Chapter 6

Apple Farming and Pollination Issues in Balochistan, Pakistan

Balochistan: The 'Fruit Bowl' of Pakistan

Balochistan is located in the western part of Pakistan. It comprises 43.6% of the area of Pakistan, but as a result of the arid climate and poor water resources it has the smallest amount of arable land of all the country's four provinces. In the northern uplands of Balochistan where these apple surveys were carried out, only about 4% of the land is potentially available for cultivation (Jasra et al. 2000). Of this, less than half is actually cultivated (242,000 of 13.2 million hectares) (Hafeez 1998). There are four major ecological zones in the province ranging from coastal belts to high altitudes of more than 2,500 masl. The soils of the uplands of Balochistan are fertile and dry. Sunny weather prevails throughout the year and is ideal for growing fruits and nuts such as apples, peaches, apricots, plums, pears, cherries, almonds, pomegranates, pistachio nuts, and grapes. Fruit production has emerged as a major farming activity and Balochistan is often called the 'fruit bowl' of Pakistan. Balochistan contributes about 50% of the total deciduous fruit production and over 80% of the total apple production of Pakistan (Government of Pakistan 1999).

Apples are considered a relatively more profitable crop among deciduous fruits and fruit growers are extending orchard farming to upland Balochistan. Apple orchards have been planted in areas at altitudes of 1,200m and above. The prime quality apples come from the highlands at altitudes above 2,000m because of the greater number of chilling hours.

Currently, apples are mainly produced in the valleys of Kalat, Killa Saifullah, Loralai, Mastung, Pishin, Quetta, and Ziarat. The area under apple cultivation has increased more than thirteen times during the past three decades (Government of Pakistan 1999), from less than 2,700 ha in 6 of the 26 districts in 1969/70, to 35,900 ha in 16 districts in 1997/8 (Figure 6.1). At present, the annual production of apples in Balochistan is about 482,600 tonnes (Government of Pakistan 1999), which brings in over PRs 9.2 billion (US $154 million).

Apple Productivity

Apple production in Balochistan has increased considerably since 1987, as a result of the increase in apple-growing area (Figure 6.1). However, apple productivity (yield per unit area) has remained far below the potential. The underlying reasons for the low productivity include lack of irrigation,

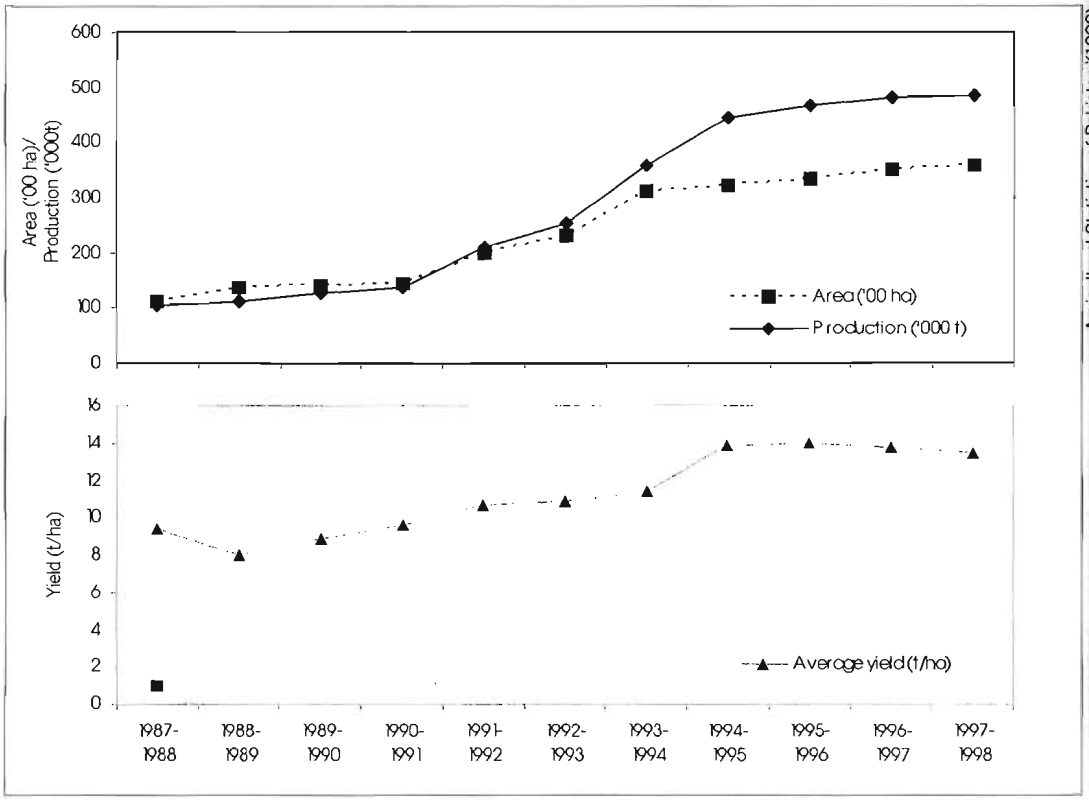


Figure 6.1: *Apple cultivating area and production of apples in Balochistan*

poor quality rootstock, low applications of organic matter, overuse of inorganic fertilisers, indiscriminate use of pesticides, and inadequate pollination. The gap between actual and potential yields of apple orchards could be reduced by using better quality planting materials, better agronomic inputs, balanced applications of organic manure and inorganic fertilisers, and by managing pollination. Inadequate pollination not only reduces apple yield, it also causes low fruit quality. The study focused on understanding the possible reasons for inadequate pollination and on farmers' management approaches, if any.

