global pollinator declines: trends, impacts and drivers. *Trends in Ecology and Evolution*. **25**(6):345–353.