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Horticultural Development in Nepal: Progress, Potential and Problems

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Introduction

Nepal, situated along the slopes of the Himalayas, is a land-locked country bordered by India to the east, south, and west and China to the north. Rectangular in shape, it has an area of approximately 147,181 sq.km, extending roughly 880 km from east to west and 130 to 240 km from north to south. The topography is highly variable, ranging from the plains of the terai, with an elevation of 60 to 300 m above mean sea level, to the deep valleys and high mountains 8838 m above mean sea level. From the south to the north, Nepal can be divided into three parallel ecological zones, each of which extends east to west across the country: the terai, the mid-hills, and the high mountains. The terai, accounting for about two-thirds of the country's total cultivated area (2,653,300 hectares), is the bread basket of Nepal. The mid-hill region has considerable potential for horticultural development. The high mountains, usually under perpetual snow, are largely unsuitable for cultivation. Administratively, Nepal has been divided into 75 districts, 14 zones, and 5 development regions (Figure 5.1).

At present, the population of Nepal is over 17 million, out of which 44 per cent live in the terai and 56 per cent in the hills. The population is growing with an annual growth rate of 2.6 per cent.

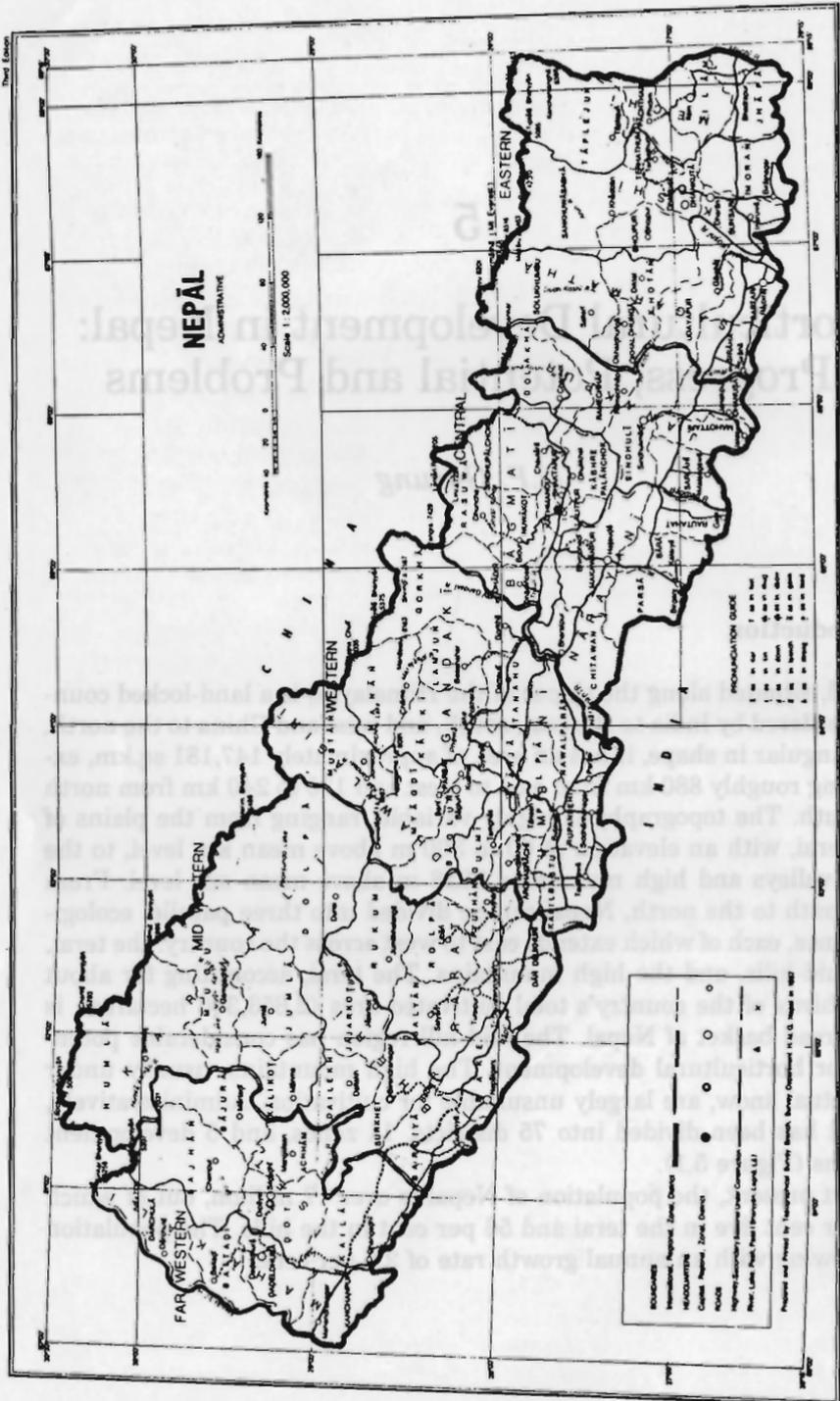


Figure 5.1: Showing Different Zones, and Development Region.

Status of Agriculture

Agriculture is the dominant economic sector in Nepal on which nearly 93 per cent of the total population are at least partially dependent for their livelihood. The agricultural sector generates about two-thirds of the gross domestic product and provides about 75 per cent of all exports. In fact, agriculture is the backbone of Nepal's economy.