The studies focused on the major apple-growing areas of Kalat, Killa Saifullah (Zhob), Loralai, Mastung, Pishin, Quetta, and Ziarat (Sibi) Districts. A total of 76 households were surveyed, details are provided in Chapter 3, Table 3.3.

Official Statistics

Data from the Agricultural Department of Balochistan show that in 1973/74 most apple cultivation was in Quetta and Pishin Districts, with about 1,500 ha of orchards producing 10,000 tonnes of apples annually. The latest figures show 11,200 ha of orchards in these districts (8,200 ha producing 116,100 tonnes in Pishin and 3,000 ha producing 44,100 tonnes in Quetta). Of all the sample districts, apple cultivation had developed most in Pishin, from 2,000 ha of orchards in 1984/85, to 8,200 ha in 1996/97. Most of the new planting in Balochistan was done between 1984 and 1995.

On average, there were over 3,600 ha of apple orchards in each district during 1996/97, compared to 1,400 ha per district during 1984/85.

Figure 6.2 shows the district-wise scale of apple farming in the study areas as reported in the Agricultural Statistics of Balochistan for 1996/97. The area under apple cultivation ranged from 1700 ha in the Mastung District to 8,200 ha in the Pishin District. The average yield per hectare varied from 9.8 tonnes in Killa Saifulla District to 16.4 tonnes in Ziarat District, with a reported average for the whole province of 13.7 tonnes per ha (Figure 6.1). However, there was a marked discrepancy between the yields that farmers reported and the official statistics (see below).

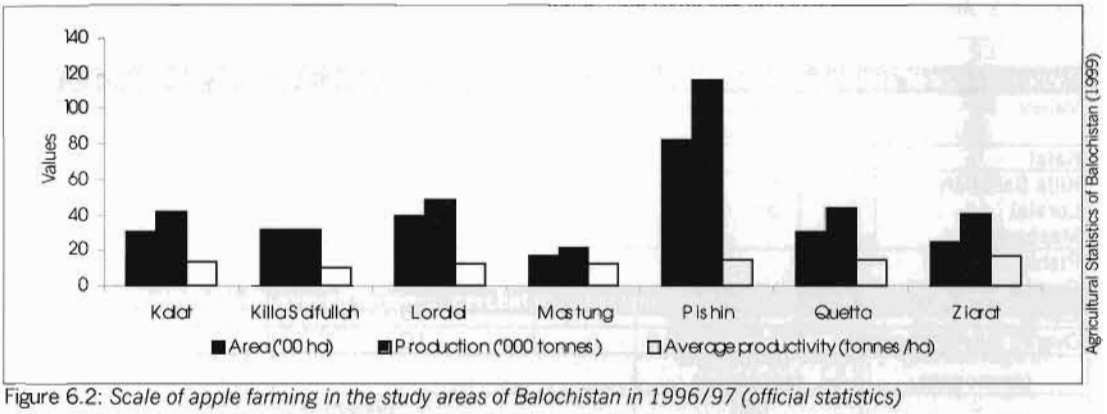


Figure 6.2: *Scale of apple farming in the study areas of Balochistan in 1996/97 (official statistics)*

Survey Findings

Landholdings and size of apple orchards

The average size of landholdings in Balochistan was very high compared to that in the other areas of the Hindu Kush-Himalayan (HKH) region covered by the survey. Figure 6.3 shows the average landholding size and area under apple cultivation in the surveyed villages. The overall average landholding size was 18.2 ha, with a range of averages in the different valleys from 27.7 ha in Killa Saifullah to 9.6 ha in Quetta and Loralai. The overall average area under apple cultivation was 9.3 ha, 57% of the farm area. The percentage of farm area with apple orchards varied from 84% in Loralai Valley to 24% in Ziarat (Figure 6.3). Overall the smaller the landholding size the higher was the proportion devoted to apples, in other words the actual area of apple orchards per farmer was less variable than the landholding size.

The apple orchards in Balochistan are relatively young (Table 6.1). The average age of apple trees reported by the surveyed farmers was 21 years in the older orchards and 10 years in the younger orchards. The oldest plantations were reported in Loralai where one farmer had an orchard that was 50 years old. The youngest orchards were in Killa Saifullah, where the average orchard age was about 11 years. The average tree density in the orchards ranged from 170 to 240 trees per ha. Intercropping with vegetables and alfalfa was common until the trees reached the fruit-bearing stage. Generally farmers did not appreciate the value of pruning the trees.

