8

Development of Horticulture in the Mountain Regions of Pakistan: Progress, Potential and Constraints

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Introduction

In the mountain areas of Pakistan, there is a comparative advantage in growing horticultural crops. However, the present situation with its traditional patterns of production, harvesting, handling and marketing has to be fully developed to a stage where a higher volume of quality products can compete in large markets and for higher prices. The present horticultural system is low input, low output. Technology has to be developed that is most suited to small landowners and producers. Climatically, the mountain areas of Pakistan offer unlimited development opportunity for selected horticultural crops which have excellent cash potential. Critics of subsistence farming must acknowledge that mountain farming, even in remote areas, does have the cash potential necessary for the survival and sustainability of small farms, provided this potential is properly harnessed and the present-day subsistence farming based on cereal crops is transformed into commercial farming.

The mountain areas examined in this report cover the following administrative sub-divisions:

- The federally administered Northern areas comprising the districts of Gilgit, Baltistan, and Diamer;
- the Malakand and Hazara divisions of the North West Frontier Province (NWFP); Hazara Division consists of Kohistan, Mansehra, and Abbottabad districts and the Malakand Division includes the

district of Chitral and Swat and the provincially administered Malakand Agency.

- the Murree Hills *tehsil* of the Rawalpindi district of the Punjab province; and
- the province of Baluchistan, a major part of which is mountainous.

The next section of this report presents the climate and ecological zoning of the mountain areas of Pakistan. This is followed by separate sections on fruit crop cultivation, vegetable crops cultivation, and potato cultivation. The two remaining sections deal with marketing and processing of fruits and vegetables and with strategies and recommendations for future development.

Climate and Ecological Zoning of Pakistan's Mountain Areas

The Northern Areas

The climate varies in each valley according to altitude. Each valley has its own microclimate so that plants respond not to an average situation, but to the immediate, proximal prevailing conditions of an area. However, generally speaking, most parts of the Northern areas are arid, rugged mountain desert. As it is a rain shadow area, the annual rainfall varies between 100–200 mm. The climate at lower elevations has two extremes, cold in winter and hot in summer, becoming temperate (continental Mediterranean) at about 2000 m above sea level. Most precipitation occurs during winter, mostly in the form of snow.

Due to aridity, vegetation is absent and there is nothing to insulate the bare rock. Solar radiation is absorbed and converted into a long heat wave. At 37° N latitude, days are long in summer, with virtually no cloud cover and nights are correspondingly short, causing considerable discomfort to people. On the other hand, the same process is important at high altitudes (3000 m), where it enables more heat to be accumulated during a shorter growing season which hastens the maturing of crops.

TEMPERATURE

Figure 8.1 represents a summary of the monthly mean average daily temperature for selected places in the Northern areas located at different elevations. The most striking features are the great similarity of the pattern of seasonal change and the very large variation in temperature during winter, which is a typical feature of temperate mountains. Thus, one can grow a wide variety of crops by choosing the correct altitude and those months which correspond to the required temperature regime.

Besides sunshine, fruit needs cool nights for flavour and sweetness to develop. Cherries mature early before temperatures get too hot, but

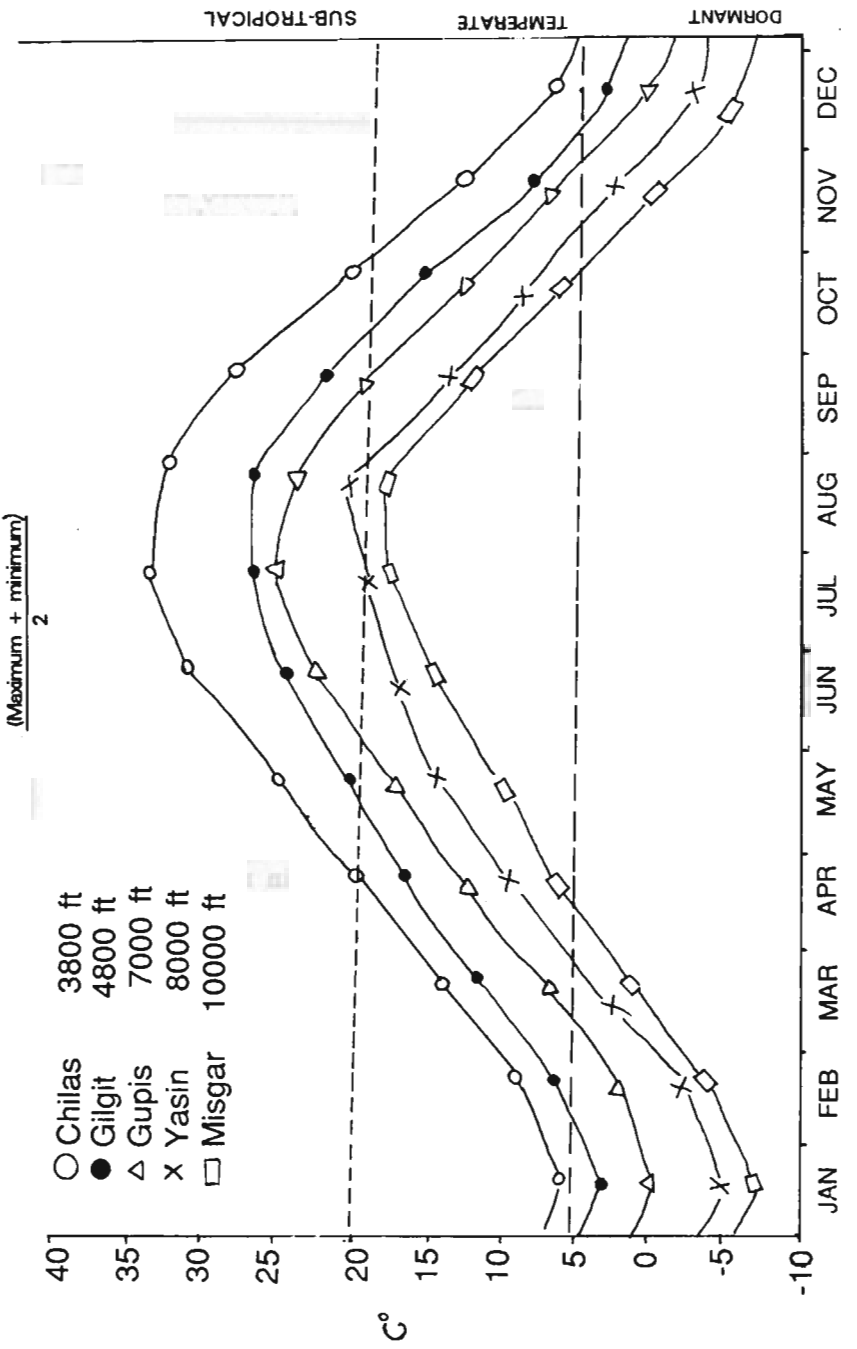


Figure 8.1: Monthly mean average daily temperature in the Northern areas of Pakistan

would not be an ideal crop below 1400 m. At these lower altitudes, almond would be excellent as its quality does not depend primarily on the sweetness or colour of succulent tissue.

Rainfall

As a rain shadow area, the Northern areas receive the attenuated effect of both the summer monsoon and the winter westerly depression. The cut-off from the summer rains is almost complete, and only rarely does moist air penetrate to bring heavy rain that can cause considerable damage through torrents. In the high mountain mass areas, above 5000 m, there is much snowfall and the subsequent melting of this snow sustains human settlements in the area, which otherwise is a mountain desert.

Figure 8.2 represents a summary of monthly mean rainfall. The Northern areas being a rain shadow area, rainfall is 100–200 mm per year.

Effect of Aspect on Maturity

Shade is an important ecological factor, at the scale of topographical shade (it becomes a decisive factor preventing a second crop in marginal double-cropped areas), and within the field. Both the growing period and maturity of crops are modified by aspect, in addition to altitude and temperature. South-facing villages receive considerably more sunlight than north-facing villages. In north-facing fields, crops usually mature a week to 10 days later.

Effect of Radiation

Another important factor influencing habitats in mountainous areas is the radiation which affects photosynthetic potential, temperature, evaporation, and, therefore, water balance. The Northern areas have a high incident radiation level because of the rain shadow effect reducing cloud cover, especially in summer, when 70 per cent of the maximum possible sunshine hours occur.

The quality of radiation is intense at increasing altitudes, where the atmosphere is less dense with higher transmissivity and less water vapour and there is more ultraviolet radiation than at lower levels. Provided the temperature regime is suitable and with good crop management, very high yields of temperate crops can be obtained in the area. Apricots have the highest sugar content of any in the world and callus forms readily, facilitating propagation by cutting, budding, or grafting.

Mature trees when severely cut back readily sprout new shoots from epicormic buds. Shade has very little effect on field crops as the light

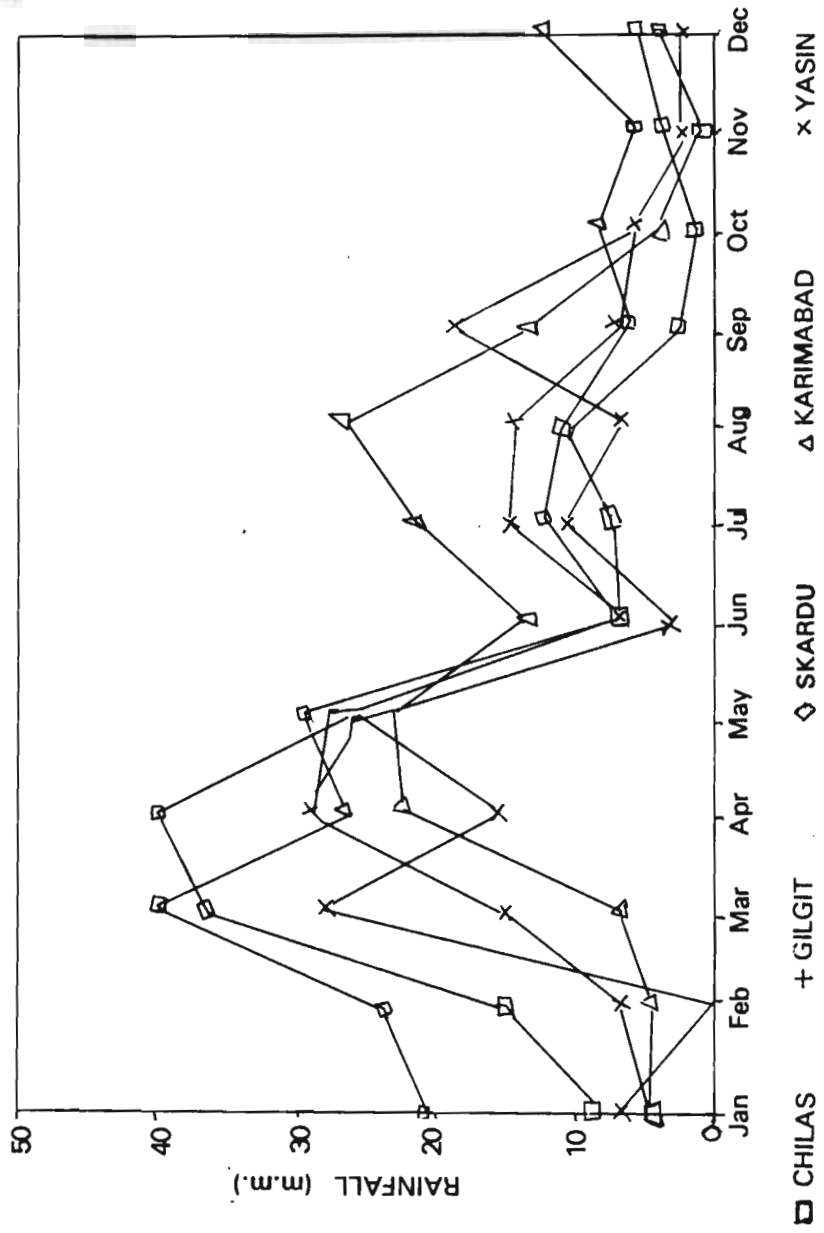


Figure 8.2: Mean monthly rainfall in the Northern regions of Pakistan

penetrates more deeply through tree canopies. Light intensity and radiation both affect some vegetable crops such as pepper, tomato, melon, and apple, causing severe sun-scald to exposed fruits.

Growing Period

In the Northern areas, the main limitation on the growing period is temperature, which is primarily a function of altitude. The growing period varies from 344 days at 1372 m to under 190 days in upper villages located at 3200 m. From the available climatic data, temperature profiles were produced for each 165 m interval, from 1372 to 3200 m height above sea level. These in turn were used to produce growing periods on the basis of the number of days estimated to be above 5° (Table 8.1).

TABLE 8.1
Growing periods for Gilgit District

Altitude		No. of growing days
ft	m	
4,500	1,372	344
5,000	1,524	331
5,500	1,676	314
6,000	1,829	303
6,500	1,981	277
7,000	2,134	264
7,500	2,286	254
8,000	2,438	241
8,500	2,591	232
9,000	2,743	222
9,500	2,896	210
10,000	3,048	199
10,500	3,200	187

Agro-Ecosystem Zoning

Since each valley has its own microclimate, agro-ecosystem zoning is considered to be extremely important for sustainable agricultural development in the Northern areas, providing: knowledge of natural resources that are available, their location, their potential role in development, and the limitations to their use; and information on the perspective breadth of applicability of proposed innovations and intervention.

In collaboration with the International Institute of Environmental Development, London, the zoning of Hunza valley was undertaken. Zones were drawn up primarily on the basis of the growing period, which is a function of temperature regime, altitude, and, to a lesser extent, aspect, radiation, and the predominant soil type and land form. Nine zones were

established in Hunza valley. Similar zoning of other valleys is planned in the near future.

Malakand and Hazara Division of the NWFP

In the district of Swat and Dir, November, December, January, and February are the coldest months in Swat and March is also cold in Dir, while June, July, and August are the hottest months with the maximum temperature not exceeding 40°C. Nights are comparatively cool. High seasonal temperatures allow the cultivation of most deciduous fruits and temperate types of vegetables.

Figure 8.3 provides annual rainfall figures for a range of areas. There is wide diversity in precipitation, but run-off from the higher rainfall zones ensures, in most instances, adequate water even in the rain shadow area. The valleys are narrow and the ratio of arable land to river flow is relatively small. In general, there is adequate irrigation water.

A feature of the monthly rainfall distribution is the double peak in early spring and the late summer. Obviously, the region is subject to monsoon rain when soil temperature is at its highest. Apples are, therefore, susceptible to crown rotting under such conditions. Also,extreme fluctuations in soil moisture levels during the growing season can favour the disease. The rainfall pattern leads to alternate periods of wet and dry. South of Mingora is basically too hot for apples at low altitudes, but suitable for plum, apricot, peach, and cherry cultivation with varieties that mature before the monsoon. This area is not suitable for vegetable seed production. Sooty mould is a problem for apples because of the heavy monsoon rain; besides, apples do not store well.