The terai accounts for 23 per cent and the hills (including mountains) for 77 per cent of the Nepal's total land area. The average size of land holding is about 0.5 hectare in the hills and 1.8 hectares in the terai. At present, only about 15 per cent of the total cultivated land is irrigated while the rest of the area is rainfed. The use of chemical fertilizers is about 16 kg of plant nutrient per hectare of cropped area.

The principal agricultural crops of Nepal are paddy, maize, wheat, barley, millet, sugar cane, tobacco, oilseeds, pulses, and potato. Crop yields are generally low.

Horticultural Situation

Geographically the kingdom of Nepal lies within the sub-tropical zone (26° 15' to 30° 30' N latitude and 80° 00' to 88° 15' E longitude), but due to wide variations in altitude, and climates consequently ranging from tropical to alpine types, a wide range of horticultural crops (fruits, vegetables, spices, herbs, and flowers) are grown successfully. In the 1960s, keeping in view the tremendous scope of horticultural development in Nepal, His Majesty's Government of Nepal launched horticultural development programmes to improve the economic and nutritional status of the people. Since then, 33 horticultural farms have been established (Annex 1) and are located at different parts of the country, representing diverse agroclimatic conditions. These farms provide improved planting material, seeds, and technical services, and are used as testing sites for research and training centres for farmers.

Fruit Production

The southern plains of the terai, being tropical areas (below 1000 m above mean sea level), are suitable for growing fruits like mango, litchi, guava, banana, pineapple, papaya. The sub-tropical areas of the mid-hills (1000 to 1800 m) are particularly suitable for growing citrus, pear, peach, and plum (warm temperate). In temperate areas between 1800 and 2800 m altitude, fruits like apple and walnut (in the low rainfall areas) are grown very successfully (Figure 5.2).

In Nepal, the hills being more suitable for fruits crops, the hill region is by far the major producer of fruits. The orange and apple are both commercially important fruits of the hills.

Cultivation of fruits is largely limited to backyard gardens and the produce is used mainly for home consumption. However, Table 5.1 provides estimated acreage and production of different fruits in 1984/85. On the basis of total production given in the table, the per caput, consumption of fruits is about 20.5 kg. Out of the total area (51,176 hectares) under fruits, the central development region occupied the maximum area of 17,795 hectares (34.8 per cent), followed by the eastern development region 10,670 hectares (20.8 per cent), the western development region 10,484 hectares (20.5 per cent), and the mid-western development region 4,710 hectares (9.2 per cent). The distribution of area and the production of fruits by development regions has been summarized in Table 5.2.

TABLE 5.1
Area and production of fruits in Nepal

Fruits crops	Area (ha)	Production (mt)
Citrus	7,857	45,100
Non-citrus	43,319	297,935
Total	51,176	343,035

TABLE 5.2
Area and production of different fruits by development regions (1984/85)

Development region	Area (ha)			Production (mt)		
	Citrus	Non-citrus	Total	Citrus	Non-citrus	Total
Eastern	2,270	8,400	10,670	14,017.0	57,775	71,792.0
Central	2,674	15,121	17,795	13,539.0	104,000	117,539.0
Western	1,959	8,525	10,484	12,375.5	58,630	71,005.5
Mid-western	601	6,916	7,517	3,364.5	47,560	50,924.5
Far western	353	4,357	4,710	1,804.0	29,970	31,774.0
Total	7,857	43,319	51,176	45,100.0	297,935	343,035.0

The central development region contributed about 34.3 per cent of the country's total fruit production, the eastern development region 20.9 per cent, the western development region 20.7 per cent, the Mid-western region 14.8 per cent, and the Far western development region 9.3 per cent.

In Nepal, systematic fruit development activities started in the 1960s. With only a few thousand hectares of land under fruit cultivation at that time, the area has increased to 56,164 hectares with a production of 390,282 metric tons in 1986/87.

The progress of fruit development programmes from 1974/75 to 1986/87 has been summarized in Table 5.3. The table shows that the

TABLE 5.3
Fruit development 1974/75 to 1986/87

Particulars	Area ('000 ha)	Production ('000 mt)
Situation at the end of Fourth Plan (1974/75)	32.5	254
Situation at the end of Fifth Plan (1979/80)	41.8	274
Situation at the end of Sixth Plan (1984/85)	51.0	343
Situation at 1986/87	56.0	390
Target for Seventh Plan period (1985-1990)	63.0	462
Target for 2000 A.D.	87.6	702

total area under fruit crops increased by 72.3 per cent and the total production of fruit by 53.5 per cent between 1974/75 and 1986/87.

Priority Districts for Fruit Production

Considering the performance of various important fruit crops and their potential for the production of quality fruits, some districts have been identified for the intensification of commercial production of different kinds of fruit in various development regions, which are prioritized for commercial orchard development (Table 5.4). The central development region leads the other development regions in fruits.

Fruit Production Programme

Keeping in view the increasing demand for fruit in the country, several fruit production programmes are under implementation. Table 5.3 shows that during the Seventh Plan period, the total area under fruits was planned to be increased from about 51,000 hectares to about 63,000 hectares a net increase of about 11,900 hectares (23 per cent). Similarly, the total production of fruits was planned to be increased from 343,000 mt to 462,000 mt, a net increase of about 34.5 per cent. Among the various fruits, major emphasis has been laid on citrus.

In order to develop citrus fruits a National Citrus Development Programme was started in 1972 with its headquarters located at Paripately, Dhankuta in the eastern development region. The major objective of this programme is to bring about all-round development of citrus fruits. This programme recommends various rootstocks, plant propagation techniques and cultural and plant protection to citrus farmers.