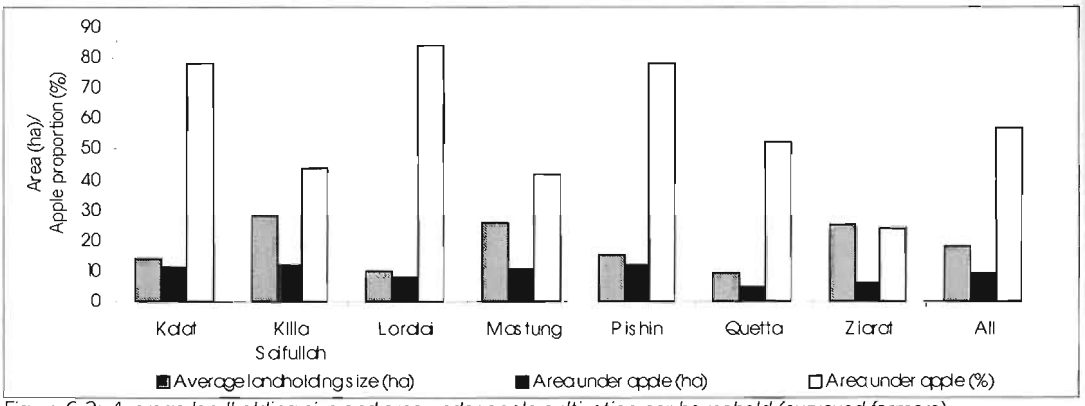


Figure 6.3: *Average landholding size and area under apple cultivation per household (surveyed farmers)*

Table 6.1: **Age of apple orchards in the sample valleys of Balochistan**

Valley	Average age of old plantations (>15 years)	Average age of new plantations (<15 years)	Average age of all plantations
Kalat	21	12	16.5
Killa Saifullah	15	6	10.5
Loralai	32	10	21
Mastung	19	12	15.5
Pishin	19	11	15
Quetta	19	10	14.5
Ziarat	19	10	14.5
Overall average (years)	20.6	10	15.5

Apple varieties

The two most popular varieties in all the sample districts were Red Delicious and Golden Delicious, which dominate all the recently developed orchards, with Gaja following behind. (Golden Delicious is a pollinizer for Red Delicious, and can also act as a self-pollinizer to a limited extent). Other varieties reported included Amri, Kashmiri, Mashadi, Katja, and Dilber, although these are now becoming less popular among the farmers. Semi-dwarf rootstock was introduced recently but had received a mixed response from farmers, despite the advantages of smaller trees and early fruit bearing (after 3-4 years).

Over half of all the orchard owners (about 53%) did not know about the need for pollinizers and did not plant specific varieties as pollinizers (Table 6.2). There were big differences among the valleys, however, the vast majority of apple growers in Mastung, Pishin, and Quetta did not know about pollinizers, whereas all of those in Killa Saifullah and Loralai did. In Killa Saifullah, 60% of the surveyed farmers planted a local variety as a pollinizer, in the Loralai Valley 60% planted Gaja.

Sales

Table 6.3 summarises the information given by farmers about the sale of their apples. Apple selling is either undertaken by the farmers themselves or by contractors who purchase the future harvest during spring when the trees are in blossom. Usually a contractor pays a third of the total agreed price to the orchard owner in advance. The majority of farmers, particularly the small and

Table 6.2: **Apple varieties grown in Balochistan (surveyed farmers, percentage of responses)**				
Valley	Main varieties	Pollinizer varieties	Farmers deliberately growing pollinizer varieties (%)	Farmers not knowing of the need for pollinizers (%)
Kalat	Traditional, Red Delicious, Golden Delicious, Gaja	Mixed	28	72
Killa Saifullah	Kashmiri, Red Delicious, Golden Delicious, Gaja, Amri	Golden Delicious Local variety	40 60	0
Loralai	Gaja, Red Delicious	Gaja Golden Delicious Mashadi	60 20 20	0
Mastung	Traditional, Red Delicious, Golden Delicious, Amri, Mashadi		0	100
Pishin	Amri, Red Delicious, Golden Delicious	Golden Delicious	7	93
Quetta	Amri, Red Delicious, Mixed, Gaja, Mashadi, Golden Delicious	Golden Delicious	7	93
Ziarat	Mixed, Red Delicious, Golden Delicious, Traditional, Gaja	Mixed Gaja	68 16	16

Table 6.3: **Apple sales (surveyed farmers, percentage of responses)**				
Valley	Price per kg (US $)	Markets	National sales (percentage in responses)	Export sales (percentage in responses)
Kalat	0.32	City market	100	–
Killa Saifullah	0.19	Quetta, Punjab, Multan, Lahore, Faisalabad, Karachi	100	–
Loralai	0.44	Quetta, Karachi, Lahore, Rawalpindi, Faisalabad	100	–
Mastung	0.32	City market Contractor	66 20	14
Pishin	0.24	Contractor City market No answer	23 23 54	–
Quetta	0.23	Contractor Sialkot, Lahore (Punjab)	69 31	–
Ziarat	0.40	City market Lahore, Multan, Karachi	83 17	–
Average	0.31			

medium-sized ones, entered into such pre-harvest contracts. Whether small farmers undertake to sell their produce directly depends upon the distance to the main market.

