Contribution of Managed Crop Pollination to Food Security and Biodiversity Conservation

Managed crop pollination can play a significant role in alleviating poverty, ensuring food security, and maintaining biodiversity. Agriculture is the mainstay of over 80 per cent of the rural population in the countries of the Hindu Kush-Himalayan Region. However, as many as 93 per cent of the farmers in the hill and mountain areas of the region are marginal or small land-owning families cultivating up to one to two hectares of land (Partap 1995).

Information collected by ICIMOD through various studies indicates that the agricultural land resources in most mountain areas are not only marginal in productivity but are also deteriorating further, as indicated by declining soil fertility and crop productivity. In many areas this is leading to food shortages of varying degrees among mountain families. These food shortages are further setting a chain reaction into a process of poverty-resource degradation-scarcity-poverty (Jodha and Shrestha 1993). This pessimistic scenario means that efforts should be made to explore all possible ways to increase the productivity and carrying capacity of these farming systems. This, however, cannot be done by emphasising cultivation of grain crops alone.

If mountain farmers are going to compete favourably in the modern world, instead of being swallowed up by it, they must be given options and alternatives that are not already captured by competition. Cash crop farming – horticultural and off-season vegetables – is one comparative advantage that can be exploited by mountain farmers. This also is one of the few promising options available for promoting food security; at least in some mountain areas.

Isolated experiences of cash crop farming in the Hindu Kush-Himalayan Region demonstrate that mountains can never have a comparative advantage in producing adequate foodgrains (Partap 1995). Thus, mountain farmers today have an increasing inclination to grow vegetables and fruits which bring in substantial incomes. The production of both seasonal and off-season vegetables is increasing in different parts of the Hindu Kush-Himalayan Region, where many small farmers are engaged in vegetable production both for local markets and for export purposes (Table 1). A variety of temperate and subtropical fruits, such as apples, peaches, pears, plums, almonds, apricots, grapes, and cherries is also being grown (Table 2). Logically, this should increase the need for managed crop pollination in these areas. Equally interesting is the adoption of apiculture as an enterprise by many people, and it is particularly popular now in the North West Frontier Province of Pakistan. In these areas, mobile apiaries are employed for honey collection, and these are ready-made resources for managed crop pollination of mutual benefit to different interest groups. There are few linkages between cash

Box 3: Comparative Advantages of *Apis Cerana* over *Apis Mellifera* for Crop Pollination in a Mountain Environment

- *A. cerana* begins its foraging activities early in the morning when temperatures are low. According to reports, the foraging activities of *A. cerana* take place at temperatures 5-7°C lower than those known to initiate *A. mellifera* foraging activities. This is especially significant for mountain/hill agricultural productivity.
- The peak foraging activities of *A. cerana* are observed at temperatures 5-6°C lower than those of *A. mellifera*. Thus, *A. cerana* could be used for the pollination of crops flowering in late winter or early spring in hill/mountain areas.
- The average duration of the daily foraging activities of *A. cerana* is longer than *A. mellifera*. This is because of the early initiation and late cessation of foraging activities in the former species. *A. cerana* may, thus, ensure adequate pollination of crops in less time, particularly during adverse weather conditions, e.g., during the frosty spring season when honeybee activities are severely curtailed.
- *A. cerana* can forage at temperatures as low as 7°C. Such cold hardiness in this native bee species offers comparative advantages to mountain farmers keeping bees for pollination purposes, especially for crops such as apples, peaches, plums, and cherries which flower during late winter or early spring.
- The flight range of *A. cerana* is half that of *A. mellifera*. This is of particular interest, especially when pollination of small plots of specific crops is the case. An *A. cerana* hive, when placed in the vicinity of a specific crop, restricts itself to pollinating that crop only and does not wander off or escape to other areas.
- Beekeeping with *A. cerana* requires lower maintenance costs than *A. mellifera*; the latter requires expensive technology which marginal farmers in developing countries of the Himalayan region cannot afford. Moreover, colonies of *A. cerana* require a lesser degree of chemical treatment to control epidemics.
- Many vegetables, oil seeds, fruits, and other crops have evolved together with *A. cerana*. It is likely that these plants have developed symbiotic relationships with this bee species, and they are, thus, indispensable to each other. Exotic *A. mellifera* may disturb this coexistence and inefficiently pollinate these native crops reducing their reproductive success.

Source: Verma and Partap 1993

crop farmers and entrepreneurs with mobile bee colonies in these areas of Pakistan, and this could be because of the lack of awareness about the benefits of managed crop pollination.

Cash crops assume great importance in helping farmers emerge from the poverty trap (Koirala 1992; Sharma 1995, Sharma and Sharma 1996; Yanhua et al. 1992). In addition, the economics of these pocket areas indicates that there is food security and reasonable economic well-being (Partap 1995). The concerns of farmers engaged in cash crop farming are with maximising yields and improving the quality of their produce, whether of fruits, seeds, or other plant parts. This broadened concept of food security, which focusses on efforts to increase access to food rather than growing grain crops, is already being promoted, both by farmers and

by the governments, as the basis for transforming subsistence mountain agriculture. The trends in agricultural development in the HKH Region clearly indicate that, in the coming decades, farmers in the region will move more and more towards cash crop farming in order to harness the comparative advantages of the mountain environment (Partap 1996).

