NEPAL

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Introduction

Nepal is predominantly an agricultural country with over half of its gross domestic product originating in agriculture, and more than 80% of its labor force engaged in the sector. It is obvious that agriculture must play a dominant role in the country's development, mainly through the creation of employment for the expanding labor force and by increasing labor's productivity. The sector's most urgent tasks are to provide food for a growing population, employ surplus labor gainfully, enhance farmers' incomes, and raise the nutritional status of the population from its present low level. As recognized by the Eighth Five Year Plan of Nepal, vegetable cultivation can contribute towards meeting most of these objectives (NPC 1992).

Nepal, with an area of 147,181 km^2, extends for about 800 km along the Himalayas between latitudes 26 and 30 degrees north and longitudes 80 and 88 degrees east. Nepal is wedged between the People's Republic of China in the north and the Republic of India in the south, west, and east. The country is land-locked, with the nearest accessible seaport more than 600 km from its south-eastern border.

The country can be divided into three physiographic regions: the Tarai, Hills, and Mountains. The population, total area, cultivated area, and cropping intensity in these zones are shown in Table 1. In the Mountains, less than 3% of the total land area is cultivated, compared with 16.5 and 65.5%, respectively, in the Hills and Tarai.

Table 1. Population, total area, cultivated area, and cropping intensity in Nepal by ecological zone, 1991–92

	Mountains	Hills	Tarai	Total
Population ('000)	1,349.9	8,505.9	8,635.3	19,841.1
Total area ('000 ha)	6,308.5	6,329.4	2,110.4	14,748.3
Cultivated area ('000 ha)	176.9	1,047.3	1,374.8	2,599.0
Cropping intensity (%)	161	177	175	176

Sources: Population: CBS (1993a); Total area: LRMP (1986); Cultivated area: CBS (1993a); Cropping intensity: CBS (1993b).

The country's population was about 19.8 million in 1991 (CBS 1993a). The Tarai is the most densely populated region, with about 44% of the total population living on only about 14% of the total land area (density 409 people/ km^2). In contrast, the Mountain region, with nearly 43% of the total area, has only about 7% of the total population (density 21 people/km^2). The density in the Hills region is 134 people/km^2.

In 1991–92, average per capita food consumption in Nepal was about 1.03 kg/day of which cereals constituted 50%, non-cereal plant food 15%, fruits and vegetables 21%, and livestock products 14% [Department of Agricultural Development (DoAD 1992c)]. The diet of the people is heavily dominated by rice.

Rice is the major crop, occupying about 37% of the total cropped area, followed by wheat with 16% of the cropped area. Other crops grown in the country are maize, millet, barley, potato, cash crops, and a variety of fruits and vegetables. Total area under vegetables in 1995 was estimated to be about 144,000 ha, only about 4% of the total cropped area. In the Tarai, the important vegetables grown are tomato, eggplant, chili, cucurbits, okra, onion, cauliflower, cabbage, and potato. The most important subtropical and temperate vegetables grown in the Hills include cauliflower, tomato, potato, radish, cabbage, carrot, peas, cucurbits, beans, and celery. Temperate vegetables, such as radish, turnip, broad-leaf mustard, etc., which require a short growing season during the warm season, are produced in the Himalayan region. Production of vegetable seed is most suited to the trans-Himalayan region, which has arid conditions and good irrigation facilities.

In 1995, total vegetable production, excluding potato, was estimated to be 1.33 million t, at an average yield of roughly 9.2 t/ha. With an estimated population of 22 million in 1995, annual per capita vegetable availability at the farm level is estimated to be about 60 kg.

Physiographic Regions

As mentioned earlier, Nepal can be divided into three physiographic regions (Hills, Mountains, and Tarai). The Mountain region of Nepal is divided into high Mountain and high Himal; and valleys between mid Mountains and Tarai are classified as Siwaliks. Together with the Hills and Tarai, there are therefore five physiographic regions in the country (Fig. 1). The following is a brief description of each region.

Tarai

The Tarai region covers an area of about 2.1 million ha; elevation ranges from 60 to 330 m above mean sea level (amsl) (PACMAR and EC 1991); soils are deep and well-suited to crop production. This region has a high potential for increasing crop production through irrigation development, construction of roads, and improvement in the supply of agricultural inputs. The potential for increased production of winter vegetables is very high.

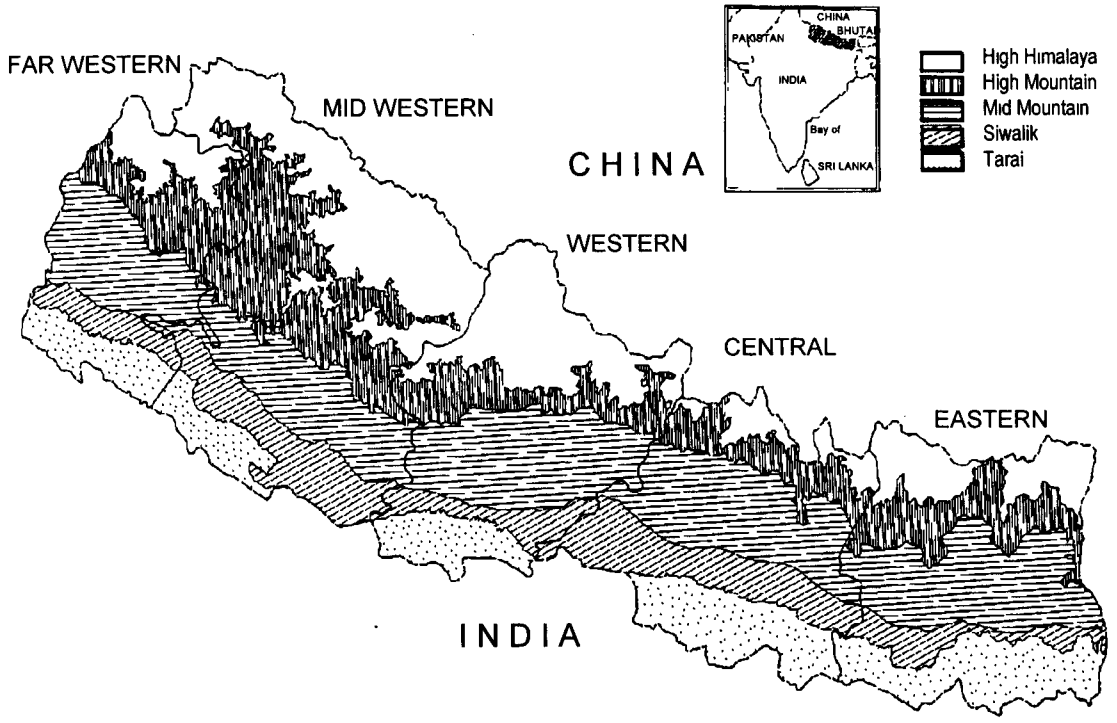


Fig. 1. Physiographic regions of Nepal

Siwaliks

The Siwalik region covers 1.9 million ha. Although the hills in this region are extremely rugged, the distance from valley bottom to ridge top is usually less than 700 m. Most of the cultivable land in this region is in the Dun Valleys, which have some potential for vegetable production.

Mid Mountains or Hills

With an area of 4.4 million ha, this region consists of low to moderately high mountains and deeply incised river valleys. Elevation in this region ranges from 500 to 3000 m. Most farming is done on terraces built on slopes of less than 30°. In order to overcome land degradation problems, the government has emphasized horticulture development in this region.

High Mountains

This region has an area of about 2.9 million ha and elevation ranges from 3000 to 5000 m. More than 90% of the total cultivated land in this region is on terraced sloping land. A wide range of warm temperate and cool temperate vegetable crops can be grown, but lack of roads is a bottleneck to the marketing of surpluses.

High Himal

This region covers 3.4 million ha and elevation ranges from 2500 to 8848 m. Total cultivated area is less than 0.2% of the whole region. Expansion of cultivated area is limited by lack of arable land and irrigation. Although access to this region is extremely difficult, trekkers in some areas of this region are generating a small but steadily growing demand for vegetables.

Agroecological Zones

Based on physiography, delineation of presently cultivated area, and altitude, four distinct agroecological zones can be identified with different potentials for vegetable production (PACMAR and EC 1991).

Tropical Zone

The tropical zone runs east–west along the southern part of Nepal, with elevation ranging from 60 to 1000 m. The temperature fluctuates between 7° and 24°C in December–January and between 24° and 41°C in June–July, with the mean temperatures around 20–24°C. Annual rainfall varies from 1300 mm in the east to 600 mm in the west. This climate is found in some parts of the mid Hills and Siwaliks and all parts of the Tarai. This zone has good road access and accounts for about 60% of the total cultivated land in the country. Seasonal variation in temperature and rainfall in this zone permits the cultivation of vegetables in different seasons of the year. Potato and other temperate crops are grown in the cool dry season, but other crops grow best in the monsoon season.

Subtropical Zone

The subtropical zone also runs east–west almost along the middle part of the country with elevation between 1000 and 1500 m. Summers are long, humid, and warm, with temperatures of 13–27°C in June–July and 2–17°C in December–January. Annual rainfall varies between 2800 mm in the east and 1000 mm in the west. This climate is found in some parts of the high Hills and most parts of the middle Hills and Siwaliks, and covers about 20% of the cultivated land. As in the tropical zone, most vegetables, including potato, can be grown here. Road access is limited to some interior valleys of the Mid Mountain Region or Hills.

Warm Temperate Zone

The warm temperate zone is restricted to hill slopes in the mid and high Mountain physiographic regions and has elevation ranging from 1500 to 2000 m. The zone is neither very cold during winter nor very hot during summer, but there is occasionally snow in the higher areas. The average winter daily temperatures fluctuate between 9° and 10°C in December–January and between 12° and 21°C in June–July. Annual mean temperatures range from 15° to 17°C, while annual rainfall varies from 900 mm in the east to 140 mm in the west. This type of climate can be found in many parts of the high Hills and covers about 12% of the cultivated land. The most commonly grown vegetables in this zone include cauliflower, cabbage, radish, broad-leaf mustard, and potato. Road access is even more limited in this zone than in the tropical and subtropical zones, which means there are fewer accessible commercial production pockets.

Cool Temperate Zone

In the cool temperate zone, elevation ranges from 2000 to 3000 m. Temperatures are usually low and there is snowfall every year. Mean annual temperatures range from 10° to 15°C. The eastern part receives more rain than the western part. This zone is restricted to areas of the major Himalayan mountain chain and has about 1.5% of the total arable land. Fresh vegetables and virus-free, good quality vegetable seed can be produced commercially in the cool temperate zone. Good quality seed for crops such as cabbage and carrot are produced in some pockets of this agroecological region. Commercial production is constrained by lack of roads in this zone.

Communications

By and large, transportation and communication systems in Nepal are poor. Although great progress has been achieved by the construction of the East-West Highway and the north-south link roads, in 1990 only 48% of the country was within a one-day walk of a road head (PACMAR and EC 1991). Only about a quarter of the 10 million inhabitants of the Hill and Mountain regions have effective access to roads capable of delivering inputs and carrying produce to markets. The total road length in Nepal is reported to be 10,724 km (DoR 1995). Road distribution is 53% in the Tarai, 42% in the Hills and only 5% in the Mountains.