Agro-Ecosystem Zoning of Malakand Division

Given the different temperature and rainfall regions, Malakand Division has been divided into four distinct agro-ecological zone—Malakand Agency, Swat, Dir, and Chitral districts—for the purpose of possible fruit and vegetable production and innovative practices. Higher-altitude pastures and forests above the snow line have been left aside. The main agro-ecozones are:

Zone I: Hot and humid in summer, cold in winter, with frost occurring at night in December and January. Two crops are grown per year. This zone includes lower Swat, lower Dir, and lower Chitral districts and Malakand Agency, excluding Dargai.

Zone II: Warm and humid in summer with heavy frost and occasional light snow in certain areas during December and January. This zone is composed of middle Swat, Dir, and Chitral. Two crops are grown per year.

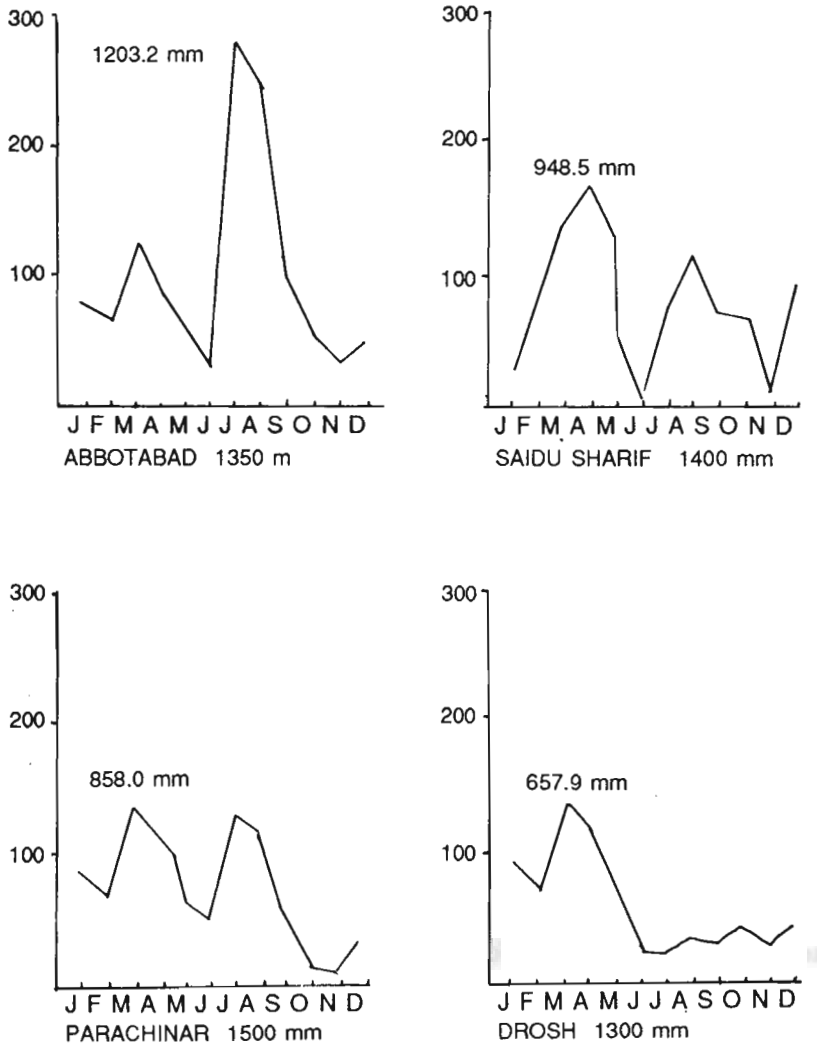


Figure 8.3: Mean monthly rainfall in Hazara and Malakand divisions of Pakistan

Zone III: High altitude areas with temperate climate where summers are comparatively mild and heavy snow falls during winter; only one crop is possible during the summer months after the snow melts. This zone includes upper Swat, upper Dir, and upper Chitral.

Zone IV: Lower part of Malakand Agency. This is a unique pocket where the winter is frost-free and the summer is hot and humid.

Cropping Patterns of the Zones and Their Potential

Zone I is a double-cropped zone where wheat and barley are planted in October and November, and harvested in May. Maize or rice crops follow. The following is the cropping pattern:

Wheat or Barley	—	Maize
Wheat or Barley	—	Rice

Among the fruit crops, some citrus and guava orchards exist. Vegetables are mainly grown for home consumption on small plots.

Buner area, where both irrigated and rainfed agriculture is in vogue, offers tremendous scope for fruit and vegetable development. Major food crops such as wheat, barley, and maize are grown along the natural water streams where water is readily available. Rice is also cultivated. The scarcity of water limits the cultivation of vegetable and fruit crops on a commercial basis. Tubewells are being sunk to harness ground water through a Dutch-assisted project. It should then be possible to develop horticultural crops commercially. The cost of sinking these tubewells can only be justified or recovered if high-value horticultural crops are grown on a large scale. These crops would require less water than field crops and a larger area could be brought under cultivation. In Buner, fruit production is not popular. However, great potential exists for late citrus and the blood-red variety of orange, early ripening plum, apricot, peach, and grape should adapt well to this area. Guava also has possibilities. In the cool season peas, carrot, cabbage, cauliflower, spinach, turnip, beet, and Brussels sprout could be cultivated and in the warm season cucurbits (pumpkin, melon, and other gourds). Beans, eggplant, and chilli could also be cultivated from March to August.

Zone II is also a double crop area and the cropping pattern is as follows:

Wheat, Barley, Onion — Maize, Rice, Tomato

Among the vegetable crops, tomato and onion are commercially grown in certain areas of Swat and Dir. In Chitral, olericulture is very poor. Only leafy vegetables such as spinach sonchal (*Malva* sp.) and Chinese spinach are grown. There is an acute shortage of vegetable when the Lowari Pass closes for November to the end of May.

Around Mingora and Saidu Sharif, other vegetables such as peas, cauliflower, spinach, radish, turnip, cucumber, okra, eggplant, and some beans are grown for the market. Cultivation of vegetables on rented land is also common. In these areas, a vegetable-based cropping system consists of companion and relay cropping. Small plants and quick-maturing crops are interplanted with slow-growing ones. The most intensive type of vegetable cultivation is practised on expensive land close to the cities.

Apple, plum, apricot, persimmon, and grape on a small-scale, as well as walnut and almond are grown.

Because of the favourable agroclimatic conditions, this area offers development of most types of fruits and vegetables. Among the vegetable crops, carrot, cabbage, and capsicum offer tremendous scope for development, but these are not grown at present. The climate is suitable for vegetable seed production of most crops.

Among fruits, cherries, which offer great potential, are not grown, but strawberry is cultivated in Mingora. This has great potential for further development when links with a processing industry are established. For fresh fruit supply to markets such as Islamabad and Peshawar, PIA may offer reduced air freight rates. New red types of pear not known in this area also have potential for local as well as distant markets.

In *Zone III*, only a single crop is possible during the summer, the cropping pattern being:

Maize, Wheat, Barley, Potato — Fallow, Potato

Vegetables are seldom grown, but apple, walnut, and some apricots are grown on the edges of crop fields.

These areas could take advantage of their production season to profitably market selected vegetables such as carrot, cabbage, peas, turnip, and radish at a time when there is a great dearth of these vegetables in areas of high consumption in the Punjab and NWFP plains and even in Sind. In the fruit category various kinds of berries appear to be suitable for commercial exploitation.

In *Zone IV*, winters are frost-free and farmers exploit this to the maximum extent by growing two crops of tomato. One crop is harvested in April-May and the second late crop in November, December, and January. During these months no other area produces tomato commercially. Tomato from Dargai is transported to most parts of Pakistan. The main cropping patterns are:

Wheat, Tomato — Maize, Tomato, Rice

Blood-red orange, guava, and plum are grown but there are relatively few regular orchards. Vegetables or fodder crops are intercropped in these orchards.

Frost-susceptible crops such as capsicum and eggplant, and off-season production of melon could be introduced and marketed from October to December in distant markets during lean periods of production in other areas.

However, the Northern areas of the NWFP are rapidly becoming the most important area for the production of various fruits and vegetables in the province. Heavy planting over the past 10 years is beginning to produce fruit which is increasing annually, and this is also true of certain vegetables such as tomato and onion.

Murree Hills in the Punjab Province

In the apple-growing areas (1500–2700 m) the average rainfall is between 875 and 1250 mm but, unfortunately, it is not evenly distributed. The bulk is received during the monsoon (July to September), while the early summer months (April to June) usually get little rainfall. Hailstorms are a great impediment to fruit and vegetable seed production. Hailing is more frequent in the months of March and April when it causes serious damage to blossom and newly set fruit and results in the wholesale laceration of foliage. To avert hail damage, the netting of apple orchards has been tried, but with very poor response from farmers because of its cost and cumbersomeness. Screening of late-blooming varieties and the use of growth regulators for delayed flowering would be obvious approaches to overcome this problem to some extent.

Baluchistan

TEMPERATURE AND RAINFALL

Baluchistan is the largest province in Pakistan. The temperature range is very great from the Kachi plain, where the maximum summer temperature reaches 50°C, with minimum night temperature around 30°C, to the high altitude areas of Kalat, Quetta, Ziarat, and Khan Mehterzai districts where the winter is very severe. Rainfall is the most erratic element here and the climate of the province is arid with an average annual precipitation of 375 mm.

ECOLOGICAL ZONES

On the basis of district characteristics of topography, climate, and soil, this province can be divided into five ecological zones.

1 *Plains*
2 *Lower valleys*: These two zones with elevation up to 600 m and rainfall below 150 mm annually are not suited to deciduous fruit tree cultivation.
3 *Medium valleys*: The elevation ranges from 600 to 1200 m above sea level and the rainfall varies annually from 200 to 350 mm. The summer is not very warm. Very little snowfall occurs in winter but severe frost is common. This zone includes Khuzdar, Panjgur, Zhob, Loralai, and Chaman, which are favourable to the growing of pomegranate, almond, grape, apricot, peach, and also dates and loquat.
4 *Higher valleys*: The elevation ranges from 1200 to 2000 m above seal level. This zone includes, Gulistan, Pishin, Killa Saifullah, Quetta Valley, Mustung, and Kalat. The climate is comparatively mild in summer,

up to 35°C, the winter is cold with snowfall and sub-zero temperatures. Annual rainfall ranges between 200 and 300 mm. This zone is favourable to the growing of deciduous fruits: grape, apple, apricot, pear, pistachio, pomegranate.

5 *High lands*: This zone includes Khan Mehterzai, Kawas, and Zindra in Ziarat Valley, as well as Toba Achakzai and Toba Kakri. Its elevation is more than 2000 m above sea level. The winters are very severe with heavy snowfall. Summers are relatively cool, the temperature seldom rising above 33°C. Because of the severity of the climate, only a few fruit trees are grown, mainly apples and cherries, but they produce fruit of good quality.

Fruit Crop Cultivation

Zonation of Fruit Species by Altitude Levels

In considering ways to improve the livelihood of small farmers in the mountain areas, policy makers commonly overlook the possibilities of fruit production. Although fruit trees produce well on the best land, they can also grow on land that is unused because it is steep, gravelly, low in fertility, or lacking adequate irrigation or water supply for cereal crops. Fruit trees in mountain areas are also well suited for mixing or intercropping with annual cereal crops, vegetables, or bulbous flowers which can be planted between widely spaced trees. Because of their extensive root system, trees control erosion and landslides, besides which, they are more stable than annual crops, producing despite rainfall fluctuations in some rainfed mountain areas. Typically, once established they require less intensive care. Consequently, a few fruit trees can provide a relatively steady income to small farmers, buffering them against fluctuations in income from annual crops, which are more sensitive to weather variations. With the construction of new highways, metalled and gravel link roads in mountain areas, and a readily available transport service, fruit production has great potential to develop into a major farming enterprise in these areas, namely Gilgit, Chitral, Baltistan, Hazara, Kohistan, Swat, Dir, Parachinar, north and south Waziristan, Murree Hills, and Azad Kashmir.

Fruits are a very rich source of carbohydrates, proteins, minerals, and vitamins, which are essential for human health and vigour. Pakistan is blessed with varied agroclimatic conditions that make it possible to grow all types of fruits. The seasonal temperature changes in conjunction with altitude are clues for the optimum location of fruits. The zoning of fruit crops at various altitudes is given in Table 8.2. In certain high rainfall mountain areas, the altitude may be the same as in arid and semiarid areas but it may not be possible to grow certain fruits such as pistachio,

TABLE 8.2
Zoning of deciduous fruit growing in the mountain areas of Pakistan

Altitude (m)	Fruit that can be grown profitably
1200	Almond, pomegranate, apricot, plum, persimmon, peach, grape, fig, pistachio, mulberry, strawberry, and other fruits
1500	Almond, pomegranate, apricot, plum, persimmon, peach, grape, fig, pistachio, cherry, pear, walnut, mulberry, and strawberry
1800	Almond, apple, apricot, plum, peach, grape, cherry, pear, walnut, mulberry, and strawberry
2100	Apricot, apple, peach, plum, pear, walnut, and strawberry
2400	Apricot, apple, pear, peach, and berry fruit
2700	Apricot, apple, berry fruits (gooseberry, currants, raspberry)
3000	Apricot, (early maturing cultivars only) and berry fruits (gooseberry, currants, raspberry)

almond, grape, cherry, or pomegranate. This aspect has to be taken into consideration when planting fruit crops.

The history of fruit culture in the mountain area is difficult to trace. However, it is presumed that the British who resided in these areas since the early part of the 19th century were instrumental in the introduction of apples and cherries, initially, and other deciduous fruits later, perhaps around 1915.

There are no regular fruit orchards in the mountain areas, except in Quetta, Kalat, Ziarat, and Swat valleys. In other places, only a few trees of each type are grown by individual households along terraced field boundaries to meet their own domestic needs. Surplus apricots, apples, and mulberries are dried for consumption in winter, as also apricot kernels and other fruit. Small surpluses are marketed in nearby areas by individual households.

Separate statistics of area and production of deciduous fruits for each mountain area are not available and in most places not even collected.

Area and Production of Fruits by Species and Location

Because of the varied agroclimatic conditions the production of almost all types of fruits is possible. Among the leading fruits produced in Pakistan is citrus, followed by mango, guava, dates and banana, all grown in the plains of Pakistan with tropical and sub-tropical climate. Area and production of deciduous fruits in Pakistan are given in Annex 1.

Punjab is by far the leading province, contributing 68.6 per cent of the national production, while Sind contributes 16.7 per cent, Baluchistan 9.11 per cent, and the NWFP 5.7 per cent.

Citrus, guava, mango, pomegranate, and dates are the main fruits of the Punjab; Sind contributes banana, mango, and dates; the NWFP

contributes, pear, plum, apple, apricot, and persimmon. The province of Baluchistan contributes grape, almond, peach, apricot, apple, and dates.

Punjab's share in deciduous fruit is very meagre and Sind has almost none (Figure 8.4). In other mountain areas of Azad Kashmir, Gilgit, Diamer, and Baltistan, these fruits are grown, but their area and production are not reported.

Deciduous Fruit Growing Areas

About 97 per cent of the almond production comes from Baluchistan where the main production areas are the districts of Loralai and Zhob.

During the past 20 years, both the apple-growing areas and production have increased much more than for other deciduous fruits. Baluchistan is the leading province for apple production. The NWFP also has important production. Sizeable quantities are also produced in the Northern areas and in Azad Kashmir. In Baluchistan, the main production areas are Pishin, Ziarat, Quetta, and Kalat.