Apart from this, His Majesty's Government has launched a National Priority Programme for the development of citrus fruits on a commercial scale since 1983/84. Initially, this programme was implemented in five selected districts. Dhankuta, Sindhuli, Ramechhap, Kaski, and Dailekh—but will be extended to 15 other districts prioritized for commercial development of citrus fruits (see Table 5.4). Under this pro-

TABLE 5.4
 Districts prioritized for commercial fruit development

Fruit	Priority districts				
	Eastern	Central	Western	Mid-western	Far western
Citrus	Illam, Panchthar, Dhankuta, Bhojpur, Tehrathum, Sankhuwasabha	Sindhuli, Ramechhap, Kabhrepalanchok, Dhading	Gorkha, Lajjung, Tanahun, Syangja, Kaski, Palpa, Gulmi	Salyan, Dailekh	Dadeldhura
Apple	Solukhumbu	Sindhupalchok, Rasuwa	Mustang	Jumla, Dolpa, Kalikot, Rukum	Doti, Baitadi, Darchula
Walnut				Dolpa, Jumla, Kalikot, Rukum	Baitadi, Bajhang, Darchula
Pear			Sindhupalchok, Kabhrepalanchok, Bhaktapur, Lalitpur, Makwanpur, Dhading, Rasuwa, Nuwakot	Palpa	
Grape				Manang, Mustang	Banke, Bardia
Mango	Sunsari, Saptari, Siraha	Dhanusha, Mahottari, Sarlahi, Bara, Rauthat Parsa, Chitwan	Nawalparasi, Rupendehi, Kapilbastu	Dang, Surkhet	
Banana		Dhanusha, Mahottari, Sarlahi, Chitwan, Kabhrepalanchok, Nuwakot, Dhading			
Pineapple		Sarlahi, Chitwan, Nuwakot, Dhading			

gramme, farmers are encouraged to grow grafted plants and are provided with 50 per cent subsidy towards the cost of plants, plant protection chemicals, fertilizers, horticultural tools and implements, and irrigation. A number of private nurseries have been established in these districts to supply grafted plants. A total area of 4385 hectares was earmarked to be covered under this priority programme within the Seventh Plan period.

Two special projects for the development of fruits are already in operation. The Horticultural Development Project with technical and financial assistance from the Government of Japan has been implemented since 1986/87. The main objectives of the project are to develop fruit production techniques for Junar (Sweet Orange), grape and chestnut through technical development and training of extension workers and fruit farmers. Under this project, research and training facilities have been created at Kirtipur Horticulture Research Station. The project is promoting Junar in Sindhuli and Ramechhap, grape in Banke and Bardia, and chestnut in and around Kathmandu Valley and Kakani hills of Nuwakot districts at selected locations.

With loan assistance from the Asian Development Bank and technical assistance from UNDP, the Hill Fruit Development Project has been implemented since July 1988. The project area covers 11 hill districts of the eastern development region and the development of citrus fruit forms the main component of the project. Under this project, 5000 hectares is proposed to be brought under various fruits. Out of this total area, 4000 hectares will be covered under commercial orchards and 1000 hectares under homestead gardens.

Most of the Integrated Rural Development Projects and Integrated Agricultural Development Projects under implementation in Nepal have fruit development as a minor component.

The expansion of horticulture in Nepal, and the hills in particular, is limited by lack of roads and storage and marketing facilities. Because of these constraints, commercial fruit growing has been developed in accessible areas, particularly along roads and highways, near urban areas and areas within a 20 km radius of district headquarters.

Important Fruits of Nepal

Citrus

Citrus fruit represents the most important group of fruit in Nepal. Citrus fruits are extensively grown in the mid-hills of Nepal, covering an area of 9495.5 hectares with an estimated production of 64,132.0 metric tons of fruit annually (1986/87) as shown in Table 5.5.

In Nepal, mandarin orange (Suntala), sweet orange (Junar), lime (Kagatee) and hill lemon (Nibuwa) constitute the major citrus fruits of

TABLE 5.5
Area, production of citrus fruits by development region (1986/87)

Development region	Area (ha)	Production (mt)
Eastern	2,609.0	18,874.0
Central	3,381.5	21,101.0
Western	2,242.0	16,586.0
Mid-western	721.5	4,841.0
Far western	9,495.5	64,132.0
Total	9,945.5	64,132.0

Source: Department of Agriculture, Horticulture Section.

the hills. Among these citrus fruits, the mandarin orange, the most important fruit grown in the kingdom, is extensively cultivated in more than 20 districts of the mid-hills (1000 to 1500 m altitude). The majority of mandarin plants are still raised from seed. Junar, a locally grown variety of sweet orange, is of exceedingly good quality and is grown in Dhankuta, Bhojpur, Ramechhap and Sindhuli districts. It is grafted on rough lemon or trifoliolate rootstocks. In some parts of Nepal such as the Pokhara Valley, citrus greening virus disease has adversely affected the production of high quality fruit.

Mango

Mango ranks second to citrus fruits and covers an approximate area of 7515 hectares with a production of 54,209 mt. It is cultivated in more than 15 districts of the terai. Most of the varieties grown in Nepal are the same as in India, commercially important varieties including Dasehri and Langra chausa. Mango hopper and mango stone weevil are important pests and powdery mildew a common disease. Mango malformation is also a common problem.

Apple

Among the various fruits, apple is of late introduction in the country. Now it is commercially grown in the temperate regions of northwestern parts of the country, at an altitude of 2000 m or above, where there is low rainfall with good snowfall in winter. It occupies an area of 5000 hectares with a production of 50,000 mt. Apple is grown in more than 11 districts, the important ones being Mustang, Jumla, Dolpa, Solukhumbu, Rasuwa, and Baitadi districts.