Social Taboos

A number of socioeconomic and cultural taboos influence vegetable production and consumption in the country. The following are typical examples:

- A very common notion among consumers in Nepal is that vegetables add "taste" and "variety" to food, but that they are not a rich source of nutrients.
- In rural areas, vegetables are not normally sold, as this is considered to negatively affect one's dignity. This belief has hindered development of commercial vegetable production.
- It is widely believed, particularly in rural areas, that lactating mothers should not eat green vegetables because they are harmful to both mother and baby. This belief adversely affects the nutritional level of these vulnerable groups.
- It is believed that people with a fever, cold, or other sickness should not consume vegetables.

These beliefs result from ignorance about the nutritional value of vegetables. Most of them are now disappearing for various reasons, including general improvement in people's educational status; exposure of rural people to the food habits of educated urban dwellers; media campaigns about food, health, agriculture, and child care; awareness about the need to raise production and income; and availability of markets for vegetables, particularly near urban centers and highways.

Major Vegetable Species and Production Areas

As stated above, diverse topographic features and climatic conditions in Nepal permit the successful production of a large number of vegetables. About 250 vegetable crops are grown in Nepal, of which more than 50 are common (Pun 1987).

In terms of area, production, and value of production, cauliflower is the most important vegetable in the country, followed by cabbage. Other important vegetables in terms of area include tomato, eggplant, and chili. Onion is the fourth most important vegetable based on volume and value of production.

Major vegetable production pockets are shown in Fig. 2. They are mainly along the major highways and close to urban centers. Major areas of vegetable production and periods of supply to urban centers are presented in Table 2.

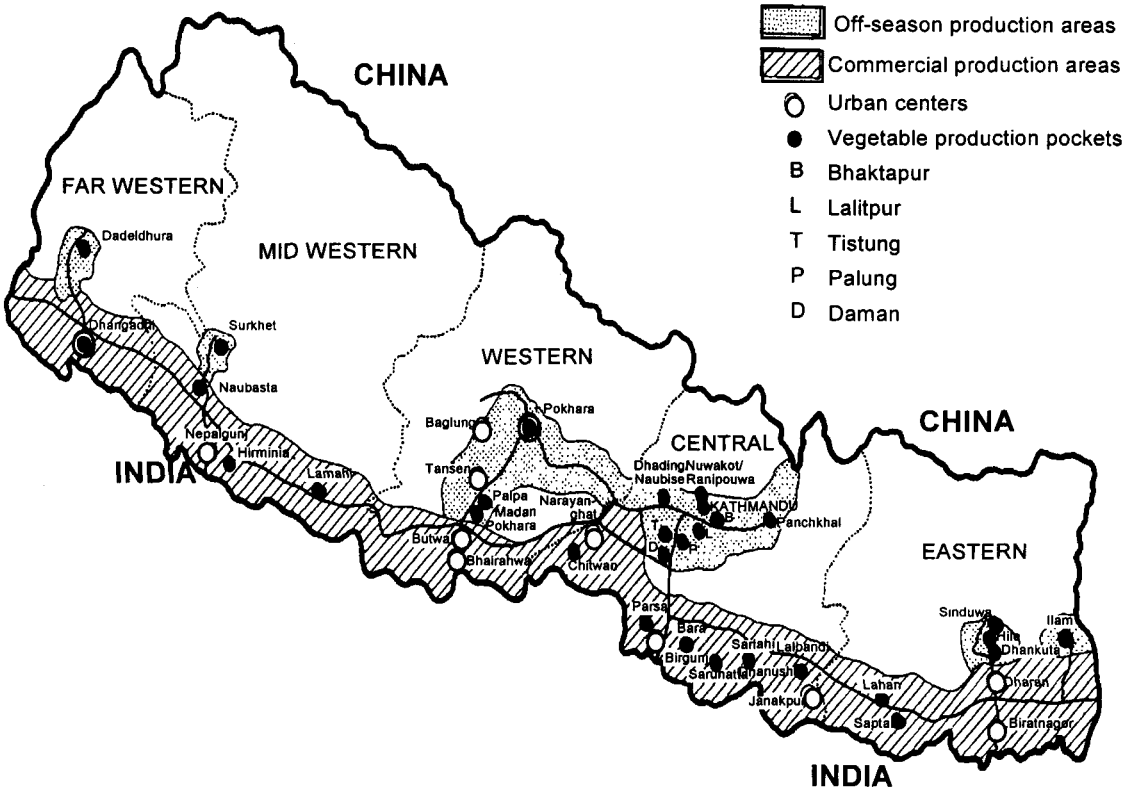


Fig. 2. Important vegetable production pockets and major urban centers in Nepal.

Vegetable Development Programs

Between 1980–81 and 1989–90, the government implemented vegetable production programs by categorizing the total vegetable area into three types of programs based on production and marketing potential. The *Special Program* was launched in irrigated areas with motorable roads and easy access to markets. In such areas, technology, inputs, credit, and other support were intensively provided to commercial vegetable growers by the government. In 1990, 31 districts of the country, out of a total 75, were covered by this program. The *General Program* was implemented in other accessible areas. Government support was limited to input supply and farmer training. The main objective of this program was to increase vegetable production for local consumption. A sizable vegetable area came

under the *Least Priority Program*, in which the government provided limited extension support. This area benefited indirectly from technology dissemination in adjoining special and general program areas.

Table 2. Major vegetable production areas and periods of supply to urban centers

Crop	% of total veg. area	Period of supply	Production districts	Varieties grown*
Broad leaf mustard	5.3	Nov-Feb	Kathmandu Valley	Khumal Broad Leaf,
		May-Jul	Mustang, Dhankuta, Terhathum	Marpha Broad Leaf
		Nov-Jan	Chitwan, Dang	
Cabbage	11.0	Jun-Jul	Makwanpur, Dhankuta, Ilam Terhathum, Palpa	Golden Acre, Pride of India
		Dec-Mar	Bara, Parsa, Chitwan	Late Large
		Apr-Jun	Kathmandu Valley	Drumhead, Copenhagen
Cauliflower	13.7	Nov-Dec, Feb-Mar	Kathmandu Valley, Palpa	Kathmandu Local
		Sep-Jan	Bara, Rautahat, Sarlahi	Snowball 16
			Banke	Dipali, Kibo Giant
		Oct-Dec		Nuwakot
		May-Oct	Makwanpur, Dhankuta, Terhathum	
Chili	6.8	Aug-Sep	Kathmandu Valley, Kavre, Dhading	Jwala, Yatsufusa, Nepali Local
		Jun-Jul	Bara, Sarlahi, Dhanusha	
Eggplant	6.6	Sep-Dec	Sarlahi, Dhanusa, Bara, Saptari	Kranti, Noorki, Birgunj White,
		Jan-Feb	Siraha	Sarlahi Green,
		Mar-May	Dhading	Purple Long
		Jun-Aug	Kath. Valley, Nuwakot	
Fresh beans	4.3	Apr-Jul	Kathmandu Valley	Kentucky Wonder,
		Oct-Dec, Mar-May	Dhading	Contender Giant, Stringless
Market tomato	7.5	Oct-Feb	Sarlahi, Dhanusha, Bara Siraha, Banke	Pusa Ruby, Pusa Early Dwarf
		Mar-May	Dhading, Nuwakot	Roma, CL 1131
		Jun-Sep	Kavre, Kathmandu Valley, Dhading	
Okra	5.1	May-Jul	Bara	Pusa Sawani, Local
		Aug-Sep	Kath. Valley	Parwani Kranti
Onion	5.7	Apr-Jun	Bara, Saptari Kathmandu Valley	Red Creole, Kath. Local, Nasik Red
Peas	4.8	Aug-Oct	Makwanpur	New Line Perfection,
		Oct-Dec	Bara	Bonne Ville
		Jan-Feb	Dhankuta	
		Mar-Apr	Kath. Valley	
Radish	5.2	May-Oct	Makwanpur, Nuwakot Palpa	White Neck, Minoo Early, Pyuthane Red,
		Nov-Feb	Kath. Valley, Rautahat	Chalis Dine
Others**	24.0			

* Most varieties are widely adapted and so can be grown in different production areas during different seasons.

** Others include several vegetables, such as carrot, sweet pepper, cucumber, sponge gourd, bitter gourd, bottle gourd, pointed gourd, snake gourd, spinach, celery, squash, turnip, broccoli, green garlic and Swiss chard.

Source: Rekhi et al. (1990) and VDD (1991).

Trend Analysis

National Trends

Time series statistics were available for total vegetables and potato, but not for individual vegetables. Therefore, this analysis is confined to total vegetables and potato. Estimated growth rates in total vegetable and potato area, yield, and production for 1974–1995, as well as disaggregated data for 1974–83 and 1984–95, are presented in Table 3.

Table 3. Growth rates (%/year) in area, production, and yield of vegetables by period

	Total vegetables			Potato		
Period	Area	Yield	Production	Area	Yield	Production
1974–1995	2.95	2.91	5.86	3.64	2.67	6.31
1974–1983	5.68	0.59*	6.19	0.79*	1.46*	2.25*
1984–1995	0.13*	5.03	5.16	4.24	5.04	9.28

*Not significant at the 5% level.
Source: Trends in total vegetables were computed from Vegetable Development Division (VDD), 1995 data and trends in potato were estimated from Ministry of Agriculture 1995 data.

The total vegetable area in Nepal increased steadily from 82,000 ha in 1974 to about 140,000 ha in 1988, but has stayed more or less constant since. Over the 21-year period, vegetable area and yield both grew at an annual rate of about 3.0%, so total vegetable production in Nepal increased by 5.9% per year.

However, the improvements did not follow a consistent pattern. In the first decade, vegetable area expanded rapidly, but yields increased only marginally. During the following decade, there was little increase in vegetable area, but yields increased significantly, due mainly to the spread of improved varieties and increase in the use of other complementary inputs in irrigated areas.

The potato area more than doubled from 48,000 ha in 1974 to 106,000 ha in 1995 (3.6% annual growth), while its production increased more than three times from 285,000 to 898,350 t (6.3% per annum). The yield increase in the period was also impressive, from about 6 t to 8.5 t (2.7% per annum) (Table 3). However, most of this increase took place in the last decade.

Trends by Program

The areas covered by Special, General, and Least Priority programs in 1980 were 1.3%, 6.9%, and 91.8%, respectively, of the total vegetable area. By 1989, these shares changed to 3.6%, 16.9%, and 79.5%. Total vegetable area in Nepal also increased dramatically during this period, so although the area under the Special Program was still only a very small percentage of the total in 1989, its annual growth rate in the 1980s was more than 16% (Table 4). Yields also increased during this period; in one decade, yield per ha under this program increased from 6 t/ha to 15 t/ha, which is quite remarkable.