For apricot, 74 per cent of the growing area, giving 81 per cent of the production, is in Baluchistan. The other production areas in the NWFP are Peshawar and Malakand division. The Northern areas and Azad Kashmir also produce a sizeable amount. In Baluchistan, Loralai is the leading area, followed by Zhob, Pishin, Quetta, and then Kalat.

Approximately 98 per cent of grape is produced in Baluchistan province. The main districts of production are Pishin and Quetta.

The main growing areas for pomegranate are the Multan division of the Punjab, followed by Baluchistan.

Almost the entire production of cherry is from Baluchistan, mainly in the Ziarat valley. Some are produced in the Northern areas as well.

Peach is mainly produced in NWFP and Baluchistan and some in the Northern areas.

The major quantity of pear is produced in NWFP, some in Punjab, Baluchistan, Azad Kashmir, and Northern areas.

Plum is produced mainly in Peshawar district of NWFP with about 25 per cent from Baluchistan.

Pistachio is grown in a very small area of Baluchistan only.

Causes of Production Expansion

In Quetta and Kalat valleys of Baluchistan, the area under fruit has increased because of availability of electric power. Tubewells were sunk for irrigation water, which was an expensive operation as the rechargeable water-table is very low. Only horticultural crops could compensate for this expensive investment. New land has been created and is being created wherever electricity is available. Barren rocky land unsuit-

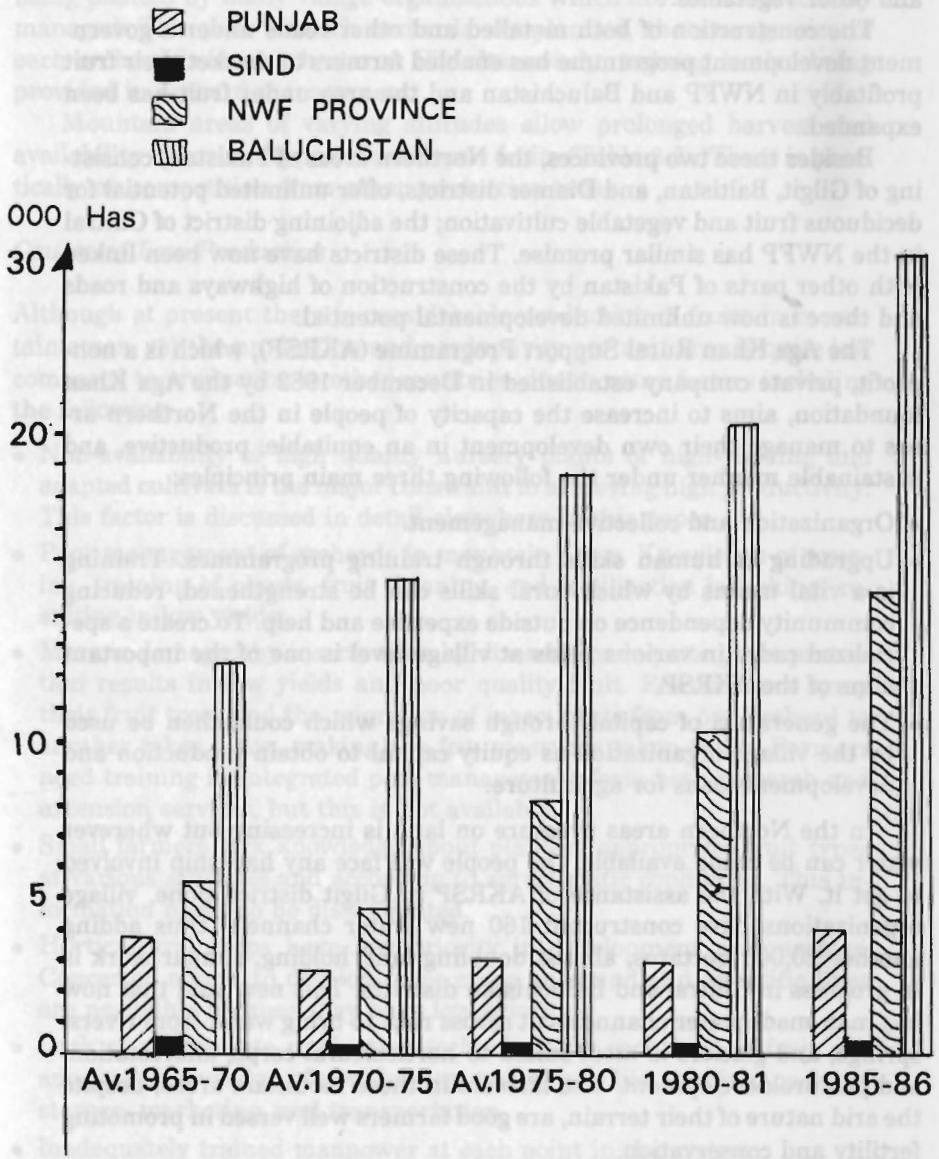


Figure 8.4: Deciduous fruit cultivation areas in Pakistan, 1965–1970 to 1985–1986

able for agriculture is being brought under horticultural crops wherever electric power and water are made available. Retention walls are being constructed, about 1 m high, which are then filled with river soil. Fruit

orchards have been planted, which are intercropped with potato, onion, and other vegetables.

The construction of both metalled and other roads under a government development programme has enabled farmers to market their fruit profitably in NWFP and Baluchistan and the area under fruit has been expanded.

Besides these two provinces, the Northern areas of Pakistan, consisting of Gilgit, Baltistan, and Diamer districts, offer unlimited potential for deciduous fruit and vegetable cultivation; the adjoining district of Chitral in the NWFP has similar promise. These districts have now been linked with other parts of Pakistan by the construction of highways and roads and there is now unlimited developmental potential.

The Aga Khan Rural Support Programme (AKRSP), which is a non-profit, private company established in December 1982 by the Aga Khan foundation, aims to increase the capacity of people in the Northern areas to manage their own development in an equitable, productive, and sustainable manner under the following three main principles:

- Organization and collective management.
- Upgrading of human skills through training programmes. Training is a vital means by which rural skills can be strengthened, reducing community dependence on outside expertise and help. To create a specialized cadre in various fields at village level is one of the important aims of the AKRSP.
- The generation of capital through savings which could then be used by the village organization as equity capital to obtain production and development loans for agriculture.

In the Northern areas pressure on land is increasing but wherever water can be made available, the people will face any hardship involved to get it. With the assistance of AKRSP in Gilgit district alone, village organizations have constructed 160 new water channels, thus adding another 20,000 hectares, almost doubling land holding, similar work is in progress in Chitral and Baluchistan districts. This new land that now has man-made water channels cut across rock to bring water from rivers, springs, and glaciers is most suited to horticultural corps, afforestation, and pasture development. The farmers in these mountain areas, despite the arid nature of their terrain, are good farmers well versed in promoting fertility and conservation.

The AKRSP has also financed 131 link roads, the total length of these roads being 1210 km, enabling farmers to market their surplus produce. Similarly, 15 bridges have also been financed. These have been micro-projects but the government has under consideration macro-projects such as the construction of major roads, bridges, and hydel projects. There is great demand for fruit trees here. The AKRSP has supplied about 60,000

fruit trees in the last three years at cost. Mixed regular orchards are being planted by many village organizations which are to be collectively managed. This year 30 such orchards are planned, the average size of each orchard being 1.5 hectares. Simultaneously, training is also being provided in orchard management.

Mountain areas of varying altitudes allow prolonged harvest and availability of various types of deciduous fruits (Table 8.3). There is practically no competition from other production areas.

Causes of Low Production

Although at present there is considerable production of fruits in mountain areas, yet the production and productivity per unit area is quite low compared to production in other countries, due to many factors including the following:

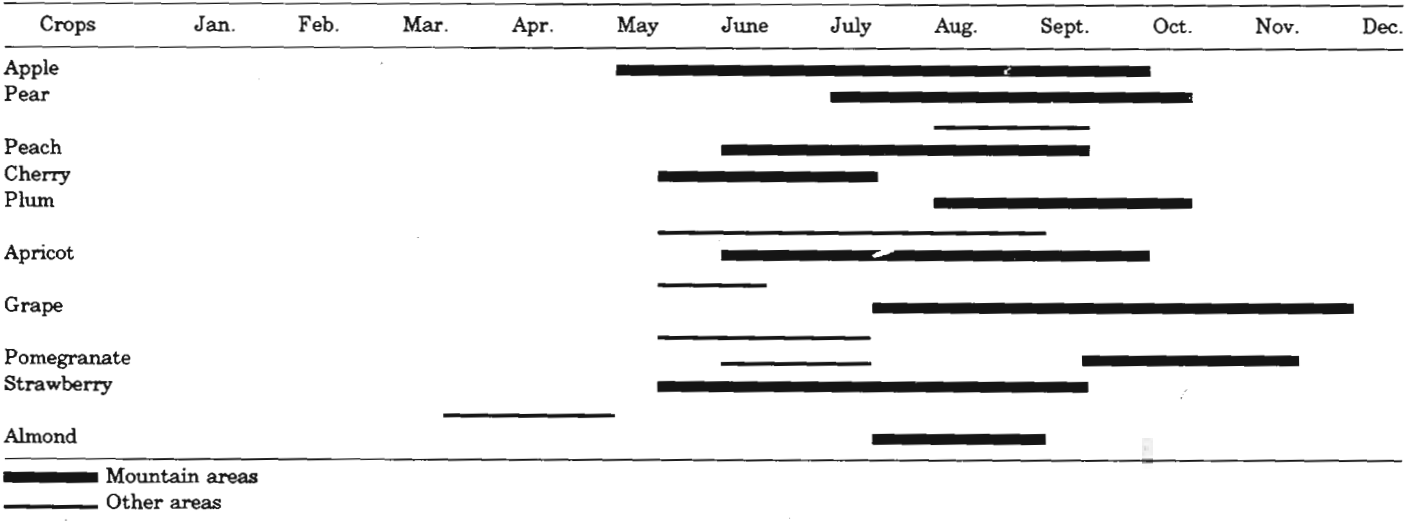
- Non-availability of high quality nursery plants of high-yielding and adapted cultivars is the major constraint to achieving high productivity. This factor is discussed in detail elsewhere in this paper.
- Poor management of orchards in mountain areas. Knowledge of pruning, training of plants, fruit thinning, and fertilization is lacking, resulting in low yields.
- More is damaged by insects than by disease. Inadequate plant protection results in low yields and poor quality fruit. Few farmers spray their fruit trees and the migration of insect pests from one orchard to another takes place, making the few measures taken futile. Farmers need training in integrated pest management form both research and extension services, but this is not available.
- Small farmers lack knowledge about planting appropriate fruit types at various altitudes and according to agroclimatic conditions. This information needs to be disseminated.
- Horticultural crops have low priority in development programmes. Concerted efforts to develop these crops on sound and scientific lines are negligible because they have low priority.
- Lack of appropriate production technology for each type of fruit. Inadequate knowledge of post-harvest techniques like grading, packing, storage, marketing, and transportation.
- Inadequately trained manpower at each point in the system.

Research of Fruit Crops

Each province has its own Agricultural Research Institute with research sub-stations in different agro-ecological locations for research into specific fruits. In addition to these provincial research institutes, there is

TABLE 8.3

Harvesting periods of major deciduous fruits in the mountains and other areas of Pakistan



the National Agricultural Research Centre at the federal level in Islamabad, which coordinates all provincial research and carries out basic research.

Some of the provincial research sub-stations have been upgraded to full-fledged research institutes. Through the concerted efforts of these institutes a large number of new varieties of different fruit species have been introduced successfully for large-scale cultivation.

Research into other aspects of fruit growing has also been carried out and recommendations made. These research endeavours included:

- Use of fertilizer and micro-nutrients
- Growth regulators
- Flood, drip, and sprinkler irrigation
- Integrated pest management
- Control of diseases
- Post-harvest physiology
- Evaluation of size controlling rootstocks
- Effect of pruning on yield
- Rootstock/scion compatibility studies, (Table 8.4 gives the stock-scion compatibility chart of some deciduous fruits.)

TABLE 8.4

Stock/scion compatibility of selected deciduous fruits in Pakistan

	Scion								
Stock	Apple	Cherry (sweet)	Cherry (sour)	Almond	Apricot	Peach	Plum	Pear	Quince
Apple	X								
Cherry (sweet)		X	X						
Cherry (sour)		X	X						
Almond				X		X			
Apricot					X	X			–
Peach				X	X	X			
Plum		X	X	X	X	–	X		
Pear						–		X	
Quince							–	–	X

Problems That Remain to Be Solved

- Mango malformation
- Screening of various rootstocks for salt tolerance
- Splitting of pomegranate
- Gumosis in stone fruit crops
- Alternate bearing in most fruit crops
- Stem borers in apple, shoot borer in peach
- Collar rot of apple
- Introduction and evaluation of new cultivars being continued

Excellent work in testing new rootstocks and varieties has been done and a number of suitable rootstocks and varieties with sequential maturity have been identified by various research institutes. These new rootstocks and varieties need dissemination through the development of fruit plant nurseries run on scientific lines.

Nursery Development and Management

The key element in expanding mountain area fruit production is the availability of good nursery stock at reasonable cost. Nurseries that produce quality trees are where a progressive fruit industry begins and, when nurseries are poorly run, then the industry often ends.

Comparison of tree crops with cereal crops will clarify why nursery stock is so critical. In the case of cereal crops which are grown in dense plantings, a few unproductive plants can be ignored. Fruit production, however, depends on fewer plants per unit of land, and a single unproductive or diseased plant can affect the farmer's income. Thus, the careful selection of individual trees is exceedingly important. Second, annual crops such as cereals occupy the land for only a season, while the fruit trees remain for many years. Therefore, fruit trees should be of the best possible quality if they are to provide a good cash return to the small farmer year after year. Third, fruit trees begin to bear some years after planting. A mistake made in producing or selecting nursery stock will reveal itself only after the farmer has spent time and money in growing the tree for several years.

Good quality fruit plants can be produced in nurseries if the right choice is made. The rootstock and the cultivar to propagate should be selected by a person experienced in fruit production and with knowledge of the area. Management of trees, grafting and budding techniques, and disease and pest control must be carefully discussed and implemented.

Nursery operations should ideally be supported by a properly staffed fruit research programme. Unfortunately, in most areas only poor quality

nursery stock is available to fruit growers because of management failures in both government-operated and private nurseries. In areas such as Swat, Quetta, Kalat, Ziarat, and Hazara where there are private nurseries, there is little consciousness of quality. Standardized disease-free rootstock is not used. The supply from these nurseries is far lower than the demand. In all other mountain areas there are government department nurseries, but they run at about 25–30 per cent of their production capacity. Each canal (1/8th of an acre) should produce, after allowing for stoolbeds, green manure crops, and unbudded layers, 1000 trees per year for sale. This has not been the case because of lack of knowledge of intensive techniques. Therefore, the government and private nurseries, combined, cannot meet the ever-growing demand of farmers. The selection of proper rootstocks and more scion cultivars has to be considered. The scion is important because it is directly responsible for fruit production and quality. It is the carrier of genetic potential for high production and the chief determinant of quality.