The most commonly liked and widely grown apple varieties are Red Delicious, Golden Delicious, and Jonathan. Crab apples are used as rootstock. Malling series rootstocks have also been introduced.

Inadequate storage facilities and lack of transport are the major problems in expanding apple cultivation.

Vegetable Production

Area and Production

Because of the diverse agroclimatic conditions in Nepal, there is tremendous scope for vegetable growing. Increase in population, change in food habits of the people due to increased knowledge of the nutritional value of vegetables, and the tourist influx into Nepal have made vegetable cultivation more important. According to the Seventh Five-year Plan, 140,500 hectares of cropped area was brought under vegetable cultivation, thereby producing 970,000 mt of fresh vegetables. The production of fresh vegetables in 1984/85 was estimated to be 741,600 mt from the cropped area of 138,000 hectares. The average productivity was 5.37 tons/hectares, which is rather low compared to that of other countries. With this production, the per caput consumption comes to only 45.5 kg per annum (except potato) in Nepal as against the international standard of 100 kg. Hence, the present production of fresh vegetables has to be doubled, which is a challenging task. Table 5.6 gives the area and production of fresh vegetables by development region (1984/85).

TABLE 5.6
Area, production of vegetables by development region

Development region	Area (ha)	Production (mt)
Eastern	39,882	214,322.4
Central	63,480	341,136.0
Western	20,700	111,240.0
Mid-western	9,798	52,653.6
Far western	4,140	22,248.0
Total	138,000	741,600.0

Out of the total area under vegetables, the central development region occupied the maximum area of (46 per cent), followed by the eastern development region with (28.9 per cent) and the western development region (15 per cent), but the mid-western and far western regions are still far behind in vegetable cultivation with 3 per cent.

Similarly, in the production of fresh vegetables the various development regions contributed in exactly the same ratio as shown under area cultivated. In some of the areas in the central region the standard of vegetable cultivation is fairly high.

TABLE 5.7
Vegetable development 1974/75 to 1986/87

	Area '000 ha	Production '000 mt
1974/75	82.0	407.5
1979/80	96.0	485.4
1984/85	138.0	741.6
1986/87	138.9	838.9
1989/90*	140.5	970.0
2000 A.D.*		1,515.0

* Planned targets

The progress of vegetable development programmes from 1974/75 to 1986/87 has been summarized in Table 5.7.

The total area under vegetable crops increased by 69.4 per cent and the total production of vegetables by 105.8 per cent between 1974/75 and 1986/87. However, as area under vegetables is going to continue to be a limiting factor, the productivity per unit area has to be increased from now onwards. Attempts are being made to achieve this objective by adopting new improved technologies.

Priority Areas for Vegetable Production

Areas which have motorable roads and access to markets in the vicinity have received priority for the launching of special programmes of vegetable production. (However, the general programme is launched all over the country with little support of seeds and technical services.) Commercial production of vegetables will be intensified in some selected pocket areas near highways and main consumption centres (urban areas).

Vegetable Production Programmes

In order to cope with the increasing demand for fresh vegetables in the country, several production programmes are already in operation. In the current plan period, the total area under vegetables is planned to be increased from about 138,000 hectares to about 140,500 hectares, which is a net increase of 2,500 hectares (2 per cent), while the total production of vegetables, which was 741,600 mt in 1984/85, will be increased to 970,200 mt, a net increase of 228,600 mt (31 per cent).

The whole production programme has been divided into three categories—special, general, and kitchen gardening programme. Thirty districts are covered under the special programme, covering an area of 4,800 hectares with a production target of 7,200 mt. Seeds, fertilizers, chemicals, sprayers, and credit are provided under this programme.

Cultivation of off-season vegetables is being specially encouraged in the hills. In order to make the country self-sufficient in vegetable production and to promote export, the production of fresh vegetables will be increased from 10 to 15 mt/hectare.

Under the general programme, the demand for fresh vegetables from local areas will be fulfilled by placing 24,000 hectares of land area for production of 192,000 mt of vegetables, thereby increasing productivity from 7 to 9.5 mt/hectare. Composite vegetable seed packets will be provided for the cultivation of vegetable crops.

Under the kitchen gardening programme in the rural areas, 606,000 mt of fresh vegetables will be produced by covering 111,700 hectares of area. Fertilizer, technology and extension services are provided under the scheme.

Important Vegetable Crops

Popular vegetables in Nepal are cauliflower, cabbage, tomato, brinjal, onion, radish, carrot, beans, sweet pepper, peas, chilli, bhindi, turnip, broad leaf mustard, cucumber, and pumpkin.

Because of the availability of a wide range of agroclimatic conditions for cultivation of various vegetable crops, winter vegetables of the terai such as tomato and brinjal can be easily grown as summer vegetables in the mid-hills. Similarly, temperate vegetables such as cauliflower, cabbage, radish, and carrot etc. are grown on the high hills during summer as off-season crops. In this respect Nepal is in an advantageous position. With improvement of the north-south transportation system, these main season and off-season vegetables can be made available to urban populations all year round.

Vegetable Seed Production Programme

The most important input in vegetable production is good quality seed. To make the vegetable programme a success, an effective distribution system with timely availability of seeds is crucial. The demand for vegetable seeds exists throughout the country. In order to cater for the increasing demand for good quality seed, a seed production programme was launched in different agro-ecological zones for different kinds of vegetables. Various seed production pockets such as Marpha, Bhaktapur, Mushikot, Dhankuta, Sarlahi and Dolpa have been identified so far.