Table 4.Growth rates (%/year) in area, production, and yield of vegetables by program areas, 1980–1989

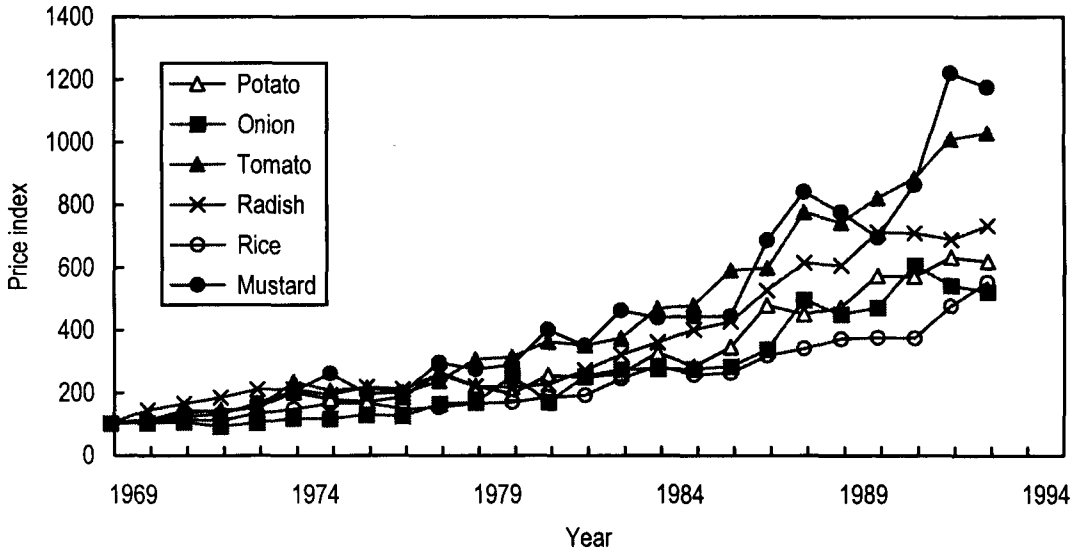
Program	Area	Production	Yield
Special Program	16.13	26.38	8.82
General Program	10.57	16.60	5.45
Least Priority Program	1.72	3.65	1.90

Source: Computed from VDD (1991) data.

Under the General Program, area more than tripled during this period, from 7200 to 23,700 ha, and yield per ha increased from 5 to 9.4 t/ha. The annual production growth rate was 16.6%.

Price Trend

Nominal price indices of national average retail prices of major vegetables, cereals, and cash crops between 1969 and 1993 are presented in Fig. 3. In general, increases in vegetable prices were higher than for cereal. Among vegetables, the increase in the price index of tomato was the highest at 1025 over a period of 24 years, followed by the price indices of radish and potato. However, onion suffered a setback in prices in relative terms, as the price index of this commodity rose less than that of rice, the main staple food.



Source: DoAD various issues.

Fig. 3. Trend in major vegetable and cereal price indices, 1969-93

Variability in Production

Unexpectedly, the coefficients of variation (CV) in vegetable production and yield (estimated after detrending these variables) were generally lower than those values in rice production. This might be due to the aggregation of so many vegetables in the total vegetables category, such that the lower value of any of the parameters of one vegetable in a given year might be compensated for by the

corresponding higher value of the same parameter for other vegetables. It might also be due to unreliable statistics, evident from the same values for area, production, and yield of vegetables being repeated for many years. The detrended CV of potato and rice area increased by 61% and 112%, respectively from 1974–83 to 1984–95 (Table 5). The CV of potato yield increased more dramatically (208%) during this period, whereas that of rice declined by 8%.

Table 5. Coefficients of variation (%) in vegetable and rice production, area, and yield by period during 1974-95

	Total vegetables			Potato			Rice		
Period	Area	Yield	Production	Area	Yield	Production	Area	Yield	Production
1974–83	5.79	3.71	2.72	4.02	3.97	3.49	2.12	9.91	9.87
1984–95	3.90	4.11	2.89	6.47	12.27	12.18	4.49	9.15	13.17
1974–95	5.11	3.99	2.80	5.57	8.93	8.73	3.58	9.62	11.74
% Change (1974–95)	-33	11	6	61	208	249	112	-8	33

Source: Computed from VDD (1991) and MoA (1995) data.

International Trade

Total imports of vegetables in Nepal have far exceeded total exports. Nepal exported vegetables worth NPR 6.3 million but imported NPR 104.3 million worth of vegetables in 1991. The trade deficit has been widening over time as vegetable exports are declining while imports are increasing at a high rate (Table 6). Nepal's vegetable exports and imports are mainly limited to trade with India.

Table 6. Annual growth rates and variability in exports and imports of vegetables, 1982–83 to 1990–91

	Potato		Tomato		Onion and garlic		Others	Total
	Quantity	Value	Quantity	Value	Quantity	Value	Value	Value
Import growth (%)	12.0	15.4	7.5	1.8	7.0	13.5	6.0	13.7
Export growth (%)	-17.5	-9.3	-0.5	17.3	-12.8	1.5	5.3	-2.8
CV (%) import	39.1	46.4	77.9	78.5	27.1	42.3	32.9	40.7
CV (%) export	58.8	42.8	62.8	94.3	74.4	90.1	59.8	36.4

Source: Computed from Department of Customs (various issues 1990-1992) data.

Note: Because import and export tariffs on agricultural products are minimal, customs authorities do not maintain accurate trade statistics. In addition, the long and open border with India leads to movement of agricultural products all along the border, which cannot be covered by a limited number of customs checkpoints. As a result, import and export data might be biased downward.

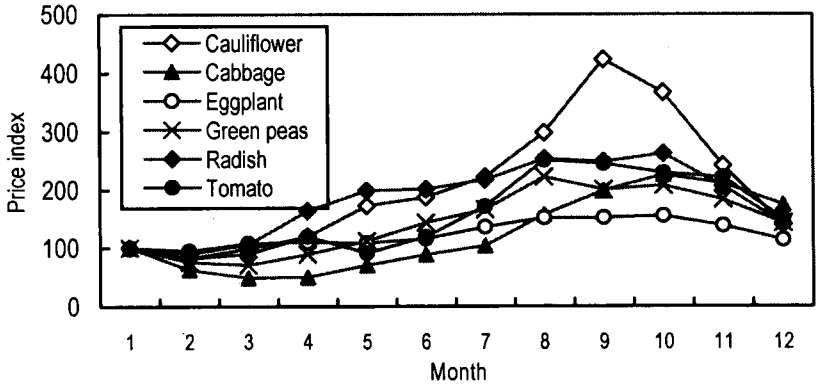
The main vegetables imported are potato, onion, garlic, and tomato. The trade in potato constituted more than half of the total trade value; imports were worth NPR 64.5 million, and exports NPR 2.8 million. In 1991, Nepal exported about 800 t of potato, but imported about 41,000 t. The trend in potato imports has not been consistent; imports increased from 16,000 t in 1981 to a high of about 54,000 t in 1988, but then declined to the 1991 level. In contrast, potato exports have in general showed a trend of gradual decline during this period. Onion and garlic imports increased from 4,800 t in 1983 to a high of 11,400 t in 1988. Exports of onion and garlic were only a fraction of imports.

Export and import data for tomato, onion, and garlic show wide year-to-year fluctuations and no clear trends as suggested by high coefficients of variation (CV) in these statistics (Table 6). The high degree of variability in the import and export of vegetables is indicative of the unstable nature of vegetable production, the drastic changes in vegetable trade policies in the wake of vegetable shortages and surpluses, and perhaps also the inconsistency and unreliability of the recording system of the customs offices.

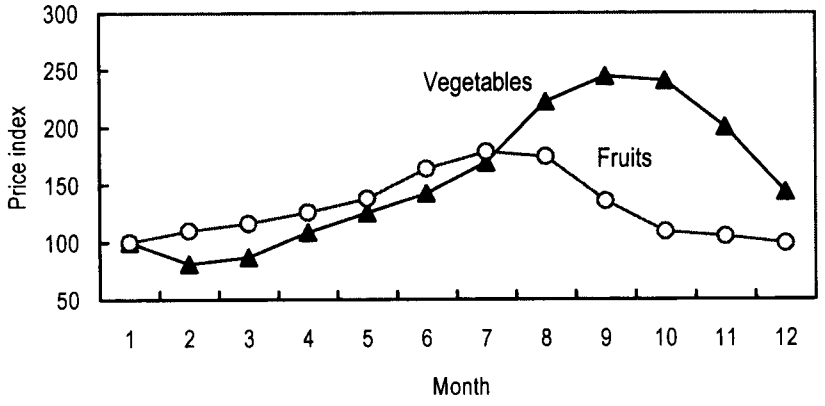
Seasonality

The seasonal monthly price indices start increasing in April, from their lowest level during January–March, and peak during August–October (Fig. 4). The extent of seasonality in individual vegetables varies from more than 400% in cauliflower to 63% in eggplant. The average seasonality in the price of all vegetables as a group is about 200%, which is much higher than the average seasonality in fruit prices (Fig. 4).

A. Individual vegetables



B. Overall fruits and vegetables



Source: DoAD (various issues 1991-1994).

Fig. 4. Seasonality in vegetable and fruit prices (average of 1989-93)

It is usually believed that high vegetable prices are compensated by low fruit prices, and that therefore overall micronutrient availability from these sources does not change. However, this is only partially true.

Farm Management Practices

Based on available literature, a brief review of the farm management practices of vegetable growers in different regions of Nepal is presented below.

Kathmandu Valley (Representing Nepal's Hills)

Pandey (1993) documented the management practices of a specialized group of vegetable farmers (called the *Jyapoo*) of the Kathmandu valley. The management practices described in that study are summarized below.

Cropping Patterns

The cropping systems in Kathmandu valley, representing Nepal's Hills, are reported in Table 7. Three distinct cropping systems are prevalent in the valley: rice-based, maize-based, and vegetable-based. Rice-based cropping systems are predominant, although vegetable-based cropping systems in this area are more common than in other regions. Vegetable-based cropping systems are being adopted by farmers in other hill areas of Nepal, such as Pokhara. In the peri-urban area of Kathmandu valley, mixed cultivation is also practiced for some groups of vegetable crops. In such cases, planting, intercultural, and harvesting activities are intensive, and cropping intensities can be as high as 500–600%.

Table 7. Vegetable cropping systems in Kathmandu valley (representing Nepal's Hills)

First crop	Months	Second crop	Months	Third crop	Months
A. Rice-based cropping systems					
Rice	June-Oct.	Cole crops-cole crops	Nov.-Feb.	Beans/cowpeas/chili/tomato/ cucurbits	Feb.-May
Rice	June-Oct.	Turnip/carrot-turnip/ root crops-cabbage	Nov.-Feb.	Eggplant/sweet pepper/tomato	Feb.-May
Rice	June-Oct.	Fava bean/peas	Nov.-Feb.	Mustard/squash/cucumber	Feb.-May
Rice	June-Oct.	Onion/garlic	Nov.-Feb.	Amaranthus/mustard	Feb.-May
Rice	June-Oct.	Broad leaf mustard	Nov.-Feb.	Potato (radish/bean)	Feb.-May
Rice	June-Oct.	Cress/spinach/lettuce	Nov.-Feb.	Tomato/sweet pepper/ eggplant/cucumber/squash	Feb.-May
Rice	June-Oct.	Cabbage/cauliflower	Nov.-Feb.	Squash/cucumber	Feb.-May
Rice	June-Oct.	Fallow/cauliflower	Nov.-Feb.	Potato	Feb.-May
Rice	June-Oct.	Radish-radish	Nov.-Feb.	Sweet pepper (mustard)	Feb.-May
Rice	June-Oct.	Radish	Nov.-Feb.	Onion-mustard	Feb.-May
Rice	June-Oct.	Carrot/knolkhol	Nov.-Feb.	Cucumber	Feb.-May

Contd. Table 7.