Encouraged by global forces of liberalisation, a broader concept of food security, and new knowledge about the comparative advantages of mountain farming, national and local governments and supporting institutions are already working towards changing the focus of agricultural development in mountain areas. National planning, e.g., the Agricultural Perspective Plan of Nepal; provincial planning, such as Agenda 21 for sustainable agriculture in Tibet; or Agricultural Development Plans in Himachal Pradesh; and the local government strategies seen in Ningnan and Miyi Counties, Sichuan, China are clearly supportive of promoting commercialisation of mountain farming (APROSC and John Mellor Associates 1995; XAR 1996; Yanhua et al.1995). This development process is creating a need to integrate agricultural development planning and managed crop pollination.

The positive implications of crop pollination in cash crop farming and thus to food security and poverty alleviation are very clear. Farmers will have to opt for ways of ensuring sustained yields from cash crops. Among the different factors affecting the yield and quality of new cash crops, pollination has the most critical role. As stated earlier, many commercial varieties of fruit and vegetable crops grown in mountain areas are self-sterile and thus require cross-pollination of their flowers for a healthy harvest. Cross-pollination of flowers by honeybees and other natural insect pollinators is therefore one of the effective processes for maintaining yield and quality in fruits, seeds, and grains.

Exploiting this option for augmenting crop productivity is essential for improving the food security situation. Also, with natural crop pollination at risk, farmers may no longer be able to afford risking crop production because of the uncertain services of natural insect pollinators. It will, therefore, become necessary to promote the use of honeybees and domesticated insects, with which mountain farmers are quite familiar, for managed crop pollination in order to avert the crisis in mountain agriculture.

Helping Conserve Himalayan Honeybees

The HKH Region is home to several native species of honeybees. Among these *A. cerana* is a popular honeybee with mountain farming communities, and it is managed traditionally for the production of honey. In recent decades, the European honeybee, *A. mellifera,* was introduced into the HKH Region because it is a better honey producer under modern management conditions. The result has been that *A. mellifera* has replaced *A. cerana* in several areas of the HKH Region. Studies carried out by ICIMOD and others have shown that today there are only a few areas where *A. cerana* can be found, e.g., in Nepal, the Indian Himalayas,

and Yunnan, China (ICIMOD 1994a; 1994b; Bangyu and Tan 1996). In Pakistan, where *A. mellifera* was promoted much more vigorously in the Northern Areas, the last strains of *A. cerana* survive with a few hundred villagers in Kalash Valley in Chitral (personal communication, AKRSP).

Experts argue that the coming decade may be crucial in the context of saving the Himalayan honeybee species, *A. cerana,* from extinction (Verma 1994). Already several good races might have been lost, even before they could be documented. Evidence is now available indicating that *A. mellifera* has already displaced the native, *A. cerana,* species in many low hill areas of the Hindu Kush-Himalayan Region, due to its allopatric nature.

However, managed crop pollination in mountain areas provides the hope of saving *A. cerana* from extinction. Research carried out at ICIMOD (Verma and Partap 1993; 1994; Partap and Verma 1992; 1994) and elsewhere indicates that there is a useful role for both species in crop pollination.

The knowledge and information available indicate that it is possible to promote crop pollination strategies in which both *A. cerana* and *A. mellifera* can be made to play complementary roles. Both species are good pollinators in different agro-ecological zones. The races of *A. mellifera* which have been introduced into the HKH do not survive in the cold winter and spring temperatures of these mountain areas. *A. mellifera* has to migrate to low hill areas with warmer temperature regimes. Therefore, as described earlier, it is less useful for pollination of major cash crops in mountain areas. On the other hand, research on the genetic diversity and productivity of *A. cerana* carried out under a special ICIMOD programme (Verma 1994) showed that a subspecies of *A. cerana,* i.e., *A. cerana cerana,* occurs in the high mountain areas of the HKH Region. It is larger in size, darker in colour, and equivalent to *A. mellifera* in terms of honey production. Since this subspecies of *A. cerana* is well adapted to the cold climatic conditions of high mountain areas, it would be highly suitable for the pollination of spring flowering crops and honey production in most mountain agro-ecosystems.

Since *A. mellifera* is good for the warmer agroclimatic conditions of low and mid-hill areas, it should be restricted to these areas only. *A. cerana,* particularly the subspecies occurring at higher altitudes (notably Jumla in Nepal, Kashmir and Himachal Pradesh in India, and Yunan in China), is good for colder, agroclimatic mountain regimes. This information gives a vital clue to the complementary roles that can be played by both species in crop pollination and in producing useful by-products, i.e, honey and other beehive products. Thus, natural zonation of bee pollination areas to be served by *A. cerana* and *A. mellifera* can also become the basis of conservation strategies for saving *A. cerana.* Like crops, conservation of honeybees is also related to farmers' choices. Therefore, conservation through promoting use of *A. cerana* for pollination is certainly a good option.

As mentioned earlier, the Asian honeybee, *A. cerana,* is in crisis, and, therefore, our dependence on this honeybee species might clearly exacerbate the pollina-

tion crisis. Unless this species is saved, it will limit the scope for managed crop pollination in native areas where farmers practise traditional beekeeping; in this event new pollinators will have to be identified, tested, managed, and promoted. The cost of the latter would indeed be high.

Lastly, wider use of managed crop pollination is possible with the key assumption that insecticide application in crop husbandry will be replaced by other alternatives. It is important to save bees, the crop pollinators, from the adverse effects of chemicals. While it may not discourage use of chemical fertilizers in crop management, integrated pest management (IPM), the key component of organic farming, receives more focus. Therefore, in promoting managed crop pollination, organic farming approaches should be integrated into the whole process.