At the central level, the Vegetable Development Division is responsible for the production and organization of foundation seed. Vegetable programmes at various horticultural farms are technically controlled by the division. Seeds produced in horticulture farms are of two categories: foundation seed for further multiplication and improved seed for sale

in commercial production pockets. Improved seed is handed over to the Agriculture Inputs Corporation for distribution.

A total quantity of 84 mt of seeds was produced in 1986/87. This year (1989/90) there is a target of 132 mt of seeds.

Since 1981, an HMG/FAO Vegetable Seed Production Project, financed by the Government of Switzerland, has been operating in Nepal. The project, which is in the third phase of its operation, has been designed to assist the Vegetable Development Division to increase vegetable production in the country and to develop a sound vegetable seed industry in the private sector. So far, the project has been able to identify vegetable varieties suitable for Nepal and has provided training for technical personnel and seed growers. Facilities have been created by the project for processing and storage of vegetable seeds at five horticulture centres located in different agroclimatic regions. Besides this, other infrastructural facilities have been created for research and seed production.

Under the banner of the project and with funding from the United Nations Capital Development Fund (UNCDF), additional assistance will be provided to create a wholesale market facility for fresh fruit and vegetables, to be located at Kalimati, Kathmandu. From UNCDF funding, support to private ventures in the areas of food processing, storage, and seed production will also be provided.

As with fruits, vegetable development also forms a minor component of various foreign-assisted Integrated Rural Development Projects and Integrated Agricultural Development Projects.

Potato Production

Among the major crops of Nepal, potato is grown at various altitudes, such as high hill, mid-hill, and terai, during different times of the year and is used as a vegetable and as a substitute for cereal food. It is mainly a cash crop in the terai and mid-hills and a main food crop in the high hills. In the context of the Basic Needs Fulfillment Programme potato is considered a basic food crop and a cheaper source of the calories required by the people.

Area and Production

The potato development programme in the Seventh Five-year Plan aimed at increasing the overall potato production and productivity in the country to maintain the present per caput consumption rate of 20 kg per annum. During the current plan period, keeping the production area unchanged, the present production of potato is targeted to increase from 420,000 to 521,000 mt and productivity from 6.9 to 8.7 mt per hectare.

TABLE 5.8

Area, production and productivity of potatoes by development region (1984/85)

Development region	Area (ha)	Production (mt)	Productivity (mt/ha)
Eastern	22,190	136,490	6.1
Central	24,090	167,350	6.9
Western	8,780	56,500	6.4
Mid-western	6,720	39,150	5.8
Far western	3,760	20,670	5.5
Total	65,540	420,160	6.4

Table 5.8 gives the area and production of potatoes by development region in 1984/85. It indicates that during 1984/85, out of the total area (65,540 hectares) under potatoes, the central development region occupied the maximum area of 24,090 hectares (36.8 per cent), closely followed by the eastern development region with 22,190 hectares (33.9 per cent). The western mid-western and far western development regions have also picked up potato cultivation (13.4, 10.2, and 5.7 per cent respectively) but these regions require further intensification to make potato popular. Similarly, on the production front, the central development region contributed about 39.8 per cent, followed by the eastern development region with 32.5 per cent. The western, mid-western and far western regions contributed only 13.5 per cent, 9.3 per cent, and 4.9 per cent respectively.

In Nepal, the three ecological belts—the terai, mid-hills and mountain—have shown significant differences in potato production, which is summarized in Table 5.9. The table clearly shows that the hills produced little more than half the total quantity of potatoes (53.2 per cent), whereas the terai contributed 26.5 per cent and the mountains 20.3 per cent. In that year area under potato cultivation was 35,720 hectares (54.5 per cent) in the hills, 16,430 hectares (25.1 per cent) in the terai, and 13,390 hectares (20.4 per cent) in the mountains. However, no particular difference was observed in productivity among the three ecological belts.

TABLE 5.9

Area, production and productivity of potatoes by ecological belt (1984/85)

Belt	Area (ha)	Production (mt)	Productivity (mt/ha)
Mountain	13,390	85,230	6.4
Hill	35,720	223,770	6.3
Terai	16,430	111,160	6.7
Total	65,540	420,160	6.4

The progress of potato development programmes from 1974/75 to 1986/87 is summarized in Table 5.10. The total area under potato cultivation increased by 37.8 per cent and the total production of potato by 28.7 per cent between 1974/75 and 1986/87. Strangely enough, productivity decreased considerably during that period.

TABLE 5.10
Potato development 1974/75 to 1986/87

	Area (’000 ha)	Production (’000 mt)	Productivity (mt/ha)
Situation at the end of Fourth Plan (1974/75)	53.7	307	5.7
Situation at the end of Fifth Plan (1979/80)	51.0	278	5.4
Situation at the end of sixth Plan (1984/85)	65.5	420	6.4
Situation at 1986/87	74.0	395	5.3
Target for Seventh Plan (1985–1990)	60.0	521	8.7
Target for 2000 A.D.	66.0	869	13.1

Source: Department of Agriculture, National Potato Development Programme

Priority Districts for Potato Production

The National Potato Development Programme (NPDP), with its headquarters located in Khumaltar, Lalitpur, is responsible for providing healthy and improved seed to potato growers. The government farms are mainly engaged in the production of basic seed to be supplied to certified private growers. These certified private growers are encouraged to produce commercial seed potato. Private seed growers' associations have been formed in many potato-growing districts. The programme supervises seed production activity in special potato production districts, which are 57 in number. Distribution by development region is as follows:

Eastern	11
Central	16
Western	10
Mid-western	12
Far western	8
Total	57

The districts for the potato programme are put under the supervision of various agriculture and horticulture farms and centres.