First crop	Months	Second crop	Months	Third crop	Months
B. Maize-based cropping patterns					
Maize	May-Aug.	Cole crops	Aug.- Dec.	Onion/cress/spinach	Dec.- Apr.
Maize	May-Aug.	Root crops	Aug.- Dec.	Garlic/potato/cole crops	Dec.- Apr.
Maize	May-Aug.	Broad leaf mustard	Aug.- Dec.	Cabbage/potato/onion/cauliflower	Dec.- Apr.
Maize	May-Aug.	Cole crops	Aug.- Dec.	Late cole crop/leafy vegetable Green onion/carrot/leafy green	Dec.- Apr. Dec.- Apr.
Maize	May-Aug.	Potato	Aug.- Dec.	Onion/carrot/leafy greens	Dec.- Apr.
C. Vegetable-based cropping patterns					
Beans/cowpeas	May-Aug./Sep.	Radish/turnip	Aug. - Dec.	Onion/garlic	Dec.-Apr.
Carrot	May-Aug./Sep.	Beans/cowpeas	Aug. - Dec.	Radish/knolkhol/turnip	Dec.-Apr.
Chili	May-Aug./Sep.	Broad leaf mustard	Aug. - Dec.	Potato/radish	Dec.-Apr.
Chili/ginger	May-Aug./Sep.	Winter vegetables	Aug. - Dec.	Winter vegetables	Dec.-Apr.
Colocasia	May-Aug./Sep.	Broad bean	Aug. - Dec.	Mustard	Dec.-Apr.
Gourd	May-Aug./Sep.	Spinach/cress/ coriander/fenugreek	Aug. - Dec.	Peas/turnip/carrot/ spinach/cress/coriander	Dec -Apr
Okra/pumpkin/ cucumber	May-Aug./Sep.	Cole crops	Aug. - Dec.	Squash/cucumber/potato/beans	Dec.-Apr.
Soybean	May-Aug./Sep.	Onion green	Aug. - Dec.	Coriander/lettuce	Dec.-Apr.
Sweet pepper	May-Aug./Sep.	Potato	Aug. - Dec.	Late cauliflower/cabbage	Dec.-Apr.
Tomato/eggplant	May-Aug./Sep.	Radish/mustard	Aug. - Dec.	Onion/potato	Dec.-Apr.

/ dividing crops means one or the other.

Adoption of Vegetable Material

Vegetable material (or varieties of different vegetables) adopted by farmers are reported in Table 8. Most of these varieties have been adapted, acclimatized, and naturalized by Jyapoo farmers, and these varieties have acquired indigenous traits due to the processes of natural selection and genetic shift. This indigenous germplasm has also been used as a source of breeding material by national vegetable scientists. Although most Jyapoo farmers lack formal training in plant breeding, they use individual/mass selection procedures for crop maintenance and seed production. For example, medium- and early-maturing plants are allowed to flower and set seeds. Seeds from these plants are then combined and used as planting material in the next season.

Soil Preparation

Human labor is used for soil preparation in the valley as the use of animal labor is prohibited for religious reasons. Land is prepared by pulverizing soils to allow easier root penetration, to facilitate mixing manure and fertilizer, and to help destroy harmful insects and pests. Crops such as cress, spinach, fennel, fenugreek, garlic, onion, and coriander are sown on sunken beds, and crops such as cauliflower, cabbage, broad leaf mustard, potato, radish, tomato, chili, and eggplant are planted on raised beds.

Table 8. Vegetable types adopted and maintained by Jyapoo farmers in Kathmandu Valley

Vegetable	Variety
Asparagus bean	Red Seeded White Pod
Bitter gourd	White long
Broad leaf mustard	Khumal Broad Leaf
Capsicum	Mild Pungent (adapted from California Wonder)
Cauliflower	Kathmandu Local
Chili	Kathmandu Local
Colocasia	Local
Coriander	Local
Cress	Nepali
Cucumber	Kusle, Nepali
Eggplant	Purple Long
Fennel	Local
Fenugreek	Local
Garlic	Local
Ginger	Local
Lettuce	Adapted from Imported Variety
Okra	Local
Onion	(Nepali) Light Red
Pumpkin	Local
Radish	Pyuthane
Spinach	Gobre, and Patane
Sponge gourd	Light Green Long (Kathmandu Local)
Squash	Gray
Tomato	Local
Turnip	Kathmandu Red

Source : Pandey (1993).

Planting and Nursery Management

The choice of planting technique is influenced by factors such as the type of vegetable, the schedule for marketing, the desired yield, and the shape, size or weight of the product. For example, carrot, radish, turnip, spinach, cress, coriander, celery, beans, and okra are sown directly. Eggplant, cauliflower, broad leaf mustard, chili, cucumber, and tomato are transplanted. Cauliflower, eggplant, and chili are also replanted for delayed production.

Nursery seedbeds are generally preferred near the residence or in a safe corner of the main field. The nursery soil is given a fine tilth and weeds, plant debris, pebbles, chaff, etc., are removed. After preparing raised or sunken beds, 2–5 kg/m^2 of well decomposed compost is mixed with the nursery soil. Seeds are usually broadcast and covered with a mixture of soil, ash, and compost.

Irrigation

The timing and quantity of irrigation water to be applied are influenced by conditions such as the type of crop produced, type of soil, temperature, stage of plant growth, etc. In Kathmandu valley, the soils are heavy clay and so drainage is more important than irrigation for successful vegetable production, especially during the monsoon and autumn seasons. Good drainage is essential in rice-based vegetable cropping patterns and for rainy season vegetable production. Crops such as cauliflower and cabbage, which are highly susceptible to high soil moisture, are planted on raised beds.

Weeding and Other Cultural Practices

Weeding is mostly done manually, and no herbicide is used. Weeds are fed to animals or are composted, depending upon the distance of the farm from the household, the type of animal raised, and the quantity and type of weeds gathered.

Vegetable growers of the Kathmandu valley have traditionally practiced biological methods to control insects and diseases in vegetables. For example, when garlic, onion, carrot, ginger, basil, dundu, chive, and coriander are interplanted with brassicas and other vegetable crops, the incidence of feeding and sucking insects on vegetable crops is low. Mixed or companion crop planting also promotes the population of predators of most harmful insects. The following traditional intercultural practices are reported to control insects:

- Tobacco leaf extracts and washing soap solution for aphids and smaller sucking insects.
- Garlic, clove extract, and kerosene oil to prevent caterpillars, cutworms, and aphids.
- Leaf and leaf extracts of chinaberry (*Melia azedarach* L.) as an insect repellent.

However, such practices are being rapidly replaced by indiscriminate use of pesticides, causing concerns for public health and the environment.

Harvesting

Harvesting vegetables usually requires more labor than harvesting other food or cash crops. Most vegetables are harvested in more than one batch. Rainy periods and early morning hours are avoided for harvesting. Usually baskets called *kharpan* are used for transporting vegetables.

Western Hills

Important practices followed by vegetable farmers in this region are, as found by Budathoki et al. (1993), are discussed below.

Cropping Pattern

In the Hills, the three types of cropping systems, similar to those prevalent in the Kathmandu valley (see Table 7), are maize-based, rice-based, and vegetable-based. However, the vegetable-based cropping patterns are not as important here as in the Kathmandu valley.

Soil Fertility Management

Hill farmers depend primarily on organic manure, either compost prepared from locally available organic materials or farmyard manure. Large amounts of both types are applied to kitchen gardens at the time of land preparation. In addition, farmers also use wood ash, cattle urine, leguminous crops, mulch, recycled weeds, etc., as part of soil fertility maintenance.

Plant Protection

Traditional practices used by farmers to minimize crop losses include:

- use of local varieties
- mixed cropping
- use of wood ash, cow dung slurry, diluted cattle urine, and plant extracts
- adjustment of planting time.

Moisture Conservation and Management

Farmers also practice moisture conservation methods, such as the use of residual soil moisture, shallow plowing, mulching, household waste water, etc. During the monsoon months, when precipitation is very heavy, farmers use raised beds (about 30–45 cm) separated by trenches for drainage.

Eastern High Hills

In the high Hills of eastern Nepal (above 1800 m) potato farming is mostly fallow-based and farmers follow a low input system. This practice, called the *Buk method*, has the following features:

- The vegetation which grows during the fallow period provides necessary soil nutrients, and additional manure or fertilizer is not used.
- Inter-cultural operations are not done.
- Cultivation is done on natural slopes on a four- to six-year fallow cycle. First, the vegetated soil is sliced and piled. Then these piles of grass roots and surface vegetation are burned. Finally, individual potato seeds are sown into the piles.
- Plots are planted on a communal basis, so fencing is not required because everyone is mindful about keeping their animals out of their fields, and the chance of theft is low.

Tarai

In the Tarai, farming is mainly rice-based, and only small areas are given over to year-round vegetable-based cropping systems. The rice-based cropping systems in which vegetables are grown are described in Table 9. No substantial research effort has been undertaken to identify the farm management practices adopted for different vegetables grown in this area.

Table 9. Vegetable cropping patterns in the Tarai

First crop (July-Oct)	Second crop (Nov-Feb)	Third crop (Mar-Jun)
Rice	Tomato/onion/ eggplant/peas/garlic	Pumpkin/cucumber/ gourd/cowpea/okra/chili
Rice	Cauliflower/cabbage	Garlic/potato/cole crops
Rice	Potato/cauliflower/ eggplant	Bottle gourd/bitter gourd/ okra/cucumber/maize
Vegetables	Vegetables	Vegetables

Sources: Jansen et al. (1994).

Economics of Production

Input Use

Inputs for seven types of vegetable crops in four districts representing Hill and Tarai regions are presented in Table 10.

Table 10. Comparison of input use in vegetables and cereal crops, 1992–93

Input	Crop	Tarai		Hills		Average
		Sarlahi	Bara	Dhading	Makwanpur	
Labor (days/ha)	Cauliflower	371	377	374	278	350
	Potato	-	311	-	320	316
	Okra	516	493	407	-	472
	Onion	-	270	-	-	270
	Peas	-	-	353	314	334
	Radish	-	-	-	320	320
	Tomato	401	437	343	-	394
	Average for vegetables	429	378	369	308	371
	Maize	135	135	165	158	148
	Paddy	159	162	250	205	194
	Wheat	102	109	130	130	118
	Average for cereals	132	135	182	164	153
Fertilizer (kg NPK/ha)	Cauliflower	239	149	183	412	246
	Okra	206	101	193	-	167
	Onion	-	252	-	-	252
	Peas	-	-	52	77	65
	Potato	-	302	-	240	271
	Radish	-	-	-	5	5
	Tomato	21	56	179	-	85
	Average for vegetables	155	172	152	184	166
	Maize	6	6	10	60	21
	Paddy	54	106	94	86	85
	Wheat	58	58	60	60	59
	Average for cereals	39	57	55	69	55

Contd. Table 10.

Input	Crop	Tarai		Hills		Average
		Sarlahi	Bara	Dhading	Makwanpur	
Pesticides (NPR/ha)	Cauliflower	-	-	644	27	336
	Okra	1203	990	240	-	811
	Onion	-	-	-	-	-
	Potato	-	1200	-	11	606
	Peas	-	-	104	660	382
	Radish	-	-	-	10	10
	Tomato	-	-	145	-	145
	Average for vegetables	1203	1095	283	177	690

Source: DoAD (1992a, b).
Note: Pesticide use in cereal crops was not reported.
- not included in the survey.