The apple producers in the northern highlands (Killa Saifullah, Loralai, and Ziarat) benefit from a favourable geographical position and close linkages with Punjab Province where they have a big market outlet. Most of these apples went to wholesale markets in Multan, Faisalabad, Lahore, Sialkot, and Rawalpindi, some went to markets in Quetta and Karachi. Only a few farmers in Mastung District exported apples outside Pakistan. The average price that farmers received varied from US $0.19 per kg to US $ 0.44 per kg, depending upon the fruit quality, with an overall average of U$ 0.31 per kg.

Apple productivity

The average yields reported by farmers for the different valleys ranged from 2.9 tonnes per ha in Kalat to 2.3 tonnes per ha in Killa Saifullah (Table 6.4). The average yield per ha for individual farmers depended on the site and perhaps on farmers' management practices, but less on the variety. Among all the varieties, Golden Delicious, Kashmiri, Mashadi, and Gaja were relatively higher yielding. The overall highest yield was an estimated 3.9 tonnes per ha for Mashadi in Mastung followed by 3.6 tonnes per ha for Golden Delicious in Kalat and for Kashmiri in Quetta. The lowest yield was 1.9 tonnes per ha for Red Delicious in Pishin and Katja in Mastung. Reported problems affecting the yield in many orchards included low fruit bearing and excessive fruit drop.

The reported yields were far lower than those of 10-16 tonnes per ha reported for the same areas for 1996/97 by the Government of Balochistan (Figure 6.2, Table 6.4). The official statistics for the whole province show more or less constant yields from 1994 to 1998 of more than 13 tonnes per ha. However, the majority of farmers in all the valleys except Ziarat, and three-quarters overall, reported that the yield had decreased over the last five years (Table 6.4). It seems possible that the official records are based on extrapolation of past values, or that some of the area and/or production estimates are generalised from atypical cases and do not fully reflect the real situation. Whatever the reason, the relatively high values officially reported for average apple productivity have misled institutions into believing that there is no apple productivity problem. As a result, research and extension agencies are paying no attention to problems like failed pollination that are limiting apple productivity.

The reasons given by farmers for the decline in yield are summarised in Figure 6.4. More than half (55%) thought that weather changes coupled with pest attack and disease were the major factors, 51% considered that weather changes alone were responsible, and a little less than a third believed that scarcity of pollinating insects and honeybees and absence of beekeeping was the cause.

Pesticide use

The common pests in the apple orchards of Balochistan include codling moth, mites, tip borers, shot hole borers, hairy caterpillars, aphids, and fruit flies. The agricultural extension services

Table 6.4: **Apple productivity as reported by the Government of Balochistan and the farmers' in the survey and changes observed by farmers**

Valley	Apple productivity in tonnes per ha		Apple productivity declining (percentage of responses)
	Farmers' survey (2000)	Govt. of Balochistan (1996/97)	
Kalat	2.9	16.2	100
Killa Saifullah	2.3	15.2	75
Loralai	2.6	15.1	83
Mastung	2.8	16.2	67
Pishin	NA	15.3	NA
Quetta	2.6	15.1	80
Ziarat	2.5	17.4	25
Average			72

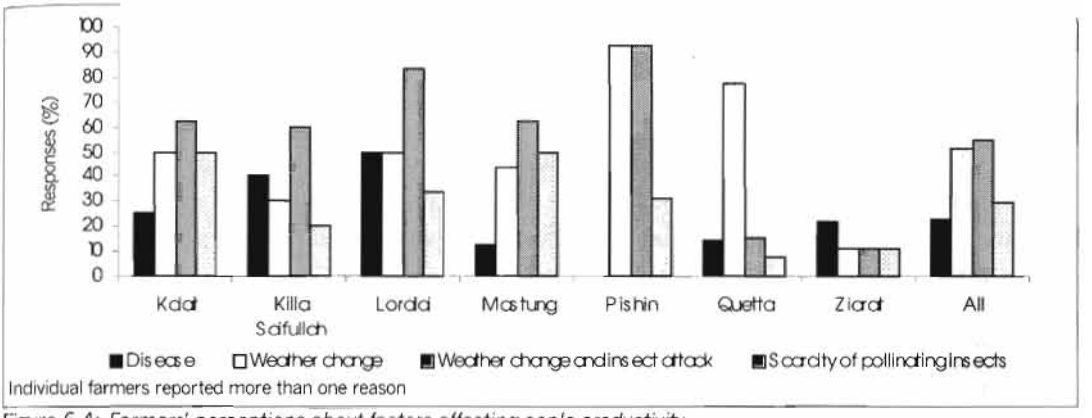


Figure 6.4: *Farmers' perceptions about factors affecting apple productivity*

recommend two sprays of a pesticide called gusathion, one in late March or early April and another 10 days later.