Potato Production Programmes

To maintain the present per caput consumption status of potato at 20 kg per annum, the strategy is to strive for an increase of yield per unit area rather than to expand the cultivated area at the expense of other crops. In order to achieve this target, two types of production programmes—special and general—are being launched at farmers' level. Under the special production programme, farmers are being encouraged to increase productivity to 17.14 mt/hectare by adequate use of fertilizers at the rate of 150:100:50 kg NPK. For general programme and in unirrigated areas an application of fertilizer at a ratio of 75:50:25 kg NPK is recommended to raise the productivity to 6.98 mt/hectare. Besides this, the application of 10 mt of farmyard manure per hectare is also recommended to improve soil condition. The farmers are being encouraged to use plant protection measures. In order to increase production and productivity, it is planned to bring from the general programme to the special programme an additional area of 7000 hectares. Farmers who followed the recommended practices and who planted newer varieties in a normal year obtained the following encouraging yields:

Hills	10–15 mt/ha
Kathmandu valley	25–35 mt/ha
Terai	25–30 mt/ha

Potato Seed Production Programme

Healthy and improved potato seed plays a major role in potato production. The use of *in vitro* and rapid multiplication techniques are already in application at NPDP headquarters. Disease-free germplasm seed materials (tuberlets) thus produced are multiplied in government farms and their affiliated farmers' fields. The production of disease-free tuberlets from true seed is also in process. Foundation seed thus produced in government farms and by their affiliated farmers are multiplied further and distributed. Foundation seeds are made available to farmers through District Agriculture Development Offices' (DADO) extension services. The NPDP has made provision to distribute 10 per cent of its basic tuberlet seeds to selected farmers with the help of DADOs in remote hill areas in all five regions. These farmers are expected to produce 20 mt of foundation seed for their area. These foundation seeds are further multiplied as improved seed which will be distributed to farmers for commercial potato production.

The Swiss Development Cooperation has been supporting the NPDP technically and financially since 1978. Their joint effort has increased production and productivity of potato. The NPDP has entered into its third phase and is planned for a period of four years (mid-1988 to mid-1992).

During this third phase, NPDP will concentrate on trial and research, seed production, training and extension work, and playing a coordination and leadership role in potato development in Nepal.

Construction of cold stores in the terai and rustic stores in hills and high hills will be encouraged in the private sector. The establishment of potato processing industries in technical support of the Central Food Research Laboratory is envisaged in the Seventh Plan period.

Mushroom Production

Edible mushroom is considered a very delicious and nutritive food. It contains protein, vitamins, and minerals in good amount. Though the protein content of mushroom is less than in meat, it is more than in vegetables. Mushroom has proved beneficial to diabetic and cholesterol patients. Because of its nutritive value, mushroom cultivation has been encouraged. In Nepal, where there is the problem of malnutrition, mushroom cultivation can provide supplementary nutrition.

In Nepal, scientific mushroom cultivation was started in 1982 by the Department of Agriculture with the establishment of a mushroom production unit under the Plant Pathology Division in Khumaltar with the following objectives:

- To develop technology for increasing mushroom production through necessary research;
- To extend knowledge and technique of mushroom cultivation as a cash crop to small farmers;
- To stop mushroom import and make the country self-sufficient in mushroom production; and
- To encourage mushroom export in order to earn foreign currency.

When mushroom cultivation techniques were first made available to farmers the number of farmers was very few. Now more than 200 farmers are engaged in mushroom cultivation. Mushroom cultivation is completely different from cereal and vegetable cultivation. Temperature and humidity play a major role in mushroom cultivation. In developed countries, mushroom is cultivated in special rooms where temperature and humidity are regulated. Though our farmers cannot yet afford such facilities, they can cultivate mushroom (*Agaricus* type) making use of their traditional houses. Two crops of mushroom can be easily harvested under Kathmandu conditions.

According to the Seventh Plan mushroom production was to increase from 75 to 300 metric tons. Taking into account the urban demand for mushroom, production programmes have been confined to the districts of Kathmandu, Lalitpur, and Bhaktapur. In Dadhikot village panchayat

of Bhaktapur district, 20 to 25 families are engaged in mushroom cultivation.

The mushroom production unit of Khumaltar is solely responsible for appropriate technology development, technical advice, training, and seed production of mushroom. Mushroom farmers have to contact this particular unit for seed supply.

Marketing of Horticultural Crops

All horticultural crops are bulky and highly perishable by nature. It is therefore important to dispose of the produce as early as possible to avoid loss in weight and rotting. The losses can be reduced to the minimum through proper packaging, transport, cold storage, and handling.

There are no separate markets for fruits and vegetables in rural areas. However, 'Hat Bazaars' or periodic markets, mainly on a weekly basis, are in existence. Rural markets are needed to support the development of livestock, horticulture, and special crop production programmes. The marketing of horticultural crops has become a problem in some commercial production areas; commercial growers sell the produce either directly to the consumer or to middlemen or retailers who make a high profit. Usually the middleman's profit is added to the consumer price, which is always 100 per cent higher than the price paid to the farmer. There are no regulated and organized wholesale markets for fresh fruits and vegetables. Nepalese farmers are good producers, but poor sellers. Usually they sell their products to traders at very low prices.