Labor

The most labor-intensive crops were okra and tomato. Labor use on vegetables was generally higher in the Tarai than in the Hills. Labor inputs to vegetable cultivation were higher than to cereal cultivation, mainly because of the higher labor requirement for harvesting of vegetables.

Fertilizer

Subsistence vegetable farmers choose to apply large quantities of farmyard manure because they grow vegetables on small pieces of land. On the other hand, commercial vegetable farmers in general do not have enough organic manure and have to rely on chemical fertilizer (Pandey 1993). Fertilizer use was much higher on vegetables than on cereals.

Pesticide

Tarai farmers used higher doses of pesticides than Hill farmers because the environment of the Tarai is more conducive for bacterial and fungal growth.

Other Inputs

Subsistence vegetable farmers, especially the Jyapoo farmers in the Kathmandu valley, produce their own seed. Commercial farmers buy vegetable seeds from other sources who provide information about cultivars and their specific requirements; the main criteria considered include quality, type, grade, appropriateness by season, etc. (MoA 1986). In the Special production area, 87% of commercial farmers used chemical fertilizer, 88% used improved seeds, and 82% used pesticides; in the General production program area, these figures were found to be 69%, 46%, and 54%, respectively (MoA 1986). Another study (MoA 1987) showed that all surveyed farmers used farmyard manure, about 90% used poultry manure, and 96% used pesticides.

Cost Structure

The cost structure of some vegetables is shown in Table 11. For simplicity, all variable costs (except

those for labor, fertilizer, and pesticides) and all associated fixed costs were added together in "other cost." The share of fertilizer and pesticide costs is small, mainly because of the low use of these inputs, but also because of subsidization of fertilizer.

Table 11. Cost of production and input share in selected vegetables in Nepal (average of Tarai and Hills), 1991–92.

	Cost (NPR/ha)					Percentage share (%)			
Vegetable	Labor	Fertilizer	Pesticide	Other cost	Total	Labor	Fertilizer	Pesticide	Other cost
Cauliflower	10662	3133	168	5539	19502	54.7	16.0	0.9	28.4
Okra	14489	1960	811	4489	21749	66.6	9.0	3.7	20.6
Peas	10790	746	382	6145	18063	59.7	4.1	2.2	34.0
Potato	10265	1957	606	10887	23715	43.3	8.2	2.6	45.9
Radish	11120	63	10	5575	16768	66.3	0.4	0.1	33.2
Tomato	11810	1045	48	6271	19174	61.6	5.4	0.3	32.7

Source: DoAD (1992b).

Farm Level Profitability

Seed Production

There have been a number of studies on the economics of vegetable seed production in Nepal (No-Frills 1989; Munankami 1990; Munankami and Dhakal 1990; Munankami and Gautam 1990; Munankami and Jha 1990; Munankami and Mahat 1990; Munankami and Neupane 1990; Munankami et al. 1990; Napit and Thapa 1990; Pandey et al. 1990; Munankami and Neupane 1991). These studies have covered vegetable crops such as radish, carrot, broad leaf mustard, pole bean, tomato, and onion. The production areas surveyed have included various locations in the Tarai, mid Hills, and high Mountains. Most of these studies have shown that vegetable seed production is more profitable than the production of food-grain crops (Table 12).

Table 12. Economics of vegetable seed production per ha in Nepal

			Input use			Total	Gross	Net	
Crop	Region	Year	Fertilizer (NPR)	Pesticide (NPR)	Human labor (days)	cost[1] (NPR)	income[2] (NPR)	return[3] (NPR)	Reference
Broad leaf mustard	Terhathum	1990	1246	267	325	8900	13540	4640	Munankami & Neupane (1991)
Carrot	Mustang	1989	5134	5134	986	85570	101900	16330	Munankami & Dhakal (1990)
Onion	Rukum	1990	893	1225	637	46300	97310	51010	Munankami & Gautam (1990)
Radish	Bhaktapur	1989	1720	560	580	21800	32960	11160	Pandey et al. (1990)
Radish	Dhankuta	1990	1566	209	389	10440	20660	10220	Munankami et al. (1990)
Radish	Rukum	1990	922	922	755	30740	40460	9720	Munankami & Neupane (1990)

[1]Total costs include costs for human and bullock labor, seeds, fertilizer, plant protection chemicals, equipment and sprayers, interest, land and water tax, repair and maintenance of farm equipment, and depreciation of farm equipment; [2]Gross income=value of main and byproducts; [3]Net returns=gross income – total costs.

Vegetable Production

Comparative net profitability scenarios between vegetables and competing crops in two Hill and two Tarai districts are presented in Table 13. Although vegetables are more expensive to produce than cereals, they are also more profitable. The average net return from vegetables was five times more than that from cereals in Sarlahi, and seven times more in Bara (Table 13). Cauliflower gave the highest net return, especially in the Tarai (Bara district).

Table 13. Cost of production and returns (NPR/ha) to vegetables in selected Tarai and Hill districts, 1991–92

Item	Crop	Tarai		Hills		Overall average
		Sarlahi	Bara	Dhading	Makwanpur	
A. Total costs	Cauliflower	19,883	17,679	19,796	20,645	19,501
	Okra	23,981	21,944	19,323	-	21,749
	Onion	-	28,824	-	-	28,824
	Peas	-	-	16,806	19,320	18,063
	Potato	-	27,254	-	20,173	23,714
	Radish	-	-	-	16,848	16,848
	Tomato	15,348	20,965	21,211	-	19,175
	Average for vegetables	19,737	23,333	19,284	19,247	21,125
	Rice	7,492	7,974	11,099	8,603	8,792
	Wheat	-	6,477	7,395	7,239	7,037
	Average for cereals	7,492	7,226	9,247	7,921	7,915
B. Gross returns	Cauliflower	63,000	76,550	67,504	60,500	66,889
	Okra	54,546	57,749	59,312	-	57,202
	Onion	-	57,532	-	-	57,532
	Peas	-	-	50,882	48,000	49,441
	Potato	-	66,155	-	54,000	60,078
	Radish	-	-	-	37,500	37,500
	Tomato	40,348	42,112	44,819	-	42,426
	Average for vegetables	52,631	60,020	55,629	50,000	53,010
	Rice	14,080	16,511	18,645	17,079	16,587
	Wheat	-	8,305	8,999	10,120	9,141
	Average for cereals	14,080	12,425	13,822	13,600	12,864
C. Net returns	Cauliflower	43,117	58,871	47,708	39,855	47,388
	Okra	30,565	35,805	39,989	-	35,453
	Onion	-	28,708	-	-	28,708
	Peas	-	-	34,076	28,680	31,378
	Potato	-	38,901	-	33,827	36,364
	Radish	-	-	-	20,652	20,652
	Tomato	25,000	21,147	23,608	-	23,252
	Average for vegetables	32,894	36,686	36,345	30,754	31,885
	Rice	6,588	8,570	7,546	8,476	7,795
	Wheat	-	1,828	1,604	2,881	2,104
	Average for cereals	6,588	5,199	4,729	5,679	5,001

Source: DoAD (1992b).

An earlier study also reported higher returns (gross margin) for vegetable crops than cereal crops in Hill and Tarai districts (Rekhi et al. 1990). However, this study did not give detailed information on total costs and net returns of these crops.

These studies have shown high profitability in vegetable production compared to other crops. However, a substantial volume of vegetables comes from India, suggesting that vegetable production in India might be more cost-effective than production in Nepal. A study undertaken by the Ministry of Agriculture and Winrock International has analyzed the comparative advantage of Indian and Nepali agricultural produce (including fresh vegetables) in Nepali markets. The results of the study were not available to the author at the time this report was written.

Production Constraints

Vegetable production in Nepal is influenced by a number of biophysical and socioeconomic constraints (Pun 1987; Rana 1990; Rekhi et al. 1990; Baker and Gyawali 1994; Jansen et al. 1994). Table 14 gives a brief review of the economic constraints to vegetable production which have adversely affected the growth of this subsector.

Table 14. Constraints in vegetable production in Nepal

Vegetable studied	Region/ district	Year	Vegetable production constraints									Reference
			1	2	3	4	5	6	8	9	10	
General	Peri-urban	1994	+	+		+			+	+	+	Jansen et al. 1994
Potato	Kathmandu	1987	*	**	***	*	**	•				Pandey 1993
	Bara	1987	**	*	***	•	***	***				
Potato	Kathmandu	1989	***	**	**	*	*	**				Lalika 1989
Tomato	Dhading	1991	+	+		+						Pretty 1992
Tomato	Sarlahi	1992	+	+		+			+			Bhattarai 1992

Constraints: 1 = Insect loss; 2 = Disease loss; 3 = Weeds; 4 = Non-availability of good quality seed; 5 = Post-harvest loss; 6 = Flooding or high rains; 7 = Lack of credit; 8 = Non-availability of fertilizer; 9 = Poor irrigation facilities; 10 = Lack of marketing facilities. The number of stars indicates the extent of severity of the constraint. If neither objective nor subjective quantification was available, a (+)mark shows that the constraint was studied, but that severity is not known.

Almost all studies undertaken so far have tended to list constraints faced by farmers in the production of vegetables, but have not prioritized these constraints.

Marketing System

One of the important government policies in the Eighth Five-Year Plan is to improve the agricultural marketing system through government and private sector participation (NPC 1992). The Plan recognizes that unless appropriate marketing infrastructure is developed and other related support is provided, it will not be possible to increase vegetable production and consumption.

Markets and Marketing Channels

Basically, there are two types of vegetable markets:

- producers' supply markets or collection centers located in the vicinity of production pockets; producers or middlemen bring vegetables to such markets for sale to wholesalers

- consumer markets located near major urban centers

Such major urban market centers in the country get supplies from producers' markets and from India. Wholesalers and commission agents supply vegetables from collection centers to urban centers.

The marketing channels for vegetables differ by the origin of the product. The products might come from local areas or other areas within the country, or they might be imported. Also, there are different systems for potatoes and other vegetables.

At the local scale, farmers take their produce to the local market centers and sell either to retailers or direct to consumers. These simple marketing channels are found both in the Tarai and in the Kathmandu valley. The market channels in this case are:

i) Farmer→ Retailer→ Consumer

ii) Farmer →Consumer

When vegetables come from distant market centers, the marketing channels are rather more complex, with another middleman (a wholesaler or an assembler or perhaps even both) dealing between the producer and the retailer. The marketing channels are as follows:

iii) Farmer→ Wholesaler→Retailer→ Consumer

iv) Farmer→Assembler→ Wholesaler→ Retailer→ Consumer

v) Farmer→Assembler→ Retailer→ Consumer

In the case of Kathmandu vegetable markets, channel (iii) is the most common for the vegetables produced in adjoining districts. Bhattarai (1992) described the marketing channels for tomato produced in Sarlahi district in the central Tarai, which is almost identical to the channels followed for commercial vegetables produced domestically (Fig. 5).