A part of the pattern of pesticide use in the orchards of the province since 1973/74 can be seen from the Government of Balochistan Agricultural Statistics. Between 1973/74 and 1984/85, large-scale aerial sprays were carried out supplemented by several ground sprays, and 75% of the cost of the pesticide used was subsidised. More than 14,000 ha of orchards were sprayed in 1973/74, rising to more than 30,000 ha in 1984/85, more than half of this in Pishin and Quetta. After this date, aerial spray operations were stopped, and although ground sprays continued, there was no government subsidy. The recorded area of ground sprays of orchards dropped to 6,700 ha in 1996/97. It seems that farmers continued spraying, but this is not officially recorded.

The farmers' use of pesticides is summarised in Table 6.5. Overall, 49% of the respondents regularly used different pesticides including insecticides, miticides, and fungicides in their apple orchards. The highest use was in Loralai District, where 83% of the respondents reported regular use of pesticides, the lowest was in Mastung District, where only 31% of the farmers sprayed in orchards. On average, those who sprayed did so 5 times per season, with a range from 2 to 7 sprays per season. All of those who sprayed did so at fruit set stage; except in Kalat, where between 20 and 80% did so during flowering.

Table 6.5: **The use of pesticides in apple orchards (surveyed farmers)**

Apple valley	Pesticide use (% of responses)	Number of sprays per season	Time of spraying (% responses of farmers who sprayed)		
			Before flowering	During flowering	During fruiting
Kalat	63	5	100	0	100
Killa Saifullah	50	5	20	20	100
Loralai	83	5	20	20	100
Mastung	31	5	19	19	100
Pishin	54	4	0	70	100
Quetta	36	4	19	19	100
Ziarat	56	5	20	79	100
Overall	49	5	28	32	100

Farmers' awareness about apple pollination and pollinating agents

Ninety-five per cent of all the farmers sampled (all farmers in Kalat, Killa Saifullah, Loralai, Mastung, and Quetta, 92% in Pishin, and 67% in Ziarat) had some knowledge of the apple pollination process, the majority had known about it for the last 10-12 years and those in Ziarat Valley for 18 years. About 35% had gained this awareness through their interaction with beekeepers, 39% from extension workers of the Department of Agriculture Extension, Balochistan, and 22% knew about it from other sources, including just two people who had learned from printed literature (Figure 6.5).

Half of the respondents believed wind to be an important pollinating agent for apples; about 38% regarded honeybees, butterflies, and other natural insects as pollinating agents; and 11% did not know about pollinating agents (Figure 6.6). The extent of knowledge varied considerably between valleys, 90% of respondents in Ziarat knew that insects were pollinating agents, but only 15% in Quetta and Pishin.

Ninety-seven percent of the respondents had observed various kinds of insects foraging on apple flowers in their orchards; about 45% reported honeybees, most probably the wild species, on apple