Problems

Problems in fruit tree nurseries can be grouped into two categories: in efficiency that makes the operation of nurseries expensive and mistakes that affect the farmer. The responsible management of nurseries should prevent both kinds of problems.
The major causes of inefficiency are:

- Scarcity or lack of sources for the rootstocks most commonly used
- Lack of appropriate methods for soil disinfection
- Propagation techniques that are slow or that have low rates of success
- Poor weed and pest management
- Poor irrigation practices

The major problems in a nursery that penalize the farmer are:

- Poor selection of rootstock
- Poor selection of the scion
- Use of budwood and rootstock infected by virus disease. These viruses may not kill the tree, but they can drastically depress yields throughout its life. In areas where all the trees come from the same infected bud source, the low yield may escape notice simply because there are no healthy trees with which to make comparisons. When a farmer buys a tree from a nursery that has any of these problems, he is bound to lose money, waste labour, infect his land with new pathogens, and ultimately reject fruit trees as a way to increase income.
- Lack of progeny gardens in various agro-ecological zones to obtain healthy budwood

- No fruit plant nursery certification standards or control over private nurseries

Keeping all the aforementioned problems in view, it is the non-availability of quality, disease-free nursery plants at reasonable rates that has remained the most significant deterrent to the fast expansion of deciduous fruit culture in mountain areas. The small farmer has not been able to make his small holding a viable and sustainable economic unit.

The AKRSP after thorough analysis of the present fruit nursery situation in the three mountain districts, namely, Gilgit, Chitral, and Baltistan, and seeing that the villages in inaccessible areas at very high altitudes have no access to the few government nurseries, developed a package for fruit tree nursery development in selected villages in various agro-ecologies. This package has a very strong training component in all aspects of nursery management. Training is imparted to two or three women nominated by village orgaizations. These nursery specialists are paid through the sale of nursery plants. Nurseries are laid out under the guidance and supervision of AKRSP technical staff; stool beds are established, three budded mother plants of each variety of peach, pear, apple, cherry, etc. are established to obtain authentic budwood for budding and grafting. Similarly, the plants of each variety of recommended cultivars of grape and pomegranate are also established to obtain cuttings for further propagation. In 1988, seven nurseries in the villages were established. Each nursery has an area of 1/2 to 1 acre. The development of 30 nurseries is planned. These nurseries will not only meet the plant requirements of the villages, but will also generate substantial income through the sale of surplus plants to clusters of villages around it.

Recommendations

- Government departments should immediately establish deciduous fruit progeny gardens in various agro-ecological zones of all mountain areas.
- Adequate well-trained manpower should be developed exclusively in nursery management.
- Regular training courses should be held for private nursery men.
- Fruit nursery certification standards should be formed and implemented immediately.
- All nurseries should be made liable for inspection and certification.
- All private and government nurseries should get their plants certified before sale.
- It should be made mandatory for private nursery men to obtain certified rootstocks and budwoods from the progeny garden. All private nurseries should be licensed. The Pakistan Agricultural Research

Council could render an invaluable service to poor and disadvantaged small farmers of the Northern areas by establishing an excellent deciduous fruit plant nursery and progeny garden at its Juglote station. This nursery could also take advantage of the immense variety available in the local varieties of fruit grown from chance seedlings. These are of excellent quality and some of them are unique. They also need proper documentation and characterization.

Vegetable Crops

Vegetable production for consumption is of extreme importance from the economic and health point of view in the mountain areas. Vegetables constitute a group of foods that are essential to a well-balanced diet. They have the special advantage of being a cheap and easily available source of carbohydrates, proteins, minerals, and vitamins.

Vegetable growing is a highly specialized branch of horticulture, requiring special care and attention. Vegetable crops are normally delicate, fast growing and susceptible to pest, disease, and environmental stress. Vegetable culture, being generally intensive and having a short time from planting to harvest, is most suitable to increase the income of small farmers in the mountain areas.

Area of Production

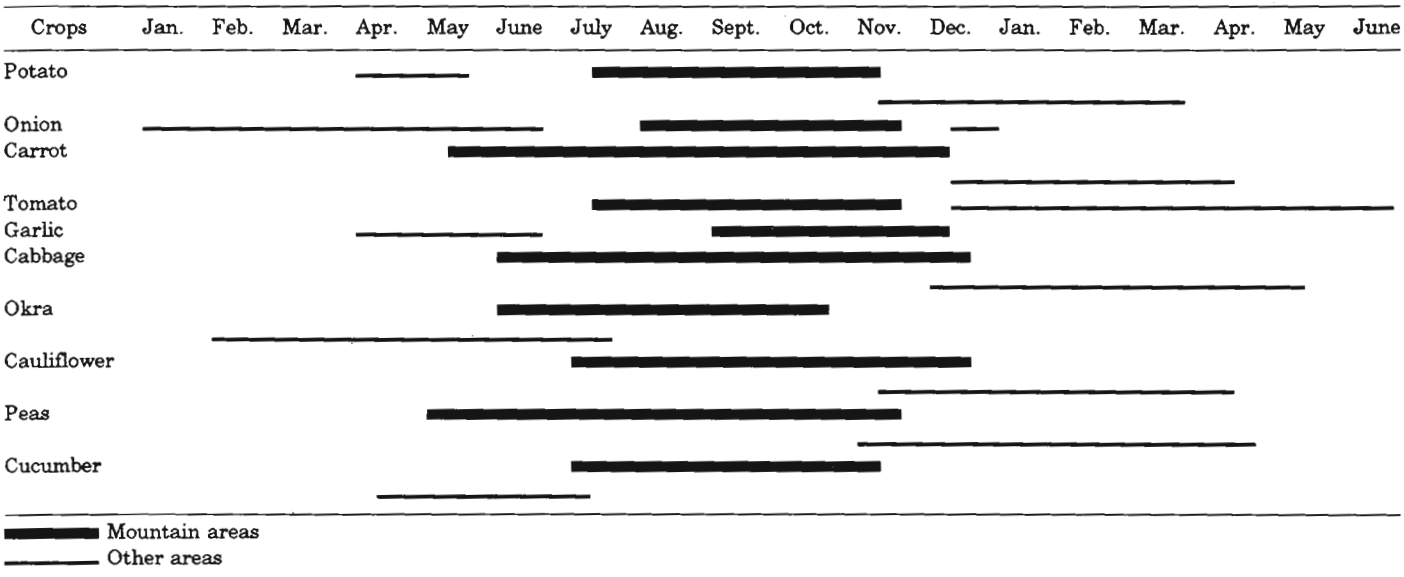
The area and production statistics of important vegetables from 1973/74 to 1985/86 are given in Annexes 3 and 4. Except for potato and onion, areas and production have remained almost static. Similarly, average yields per hectare from year to year have also remained static and low, being only 12 mt/hectare.

Unfortunately, separate area and production statistics for the mountain areas are not available. Small holdings, availability of irrigation water, link roads, and good markets in consumption areas offer great scope for expanded vegetable cultivation in mountain areas. Vegetables are grown mostly for home consumption in small patches or intercropped with other crops at present, but area like Quetta, Hazara hills, and Swat are being exploited to a limited extent.

Mountain areas have the advantage of seasonality of production. All types of vegetables can be produced during the summer season, both subtropical and temperate, when they cannot be grown in the plains. During this season prices are high and vegetables are marketed advantageously on a small scale. They do not have any competition during this season from other areas of production (Table 8.5).

TABLE 8.5

Harvesting periods of and major vegetables in mountain and other areas of Pakistan



Causes for Production Expansion

Vegetable farmers have been successful in highly intensive farming systems adapted to heavy population pressure and expensive land around cities and towns. Traditionally, they have been practising inter-cropping, mixed cropping, relay cropping, and sole cropping. There is no set pattern and crop combinations are too numerous to list. Vegetables are also inter-cropped in young fruit orchards. It is difficult to improve or to suggest what cropping pattern should be adopted.

The AKRSP, aware of the potential existing in Chitral, Baltistan, and Gilgit, has developed a production package for women, along with a strong training programme backed up by ample supply or quality seeds at cost. An integrated production package for vegetables, poultry, fish and fruit culture has also been developed to recycle waste and provide these essential commodities to local hotels to cater for the need of an ever increasing influx of tourists, both Pakistani and foreign. This type of production package gives about 8 to 10 times more income than merely growing wheat and maize on small land holdings can. For this production package, the AKRSP has also tested a number of vegetable cultivars in order to recommend suitable varieties to farmers in mountain areas. These high-yielding cultivars, suited to all agro-ecological conditions found in mountain areas from 1000 to 3000 m above sea level, are given in Table 8.6.

TABLE 8.6
Suitable vegetable varieties for mountain areas

Crop	Name of cultivar
Carrot	Nantes (first preference), Chanteney (second preference)
Cabbage	Golden acre (for early crop), Drum head (for late crop)
Cauliflower	Snow ball, Snow drift
Peas	Arkel, Green drift
Lettuce	Great lake
Beans	Contender
Tomato	Maglobe (first preference), Roma (second preference)
Okra	Perkinson spineless
Turnip	Purple top, Golden ball (for very high altitude)
Onion	Texas sweet grano, Shangshu
Radish	All season, Minnow
Pepper	Yellow wonder, California wonder
Table beet	Betroit dark red.
Chinese cabbage	Granat, Michihili
Squash	Petra, Caserta, Grey zucchini

Causes of Low Production

- Non-availability of quality seed
- Low plant population due to poor seed
- Considerable damage by insect pest and disease
- Inadequate use of fertilizer because farmers are not convinced of its efficacy
- Low priority in national development programmes
- Lack of a solid technical base and acute shortage of scientific manpower

There are other factors which have an indirect effect on production:

- Enormous post-harvest losses.
- Market gluts and low prices during peak production seasons.
- Lack of adequate cold storage facilities, poor market availability, and no stabilization of prices.
- There is no sound marketing and export policy. No market analysis is made of prospective importing countries for the preparation of a sound export programme. Thus, incentive for farmers to boost their productivity level and overall production is lacking.
- Processed and canned vegetables, being expensive, have limited demand within the country resulting in low in-take of surplus vegetables during the peak production season by the processing industry.

Vegetable Seed Situation and Prospects

In arid hill areas like Quetta, Gilgit, Baltistan, and Chitral, rainfall offers tremendous scope for the production of vegetable seeds of almost all types of vegetables, but more so the temperate type of vegetable, such as cabbage, Chinese cabbage, cauliflower, beetroot, carrot (European types), Swiss chard, and broccoli.

Vegetable seed production along scientific lines has remained a neglected field and non-availability of indigenously produced quality seed of high-yielding cultivars at reasonable cost is the major constraint restricting high productivity and the overall production of vegetables in the country. Seed quality is a vital factor for any crop improvement programme and to boost national production. All other inputs like fertilizer, water, pesticides, and labour applied to increase production cannot compensate for poor germplasm. Due to the poor quality of indigenous seed, plant population is low, resulting in reduced yields, specifically in directly seeded crops. It is, therefore, very important that farmers get pure and healthy seed of adaptive and recommended cultivars.

The Present Situation

At present there is no organized commercial vegetable seed production. In price it ranks very low compared to other inputs. However, non-availability of quality seed of higher-yielding cultivars is the major constraint restricting higher production.

Some farmers save their own seed, but a majority purchase it from the local market. The quality of this seed is unknown and farmers usually save their own seed for vegetables where this is feasible, as with eggplant, okra, tomato, beans, peas, chilli, carrot (local), and various types of cucurbit. Seeds of cabbage, Chinese cabbage, lettuce, cauliflower, onion, table beet, turnip, radish, carrot (European type), and broccoli are invariably purchased from commercial seed merchants every year. At present in the absence of a vegetable seed industry, the seeds of some economically important vegetables are multiplied on a very limited scale at various provincial research institutes by breeders who are simultaneously involved in research, seed production, and multiplication programmes. As a matter of policy, they should not be producing or multiplying seed for commercial sale, except the production of pre-basic or breeder's seed. They are not equipped to handle large amounts of seeds due to limitations of time and personnel and other infrastructure needed for seed production.

The present unsatisfactory seed situation has compelled the government to adopt a liberal policy for the import of vegetable seeds from India, Japan, the Netherlands, Denmark, the United States, and other countries, involving a substantial amount of precious foreign exchange. Seed worth millions of rupees has been imported from year to year, as shown in Table 8.7.

TABLE 8.7

Value and quantity of imported vegetable seeds

Year	Value of imported seed (millions Rs.)	Quantity (tons)
1983/84	20.4	885.8
1984/85	22.8	741.1
1985/86	37.5	1249.7
1986/87	61.2	2136.7

Seed merchants are free to import seeds of any type and of any cultivar, even though that cultivar may not have been tested and recommended for Pakistan. This is not a healthy situation and needs rectification immediately. Farmers are left with no other choice than to plant unadapted and untested cultivars, resulting in variable yields. The total vegetable seed requirement is about 2312 tons (Table 8.8), for a total area

TABLE 8.8
Seed requirements for various vegetable crops

Vegetable	Area (ha)	Seed rates (kg/ha)	Annual requirement (kg)
Kharif			
Melon	29,110	3.5	101,885
Squash	4,158	5.0	20,790
Gourd	2,890	5.0	14,450
B. gourd	2,228	9.0	20,052
Pumpkin	1,690	3.0	5,070
Okra	2,753	25.0	181,325
Brinjal	5,123	0.6	3,074
Tomato	5,026	0.6	3,016
Miscellaneous	20,158	6.1	122,393
Total			472,625
Rabi			
Turnip	8,355	4.0	33,420
Radish	3,941	10.0	39,410
Cauliflower	5,927	1.5	8,890
Cabbage	2,396	1.5	3,594
Carrot	6,374	20.0	127,480
Tomato	9,146	0.6	5,487
Pea	6,407	60.0	384,420
Spinach	4,498	25.0	112,450
Miscellaneous	18,700	15.2	284,240
Total			999,392
			1,472,017
Condiments			
Onion	48,200	10.0	482,000
Pepper	67,000	3.5	234,500
Coriander	6,200	20.0	124,000
Total			840,500
GRAND TOTAL			2,312,517

of 282,900 hectares under vegetable in Pakistan. No separate statistics are available for mountain areas.

So far, there have been no concerted efforts to alleviate the present problems of vegetable seed production, especially that of temperate (cool season) vegetables, which was a very rewarding business in the distant past in the hilly areas of Baluchistan, for example, Quetta. Baluchistan used to supply seed to south Asian countries, the Middle East, and some

African countries. During World War II, seed was also supplied to some European countries. However, with the passage of time and particularly after the creation of Pakistan, this industry died down due to lack of proper management and support from the government. To revive this industry the Government of Baluchistan initiated a pilot project with the help of the World Bank. A small seed processing plant with cleaning, grading, and packing units was established in 1976 at Quetta.

Vegetable Seed Production Prospects

The agroclimatic conditions in mountain areas offer unlimited scope for vegetable seed production of sub-tropical and especially temperate vegetables. The seed crop occupies the land for a considerably longer period than vegetables grown for marketing. Hence, it must fit into the traditional cropping pattern initially. Factors favouring seed production are:

- Low rainfall throughout the growing season and especially towards seed maturity.
- Warm days and cool nights during summer conducive to extensive flowering and formation of seed.
- Long cold winter fulfills requirement of temperate vegetables for bolting.
- Low natural incidence of disease and few insect pests.
- Great variation of climate at short distances due to range of altitude and temperature.
- No competition from other cash crops.
- Vegetable seeds are a high-value and low-volume commodity, easily grown in distant villages at any location, even those only connected by gravel or dirt roads.