Problems of Fruit and Vegetable Marketing

Inappropriate packaging, improper grading, lack of transportation and storage facilities, and poor market information and market facilities are common problems in Nepal. At present, it is the Department of Food and Agricultural Marketing Services (DFAMS) of the Ministry of Agriculture which is responsible for providing infrastructural support for marketing of agricultural produce, including horticultural produce. However, to date, there is no separate division in the DFAMS to look after the fruit and vegetable marketing aspect.

Marketing Development Programmes

As a result of horticultural development programmes launched in the country, increasing quantities of fresh fruit and vegetables are coming into production. More fruits will be produced as the percentage of fruit-bearing trees is increasing steadily. Some steps are now taken to improve

marketing of the most perishable crops such as fruits and vegetables, but these are not sufficient.

In order to develop an organized wholesale market for fresh fruits and vegetables in the Kathmandu valley, a master plan for the Kalimati site has been prepared which FAO supports under the Fresh Vegetable and Vegetable Seed Production Project. The DFAMS has already made a start on the construction of infrastructure and this Kalimati site will remain under its management.

The Hill Fruit Development Project has a major component for the overall development of marketing of fruits only in the project area. Under this project, Dharan and Birtamod will be developed as assembly markets and Biratnagar as a major terminal market for fruits. Katari will be another market for the Sagarmatha zone, to be developed in the latter part of the project. Kathmandu, Biratnagar, Dharan, and Birtamod market centres will be equipped with telex facilities for market information. A mechanical size-grader will be installed at Dharan, but Birtamod will have manually operated graders. Training will be provided to field staff.

Apart from this, the DFAMS is carrying on the following activities for the development of fruit and vegetable marketing:

- Formation of a producers' marketing group. Small financial incentives are provided to these groups.
- Construction of marketing sheds. Such sheds have been built at Naxal in Kathmandu city.
- Formation of rules and regulations for operation and management of markets.

Future programmes envisaged by DFAMS to develop fruit and vegetable marketing are as follows:

- Creation of wholesale satellite markets of Kalimati at 33 town panchayats.
- Establishment of 99 collection centres near roads and highways.
- Arrangement of retail market sites.
- Arrangement for humidifiers and cold rooms.
- Construction of cold storage in 10 towns.
- Construction of cellar storage in hills and high hills.
- Provision of processing facilities.
- Establishment of supermarkets in main towns.
- Construction of feeder roads to connect production centres and highways.
- Formation of farmers' groups.
- Provision of marketing extension services.

Processing of Fruits and Vegetables

Fruit and vegetable processing in Nepal has not been able to keep pace with the commercial production of fruits and vegetables. Much of the fruits and vegetables are sold fresh but increasing amount could be processed to stabilize prices and avoid gluts in the market. Promotion of processing industries in the private sector would be a way to use surplus fruit and vegetables. A number of processing factories have come up in the private sector but their scale of operation is modest. There are two processing units in operation in the eastern development region. Nepal Beverages and Food Products Ltd. at Tanke Sinawari, Morang district collaborating with KISSAN of India, and Rijal Tashi Industries Pvt. Ltd., Itahari, Sunsari district, collaborating with TASHI of Bhutan.

In Marpha and Jumla, where apples are cultivated on a large scale, the culls and other fruit unfit for the table are used for jam, jellies, dried slices, brandy, and wine. Similarly, surplus tomatoes in the terai region are processed into ketchup and sauces on a limited scale.

The Central Food Research Laboratory (CFRL), established under the Ministry of Agriculture, is doing a considerable amount of training in preservation and quality control and is also conducting research into different aspects of fruit and vegetable processing.

Problems of Processing Industries

A majority of fruit and vegetable processing industries are small-scale industries, mainly located in the Kathmandu valley. Raw materials are costly and their supply most irregular and unreliable. Packing materials such as tin cans, bottles, jars, and caps are imported, mainly from India. Other items such as food colours, essences, and chemical preservatives are also imported. Sometimes these are not available in time due to low volume of demand or delayed order.

Almost all the small-scale industries are managed by family members and the so-called technicians have very limited skills and knowledge about processing. Usually their products are sub-standard and quality is not consistent or uniform. Such products face problems in marketing.

The supply of raw materials such as sugar is not guaranteed and processing industries need to have a special quota for sugar.

Development Programme for Processing Industries

Fruit and vegetable processing through improved methods was first started in Nepal nearly 25 years ago when a Fruit Preservation Laboratory was established at Kirtipur Horticultural Research Station under the Department of Horticulture. Students, housewives, and small

entrepreneurs were given short-term training in fruit and vegetable preservation. Thereafter, many cottage processing units were started, mainly in the Kathmandu valley. Later on this Fruit Preservation Laboratory CFRL, is the only institution in the country with the responsibility to develop the storage and processing of food products, including fruits and vegetables. It conducts short-term training in fruit and vegetable processing. There is also an Institute of Food Technology at Dharan which trains food technologists.

Out of 40 cottage-level processing units that were registered, hardly 10 such units are now in operation. Their total quantity of production is not more than 86.7 mt per year. The two medium size processing industries, Nepal Beverages and Food Products Ltd. and Rijal Tashi Industries Pvt. Ltd., are running at about 50 per cent of their rated capacity, which is about 2900 mt per annum. Given the problem of availability of production it does not appear rational to add more fruit and vegetable processing industries, at least for the time being.

Under the Hill Fruit Development Project implemented in the 11 hill districts of the eastern development region, two demonstration-cum-training centres for fruit preservation are to be established, one in Solukhumbu and the other in Dharan. A total of 300 farmers (mainly women) are to be provided with seven days' training during the project period.

