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HORTICULTURAL DEVELOPMENT IN RASUWA

Krishna B. Shrestha

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PREFACE

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PREFACE

This paper was prepared as part of the background analysis while preparing the Integrated Economic and Environmental Development Plan for the Bagmati Zone. It examines the conditions of horticultural development in Rasuwa district and identifies areas that need substantial improvement and investment in future. The overall experience with horticultural development in the Bagmati Zone, where some of the horticultural centres are over three decades old, is most discouraging. Recently some of these centres have been closed down because of their poor performance. Poor management does not, however, reduce the potentials for horticultural development in Rasuwa district and serious efforts should be made to improve both the technical as well as the managerial side. Farmer involvement must also be very carefully promoted.

Dr. Shrestha worked as a horticulturist in Rasuwa district and is therefore very familiar with the practical problems encountered. It is hoped that the recommendations outlined will help in the development of horticulture in Rasuwa and in other areas of the Bagmati Zone where such potentials exist.

Contents

INTRODUCTION	1
Location	1
Climate and Soil	1
Land Use	1
STATUS OF HORTICULTURAL DEVELOPMENT PROGRAMMES	2
Fruit Production	2
Nursery Management	4
Vegetable Production	4
Potato Production	5
Institutions	5
Horticultural Farm	5
Activities of the Farm	5
Agricultural Development Office (ADO)	6
Agricultural Development Bank (ADB/N)	6
Agricultural Inputs' Corporation (AIC)	6
MAJOR CONSTRAINTS TO HORTICULTURAL DEVELOPMENT IN RASUWA	7
Biophysical Conditions	7
Adverse Weather	7
Soil Conditions	7
Technical Conditions	7
Research	7
Saplings and Seeds	7
Inputs	7
Disease and Pest Control	7
Skills	8
Socioeconomic Conditions	8
Institutional Conditions	8
PROSPECTS OF HORTICULTURAL DEVELOPMENT	9
Comparative Advantages	9
Land Availability and Climatic Conditions	9
Increased Production Per Unit Area	9
Creation of Job Opportunities	10
Minimising Migration	10
Utilisation of Marginal Land	10
Environment	10
Growing High-value Crops	10
Demand for Fruits and Vegetables	11
Cropping System	12
Small Farmers and Rural Development	13
Small Farmers' Development Programme	13
Rasuwa-Nuwakot Integrated Rural Development Project	14
Household Investment	14

POST-HARVEST PRACTICES

Harvesting Techniques	19
Packing and Grading	19
Storage	19
Transportation	20
Processing	20

MARKETING

Existing Marketing System	21
Proposed Marketing System	21

CREDIT

23

INPUTS

24

Planting Materials	24
Fertilisers	24
Pesticides and Fungicides	24
Tools and Implements	24

FUTURE HORTICULTURAL DEVELOPMENT PROGRAMMES IN RASUWA DISTRICT

25

Area and Production	25
<i>Fruits</i>	25
<i>Vegetables</i>	25
<i>Potato Cultivation</i>	26
<i>Institutions</i>	27
<i>Tourism</i>	27
Government Farm vis-a-vis Private Nurseries	27
Investment	28

RECOMMENDATIONS

30

Fruit Cultivation	30
Soil Management in Fruit Cultivation	30
<i>Vegetable and Potato Production</i>	31
<i>Extension and Training</i>	31
<i>Institution Building</i>	32
<i>Post-Harvest Handling</i>	34
<i>Others</i>	34