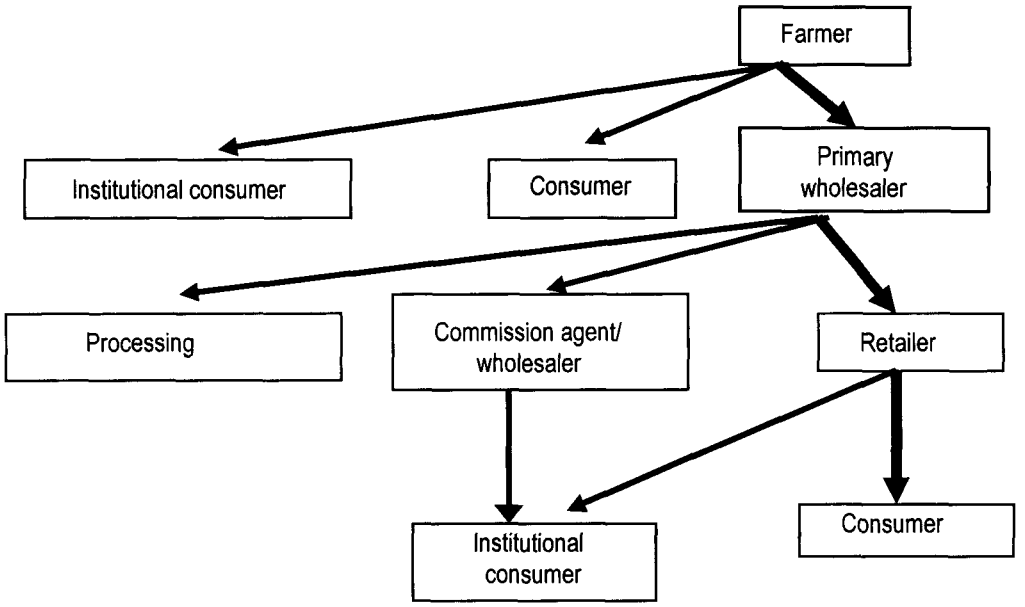
In a few production pockets, the Agricultural Marketing Development Division of the Department of Agricultural Development has organized some marketing groups in recent years. The following two channels are used for vegetables supplied from such areas:

vi) Farmer→ Marketing group→Wholesaler→ Retailer → Consumer

vii) Farmer→ Marketing group→ Retailer→Consumer

Vegetables imported from India are handled by commission agents who sell them to wholesalers in the Kathmandu market. Wholesalers then sell to retailers. For this the following market channel holds:

viii) Commission Agent→ Wholesaler→ Retailer→Consumer



Note: Width of the arrow is indicative of the magnitude of flow.
Institutional consumers include hotels, restaurants, and processing units.
Source: Bhattarai (1992).

Fig. 5. Marketing channels for tomato in Sarlahi, Nepal

Marketing Costs and Margins

Marketing margins for four vegetables at 11 locations were estimated by the Agricultural Projects Services Center (APROSC 1989) and are summarized in Table 15.

Table 15. Marketing agents' share of the consumers' price for selected vegetables, 1988–89

		Absolute share (NPR/kg)				Percentage share (%)			
Vegetable	Location	MC	Farmer**	Wholesalers	Retailer*	MC	Farmer**	Wholesalers	Retailer*
Cabbage	Dhalkewar, Dhanusha	0.9	1.5	1.1	1.5	18.0	30.0	22.0	30.0
	Birgunj, Parsa	0.8	2.0	1.3	1.5	14.3	35.7	23.2	26.8
	Lahan, Siraha	1.4	1.8	0.9	1.5	25.0	32.1	16.1	26.8
	Ralaiya, Bara	0.8	1.8	1.1	1.5	15.4	34.6	21.2	28.8
Cauli-	Dhalkewar, Dhanusha	1.1	2.8	1.4	1.8	15.5	39.4	19.7	25.4
flower	Birgunj, Parsa	0.9	2.5	1.6	2.0	12.8	35.7	22.9	28.6
	Ralaiya, Bara	0.9	2.3	1.9	2.0	12.6	32.4	26.8	28.2
Onion	Rajbiraj, Saptari	1.5	2.0	1.1	1.4	25.1	33.3	18.3	23.3
	Lahan, Siraha	1.3	1.2	1.3	1.6	24.1	22.2	24.1	29.6
Potato	Palung, Makwanpur	0.6	1.3	0.1	0.1	28.8	59.8	5.7	5.7
Tomato	Sarlahi	3.8	2.7	1.2	2.5	37.1	26.5	11.8	24.5

Sources: APROSC (1989) for cauliflower, cabbage, tomato, and onion, Satyal (1979) and Munankami (1985) for potato.
* Local transport cost at retail level also included.
** Farmer's share includes farm-level marketing costs.
MC = Marketing costs.

Of all the locations considered, tomato traded in the Sarlahi market had the highest marketing costs because this crop is highly perishable compared to the other crops considered (Table 15).

The farmer's share was highest in potato and lowest in tomato. It should be noted that the farmer's share for tomato is, in fact, composed of production cost plus on-farm marketing cost, and thus their real share is far below that reported in the table. The retailer's share of the consumer's rupee is higher than that of the wholesaler except in potato. This may be because of the high physical losses at the retail level in the former group of vegetables, in addition to the high local transport costs borne by the retailer.

A breakdown of marketing costs for selected vegetables is shown in Table 16. Transportation always accounts for the largest share of the marketing cost; management and taxes absorb only a small share.

Table 16. Shares of marketing operations in total marketing costs (%) for selected vegetables, 1988–89

Vegetable	Location	Packaging	Transport	Losses	Handling	Management	Taxes
Cabbage	Dhalkewar, Dhanusha	11.0	60.9	8.8	11.0	2.8	5.5
	Birgunj, Parsa	13.2	53.1	15.9	13.2	3.3	1.3
	Lahan, Siraha	7.4	74.0	7.8	7.4	1.9	1.5
	Kalaiya, Bara	10.4	59.0	14.2	13.1	3.3	0.0
Cauliflower	Dhalkewar, Dhanusha	9.1	50.0	25.0	9.1	2.3	4.5
	Birgunj, Parsa	11.3	45.3	28.2	11.3	2.8	1.1
	Kalaiya, Bara	11.1	50.0	25.0	11.1	2.8	0.0
Eggplant	Lalbandi, Sarlahi	11.2	55.8	13.4	11.2	2.8	5.6
	Dhalkewar, Dhanusha	10.5	57.9	13.2	10.5	2.6	5.3
	Birgunj, Parsa	12.6	50.3	20.1	12.6	3.1	1.3
	Kalaiya, Bara	7.2	71.6	10.8	7.2	1.8	1.4
	Lahan, Siraha	10.1	56.6	17.6	12.6	3.1	0.0
Onion	Rajbiraj, Saptari	12.0	61.4	9.2	7.0	8.7	1.7
	Lahan, Siraha	13.1	57.6	10.1	7.7	9.6	1.9

Source: APROSC (1989).

Marketing Constraints

Vegetables are transported from production or collection centers to markets mainly on trucks or night busses. No specialized vehicles are used to transport perishable vegetables. Transportation facilities from farms to collection centers or road heads are poor (Bhattarai 1992).

Nepal lacks infrastructure facilities, such as integrated market centers, wholesale markets, collection centers, warehouses, and processing units. A marketing information system to provide information to farmers about the prices prevailing at different market levels for various commodities, does not exist. Linkages and coordination among farmers, transporters, middlemen or agents, wholesalers, and retailers are not institutionalized (Winrock International 1993). All these problems disconnect markets from each other. Thus seasonal prices across markets do not move in the same direction. For example, during August–November, radish prices are highest in Dhanusha but lowest in Kathmandu (Fig. 6).

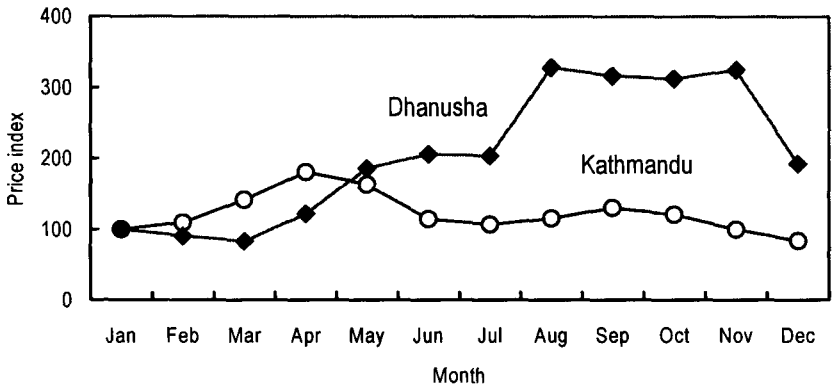


Fig. 6. Differential movements in seasonal prices of radish in Kathmandu and Dhanusha

Farmers lack knowledge on post-harvest technologies. Bruising and injury during harvesting, lack of precooling and cleaning of vegetables, absence of grading and standardization, and improper packaging, all contribute to biophysical deterioration of the product and economic loss to farmers. A study in selected markets of Nepal in 1991 showed that total physical losses from the origin market to the retail outlets were 23% for tomato, 16% for cabbage, and 12% for cauliflower (Werner and Subedi 1991).

Supply and Demand

Per Capita Availability

Per capita availability of vegetables and potato was computed for the period 1984 to 1995 using available secondary data on production, imports, and exports (Table 17). Annual per capita availability of vegetables and potato increased by 2.0% and 5.7% per year, respectively, over this period, and the combined per capita availability of vegetables and potato increased at an annual growth rate of 3.5%. While the reliability of these estimates is open to question, it is true that consumption has increased, particularly in urban and accessible rural areas, despite the sharp increase in vegetable prices.

Consumption by Income Group and Location

The multipurpose household budget survey conducted by the Nepal Rastra Bank estimated annual per capita vegetable consumption in Nepal to be about 38 kg in 1985. This is close to the figure estimated from vegetable availability if 20% post-harvest losses are assumed (Table 17). Leafy green vegetables constituted the most important vegetable type in all locations, followed by fruit vegetables, and roots and bulbs (Table 18).

Table 17. Annual per capita vegetable availability(kg) in Nepal, 1984 to 1995

Year	Vegetables	Potato	Total
1984	48	34	82
1985	50	27	77
1986	51	28	79
1987	52	37	89
1988	53	39	92
1989	54	40	94
1990	58	44	102
1991	60	46	106
1992	58	47	105
1993	60	49	109
1994	56	51	107
1995	60	53	113
Growth rate (%)	2.0	5.7	3.5

Assumptions: (1) Total availability = production + imports – export; (2) Per capita availability = total availability / population.

Table 18. Annual per capita vegetable consumption (kg) by region, physiographic zone, and vegetable type, 1985

Vegetable type	Urban Tarai	Urban Hills	Kath Valley	Rural Tarai	Rural Hills	Rural Mtns	Nepal
Fruit vegetables							
Cucurbits	7.9	9.1	7.0	9.0	8.5	2.7	8.4
Legumes	1.3	2.8	2.2	1.2	0.9	0.3	2.0
Miscellaneous	4.7	5.1	4.6	2.5	1.0	0.1	4.9
Other vegetables	2.8	7.3	5.6	2.3	2.1	1.8	4.7
Total	16.7	24.3	19.4	14.9	12.5	4.8	19.9
Leafy greens	7.5	18.0	13.9	9.0	8.3	9.6	12.0
Roots and bulbs	4.7	8.6	6.6	3.1	3.3	3.8	6.3
Grand total	28.9	50.9	39.9	27.0	24.2	18.3	38.3

Source: NRB (1989).

Among various locations, vegetable consumption was the highest in the urban Hills and lowest in the Mountains. In the Hills, the consumption of vegetables was significantly higher in urban areas than in rural areas. However, such a difference was not observed in the Tarai between urban and rural areas (Table 18).