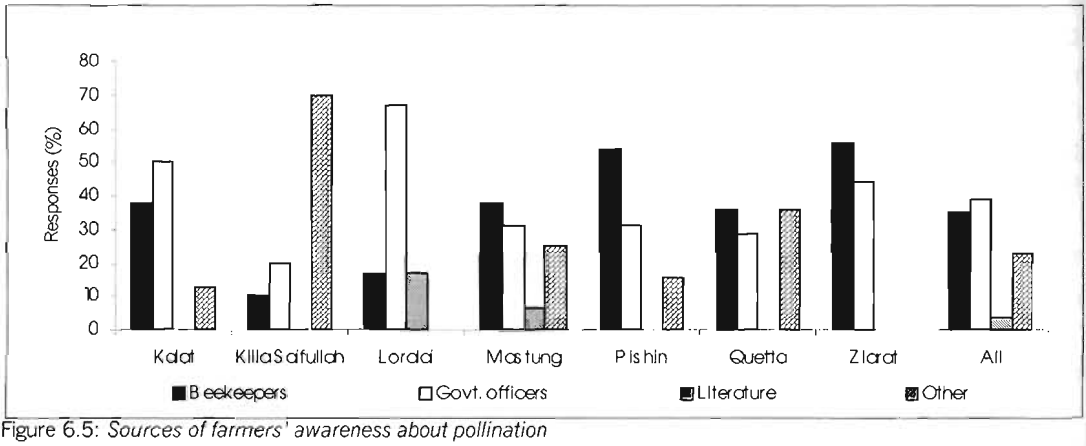


Figure 6.5: *Sources of farmers' awareness about pollination*

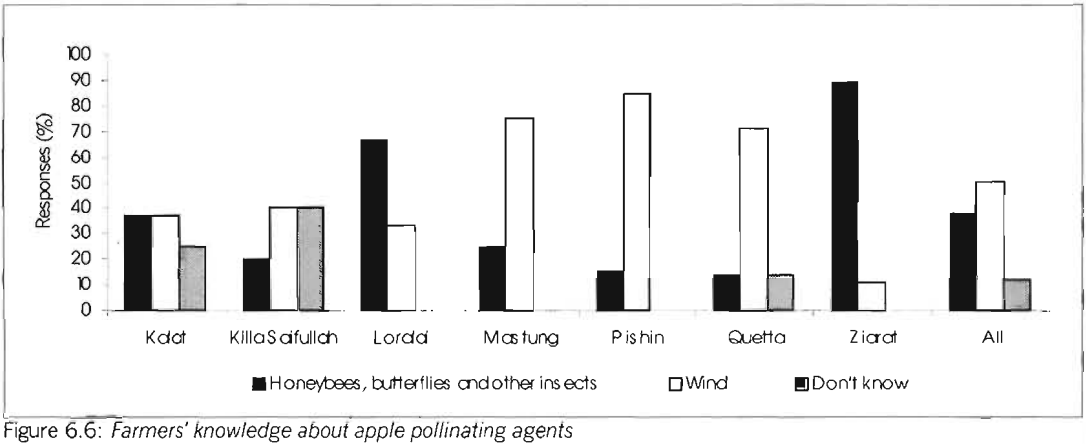


Figure 6.6: *Farmers' knowledge about apple pollinating agents*

flowers; and 86% had seen butterflies and wasps in the orchards. Figure 6.7 summarises the farmers' perceptions of the changes in populations of natural insect pollinators over time. More than three-quarters reported that insect populations were decreasing; and 17% had seen no change. Two farmers each in Pishin and Ziarat (5% of the overall total) reported that the populations of natural insect pollinators were increasing. Overall 60% of the farmers, with some in all study districts, had seen wild honeybee nests in the forests, ranging from 40% in Kalat and Mastung, to 83% in Loralai.

Farmers held multiple factors responsible for the decline in natural insect populations in orchards (Figure 6.8). Overall 84% considered pesticide use to be the major cause; nearly half thought that climate change might also be responsible; and a quarter that the increase in apple-farming areas and limited insect populations to pollinate them was a cause.

Farmers' were asked for their views on keeping honeybee colonies at apple farms, on their preferred type of bee, and on keeping bees for commercial purposes. None of the interviewed farmers kept bees and only a very small proportion (4%) were interested in keeping honeybee colonies in their orchards (one person each in Loralai, Quetta, and Ziarat). All of them preferred native bees to

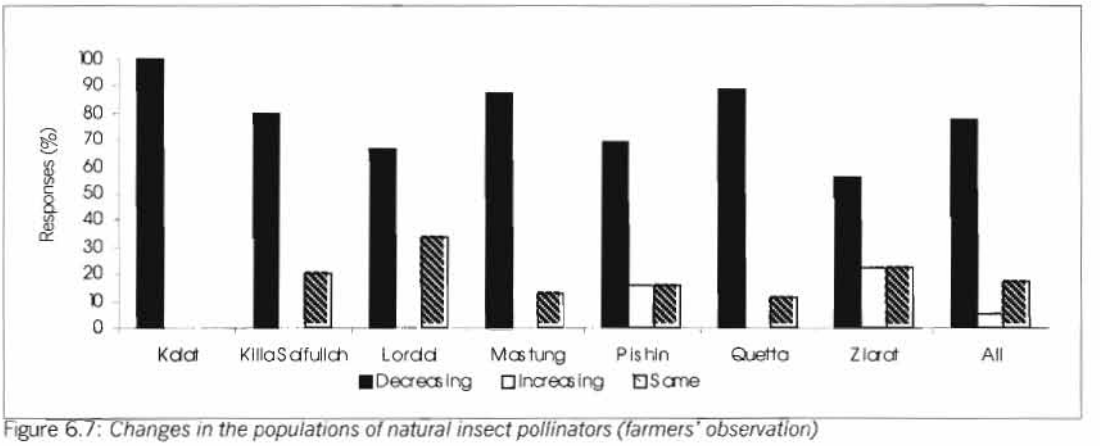
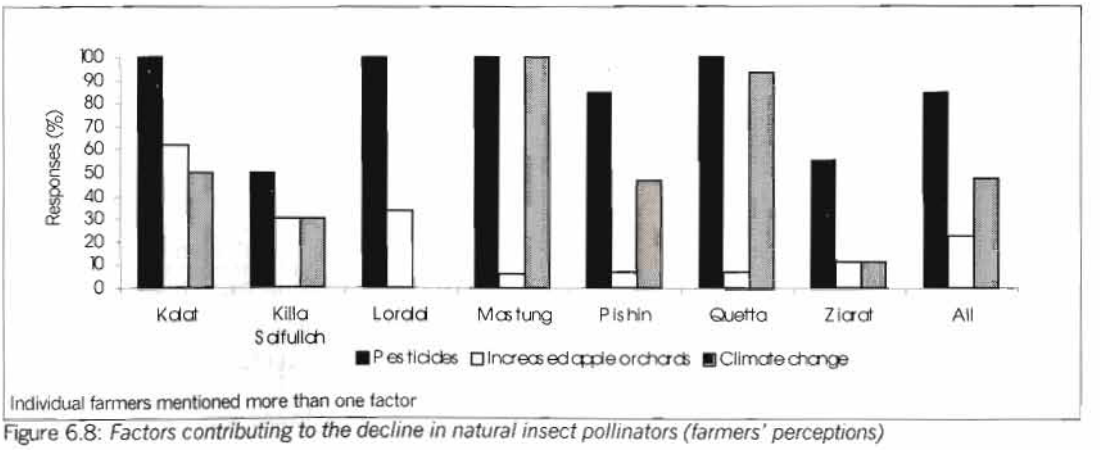