BIBLIOGRAPHY

35

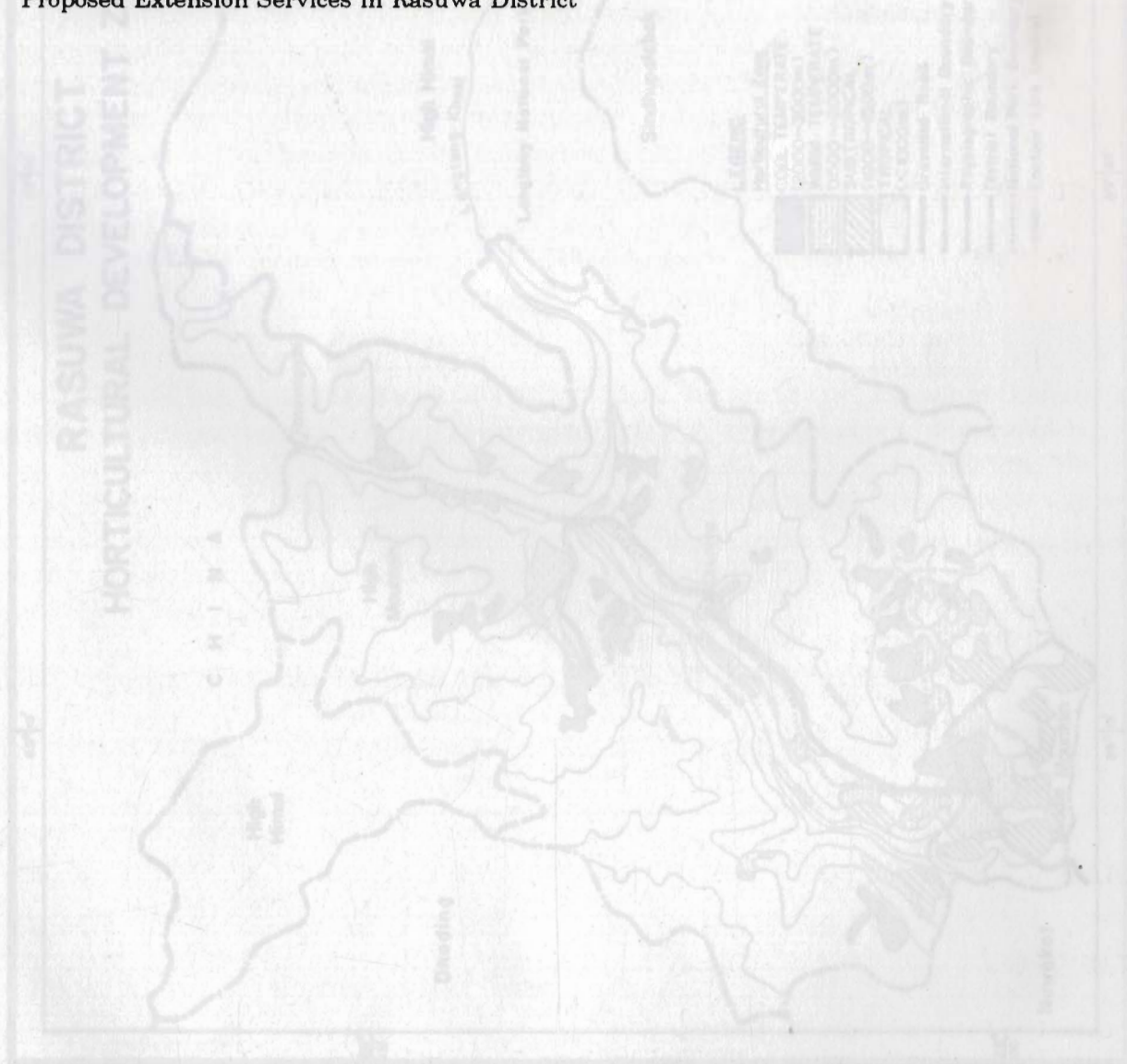
LIST OF TABLES

1: Land Use Pattern in Rasuwa District	1
2: Land Distribution According to the Various Crops Grown in Rasuwa District	2
3: Distribution in Rasuwa District up to the F.Y. 1990/91	3