Constraints to Vegetable Seed Production in Mountain Areas

The following are the major constraints to the development of a sound seed industry:

- Free grazing of animals in the fall and winter
- Very limited knowledge of crop and seed yield of various crops and cultivars (Annex 8)
- Low priority in national programmes
- Inadequate trained manpower
- Lack of knowledge of appropriate production technology
- High risk in investments
- Lack of marketing know-how vis-a-vis liberal government import policy

- Lack of proper processing, packaging, and storage facilities
- Conservative approach; traditionally vegetables are grown by women and presumably seed also produced by them.

Recommendations

Ways should be found to curtail free grazing. Problems associated with free grazing, such as winter feed shortage, should be solved through the introduction of cash crops such as vetch, rye, and turnips. The AKRSP has demonstrated this effectively.

Due to small land holdings, farmers cannot compete in seed production of some vegetables such as peas, cucurbits, okra, and radish, as these can be more economically produced in the plains than in mountain areas. Therefore, temperate-type crops (cabbage, cauliflower, pepper, onion, Swiss chard, beetroot, and carrot) should receive priority as their seed cannot be produced in the plains.

Vegetable seed production is a highly technical and specialized job for which a proper training programme for scientists as well as farmers should be drawn up. This is a prerequisite for seed production. Village level specialists, both men and women, need to be trained. It would be premature to initiate a vegetable seed production programme immediately; it may become a reality after five or six years. First, farmers have to become skilled in fresh vegetable production technology for marketing, backed up by a strong adaptive research and demonstration programme.

Seed potential for each crop and cultivar should be thoroughly investigated.

More studies are needed on disease and insect pests for each crop.

In a seed production programme the emphasis should be on quality and not quantity, because the seed has to compete with imported high quality seed which has already established its credibility with vegetable growers.

Any seed production programme should have a strong marketing component. Local seed requirements will remain small; therefore, national requirements need to be studied thoroughly.

The present liberal vegetable seed import policy of the government should be taken into account before initiating any programme.

Government departments and agencies should not become physically involved in the actual production and sale of commercial seed, but should organize seed growers' associations, or encourage private companies to take up this venture. Quality control and certification should remain with the government.

Village organizations should be used for any seed production or development programme and the services of the plant protection specialists

trained by the AKRSP in each village should be effectively used at least in the Northern Areas (Gilgit, Chitral, and Baltistan districts).

Seed laws should be strictly enforced so that farmers gain confidence in locally produced seed.

Seed imports should be curtailed gradually to provide a much needed incentive for the development of a local vegetable seed industry.

Congenial climate conditions, isolated valleys, small farmers, and market demand provide an excellent opportunity to harness this potential for vegetable seed production at various elevations.

Research on Vegetable Crops

Vegetable crop research is the responsibility of the four provincial research institutes: located at Faisalabad (previously known as Lyallpur), in the Punjab, at Tarnab, Peshawar, in the NWFP; at Mirpur Khas, in Sind; and at Sariab, Quetta, in Baluchistan. Research includes the introduction and evaluation of cultivars and agronomic and crop protection trials. Universities and colleges are involved in some research, but these institutes work in isolation and have no coordination among themselves, resulting in duplication of work. In the past the meagre resources and the efforts of the few scientists available were being wasted. However, they have been able to identify high-yielding varieties of many crops.

Cooperative Vegetable Research Programme

In 1981, the Pakistan Agricultural Research Council, with its headquarters at Islamabad, taking cogizance of its situation, formulated a cooperative research programme on vegetable crops at the national level, and is also engaged in basic research at the National Agricultural Research Centre at Islamabad. This vegetable cooperative research programme now provides the necessary coordination among the provincial research institutes, as well as additional funds to strengthen their research capability. The overall objectives of the programme are to:

- Coordinate and integrate research activities to avoid wasteful duplication of research.
- Conduct uniform national cultivar trials of economically important vegetable crops.
- Introduce and evaluate germplasm to promote intensive breeding programmes to evolve desirable cultivars of peas, tomato, carrot, cucumber, okra, onion, melons, carrot, and other vegetables.
- Develop a package of production technology for each crop for different ecologies.

- Develop cropping (multiple, inter, and relay) systems to increase crop intensity and production.
- Develop a package of production technology for rainfed areas for various crops such as peas, radish, turnip, table beet, cucumber, and water melon.
- Develop appropriate low-cost technology such as solar drying.
- Develop or introduce low-cost farm tools and equipment which can be gainfully used on small holdings for intensive cultivation (in collaboration with the Agricultural Research Centre, Islamabad).
- Evolve suitable seed production technology.
- Study plant growth regulators to increase production.
- Study micro-nutrient requirements.
- Develop systems for year-round production of vegetables of economic importance under cover.
- Develop integrated pest control methods.
- Develop linkages with international research centres and agencies.
- Train scientific manpower, short-term as well as long-term.

The specific plan of work of the programme is:

- Screening of tomato material for heat tolerance, resistance to early blight, and bacterial wilt.
- Cross combination studies.
- Screening of exotic pea germplasm for powdery mildew and root-rot resistance. Hybridizing resistant material with local cultivars to evolve resistant cultivars.
- Screening of exotic cultivars for large root size, high yield, and late maturity.
- Collection of local and exotic germplasm of melon and screening for resistance to powdery and downy mildew.
- Uniform national cultivar trials on economically important vegetables such as peas, carrot, melon, water melon, onion, okra, cabbage, cauliflower, and beans.
- Screening of local and exotic germplasm of chilli for virus resistance and using resistant materials to breed high-yielding resistant cultivars.
- Screening of cabbage cultivars resistant to head cracking and head rot.
- Efficacy trials with various fungicides, insecticides, and herbicides to control disease, insects, and weeds respectively.
- Evaluation of low-cost seedling transplanter, garlic transplanter, seeders, fertilizer applicator, and diggers.
- Studies on pre-basic and basic seed production of promising material.

- Varietal testing in collaboration with Royal Sluis and Sluis and Groot, a Dutch vegetable seed company, in order to develop commercial seed production as a joint venture.

Achievements under the national cooperative research programme are listed below:

- Six lines of tomato tolerant to heat out of AVRDC material with fruiting ability have been identified at the National Agricultural Research Centre, Islamabad. Two of these lines have also performed well at Faisalabad and given double the yield of commercial cultivars.
- One line of cucumber resistant to powdery mildew with tremendous fruiting ability has been isolated.
- One late-maturing line of okra, red in colour, has been identified which is repellent to pod borers.
- One melon line has been isolated with excellent fruiting ability, having the characteristic of being able to ripen on the shelf without desiccation, with uniform fruit development and maturity.
- A couple of carrot cultivars have been identified which are late in maturity, with large root of good shape and colour.
- Four cabbage cultivars resistant to head cracking and rot have been screened.
- Two lettuce cultivars which form excellent, compact, large heads have been identified.

All the above material will be tested on a large scale in the field.

Marketing and Processing of Fruits and Vegetables

Main Marketing Channels

A majority of fruit and vegetable farmers have small holdings and usually grow more than one type of fruit and vegetable simultaneously. Fluctuations in prices and supply are typical patterns from year to year in the marketing of fresh fruits and vegetables because of very high prices during certain periods of the year when production is limited and very low prices at peak harvest time when there is a glut in the market.

The marketing of fruits and vegetables is a complex and complicated process in Pakistan. There are three different types of markets and many different people are involved in moving produce to and through these markets. The various market types include small rural markets, primary markets at the sub-divisional level, and wholesale markets at the district level. The three different marketing channels are: large-scale buyers for processing plants and some public sector institutions; regu-

lated agricultural markets; and unregulated or weekly regulated private markets. Export marketing is covered in the next section.

Of the three types of domestic markets, small rural markets are the most numerous. They are located alongside roads leading to the larger towns and cities. They may have some improvised shops with temporary godowns and weighing scales. Transactions take place through private negotiations, with small farmers generally accepting whatever price is offered for their produce.

Primary and wholesale markets at the sub-divisional and district level are the most important places for fruit and vegetable marketing. Commission agents play a dominant role in these markets. Storage space in these markets is generally limited and usually confined to an area behind or in front of the commission agent's shop. In a few of the larger markets, cold storage facilities are available.

Current estimates are that Pakistan has about 650 markets, of which 200 are regulated under some sort of agricultural produce act. The Punjab accounts for 120 of these regulated markets and Sind another 87. Regulated markets are covered by the Agricultural Markets Ordinance of 1978 in the Punjab and by the Agricultural Produce Market Act Amendment Ordinance of 1980 in Sind. Regulated markets have a controlled schedule of fees and charges. They are under the control of market committees, elected bodies of growers and traders.

The three different marketing channels interact by supplying each other at different times, yet procedurally and organizationally they are distinct. Some large-scale buyers purchase for the needs of processors or public institutions. The government-owned Agricultural Marketing and Storage Limited, for example, has a mandate to intervene in the market when prices are considered to have fallen below the cost of production.

The commission agent, or arthi, is the kingpin in the regulated market. The arthi may advance loans to farmers who repay the principal and market their produce through him. The arthi's principal function is to auction produce on behalf of his farmer clients, or act as middleman between the farmer and the wholesale market. The buyer at the auction pays a fee to the market committee on each sale; the amount of the fee depends upon the type of produce bought and the extent to which the weight and value of the transaction is accurately reported. Commission fees range from 3 to 10 per cent depending on the product, the time of year, and other factors, such as the debt status of the farmer client. The arthi has a fixed place of business in the fruit and vegetable market from which he conducts auctions, packs and repacks produce, and maintains an office with bed, telephone, and safe. A market association of all arthis, anjuman arthi, serves as the medium for settling disputes and handling minor problems with government authorities.

Middlemen, or beoparis, are linked closely to arthis. There are two types of beopari: those who live and work in villages around a market and those who trade between markets. The village beopari bulk buys produce and arranges shipment to market. Normally, a beopari will attach himself to an arthi and sell his goods through him. In this arrangement, the arthi supplies working capital loans.

The market beopari works as a middleman between markets and between processors and markets. These middlemen also play an important role in the unregulated market. Sometimes a beopari will purchase directly from farmers and advance credit to pushcart operators who rent a cart, buy a lot of fruit, and sell it throughout the day. The pushcart operator repays the beopari the next day and the process begins again.

The largest amount of unregulated marketing occurs outside the towns at crossroads dividing village roads from trunk roads. There, beoparis set up shops where they buy produce from farmers and sell directly to government procurement centres or to processing plants. Since no market fee or sale commission is paid, growers frequently receive a higher unit price for their goods here than they would at the regulated market.

The marketing system for fruits and vegetables is similar, with only minor variations. Pre-harvest contractors, who buy entire orchards, are prevalent in fruit marketing. Similar intermediaries are not common in vegetable marketing. Secondly, cold storage appears to play a more important role in vegetable marketing. Figures 8.5 and 8.6 present the typical fruit and vegetable marketing systems in Pakistan.

Marketing Arrangements in Mountain Areas

However, in mountain areas where there is scattered production in distant valleys and where marketable surpluses are small, it becomes impossible for small farmers to market their low surplus volume individually and profitably. In these areas small farmers also lack market information and cash flow. The quality of available fruit and vegetables is highly variable. These are critical constraints that must be overcome.

Group operation in marketing can be a means by which poor mountain communities can be offered security and the opportunity to market their surplus crops at a fair price.

Marketing Promotion by Aga Khan Rural Support Programme

The AKRSP is fostering and supporting village organizations with the long-term aim that these cohesive socioeconomic groups will identify, implement, and manage on a continuous basis all the development activities pertaining to a village by optimal use of the resources available

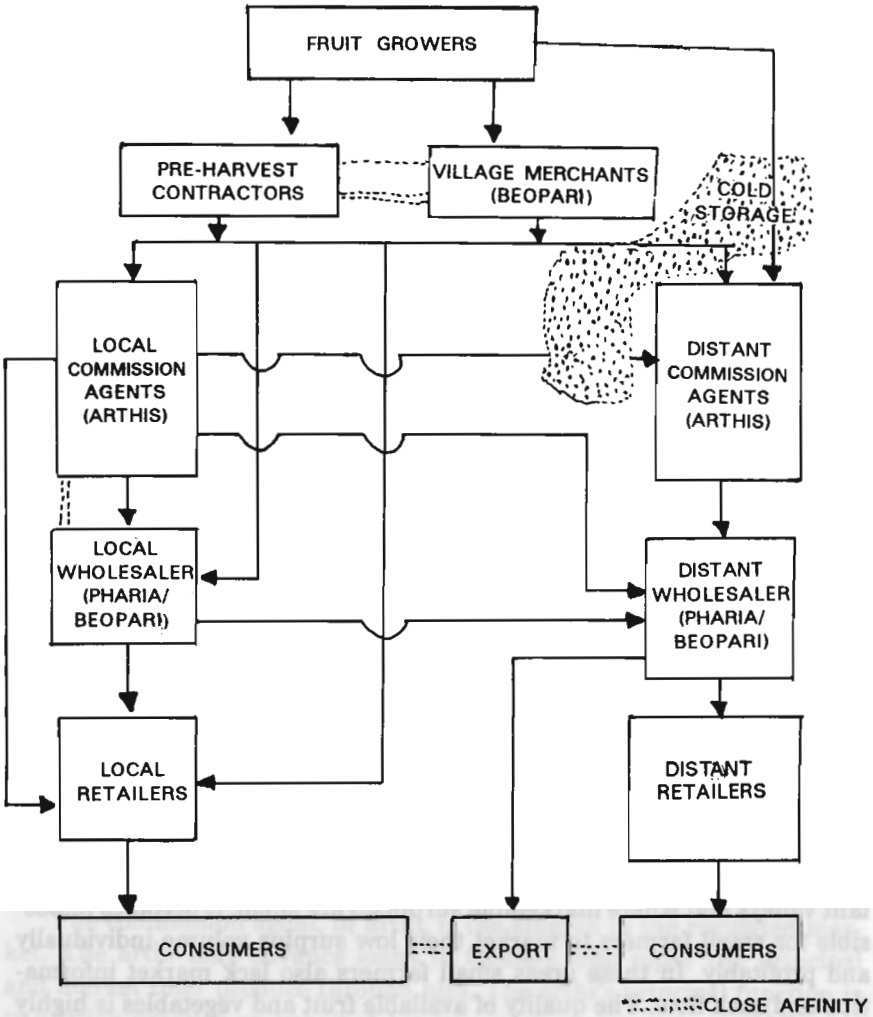


Figure 8.5: Generalized flow chart of fruit marketing in Pakistan

within and outside that village. In pursuit of these objectives, one of the major tasks ahead of a village organization is the establishment of vertically integrated marketing institutions. Such a system could be built on the cooperative collection of produce at the village level, and its subsequent marketing along the same principle.

