

# MANAGING BIO-DIVERSITY IN AGRICULTURAL ECOSYSTEMS THROUGH SUSTAINABLE MANAGEMENT OF INSECT POLLINATORS BY RURAL COMMUNITIES

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The honeybees (*Apis* spp.) and other bees (non-*Apis* species) are effective pollinators for seed and fruit production in agricultural ecosystems. Pesticides and monoculture have been major factors in the decline of their populations.

During present studies in 1999-2001, a community-based participatory approach, based on full and equal participation of women and men farmers was developed to create the best conditions for diversification of farm income. The honeybee and non-*Apis* bee populations were integrated in diverse agro-ecological areas in Hunza (2450 m) in northern mountains and Sargodha (182 m) in the plains. These two areas have multiplicity of variables. Hunza has traditional mountain agricultural ecosystem with predominantly temperate fruit trees like peach, plum, apricot, almond, cherry (*Prunus* spp.), pear (*Pyrus* spp.), apple (*Malus pumila*), 'unab' (*Ziziphus jujuba*), etc. The latter area (Sargodha) has mechanized farming system with large scale cultivation of cereals and legumes as well as oilseed, vegetable seed and fodder seed crops and tropical fruits like, citrus (*Citrus* spp.), mangoes (*Mangifera indica*), guava (*Psidium guajava*), 'ber' (*Ziziphus hysudrica*).

The hill bee *Apis cerana* (33 colonies) in traditional wall-, log- and pitcher hives and the Italian bee *Apis mellifera* (50 colonies) in low-cost Langstroth type mud- and cement hives were managed by 15 small women farmers in Hunza. *A. mellifera* (50 colonies) in modern Langstroth hives were kept by 10 farmers in Sargodha that is the traditional rock bee *Apis dorsata* area. The little bee *A. florea* nests were found occasionally.

Simultaneous observations were made on managed potential native non-*Apis* bees (*Osmia*, *Halictus*, *Nomia*, *Megachile*, *Anthophora*) that benefit agriculture by their different pollinating abilities. These were reared in artificial nests made from readily available plants/waste materials to manage, increase and conserve their populations in the vicinity of experimental hive bees.

On-farm pollination trials were conducted on various crops. In apples, the fruit set varied from 0-3% in muslin cloth bags, 1.6-9.1% in net cloth and 22.3-29.5% in open twigs. In almonds, the fruit set was 69.4% in open, 11.8 in net cloth and 7.4% in plants covered with muslin cloth; while in pear, fruit formation in open plants was 53.7%, in net cloth 23.3% and 3.2% in covered plants without honeybees and other insect pollinators in Hunza.

Studies were made on other crops in Sargodha area. On sunflower (*Helianthus annuus*), fertilization occurred in 76.3 - 84.2% florets in open heads. In flower heads covered with muslin cloth, the seed set was 0.3 - 3.5% while 4.1 - 15.5% florets were fertilized in heads covered with net cloth. On cucumber (*Cucumis sativus*), the weight of the fruit, on average was 2.73 kg per plant visited by insect pollinators and 1.9 kg per on plants not visited by bees indicating more than 30% higher fruit yield by pollination. Similarly on onion (*Allium cepa*), seed setting in open pollinated plants was 92.3% as compared to 12.4% in net cloth and 7.6% in control.

There was net income of Rs.229,279 (US\$ 3821) in Sargodha and Rs.200,013 (US\$ 3334) in Hunza through the sale of honey, honeybees and other by-products by the farmer groups.

The farming communities of two agricultural ecosystems were thus made aware that honeybees and other insect pollinators are most essential for successful cultivation of these crops. In addition to increase in farm productivity and income, this participatory technology development system ensures bio-diversity, sustainable habitats and environments by pollinating not only cultivated crops, but also wild soil-holding and soil-enriching plants in uncultivated areas.