Other important sources of data for vegetable consumption are the food consumption surveys of selected districts conducted by the Department of Food and Agricultural Marketing Services (DFAMS) in 1984 (Table 19).

Table 19. Annual per capita consumption (kg) of vegetables and potato in selected Hill, Mountain, and Tarai districts of Nepal, 1984

District	Area	Vegetables	Potato
Jhapa	Tarai	43.4	27.3
Rupandehi	Tarai	31.6	3.3
Dhankuta	Hills	25.6	20.6
Gorkha	Hills	24.1	15.5
Solukhumbu	Mtns	11.4	86.0
Mustang	Mtns	28.1	61.8

Source: DFAMS (1984, 1985).

The consumption of vegetables (and potato) by income decile in different geographic areas is shown in Table 20. In all areas, consumption levels increase with income. The consumption level of the highest income decile tends to be about 2-3 times the level of the lowest decile.

Table 20. Annual per capita vegetable and potato consumption (kg) in Nepal by ecological zone and income decile, 1985

Region	Income decile[1]									
	1	2	3	4	5	6	7	8	9	10
Rural Tarai	25	31	31	33	34	37	41	44	45	56
Rural Hills	21	23	22	26	29	34	35	35	39	44
Rural Mountains	17	18	24	25	27	31	36	34	42	47
Urban Tarai	33	36	40	43	44	48	52	60	67	72
Urban Hills	38	44	47	56	66	62	71	89	91	114
Hills	23	25	24	29	33	37	38	41	44	51
Tarai	25	32	31	34	35	38	42	46	47	57
Mountains	17	18	24	25	27	31	36	34	42	47
Nepal	23	28	28	31	33	37	40	42	45	54

Source: NRB (1989).
[1]The income deciles are defined as: 1= lowest 10%; 10 = highest 10%.

Price and Income Elasticities

Price and income elasticities for vegetables and other foods in Nepal are presented in Table 21. These elasticities were computed by Thapa and Koirala (1992) using published data from the multipurpose household budget survey conducted by the Nepal Rastra Bank in 1985. A food characteristics demand system (FCDS) model was used in computing these elasticities. An important attribute of this model is that it is relatively easy to use with sparse data from published sources (Bouis 1991).

Table 21. Price and income elasticities for vegetables and other foods in Nepal, 1985

Location/Income	Vegetables	Rice	Wheat	Maize	Meat	Fruits
Income elasticities						
Tarai						
Low income	0.28	0.45	-0.08	-0.28	1.51	1.37
High income	0.18	0.28	-0.13	-0.27	1.29	1.16
Hills						
Low income	0.18	0.71	0.47	0.05	1.30	0.14
High income	0.32	0.45	0.21	-0.14	1.21	0.30
Mountains						
Low income	0.33	0.82	0.63	0.35	1.20	0.23
High income	0.32	0.61	0.41	0.15	1.13	0.22
Own-price elasticities						
Tarai						
Low income	-1.03	-0.69	-0.94	-1.12	-1.06	-1.16
High income	-0.95	-0.53	-0.75	-0.87	-1.05	-1.14
Hills						
Low income	-1.08	-1.00	-1.13	-0.91	-1.09	-1.87
High income	-1.01	-0.77	-0.87	-0.61	-1.06	-1.48
Mountains						
Low income	-1.11	-1.12	-1.20	-1.02	-1.11	-1.57
High income	-1.02	-0.94	-0.98	-0.76	-1.08	-1.51

Sources: (i) Thapa and Koirala (1992); (ii) Unpublished results from FCDS model estimations by Thapa and Koirala.

These results show that income elasticities for vegetables, the least expensive source of micronutrients, are positive but inelastic in both low and high income groups in all three locations.

Own-price elasticities for vegetables are negative and slightly lower for low-income groups than for high-income groups in all three ecological belts.

Vegetable Policies

Demand and Supply Projections

Until 1990, only one study on vegetable demand and supply had been undertaken in Nepal; it was limited to the Kathmandu valley. However, a major effort was made recently to project the demand and supply of vegetables and potato for the country to the year 2010. The Master Plan for Horticulture Development was prepared in 1991 by Pacific Management Resources Inc., USA, and the East Consult (P) Ltd, Nepal, for the Government of Nepal and the Asian Development Bank. This study estimated current per capita consumption levels for subsistence and commercial consumers for 28 individual vegetable species. Assumptions were made about changes in consumption patterns associated with a shift toward urban living and cash economy and about population growth. Using these data, production targets were computed and various strategies and programs were identified to achieve the production targets.

Input Subsidy Policy

The government provides price and transportation subsidies on fertilizer with the objective of increasing food production and lowering farmers' costs. However, the inability of the government to allocate sufficient budget for this purpose limits the capacity of the Agricultural Input Corporation to import enough fertilizer to meet farmers' demand. In addition, continuation of the subsidy encourages unauthorized cross-border movement of fertilizer (Wallace 1986; Crown Agents 1991). Although fertilizer prices have tended to be slightly higher in Nepal than in India in recent years, some smuggling still takes place because fertilizer from Nepal (which is all imported) is considered by Indian farmers to be superior to Indian brands. The government has removed price subsidies on phosphate and potassium fertilizer, but urea prices are only 55% of the actual cost. In addition, the government provides a transportation subsidy for remote Hill districts. The continuation of a subsidy on urea is related to the adoption of a similar policy in India. The subsidy makes urea cheaper to all farmers, including vegetable farmers, but for the reason stated above, it adversely affects the supply situation in Nepal. Various studies have shown that the availability of fertilizer is a greater constraint than is price.

Underdeveloped Markets for Inputs

Distribution systems and markets for fertilizers, pesticides, seeds, and other inputs are not well developed in Nepal. In the absence of a good network of dealers and cooperatives, farmers have to travel long distances to purchase these inputs. Moreover, inputs are not available at the right time and in the quantities required. Although some acts have been passed to protect farmers from the sale of low quality inputs, such laws are not strictly enforced. The government should enforce existing acts and regulations (e.g., Seed Act, Pesticides Act) and should enact new laws (e.g., Marketing Act) to protect the interests of farmers. The growth of producers' associations in recent years is expected to exert pressure on the government to play a facilitating role in creating appropriate markets for inputs.

Lack of Credit

Studies show that only 24% of the farm families who take loans obtain them from institutional sources. The rest have to use the non-formal sector (NRB 1980). Among those who borrow from institutional sources, large farmers have better access to such credit than small and marginal farmers. The cumbersome banking procedures also discourage small vegetable growers. Loan approval takes a long time, and collateral is required. This situation requires a simplification of application procedures and a small-farmer orientation of the rural credit supply system.

Poor Irrigation Facilities

The gravity-based irrigation network so far developed in Nepal is primarily to provide supplementary irrigation to rice crops. In most of these systems, the flow of water drops drastically during winter. Farmers have used groundwater schemes, particularly shallow tubewells, for vegetable production in areas of the Tarai. Although the government subsidizes the purchase and installation of tubewells, the operation and maintenance costs of such systems are very high. More importantly, only large farmers have benefited from these systems (World Bank 1989). The Agricultural Development Bank of Nepal and some non-governmental organizations have promoted treadle and rower pumps for the benefit of small and marginal vegetable farmers.

Shortage of Good Quality Seeds

Climatically adapted and disease-free seeds or seedlings are not usually available in Nepal (PACMAR and EC 1991). The annual requirement of vegetable seed is estimated to be more than 500 t (Rekhi et al. 1990), but the current level of quality seed production is estimated to be only about 200 t. The rest of the demand is met through farmer-to-farmer exchange of seeds of unknown quality. Many studies have shown that seed production in Nepal is profitable. However, seed production has been limited due to several constraints, including an unfavorable policy environment. There is a need for comprehensive study of this situation after which action should be initiated to alleviate these constraints.

Support for the Cold Storage Industry

It is reported that Nepali farmers transport their perishable produce (most notably seed potato) across the border for cold storage in India because the charges for storage in Nepal are 2.5–4.5 times higher than in India (Gill and Bajracharya 1994). As a result, Nepali cold stores are underutilized. Poor performance is the result not only of technical factors, such as design and construction defects and the small size of operations, but also of government policies. For example:

- cold stores in Nepal are listed as industries and do not qualify for the special provisions given to agro-based industries, such as tax holidays, low interest rates, and lower electricity tariffs
- electricity charges for cold storage do not take into account off-peak-hour facilities, as spelled out in the government policy
- import duties are charged on refrigeration units required for cold storage and on specialized refrigerated vehicles at rates equivalent to imports for personal use.

Trade Restrictions

BISCONS (1994) reported that unauthorized cross-border trade in vegetables is promoted because of ad hoc valuation by customs offices and advance income tax collection. Although the Municipality Act of 1992 clearly specifies that agricultural produce brought into municipal areas for commercial purposes is to be charged octroi at 1% of the value of the goods, some municipalities are charging different rates. In addition, some municipalities make multiple octroi collections, beyond the provisions of the Act. All of these lead to unnecessary cost and delay. Vegetable exports from Nepal are subjected to ad hoc valuation and exporters face harassment by municipal authorities because such supplies do not possess official valuation papers, unlike supplies coming from India which carry official receipts given by customs offices.

Pesticide Regulations

Studies show that there is indiscriminate and heavy use of broad-spectrum pesticides on vegetable crops in Nepal (Baker and Gyawali 1994). Farmers continue to use dangerous chemicals, such as organochlorines and organophosphates. According to a survey of farmers who had been using pesticides for over five years, more than 60% waited less than two weeks between spraying and harvesting the crop. This has led to increased health hazards, particularly in urban areas. On the production front, regular misuse of broad-spectrum pesticides has resulted in resistance of pests to pesticides, resurgence of pests, and secondary pest outbreaks.

However, the government enacted the Pesticides Act in 1992, and the Act has been promulgated. The Act calls for a Registrar, together with a Pesticide Board, to develop regulations and guidelines for registration of imported chemicals, and licensing of pesticide wholesalers, retailers, and commercial applicators. The government will enforce the law by designating each district's Plant Protection Officer as an inspector. However, not all districts have plant protection officers, and it would be very difficult for these officers to effectively perform their duties as they have other responsibilities. Moreover, the disincentives to break the law are not strong enough to deter offenders. A further complication is that the long and open border with India makes it difficult to effectively enforce the regulations.

Exchange Rate Policy

Nepal has a floating exchange rate with other currencies, but a fixed exchange rate with the Indian currency. Higher inflation and lower growth in factor productivity in Nepal compared to India is making Nepal's exports to India uncompetitive (Sharma 1994). On the other hand, Indian agricultural products, including fresh vegetables, are competing with Nepali produce in Nepali markets. The uncontrolled flow of vegetables from India results in unremunerative farm-gate prices of vegetables in Nepal, particularly during peak production. On the other hand, off-season supplies mostly come from India, and fetch good prices in Nepal.

Inadequate Marketing Support System

Although Nepal has an extension system for the dissemination of new production technology to farmers, post-production aspects, such as post-harvest handling, information on markets, volume of arrivals or prices offered, and development of a support system, etc., are mostly neglected (Pun 1987). As noted above, this has resulted in an inefficient market system, where marketing margins are excessive and losses in the system are enormous. The government should work as a facilitator in creating infrastructure and in providing market information to mitigate these problems.