The communication network in mountain areas such as Gilgit, Chitral, Baltistan, Dir, Parachinar, and similar valleys is extremely poor. The problem of transportation of produce is further compounded by the absence of proper harvesting of picking, grading, and packing skills among

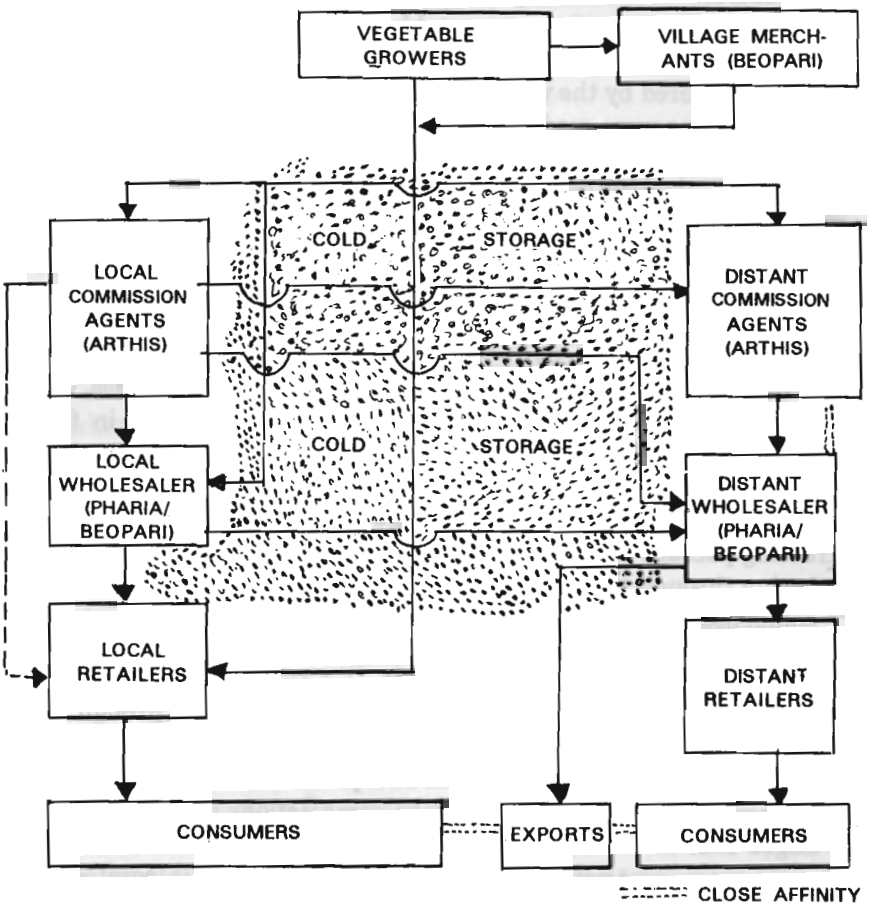


Figure 8.6: Generalized flow chart of vegetable marketing in Pakistan

the villagers and the non-availability of suitable and desirable packing material. The local markets in Gilgit, Chitral, and Skardu have been found to be relatively small, while distant urban markets are already being supplied by producers through well-established channels of communication.

Consequently, the basic marketing strategy that evolved responded to meeting these challenges. Training programmes were formulated to expose specialists from village organizations to bigger markets and to familiarize them with the actual mechanism that keeps these markets supplied.

Picking, grading, and packing techniques were demonstrated to the organizations to enable them to break into competitive markets. The pro-

cessing of fresh fruit was taught to villagers so that they could transform produce into a more easily transportable commodity. Sulphuring and dehydration techniques were also demonstrated to improve the quality of the product offered by the village organizations. Interest-free, short-term production loans were made available to them to overcome their lack of ready cash. Meanwhile, the increased productivity package, which incorporated the successful prevention of losses in crops, was beginning to expand farm production. The productive physical infrastructure package (construction of link roads, irrigation water channels, bridges, etc) also made additional water and new land available. These programmes have increased the scope for commercial and industrial development.

The increased productivity package calls for greater vigour in identifying, developing, and marketing related items with the greatest value-added potential for a majority of farmers. Special attention in future must also be given to products that take advantage of seasonality and/or novelty value.

With continuous progress, the village organizations are adopting the marketing package with enthusiasm. They have undertaken cooperative marketing through their trained marketing specialists and their services are compensated through a commission or by an agreed amount as remuneration, in addition to transportation charges.

The marketing package being offered by AKRSP in the project areas is in different stages of diffusion and refinement. Through these endeavors, village organizations have clearly demonstrated their capacity to carry out commercial transactions in a profitable manner.

Regarding the future role of village organizations in marketing, it is envisaged that ultimately marketing collectives will federate into a central cooperative association and operate together as an integrated unit. The role of the central cooperative association would be to collect market information, plan marketing operations on behalf of its member marketing collectives, arrange for transport to distant commercial markets, impart the necessary managerial and technical skills to persons nominated by its members, and provide credit and other allied facilities to its members. Private entrepreneurship is also being established through training and the provision of loans.

Direct Sales

In a normal marketing process middlemen act as intermediaries between the supplier of goods and its consumer, as already explained. These middlemen invoice their functions. Often, but mainly during a time of economic difficulty, or when a producer does not receive fair payment, while the consumer estimates the price to be too high, one may think that mid-

dlemen should be suppressed. Some attempts in this direction have been made in Pakistan, involving horticultural perishable produce.

Juma Bazars

Launched in Pakistan in 1980, first in Islamabad, a *Juma Bazar* (Friday market) is an attempt to develop the sale of the agricultural product directly by growers to consumers. The idea of *Juma Bazars* has now spread to many cities all over the country. The basic idea was to lower the price of agricultural commodities by direct sale eliminating middlemen and their share of the profit.

Being so successful the *Juma Bazars* are no longer restricted to the selling of fruits, vegetables, and poultry products, and have grown into big markets selling hundreds of articles meeting most requirements. All kinds of fruits and vegetables are available at reasonable prices, even those sold by stall holders, and fruit and vegetables grown around the town are brought for sale by the producers themselves.

Public Marketing and Storage Societies

The Agricultural Marketing and Storage Limited was set up in 1980 as a private limited company with shares. Its main objectives are:

- to support national policies designed to streamline production, storage, and marketing of perishable agricultural commodities;
- to take adequate steps for proper publicity of measures to further improve agricultural production, storage, and marketing.
- to adopt such means of making known the projects and other activities of the company as may seem expedient and, in particular, by undertaking demonstration programmes by advertising in the press, organizing seminars and exhibitions, issuing circulars, publishing literature, or through other media;
- to undertake research, surveys, and feasibility studies on the marketing of perishable agricultural commodities;
- to plan and implement projects deemed essential to improve the marketing of perishables and thereby to secure the interest of both producers and consumers;
- to involve both farmers' and consumers' cooperatives in the programme and facilitate their management of the exchange or marketing of perishables; and
- to provide fair competition at market levels and to help stabilize prices and check profiteering.

Agricultural Marketing and Storage Limited also owns and operates a citrus waxing and grading plant at Peshawar.

Post-harvest and Marketing Operations

Packing

There are some antiquated methods of packing for supply to the markets. Vegetables, by and large, are dumped in various carriers and vehicles and transported as such to the markets. Tomatoes are, however, packed in wooden crates and onions in bags. Fruits are packed in wooden crates of varying sizes. The high cost of improved packages and other packing material and limited demand for sophisticated packages in the present traditional markets are factors limiting the adoption of suitable containers for packing. Use of inappropriate and defective methods of packing result in substantial quantitative and qualitative losses. At present packing material is scarce in most mountain valleys.

Grading

Grading is almost non-existent. No efforts are made at the producer's level to classify different types of fruits and vegetables by quality. Uncertainty about the quality of produce has led to lower bids in the market and has consequently resulted in lower returns to producers. The absence of proper classification and grading has encouraged a number of malpractices. There is a tendency on the part of the producers to pack good quality fruits on top of the container and immature, damaged, and even rotten stuff at the bottom. Some loose selection and grading, done at the retailer's level, is, entirely based on personal conceptions of quality. Thus, there is a need to introduce grading and standardization on scientific lines in the interests of an improved marketing system and for the benefit of both producers and consumers.

Transportation

Transport and transport facilities are an integral link in the marketing chain and also have strategic implications for cost. The means of transport used to bring fruit and vegetables from farm to market vary according to location, type of roads, type and size of commodity, and the resources of the farmers. In mountain areas, farmers bear the sole responsibility for bringing their produce to collection points. All sorts of transportation are used; jeeps, pick-ups, animals (donkey, horses, oxen, and sometimes yak), tractor-trollies, and transport trucks where metalled roads and wider dirt roads are available. Air transport is seldom used. Cherries from Quetta are

transported by PIA to Islamabad, Lahore, and Karachi. There is a need for PIA to provide more fruit and vegetable transport facilities at special rates from Gilgit, Chitral, Swat, Muzaffarabad, Skardu, and Quetta. Freight rates vary significantly within a given mountain area, depending upon season, road condition, type of transport available, and more so the distance from the central markets. Lack of link roads and non-availability of fast transport is still a big problem.

Storage

Vegetables are available in plenty during certain months of the year and are not available in other months. Even in season, the supply is uneven, being abundant in the peak months. This invariably results in wide fluctuations in prices. Therefore, in the interest of both the producers and the consumers, it is necessary that available supplies are spread over a longer period so as to maintain prices at a reasonable level. This objective can be achieved by carrying over the surplus production for distribution in the off-season by putting it in cold storage where possible.

In Pakistan, cold storage facilities for over 365,000 tons are available in consumption areas. This capacity is considered sufficient to meet the total requirements of all horticultural products. According to a study, out of the total quantity of various products put into cold storage, potatoes command the most important position in the country; about 50 per cent comprises potatoes, particularly seed potatoes. Onions are stored to a lesser extent. The rest of the capacity is used for fruit (citrus and apples) and poultry.

In mountain production areas, there are only two mechanically cooled storage facilities of 1000 mt capacity each, one in Quetta and the other in Swat. The condition and design of most cold stores are poor. They are not properly designed to store various commodities with different storage requirements. Fruits, potatoes, onions, vegetables, poultry, and fish are all stored in the same room though each has different temperature and humidity requirements. The present cold stores can be made more efficient with little extra expenditure. They should be divided into different rooms, each room having its own temperature and humidity control system. The storage of each type of commodity under ideal conditions would then become possible.

The production of horticultural crops is going to increase in mountain areas in the next few years. Therefore, there is a need to construct storage in production areas. These need not be sophisticated and expensive structures but can be simple and comparatively cheap to operate by taking advantage of cool air during the day and night. A humidity control system would have to be provided. These stores could be constructed in high mountain valleys, so that supplies from production areas to con-

sumption areas could be regulated to the advantage of small farmers. These stores should be the property of farmers' cooperatives rather than of contractors or middlemen.

Scope for Fruit and Vegetable Processing

Another way of adding value to horticultural fresh products is by processing, especially during the production season, to avoid market gluts and keep prices at a level which benefits small farmers. There are about 55 processing and canning units in the country. Out of these, only about a dozen are comparatively large units and their products are of international standards. It is estimated that post-harvest losses are about 30 per cent due to improper handling and the highly perishable nature of these commodities. Most of the processing industry is in large cities. There are only two processing units in mountain areas, one in Quetta and the other in Swat. But their products are not of a very high standard.

Vegetables can be processed in different ways and the method differs from vegetable to vegetable. For instance, tomatoes can be preserved by conversion into tomato juice, sauce, and paste, and can be dehydrated into powdered form. Similarly, vegetables such as spinach, cauliflower, cabbage, carrot, peas, onion, garlic, butter gourd, and okra can be easily dehydrated. Mixed vegetable juice can also be prepared.

Mountain areas have the advantage of growing deciduous fruits which cannot be grown in other parts of the country. If processing units are established, these areas could have the monopoly of their produce, which is not generally processed in large quantities by other processing units. Mountain areas could take the lead in the production of apricot nectar or apricot-peach mixed nectar. Pure apple and grape juice could be marketed to great advantage. Apricot leather could also be produced and can be easily dehydrated. Cherries can be canned perfectly. Apricots, cherries, and peaches are extremely perishable by nature and cannot be marketed easily at long distances in the fresh form. In the Northern areas, about 40 per cent of the apricot production goes to waste. The greatest constraint in mountain areas for the development of a processing industry is the lack of electric power. Other constraints of capital availability and entrepreneurship can be overcome if power is provided.

Potato Cultivation and Seed Production

Role of Mountain Areas in Potato Production

Potatoes have adapted well to the mountain areas of Pakistan for a long time and now not only are the most important cash crop, but also provide

food in winter. In mountain areas, potatoes are grown during summer due to the mild climate. The crop is generally planted from March to April and harvested from August to October. At this time of the year, it cannot be grown in other parts of the country due to very hot weather. Therefore, mountain areas have the advantage of off-season production. Potatoes are supplied to the city markets from September to November when the prices are high and the potato is in short supply. It also fits in well with a number of multiple cropping patterns with little competition from other important food and cash crops.

The important mountain areas of Pakistan where potatoes are successfully grown are Hazara and Murree hills, Azad Kashmir, Chitral, Baltistan, Kohistan, Swat, Kaghan, Dir, and Quetta. Mostly grown under controlled irrigation conditions, in Hazara, Murree Hills, and Azad Kashmir, potatoes are mainly grown under rainfed conditions.

At the time of Independence, there were hardly 3000 hectares under potatoes. The red-skinned cultivar Katwa Red and the white-skinned cultivar Phulwa were mainly grown. These cultivars took 150 to 160 days to mature and were low yielders. Furthermore, difficulties were experienced in procuring the seed of the cultivars from India. Therefore, the need to replace these varieties with early-maturing and high-yielding ones was strongly felt. In fact the genesis of potato improvement in Pakistan dates back to 1955/56. The first exotic high-yielding variety Ultimus (red-skinned) was identified and approved for general cultivation. Incidentally, this cultivar did very well in mountain areas and became very popular with the farmers. It is still being maintained and grown in hilly areas. With the passage of time and the introduction of high-yielding cultivars, the areas and production increased steadily (Annex 6). Out of the present 62,900 hectares, about 15 per cent is under summer crop in mountain areas. Separate statistics for area and production in hilly areas are not available.

There are three overlapping crops grown annually and as availability of cold storage space is not a serious problem, retail and wholesale prices do not fluctuate greatly. However, they are high in October and November. This is caused by the low total production of the small summer crops in mountain areas. It is estimated that most of the summer produce is stored as seed for the next spring crop in the plains and seed is also retained by the farmers for planting summer crops in mountain areas.

With the opening of the Karakorum Highway to Gilgit and Baltistan and the improvement of roads in other mountain areas, there is tremendous scope to increase area and production, which should be exploited. These are all truckable roads and there is no problem in hauling potatoes from the mountain areas to distant markets in the plains.

Potato Seed Situation and Prospects

Seed Cycle in Pakistan

The present movement of seed in Pakistan is depicted in Figure 8.7. It shows the planting of expensive imported certified seed as the spring crop, thus exposing it to high insect vector population due to favourable climatic conditions, causing considerable increase of the virus level in spring-produced potatoes. The spring season has not been eliminated as the first planting season to generate autumn-to-autumn seed cycle for producing quality seed. Similarly, seed produced in the high hills also has to pass one spring planting in the plains to enter the autumn-to-autumn seed cycle. During autumn, due to colder temperatures, insect vectors are less active and disease incidence is minimal.