Figure 6.7: *Changes in the populations of natural insect pollinators (farmers' observation)*



Individual farmers mentioned more than one factor

Figure 6.8: *Factors contributing to the decline in natural insect pollinators (farmers' perceptions)*

European species. The majority of farmers (94%) were not keen on keeping honeybees for commercial purposes.

Migratory beekeepers from other provinces (Northwest Frontier Province (NWFP) and Punjab) do visit the highlands of Balochistan; their camps are mostly seen in the juniper forests of Ziarat during late summer, where the bees benefit from the blossom of *Perwaskis artiplicifolia*. With the onset of winter, they migrate back to their home areas. Sometimes their migratory season matches the apple-flowering season. However, very few farmers (one each in Loralai, Pishin, and Quetta) reported that the migratory beekeepers migrated colonies to their areas from Ziarat and it seems unlikely that migratory bees play more than a very minor role in apple pollination in Balochistan.

Summary

Overall the results suggest that productivity, or yield per acre, is steadily decreasing, and that the major cause is lack of pollination, mainly because there are insufficient natural insect pollinators. Only one third of farmers realised the need for natural insect pollinators, however, and even fewer were aware of the need for pollinizer trees. Even so, most farmers had noticed the decline in insect pollinators and the majority attributed it to use of pesticides and changes in climate. A number also realised that the existing populations were too small to pollinate the present and vastly increased area of orchards. There is a need to promote the integration of agricultural production practices and a wider use of strong honeybee colonies for cross-pollination. Furthermore, research is needed to determine the optimal combination of varieties for apple cultivation in Balochistan.

Summary of Issues

Apple farmers in Balochistan still benefit from extensive populations of natural insect pollinators. A high proportion of the land is left wild, and in areas near fertile valleys and water sources, wild herbs and low shrubs provide food (pollen and nectar) to a range of insects including wild bees in late spring to early autumn. Farmers also use fewer pesticides than in India and China. It is possible that overall there are adequate populations of natural insect pollinators for pollination of the state's apple crops, although there may be local deficit areas where the orchards are large in relation to the surrounding wild habitat, and apple trees too far from the insects. In addition, discussions with local non-government organisations (NGOs), agricultural scientists, and extension agents revealed that a small number of beekeepers from Abbottabad and Naushera in neighbouring NWFP regularly migrate their colonies to Balochistan in March/April and keep them there until September/October. These bees visit apple flowers in April and other wild flowers later. Thus although there is a certain lack of awareness, a certain amount of the pollination requirement is fulfilled without any intervention.

The government statistics show a much higher productivity for apples in Pakistan compared with the other countries of the HKH region, although still much lower than in more highly developed countries. These statistics did not correlate with the survey observations and appear to be misleading, but the result has been that no efforts have been made at government level to address the problem, which officially doesn't exist.

The farmers in this survey said that productivity had been declining for the past five years. However, they were essentially unaware that this could be the result of a pollination problem until 1998, when a team of scientists from the National Aridland Development and Research Institute (NADRI) of the Pakistan Agricultural Research Council (PARC), explained to them that inadequate pollination resulting from insufficient pollinizer trees and the scarcity of pollinating insects was one of the reasons for the decline in apple productivity. Thus they had never considered approaches to managing pollination.

Official institutions in Pakistan need to start thinking about possible solutions to the problem of declining yields, including pollination management to sustain apple productivity, before the situation becomes more difficult to deal with.

Issues in promoting beekeeping for pollination

Honeybees are widely recognised as being excellent pollinators and are used for pollination of various crops in most developed countries to ensure the maximum high-quality yield. There is little awareness at the policy and planning level of the potential use of honeybees to enhance the yield and quality of crops. The first effort to introduce honeybees as pollinating agents was probably made by PARC, who published a book entitled 'Honeybee Pollination of Important Entomophilous Crops' in 1987. However, subsequent research and development efforts have focused solely on commercial honey production. The Honeybee Research Institute (HBRI), under the National Agricultural Research Centre, has successfully established quite a few commercial beekeepers in Punjab and NWFP, who produce and sell honey. But honeybees are not used for pollination management.