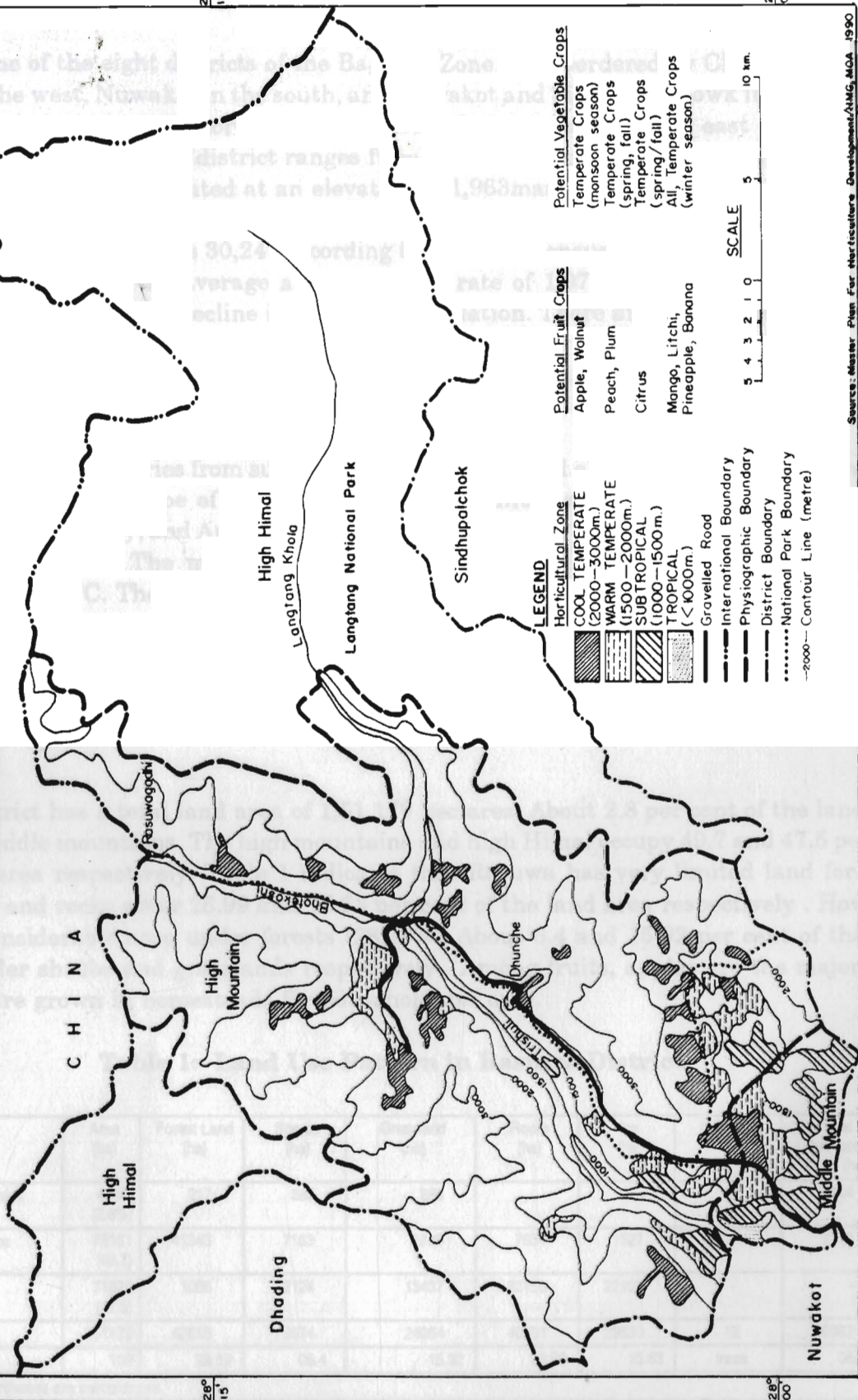
4: Benefits (Gross) of Different Crops Per Hectare in Rasuwa	9
5: Fruit, Potato, and Vegetable Production in Rasuwa (1990/91)	12
6: Demand for Fruits, Vegetables, and Potatoes in Rasuwa District	12
7: Household Investment for Potato Cultivation under Present Conditions in Rasuwa	15
8: Production Cost of Potato Cultivation Using Improved Methods	15
9: Total Cost of Vegetable (Cauliflower) Production in Rasuwa	16
10: Average Production Cost of Fruit/Ha in Rasuwa (Apples)	17
11: Production Cost of Maize in Rasuwa District	18
12: Loan Disbursement for Horticultural Crops in Rasuwa District for a Five-year Period	23
13: Expected Area and Production of Fruits, Vegetables, and Potatoes in Rasuwa District	26
14: Investment for Horticultural Development in Rasuwa	29

LIST OF FIGURES

1: The Existing Marketing System	21
2: Proposed Marketing System	22
3a: Present Organisation of Ministry of Agriculture in Reference to Rasuwa	32
3b: Linkages among the DOA, DOH, and Farmers	33
4: Proposed Extension Services in Rasuwa District	33



RASUWA DISTRICT HORTICULTURAL DEVELOPMENT ZONES



INTRODUCTION

Location

Rasuwa is one of the eight districts of the Bagmati Zone. It is bordered by China in the north, Dhading in the west, Nuwakot in the south, and Nuwakot and Sindhupalchowk in the east. This district extends from 27°02' north to 27°10' north latitude, and 85°88' east to 85°45' east longitude. The altitude of the district ranges from 600 to 7,246masl. The district headquarters are at Dhunche which is situated at an elevation of 1,963masl.