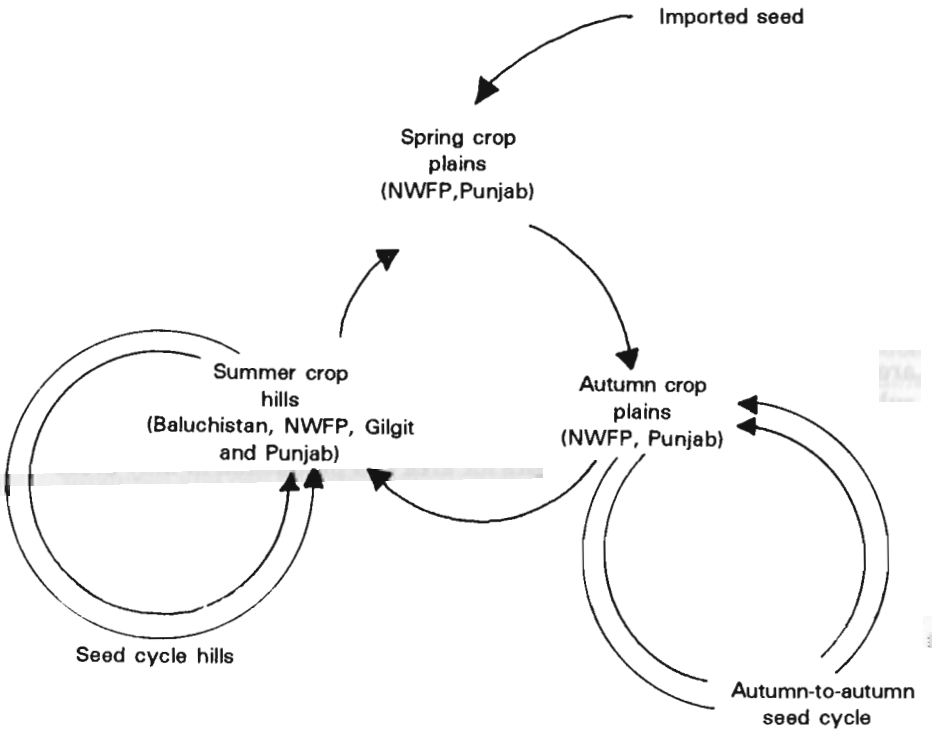


Figure 8.7: Present movement of seed potatoes in Pakistan

Local Seed Supply to the Spring Crop

Seed for the NWFP is grown in the higher hills of Kaghan (Batakundi area) and Swat (Kalam area). The Punjab is supplied with seed from

these areas as well as from Hazara hills, Azad Kashmir, and Baluchistan (Quetta, Kalat, Ziarat) areas. Kaghan seed is preferred as it is less degenerated and performs well.

Seed Supply for the Mountain Area Summer Crop

As described earlier, potatoes are grown in the mountain areas of Baluchistan where efforts are being made to establish some seed programmes, but farmers still practise their own seed production.

In early 1956, the Ministry of Food and Agriculture started a certified seed potato programme in the Quetta and Kalat valleys with cultivars, namely Bintje and Eighenheimer, with little success due to high insect vector population and the prevalence of fusarium in the soil. The higher hills of Swat and particularly of Kaghan appear to be very promising for setting up seed production programmes. More recently, Jaffer Brothers Private Ltd, have initiated seed production in upper Hunza and Gojal in the Northern areas and in Gilgit district on a contractual basis with farmers located along the Karakorum Highway, with resounding success. This programme could easily be expanded to surrounding valleys above 2500 m and also into Baltistan. These areas, being isolated, have been found to have very little insect vector population. The seed produced in Hunza and Gojal areas gave yields as high as those of the expensive imported seed from Holland. Thus, this opportunity should be exploited to the maximum and eventually it should become possible to stop the import of expensive seed which requires large foreign exchange outlays.

Seed Supply of the Autumn Crop

Seed for the autumn crop in the NWFP and the Punjab is partially met from the spring produce. Research in the Punjab during the late 1960s and early 1970s has established the autumn-to-autumn seed multiplication cycle, due to low aphid activity during this season. Efforts are under way to induct a high quality seed cycle by harvesting the immature crop in July or August. Chemicals are being tested to break the dormancy of seed so that it becomes possible to plant this seed in October-November in the plains. Once this is established, the spring crop could easily be eliminated for seed requirements.

Proposed Scheme for Quality Seed Production

Potato requires a very high investment per hectare of production. Seed is the most important item in potato production, constituting about 30 per cent of the total production cost. Seed is so important for this crop that production is directly correlated to the quality and health of the seed stock.

Lack of availability of high quality seed within the country is the single most important factor directly affecting productivity levels at present. The present low per hectare yield of 10 tons is mainly due to the inferior seed that farmers are planting. Till seed production and certification become a reality on a national basis, the present low productivity levels will prevail, and import of seed from abroad is inevitable. However, systems of potato seed production and seed certification are under way and probable improvement suggested. The objectives of this seed certification programme would be to:

- Supply high quality disease-free indigenous seed, reasonably priced, in large quantities to potato growers of all the three crops grown in Pakistan.
- Guarantee uniform standards throughout the country and free movement of seed stock among the four provinces.
- Stop import of expensive seed from abroad.

A scheme to link up the mountain area summer and autumn crops with imported seed and locally produced certified seed can be designed as shown in Figure 8.8.

Seed grown in Swat does not have a good reputation, mainly because of the all-weather accessibility to the valley. Farmers can purchase seed for their summer crop in the plains because of the comparatively low price of potatoes produced in autumn, although plains-produced seed is of poor quality. Consequently, Swat farmers produce seed of low quality and health. Therefore, a first step in a seed potato production programme should be a complete ban on the movement of seed from the plains to the hills.

Attempts to establish a basic seed programme in Batakundi area (Kaghan) with the technical assistance of GTZ of West Germany are under way. In Kalam (Swat), a seed potato pilot project is testing the feasibility of a viable certified seed programme in the high hills with the possibility of further expanded bulking of the seed stock in the mid-hills at the later stages. The seed for the central and south Punjab comes partly from Baluchistan and also some certified seed is imported annually from the Netherlands. However, the quality of Baluchistan seed is not very good. Recent success in producing quality seed in Gilgit will, it is hoped, become a major seed source for the Punjab.

Cultivation Practices

Crop Planting Methods

All planting is done manually and farmers do not practise pre-sprouting of seed. Seed for the spring season is cut into pieces with at least two eyes per piece. This reduces the seed cost and stimulates sprouting, but

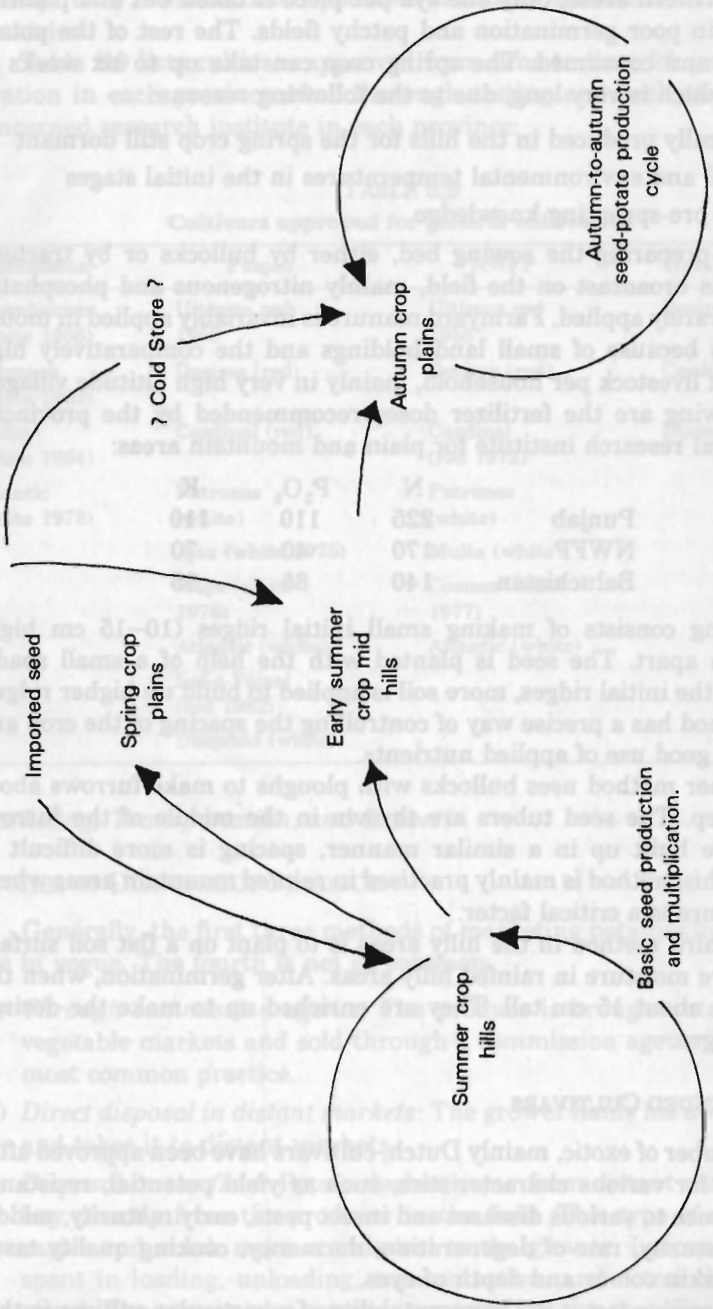


Figure 8.8: Probable pathways to link up summer and autumn crops with imported seed and locally produced certified seed

results in a very low stem density on an average of one stem per plant. In the Northern areas, only one eye per piece is taken out and planted, resulting in poor germination and patchy fields. The rest of the potato is cooked and consumed. The spring crop can take up to six weeks to emerge, which is very long, due to the following reasons:

- Seed locally produced in the hills for the spring crop still dormant
- Low soil and environmental temperatures in the initial stages
- Lack of pre-sprouting knowledge.

After preparing the sowing bed, either by bullocks or by tractors, fertilizer is broadcast on the field, mainly nitrogenous and phosphatic. Potash is rarely applied. Farmyard manure is invariably applied in mountain areas because of small land holdings and the comparatively high number of livestock per household, mainly in very high altitude villages. The following are the fertilizer doses recommended by the provincial agricultural research institute for plain and mountain areas:

	N	P_2O_5	K
Punjab	225	110	110
NWFP	170	40	70
Baluchistan	140	85	85

Seeding consists of making small initial ridges (10–15 cm high) 60–75 cm apart. The seed is planted with the help of a small spade. On top of the initial ridges, more soil is applied to build up higher ridges. This method has a precise way of controlling the spacing of the crop and results in good use of applied nutrients.

Another method uses bullocks with ploughs to make furrows about 10 cm deep. The seed tubers are thrown in the middle of the furrow. Ridges are built up in a similar manner, spacing is more difficult to control. This method is mainly practised in rainfed mountain areas where soil moisture is a critical factor.

The third method in the hilly areas is to plant on a flat soil surface to conserve moisture in rainfed hilly areas. After germination, when the plants are about 15 cm tall. They are enriched up to make the desired size of ridges.

Recommended Cultivars

A number of exotic, mainly Dutch, cultivars have been approved after screening for various characteristics, such as yield potential, resistance and tolerance to various diseases and insect pests, early maturity, middle or late maturity, rate of degeneration, dormancy, cooking quality taste, flesh and skin colour and depth of eyes.

One decisive factor in the acceptability of a particular cultivar is that consumers in the NWFP and the Punjab prefer red-skinned potatoes,

whereas in Baluchistan and Sind, consumers prefer the white-skinned variety. Only white-skinned potatoes are exported to the Persian Gulf countries.

Table 8.9 lists cultivars approved from time to time for general cultivation in each province after thorough testing and evaluation by the concerned research institute in each province:

TABLE 8.9

Cultivars approved for general cultivation

Baluchistan	Punjab	NWFP	Northern Areas
Eigenheimer (white 1956)	Ultimus red 1958	Ultimus red 1958	Desiree (red)
Patrones (white 1963)	Desiree (red)	Desiree (red)	Cardinal (red)
Multa (white 1964)	Cardinal (red)	Cardinal (red 1972)	Diamond (white)
Atlantic (white 1978)	Patrones (white)	Patrones (white)	
	Ajax (white 1975)	Multa (white)	
	Wilja (white 1976)	Cosima (white 1977)	
	Atlantic (white)	Atlantic (white)	
	Lal-e-Faisal (red 1982)		
	Diamond (white)		

Marketing, Transportation, and Export

SYSTEM OF DISPOSAL OF PRODUCE

Generally, the first three methods of marketing potatoes listed below are in vogue. The fourth is not so common.

(1) *Through commission agents*: The produce is brought into the local vegetable markets and sold through a commission agent. This is the most common practice.

(2) *Direct disposal in distant markets*: The grower hauls his own produce and takes it to distant markets.

(3) *Disposal in the field*: Potato dealers come from distant markets and buy directly from the producer in the field. This type of disposal is easier and much more economical to the grower. Labour and time spent in loading, unloading, transportation, and octroi charges are saved. The grower also receives payment on the spot. This happens quite often in mountain areas when prices in the plains are very high

in the months of October and November. Potatoes at much higher prices were lifted in 1987 and 1988 from mountain areas.

(4) *Disposal as standing crop:* This method is not very common and is occasionally practised by the non-regular potato grower only, who once in a while cultivates potatoes in smaller areas. This saves harvesting, packing, and marketing charges, and avoids possible unfavourable changes in market prices.

Whatever the disposal system, potatoes normally pass though the grower, commission agent, intermediary, and retailer before reaching the consumer.

TRANSPORTATION

The means of transport and transport facilities are important in the marketing chain and have strategic implications for the cost. Efficient communication and transport help in minimizing transit losses and thus indirectly lower transport cost and increase the producer's share in the price paid by the consumer.

In the past, the primary means of transportation was in carts, by animals, and on tractor-driven trolleys. But the increased availability of trucks, improvement in the condition of highways, and extension of roads to many villages have improved the speed and reliability of short-haul movement, as well as long-distance movement by trucks, pick-ups, and jeeps, which are fast and efficient.

The most popular with growers and potato traders is the truck service. Though more expensive than other means it is preferred because:

- Potatoes are loaded within the field or in the market of origin and unloaded within the market of destination immediately after arrival.
- As soon as the truck is loaded, it is on the road moving towards its destination.
- There are no delays in transit and arrival; therefore, produce is mainly unaffected by price fluctuations.
- Service is readily available around the clock.

The expense of truck transportation does not affect the grower or the trader because the cost is naturally transferred to the consumer who pays a higher price.

EXPORT

Potatoes have been listed recently as an exportable commodity. Due to rising demand in nearby countries, export prospects have become bright. Potatoes were first exported in 1970/71. The export trade could not be expanded because of rising prices in the domestic market. In spite

of great marketing constraints, the country exported 41,000 tons to the Gulf states in 1979/80. In fact, if better transport facilities and reasonable prices were ensured to the growers, Pakistan could easily export 100,000 tons of potatoes annually. The annual quantity of potatoes exported to nearby countries is given in Table 8.10.