Storage of Fruits and Vegetables

Perishable commodities such as fruits and vegetables need ideal storage conditions to prolong their storage life. With the increase in production of fruits and vegetables in the country, more storage facilities are necessary. At present, there are 14 cold stores of varied capacity at different locations in the country. The total capacity of these cold stores is about 12,600 mt. Kathmandu valley has two private cold stores in operation, one in Bhaktapur (1000 mt capacity) and other at Balaju (2 × 1000 mt capacity). These cold stores are mostly used to store potatoes and operate for five to six months of the year. Out of the 14 cold stores, three belong to the Agricultural Development Bank and the rest are owned by private entrepreneurs. Licenses have already been issued to construct more cold stores.

In the villages, farmers have their own traditional way of storing fruits and vegetables. Potatoes, root crops (turnip, carrot), and oranges are stored in underground pits. Apples are stored in rooms on wooden racks. These traditional methods of storage are not ideal. Loss in weight, wastage due to rotting, and danger from pests and rodents are always there.

Cellar stores constructed with locally available materials such as stone, wood, and mud, have given encouraging results. In apple-growing

districts the demand for this type of store is increasing every year. Apples can be stored for at least three to four months without much loss in quality or quantity. Cellar stores have proved equally good for storing oranges also.

In the cooler hills, rustic stores have proved very good for storing potatoes. These stores have wooden racks with thatched roofs to protect against rain.

Problems of Storage

Unfortunately, almost all the cold stores were constructed without being linked to the production area of fruits and vegetables. This is the main reason why they are often faced with problems of availability of fruits and vegetables for storage. The existing facilities are often used to store potatoes.

The construction of modern cold stores is very expensive. Electric supply is erratic. It takes years to construct and operate cold storage. In the absence of improved cold storage facilities, growers are forced to sell fruits at a cheaper rate during the glut period. Moreover, there is loss and wastage due to shrinkage and rotting.

Proposed Programmes

The construction of nine more cold storage units are proposed at Jhapa, Biratnagar, Sunsari, Saptari, Siraha, Kathmandu, Chitwan, Pokhara and Nepalgunj, because these places are main markets as well as main consumption areas and are connected with the production areas of fruits and vegetables. Three cold storage units already constructed at Pokhara, Butwal, and Sarlahi (each with 10000 mt capacity) are to be brought under operation. Two cold storage units, one in Dang (500 mt capacity) and the other in Dhangadi (400 mt capacity) are under construction.

Construction of low-cost, small, on-farm cellar stores of 3 to 5 mt capacity should be encouraged in production pockets. Altogether, 23 cellar stores have been constructed in Mustang's apple-growing areas with the financial assistance of UNDP. The construction of this type of cellar store should be subsidized in other apple-growing areas. Citrus-growing areas should also be encouraged to have cellar stores.

Under the Hill Fruit Development Project, it is proposed that a total of 40 cellar storage units (total capacity 250 mt) be constructed in Solukhumbu. Similarly, the Citrus Development Project for selected mid-hill districts of Nepal has also proposed to construct 162 cellar stores in different product pockets of the project area.

The proposed wholesale market at Kalimati, Kathmandu, will have cold storage facilities to store fruits, potato seeds, fish, and vegetables.

List of horticultural farms

Eastern development region

1. Cardamom Development Programme, Fikkal, Ilam
2. Dhankuta Agriculture Station, Paripatle, Dhankuta
3. Agriculture Station, Horticulture Unit, Tarhara, Sunsari
4. Horticulture Farm, Salleri, Solukhumbu.

Central development region

5. Horticulture Farm, Janakpur, Dhanusa
6. Horticulture Centre, Nawalpur, Sarlahi
7. Sindhuli Agriculture Farm, Sindhulimadi
8. Horticulture Farm, Bonch, Dolakha
9. Nucleus Potato Seed Farm, Nigale, Sindupalchok
10. Horticulture Farm, Sermathang (Helembu), Sindhupalchok
11. Horticulture Farm, Panchkhal, Kavrepalanchok
12. Horticulture Farm, Godavari, Lalitpur
13. Vegetable Research and Seed Production Centre, Khumaltar, Lalitpur
14. Horticulture Research Station, Kirtipur, Kathmandu
15. Horticulture Farm, Kakani, Nuwakot
16. Horticulture Farm, Trishuli, Nuwakot
17. Horticulture Farm, Dhunche, Rasuwa
18. Horticulture Farm, Dhunibesi, Dhading
19. Horticulture Farm, Daman, Makwanpur
20. Agriculture Station, Horticulture Unit, Pariwanipur, Bara
21. Horticulture Farm, Yagyapuri, Chitwan

Western development region

22. Horticulture Research Station, Malepatan, Pokhara, Kaski
23. Ginger Development Programme, Malepatan, Pokhara, Kaski
24. Horticulture Farm, Tansen, Palpa
25. Coffee Development Farm, Anpchow, Gulmi
26. National Temperate Horticulture Research Station, Marpha Mustang

Mid-western development region

27. Horticulture Farm, Rajikot, Jumla
28. Horticulture Farm, Darma, Humla
29. Vegetable Seed Production Centre, Musikot, Rukum
30. Horticulture Farm, Dailekh
31. Agriculture Station, Horticulture Unit, Khajura (Nepalgunj), Banke.

Far western development region

32. Vegetable Seed Production Centre, Dotighatal, Dadeldhura
33. Horticulture Farm, Satbanj, Baitadi