Research Achievements and Information Gaps

Achievements

Biophysical research in Nepal has emphasized varietal development. Agronomic, soil fertility, and plant protection issues have also been investigated. Improved vegetable varieties were first introduced in Nepal in the early 1950s. With the establishment of the Vegetable Development Division in 1972, technical activities such as collection of indigenous and exotic germplasm, variety testing, and seed production were initiated. Beginning in the 1980s, more serious attention was given to identifying farmers' problems, and using trials and experiments in an attempt to solve them. These included yield performance trials and agronomic, fertilizer, and plant protection experiments for important summer and winter vegetables.

By 1988 the research system had recommended 47 varieties of 30 different vegetables for different ecological regions (NARC 1989). Several recommendations, such as the optimum date for sowing and planting, the optimum age of seedlings, correct spacing, etc., have been developed and passed to farmers. Some work has also been done toward the identification and recommendation of herbicides.

Inorganic fertilizers for vegetables have been tested for different ecological regions, on the basis of which appropriate dosages have been recommended for individual crops. Similarly, several chemicals have been identified for the control of vegetable insects and diseases.

The socioeconomic research into vegetables was mainly financed by donor agencies and implemented by various national and international consultants. These projects have led to the preparation of a number of seminar papers and technical reports, mainly on vegetable seeds, post-harvest technology, and marketing. The major breakthrough in vegetable research in recent years has been the completion of the Master Plan for Horticulture Development, which delineates strategies to achieve targets. A brief review of some important areas of agricultural economics research on which some noteworthy work has been done in Nepal is presented below.

Under a USAID-sponsored project, 'Marketing research for hill cash crops in Nepal', implemented by No-Frills Consultants and Agricultural Marketing Improvement Strategies, analytical and detailed studies of the economics of vegetable seed production in different production environments were undertaken. These studies covered radish, onion, broad leaf mustard, and pole bean seed production in the mid Hills, carrot seed production in the high Hills, and tomato seed production in the Tarai. An FAO-supported project, 'Fresh vegetable and vegetable seed production', implemented since 1981 in collaboration with the Vegetable Development Division, DoAD, sponsored surveys of the cost of vegetable seed production and vegetable seed marketing. These surveys covered a number of vegetables from all the three physiographic regions. Several studies have been completed which provide valuable information on post-harvest issues, such as physical losses among different methods of transportation, constraints in post-harvest technology, suitability of alternative methods of packaging, and transportation methods (Werner and Subedi 1991, 1992; Shrestha and Werner 1992). Some of these studies have actually led to the introduction of improved methods of packaging and transportation. In addition, this project organized several workshops on vegetable seeds.

Several studies have been done to determine marketing costs and margins of vegetables, including tomato, potato, cauliflower, cabbage, eggplant, and onion (Satyal 1979; Munankami 1985; APROSC 1989; Bhattarai 1992). Most of these studies have computed costs and margins for vegetables transported from the Tarai to Kathmandu valley markets. They provide useful information about the efficiency of marketing, and the shares of various actors in marketing channels.

In recent years, studies have documented the indigenous practices of vegetable farmers in the Kathmandu valley (Pandey et al. 1990; Pandey 1993) and in the western Hills (Budhathoki et al. 1993). A unique method of potato cultivation in the high Hills of Nepal was the subject of another study (Dhakal 1993).

Information Gaps

Research on vegetables in general, and agricultural economics research in particular, has not received due attention. This situation is the result of the public sector's overwhelming emphasis on selected food-grain crops for research and development efforts. Rice, maize, and wheat have received a disproportionately large share of government resources, whereas other subsectors of agriculture, such as horticulture and livestock, have suffered (Table 22).

Table 22. Public sector research expenditure by commodity group, 1980–81 and 1988–89

Commodity group	Percentage of research budget	
	1980/81 (actual)	1988/89 (allocated)
Field crops	42	43
Fisheries	8	22
Horticultural crops	22	17
Livestock	28	18

Source: Thapa (1994).

As can be seen from the economics of vegetable production section, economic studies on vegetables have been carried out so far by different agencies and programs on an ad hoc basis without any continuity. More importantly, most of these are based on primary data collected in connection with program or project activities. Very few researchers have conducted studies based on secondary or time-series data, primarily because of the inaccessibility and unreliability of such data. Some examples of the government's neglect of the vegetable subsector are as follows:

(a) The Agricultural Statistics Division of the Ministry of Agriculture does not collect area, production and yield data on vegetable crops. The collection of such data is limited to major food-grain crops, cash crops, potato, livestock and livestock products, and fisheries. The exclusion of horticultural crops is basically due to lack of financial and human resources. The Vegetable Development Division (VDD) of DoAD is the only source of vegetable-related data. However, many researchers question the reliability of data reported by VDD because they are not based on any scientific data collection procedures. The area, production and yield data are based on progress reports of annual targets of VDD for various districts. Thus, VDD data are heavily influenced by the annual targets.

(b) The Economic Analysis Division (EAD), DoAD, publishes annual data on costs of production for several food and cash crops. These data are a good source of information on input and output quantities, costs and returns. However, EAD does not collect similar information for vegetable crops (except in 1991–92 when EAD conducted a separate study on the economics of fruit and vegetable crops).

(c) Farm management surveys conducted by the Ministry of Agriculture (MOA) present detailed economic analyses for food-grain crops, potato, cash crops, and livestock, but not for vegetable crops.

(d) The Socio-economic Research and Extension Division (SERED) and the Farming Systems Research and Development Division (FSRDD) in the Nepal Agricultural Research Center (NARC) also focused their research on food-grain crops, with some study of the livestock subsector. These divisions did not include the horticulture subsector in their research program.

Future Research Priorities

Biophysical Research

Several studies have identified important biophysical research priorities for Nepal (Rekhi et al. 1990; Shah 1990). Some of these priorities are:

- Breeding of varieties suitable for the different farming systems in Nepal
- Improvement of traditional vegetables so far neglected by the national and international research systems
- Development of appropriate post-harvest and processing technologies
- Production of high-quality seeds both for domestic and export markets
- Collection, conservation, and utilization of local genetic resources
- Development of varieties suitable for off-season vegetable production
- Development of crop production technologies with emphasis on the time and method of planting, plant production, weed control, fertilizer management, and pest control
- Varietal purification and maintenance.

Socioeconomic Research

The following are the priority areas for socioeconomic research on vegetables in Nepal:

Data Collection

Data on area, production, and yield of individual vegetable species is crucial in order to do analyses for many policy issues. Such analyses assist in the planning of vegetable improvement programs or in identifying areas for intervention. Aggregate data obscure the differential potential of individual vegetable species and are not useful for realistic planning and evaluation work. Regional data on individual vegetables can also help to identify suitable areas for different vegetables. Therefore, it is strongly recommended to start collecting individual vegetable data by district.

Rigorous Analysis of Farm-level Profitability

As cost and return data have the potential to serve many planning and research needs, e.g., generating technical coefficients and determining farm-level profitability, there is a need to collect these data from representative production environments for major vegetables on a regular basis. Careful analysis of costs of production and returns from vegetable crops vis-a-vis other competing crops is essential to establish farm-level profitability under varying production environments. Such analyses should be done for individual crops as well as for different cropping patterns. Analyses done so far have been inadequate in terms of rigor (e.g., no analysis is available on the labor use pattern), crop coverage, regional representation, regularity, etc.

Analysis of Economic Constraints

An in-depth study of economic constraints affecting vegetable production is urgently needed. Given the importance of vegetables and vegetable seed production in raising income levels and employment opportunities, particularly in the Hills, it is essential to undertake a study to identify economic constraints faced by this subsector.

Comparative Advantage of Nepali Produce

In most urban centers of Nepal, Indian vegetables are competing with domestically produced vegetables. While an overvalued exchange rate (vis-a-vis the Indian rupee) is an important reason for this situation, there are other possible factors, such as higher productivity in India, economies of scale enjoyed by Indian farmers, and a more advanced transportation network in India. There is a need for an in-depth study to identify factors responsible for this situation.

Constraints in Vegetable Marketing

As commercial vegetable production expands, farmers start facing marketing related problems. Although in recent years the government in Nepal has taken steps to liberalize the economy, many inconsistencies remain in marketing-related policies and legislation and their implementation on the ground. It is necessary to identify these constraints so that measures can be taken to overcome them.

Constraints in Cold Storage Industry

Although there are 10 cold stores presently operating in Nepal, farmers in the Tarai store their potato seed in Indian cold stores. The difference in storage charges outweighs the transportation and other transaction costs. The Nepali cold storage industry suffers from a number of problems, such as high electricity charges, irregularity in electricity supply, lack of economies of scale, and design defects. There is a need to conduct a study to analyze these issues and to collect information from across the border to be able to compare relative costs and returns.

Policy Issues

Very few studies have attempted to analyze the actual or potential impact of government policies and regulations on vegetable production, trade, and consumption. The government policies that can have such an impact include policies on fertilizer price, transportation subsidies, subsidies on irrigation, subsidies on vegetable seeds, etc. Government regulations, such as advance income tax on vegetable imports, pesticide regulations, etc., can also affect the vegetable subsector. Therefore, studies should be carried out to understand such policy issues.

Summary and Conclusions

Nepal's diverse topographic features and climatic conditions permit successful production of about 250 vegetables, of which about 50 are common. Vegetables are grown almost everywhere, but the more concentrated areas are located along the major highways and in the vicinity of urban centers.

Vegetable area grew by 2.95% per annum between 1974 and 1995. The increase in vegetable yield (2.91%) was equally impressive. As a result of area and yield increases, total vegetable production in Nepal increased by 5.86% annually in the period. The high rate of increase in vegetable production and more imports resulted in an increase in per capita annual availability, from 48 kg in 1984 to 60 kg by 1995.

Available reports show that vegetable consumption was the highest in the urban Hills and lowest in the Mountains. The consumption of vegetables in the Hills was significantly higher in urban areas than in rural areas. Such a difference, however, was not observed in the Tarai between urban and rural areas.

The consumption of vegetables and potato increased with income. The consumption levels of highest income deciles tended to be about two times the levels of the lowest decile. The income elasticities for vegetables were positive but inelastic in both low and high income groups.

Total imports of vegetables far exceeded total exports between 1982 and 1990, in terms of both quantity and value. Nepal's vegetable exports and imports are mainly limited to India. The main vegetables imported are potato, onion, garlic, and tomato. The trade in potato constituted more than half of the total trade value.

Vegetable marketing studies show that the retailer's share of the consumer's rupee is higher than the wholesaler's. This might be due to the high physical losses at the retail level and because of high local transport costs borne by the retailers. Packaging, transportation, handling, and management costs did not differ much by crop and were in the neighborhood of 12 to 14% of total marketing costs.

Various production and marketing related constraints have adversely affected the production of vegetables in Nepal. Major production constraints include shortage of good quality seed, poor irrigation facilities, and shortage of production inputs, such as chemical fertilizers. Underdeveloped markets for inputs, inadequate market information and support systems, and lack of cold storage and other physical facilities are some of the important marketing related problems. Indiscriminate and inappropriate use of pesticides and other chemicals pose major health hazards to urban consumers as the well as to farmers.

Other policy issues that affect vegetable production and marketing include an overvalued currency, the inability of the government to withdraw subsidies or to sufficiently allocate budget for fertilizer subsidization, lack of legal provisions for efficient input and output marketing (e.g., Marketing Act, Nursery Act), and prevalence of trade restrictions, such as octroi charges, ad hoc valuation by customs officials, and advance income tax collection at customs check points.

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