TABLE 8.10
Potato exports of Pakistan, 1970/71–1985/86

Year	Quantity ('000 tons)	Value (million Rs.)
1970/71	1.1	0.3
1971/72	1.0	3.2
1972/73	3.2	2.5
1973/74	7.1	0.02
1974/75	—	—
1975/76	3.2	6.0
1976/77	12.5	23.0
1977/78	7.7	10.8
1978/79	23.3	25.5
1979/80	41.0	61.5
1980/81	6.0	8.8
1981/82	6.0	9.0
1982/83	7.4	14.0
1983/84	3.5	6.4
1984/85	25.1	36.6
1985/86	1.3	2.1

Potato exports were conducted without a proper study of the export market and the technical requirements of this commodity in terms of transport, storage, demand, price, grades, etc. The interests of the producers were not given full consideration. The conditions necessary to promote and establish an export business along sound lines are stated below:

- Production must be increased substantially, over and above domestic requirements, so that internal prices do not shoot up beyond the reach of the common man. Mountain areas could play a major role in boosting production.
- Proper arrangements for storage of surplus produce are needed so that export can be regulated and spread over a longer period to obtain better prices and control of the foreign market.
- Refrigerated transport is needed both on land and on sea.
- Packing and grading must be brought to international standards.
- The growers must receive a substantial profit of at least 60 per cent over their total investment.

- The potential in mountain areas must be exploited.

Apart from being a rich source of quality food, potatoes have the potential to bring great monetary benefits and prosperity to small growers in the mountain areas, and this is being exploited to some extent. Potatoes require an initial investment in seed, fertilizer, and pesticides which is higher than for other crops. At the same time, returns are also higher than on cereal crops as potatoes give three to four times more tonnage per unit area. Another important characteristic of this crop is that it takes 120 to 180 days to mature, whereas most cereals and other cash crops mature in 120 to 365 days. It is on account of these merits that potatoes are very popular as a cash crop with progressive and skilled growers who can afford to buy costly inputs and have the spirit of entrepreneurship.

Past Research Achievements and Future Strategies

Past Achievements

Earlier research endeavours were mainly confined to varietal introduction and evaluation at the four provincial research institutes and their sub-stations. Systematic investigation of other aspects of potatoes were lacking.

Since potatoes are grown in all the provinces and the production and marketing problems of the three crops (spring, summer, autumn) are interlinked, the Pakistan Agricultural Research Council put into operation a coordinated research programme at national level with the active involvement of the provinces and the US Department of Agriculture from September 1974. This programme focused on screening potato cultivars procured from various sources for their yield potential, resistance against disease, and tolerance to major environmental stresses, and to develop a practical package of technology for the production of ware and seed potatoes. This project, after its successful completion in 1981, generated very useful scientific results to provide a good empirical base to any potato improvement programme in Pakistan. The outstanding achievements of this coordinated research programme were:

- About 300 cultivars or clones procured from different sources have been screened for yield potential and environmental stresses. This knowledge will be used in developing a cultivar improvement programme.
- Cultivars Ajax, Atlantic, FB9003-2 (Lalai-Faisal), Cardinal, and Cosima have been released.
- Other agronomic practices were perfected and packages of production technology for each province were developed.

- The glyco-alkaloid level in selected cultivars was determined and found to be much below safe levels for human consumption.
- The studies carried out to develop seed production technology have revealed that it is possible to produce and multiply disease-free basic seed at higher elevations. The seed raised at 2200–2600 m altitude performed well and has given 50–60 per cent more yield than seed from the market from private growers in the plains. These findings have cleared the course for further improvement of the potato crop.
- Facilities for tissue culture have been established at the National Agricultural Research Centre, Islamabad and Ayub Agricultural Research Institute, Faisalabad, and are now being developed in Gilgit.

On the basis of current research and experience gained under varying agro-ecological environments, the following projects are operative in the country:

- Pilot seed production project financed by the World Bank,
- A research centre set up for production of basic and certified seed potato in the NWFP, with technical assistance from GTZ of West Germany,
- A cooperative programme for research, productivity improvement, and marketing of potatoes in Pakistan, with technical assistance from Switzerland.

Future Research Strategy

Keeping in view the rising economic importance of potatoes, the Pakistan Agricultural Research Council has identified the following research thrusts, with a more integrated approach at the national level and active participation by the provincial research institutes:

- Screening of germplasm to develop a sound varietal improvement programme
- Transfer of production technology to the farm level through on-farm trial and demonstration
- Study of consumption patterns and marketing systems to improve the present food situation and ensure outlets for the produce
- Investigation methods for increased consumption and industrial use of fresh potatoes
- Partial mechanization of farm operations
- In order to provide centralized facilities and a sound base for research and development, it is essential to establish a central potato research institute at the National Agricultural Research Centre with its outreach stations in the provinces on the lines of the Potato Research Centre at Shimla, India of ICAR. This institute can be linked up with

the US Department of Agriculture research centre at Beltsville, USA, and/or CIP (Peru) to promote potato production in the region.

TRAINED MANPOWER REQUIREMENTS

There is a great shortage of technical manpower at all levels. This needs special consideration. At present there are only three Ph.Ds in the whole country on vegetable and potato crops. The Pakistan Agricultural Research Council has developed a substantial programme for advanced studies abroad. It is envisaged that under this programme highly qualified scientists should be available in three to four years. There is also a great need for short-term practical training on seed production and certification, besides production technology.

Floricultural Development

Floriculture has been almost completely neglected by development and research programmes although it possesses tremendous development potential in the mountain areas because of suitable climatic conditions. In the past six to seven years, the formation of horticultural societies and the holding of seasonal flower shows have aroused great interest in the metropolitan cities of Lahore, Islamabad, Rawalpindi, and Karachi.

Due to increased demand for bulb and tuberous flowering plants, private seed merchants, nurserymen, and PIA have started imports from European counties which are very expensive. Policy makers seem to find it easier to import than to develop these crops in the mountain areas of Pakistan, which offer unlimited scope for the production of flowering bulbs and tubers. Among the most suitable arid and cooler areas are Quetta, Kalat, Gilgit, Chitral, and Baltistan.

A research-cum-production project is immediately needed in these areas to exploit this potential.

Coordination of Long-term Horticultural Development

Ongoing Horticultural Development Projects

To increase fruit and vegetable production and availability, and to train manpower, there are a number of ongoing developmental programmes with foreign financial and technical assistance as well as aid from non-government organizations. These programmes are:

- Pak-Swiss Potato Project with headquarters at Islamabad
- NWFP-German Potato Project operational in the NWFP
- Malakand-Swiss Horticultural Development Project with headquarters in Swat

- FAO/UNDP project in the Northern Areas of Pakistan with headquarters at Gilgit
- Pak-Italian Fruit and Vegetable Development Project with headquarters at Gilgit
- Aga Khan Rural Support Programme operational in Gilgit, Baluchistan, and Chitral districts, with headquarters at Gilgit
- World Bank Integrated Hill Farming Development Project in Azad Kashmir
- FAO/UNDP Fruit Development Project in Baluchistan with headquarters at Quetta.

Role of National Fruit and Vegetable Development Board

A National Fruit and Vegetable Development Board was established in 1983 to coordinate and formulate policy regarding all aspects of fruit, vegetable, and floricultural development. The Federal Minister for Food, Agriculture and Cooperatives is the Chairman of the Board. Other board members include provincial secretaries of agriculture, representatives of diverse federal institutions, an exporter, a processor, and a grower. The Board does not have a core staff, has yet to undertake major activities, and is more or less dormant. The government should recruit core staff immediately and make the board fully functional. The functions according to the notification of the board are:

- to advise on and coordinate policies for overall development and improvement of production, processing, storage, and marketing of fruits, vegetables, and flowers;
- to suggest a national programme for the production of fruits, flowers, and vegetables and to help and guide the provincial governments and other agencies concerned to develop concrete action-oriented schemes, projects, and plans within this programme;
- to suggest and advise on suitable annual production targets of fruits, vegetables, and flowers;
- to review measures to attain production targets, including supply of inputs vis-a-vis seed, plant seedlings, fertilizer, water supply, plant protection measures, and credit facilities;
- to review arrangements for the production, import, and distribution of seed, plants, and saplings, with a view to identifying seed required to meet the full requirement of the farmers;
- to coordinate research and development efforts, including the setting up of nurseries for accelerated production of fruits and flowers;
- to review the price trends of fruits, flowers, and vegetables;

- to suggest or review policy measures to develop the marketing of fresh and processed fruits, vegetables, and flowers;
- to oversee cost of production and the prices received by farmers, suggest measures for price support, and advise on steps required to ensure fair prices to growers;
- to recommend policy measures required to remove constraints or bottlenecks in the improvement of the efficiency of fruit and vegetable industries and the setting up of cold stores;
- to recommend measures to promote the export of fruits, vegetables and flowers;
- to collect and maintain statistics on any matter relating to fruits, vegetables, flowers, and the industries concerning them; and
- to advise the government on all allied matters.

Activation of Provincial Fruit and Vegetable Development Boards

In the NWFP, there is a provincial fruit and vegetable development board which became operational in 1986. In the Punjab, there is only a fruit development board, and vegetable crops need to be included. There is no fruit or vegetable development board in Baluchistan yet, where there is an urgent need for such a board. Once these boards are fully established, the National Fruit and Vegetable Development Board should coordinate all their activities and functions.

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Annex 1

Area and production of important deciduous fruit crops in Pakistan

Table 1. Cultivated area ('000 ha)

Fruit	1958/59	1973/74	1975/76	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
Apple	0.4	6.1	8.0	9.7	10.3	10.9	11.4	11.9	12.9	13.3	14.8	17.4
Apricot	0.5	2.0	2.6	2.8	2.9	3.1	3.2	3.5	3.7	4.2	4.7	4.9
Peach	0.8	1.2	1.2	1.3	1.4	0.9	1.0	1.1	1.1	1.2	1.4	1.4
Pear	1.2	2.5	3.1	3.3	3.3	2.5	3.1	3.1	3.1	2.8	2.9	2.9
Plum	0.8	2.4	2.4	2.6	2.6	2.7	3.3	3.4	3.6	3.9	4.0	4.1
Cherry	—	0.05	0.06	0.07	0.08	0.09	0.1	1.1	1.2	1.3	1.3	1.4
Grape	1.3	2.5	2.5	2.4	2.5	2.5	2.5	2.6	2.7	2.8	2.9	2.9
Almond	—	5.8	6.1	6.3	6.3	6.4	6.4	6.5	6.5	6.7	6.9	7.0
Walnut	—	0.8	1.1	1.4	1.5	1.5	1.5	1.6	1.7	1.7	1.7	1.8
Pomegranate	1.5	1.8	2.1	2.1	1.9	2.4	2.6	2.3	2.6	2.9	3.2	3.4

Source: Planning Unit, Food and Agriculture Division, Government of Pakistan.

Table 2. Production ('000 mt)

Fruit	1958/59	1973/74	1975/76	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
Apple	3.0	51.5	66.7	87.7	93.7	99.3	107.4	114.1	128.6	128.0	142.7	166.0
Apricot	3.0	22.6	25.7	30.3	31.3	34.0	35.1	37.1	43.7	46.5	52.2	53.4
Peach	6.0	10.2	9.8	10.3	10.9	9.7	10.1	10.3	11.2	11.4	11.7	12.2
Pear	10.0	32.0	29.6	33.6	33.3	27.7	33.5	33.2	33.8	33.5	34.1	33.9
Plum	6.0	42.4	26.6	29.6	30.5	32.0	38.2	38.3	40.4	42.8	43.8	44.3
Cherry	—	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.5
Grape	6.0	28.5	28.9	32.2	28.7	29.2	26.0	26.2	26.1	26.4	26.9	28.6
Almond	—	27.2	22.2	22.3	23.1	23.6	21.2	23.2	27.1	28.0	28.5	28.8
Walnut	—	11.9	15.1	14.7	15.4	15.3	16.0	16.9	17.5	17.9	18.1	18.3
Pomegranate	10.0	26.7	26.0	28.3	26.8	30.9	31.2	29.2	31.4	29.9	31.6	32.2

Source: Planning Unit, Food and Agriculture Division, Government of Pakistan.

Annex 2

Area and production of important vegetable crops in Pakistan

Table 1. Cultivated area ('000 ha)

Fruit	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
Potato	37.7	42.9	38.0	45.2	51.5	49.5	54.5	62.9
Onion	38.7	41.9	43.2	43.2	45.3	47.4	48.2	49.4
Carrot	5.3	4.9	4.8	4.6	5.2	5.8	6.3	6.6
Tomato	9.7	10.9	11.5	12.1	13.9	14.1	14.1	15.8
Garlic	2.3	2.3	2.4	2.5	2.6	2.6	2.5	2.6
Cabbage	1.2	2.3	2.2	2.9	2.6	3.1	2.4	2.4
Okra	4.8	5.0	4.8	5.6	6.3	7.2	7.2	8.2
Cauliflower	4.7	4.9	5.7	4.8	4.9	5.5	5.9	6.2
Peas	7.2	7.6	7.8	6.4	6.3	4.8	5.7	6.6

Source: Planning Unit, Food and Agriculture Division, Government of Pakistan.

Table 2. Production ('000 mt)

Fruit	1973/74	1975/76	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
Potato	238.0	320.7	293.5	392.4	448.6	394.3	476.6	518.1	509.8	543.4	618.3
Onion	239.4	322.7	325.4	389.7	434.0	447.6	451.8	474.8	503.3	514.6	524.7
Carrot	67.6	84.4	73.8	84.3	75.8	75.9	72.4	82.7	93.3	102.8	113.8
Tomato	56.0	53.7	63.4	79.3	86.5	92.1	99.1	118.4	127.2	130.0	150.0
Garlic	2.0	1.8	3.4	4.9	5.1	4.9	5.4	6.4	6.4	6.5	6.6
Cabbage	1.8	1.3	1.3	1.2	2.3	2.1	2.9	2.6	3.1	2.4	2.4
Okra	5.2	3.7	4.4	4.8	5.0	4.8	5.6	6.3	7.2	7.2	8.2
Cauliflower	2.2	3.4	3.4	4.8	4.9	5.7	4.8	4.9	5.5	5.9	6.2
Peas	2.5	4.4	6.3	7.3	7.6	7.8	6.4	6.3	4.9	5.7	6.6
Cucumber	Not available separately										

Source: Planning Unit, Food and Agriculture Division, Government of Pakistan.

Annex 3

Yield potential of some important vegetables in the Northern areas

Vegetables	Yield potential (tons/ha)
Cabbage	50.0
Tomato	90.0
Turnip	60.0
Radish	45.0
Carrot	40.0
Swiss chard	120.0
Cauliflower	30.0
Chinese cabbage	35.0
Eggplant (black beauty)	40.0
Okra	40.0
Onion	40.0
Pepper	40.0
Peas	17.0

Annex 4

Probable seed yield of some vegetable crops

Vegetable	Range of seed yield (kg/ha)
Cabbage	1600–1800
Carrot	1800–2000
Radish	540– 800
Swiss chard	2900–3000
Turnip	1060–1660