In Pakistan, honeybees have been kept for honey production traditionally for at least two centuries. However, traditional beekeeping was exclusively with the native hive honeybee *Apis cerana*, which is well suited to the colder and more highly fluctuating temperatures encountered in the areas where apples are grown. Although bees contribute significantly towards increasing crop productivity (including mustard, berseem, shaftal, lucerne, sunflower, and sorghum), fruit bearing (including citrus species, apple, stone, and pome fruits), and seed set in forest plants (such as sisoo, eucalyptus, and willow), this is little realised by the local farmers. Commercial beekeeping has been promoted by government extension agencies in some parts of Pakistan, but the focus has been exclusively on the more productive, in terms of honey, but climatically more susceptible imported bee, *Apis mellifera*. Commercial beekeeping is rare in Balochistan because of the arid climate and lack of floral resources. The Planning and Development Department of the Government of Balochistan has published district profiles for each of the 26 administrative districts. In all these documents, beekeeping is discussed under 'Forestry', implying that it is seen as an off-farm activity for honey production only. Quotations from these official documents indicate the official perception at the policy and planning level regarding beekeeping (Table 6.6).

Although the Planning and Development Department of the Government of Balochistan considers beekeeping to be a 'wild area activity', efforts have been made from time to time to introduce beekeeping in some areas of the province. The Honeybee Research Institute of NARC, under PARC,

Table 6.6: **Beekeeping as perceived by the Planning and Development Department of the Government of Balochistan**

District profile document	Lines Quoted from Forestry Chapters
Kalat	"Because the climate of the area in general is not conducive for bee-keeping, bee-keeping activities do not exist. Some potential is available in the Harboi forest and beekeeping could be carried out on an experimental basis here. If successful, the local population could have an additional source of income". (Page 37)
Killa Saifullah	"Although honey is used in the district, bee-keeping is an alien idea as people are using wild honey only". (Page 44)
Loralai	"Due to the arid nature and scanty rainfall, there is a subsequent lack of flowers and vegetation. Thus, bee keeping is almost negligible". (Page 43)
Mastung	"Bee-keeping is not common in Mastung district. Honey is obtained from natural sources, particularly from mulberry trees. Government and the private sector could promote bee-keeping and turn it into a commercial activity". (Page 33)
Pishin	"It is surprising that, though Pishin district is one of the most important horticultural areas of Balochistan, bee-keeping is not an economic activity. The main reason put forward by the people, was that bees produce honey only in warm areas. Bees cannot survive the district's cold weather". (Page 48)
Quetta	"The district is one of the most important horticultural areas of Balochistan. Nonetheless, beekeeping as a source of economic activity does not exist on a large scale. However, in recent years this activity has been initiated in the Urak valley. The main reasons put forward by the residents for not getting involved in bee-keeping activities were that bees produce honey only in the warm areas. In the cold areas, they are not productive at all. Bees do not survive in the cold weather of the district. Thus weather is not conducive for bee-keeping. However, the area seems to have great potential for bee-keeping due to abundant flora fruit like cherries, peach, apple and mulberry". (Page 59)
Ziarat	"Bee-keepers from the North-West Frontier Province (NWFP) come to Ziarat district with their bee boxes when the fruit trees are in blossom. They stay here for two or three months and then move to other places. No information is available about local bee-keepers. On many picnic spots pure honey is sold to tourists". (Page 30)

Source: Jasra et al. 2000

has been trying since 1981 to promote beekeeping for honey production and income generation in Balochistan, but with little success. So far all attempts to initiate beekeeping in this province have failed.

What kind of beekeeping should be promoted in Balochistan?

Most of Balochistan is arid; only some high-elevation valleys in the north are capable of producing deciduous fruits like apples. Although some areas adjacent to these valleys and near water resources have flowering plants that are sources of nectar and pollen for honeybees from late spring to early autumn/ summer, the weather is cold for much of the year and there is no forage available. The main problem, however, for beekeeping in Balochistan is that temperatures fluctuate widely in the course of a single day, and *Apis mellifera* bees cannot easily be maintained under such conditions. This may be why promotion of beekeeping for honey production has been unsuccessful in this province.

In 1998, NADRI, in collaboration with HBRI and Khush-Hali Associates (a local NGO with financial assistance from ICIMOD) initiated efforts to promote beekeeping for apple pollination. The NADRI distributed colonies of *Apis mellifera* among apple growers and trained the growers to manage them for apple pollination. However, as in the past, this attempt to introduce beekeeping failed. All the colonies died within a year. In May 2000, Khush-Hali Associates sent 25 participants,

including apple farmers and agricultural development workers, to HBRI to receive more training in beekeeping and pollination management, to ensure that consistent and professionally well-equipped efforts are made to manage bees in the Balochistan environment.

The experience gained so far suggests that it may be difficult to introduce stationary beekeeping under the harsh and arid climatic conditions of Balochistan. However, it may be possible to promote migratory beekeeping because the valley areas have good weather and flora for honeybees from late spring to autumn. Some beekeepers from neighbouring NWFP already migrate their *Apis mellifera* colonies to Balochistan from spring to autumn. Thus the best approach might be to build on this and encourage migratory beekeepers to place their hives in orchards during the flowering season, whilst helping farmers to recognise the benefits and actively solicit beekeepers inputs.