The population of Rasuwa was 30,241 according to the 1981 Census and 36,768 according to the 1991 Census, indicating an average annual growth rate of 1.97 per cent. Between 1971 and 1981, there was an absolute decline in Rasuwa's population. There are 18 Village Development Committees in the district.

Climate and Soil

The climate of Rasuwa varies from subtropical to temperate and alpine, but most of the area has a temperate and alpine type of climate. The average annual rainfall is 994.3mm and occurs mainly during June, July, and August. The average temperature in Dhunche is 22.6°C maximum and 11.5°C minimum. The minimum temperature in Dhunche goes down to 0°C and the maximum up to 25°C. The area is free from hailstorms.

The cultivated lands of Rasuwa District have sandy loam soil whereas the high mountains and the Himalayan belts are mostly from rocks with thin layers of sandy or sandy loam soils.

Land Use

Rasuwa District has a total land area of 1,51,179 hectares. About 2.8 per cent of the land area lies in the middle mountains. The high mountains and high Himal occupy 49.7 and 47.5 per cent of the land area respectively. Table 1 indicates that Rasuwa has very limited land for crops (6.87%). Ice and rocks cover 26.99 and 15.63 per cent of the land area respectively. However, there is a considerable area under forests (28.19%). About 6.4 and 15.92 per cent of the land area are under shrubs and grasslands respectively. Among fruits, apples are the major crop. Vegetables are grown in homesteads for household use only.

Table 1: Land Use Pattern in Rasuwa District

Belts	Area (ha)	Forest Land (ha)	Shrubs (ha)	Grassland (ha)	Rocks (ha)	Ice (ha)	Landslide	Total Cultivated Land (ha)
Middle Mountains	4148 (2.8%)	217	387	888	-	-	12	2644
High Mountains	75161 (49.7)	41343	7163	9739	7651	1527	-	7738
High Himal	71870 (47.5)	1056	2124	13437	33150	22103	-	-
Total	151179	42616	9674	24064	40801	23630	12	10382
Percentage	100	28.19	06.4	15.92	26.99	15.63	trace	06.87

Figure in parentheses are percentages.
Adapted from the ICIMOD's Forest Report.

STATUS OF HORTICULTURAL DEVELOPMENT PROGRAMMES

Major crops such as paddy, maize, and wheat are grown generally in the middle mountain belt which has suitable soils and climates. In general, barley, finger millet, and buckwheat are cultivated in the mountains. Maize and other vegetables are also grown as alternate crops. Owing to the cold weather that prevails most of the year, only one cereal crop - either maize, wheat, or millet - is grown annually. These crops are grown in the lower parts of the districts, e.g., Dadagaun, Lahrepauwa, Sarmathali, Bhorle, etc.

Fruit Production

As can be observed from Table 1, the district has very limited land for the cultivation of cereal grains. Most of the cultivated lands are marginal and the productivity of cereals is very low (Table 2). Nearly 50 per cent of the land in the high mountain and high Himalayan belts are either rocky, icy, or covered with forests and pasture. Horticultural land lies mainly in the high mountains.

Table 2:
Land Distribution According to the Various Crops Grown in Rasuwa District

Crops	1988/89		1989/90		1990/91		1991/92 (target)	
	Area (ha)	Production MT	Area (ha)	Production MT	Area (ha)	Production MT	Area (ha)	Production MT
Paddy	1059	2162	1067	2083	1068	2253	1072	2265
Maize	2030	3136	2317	3540	2325	3697	2330	3711
Wheat	873	830	886	978	886	1012	905	1135
Finger millet	1353	1300	1302	1460	1305	1355	1400	1470
Barley	270	405	442	445	452	458	450	460
Buckwheat	-	-	-	-	-	-	5	4
Pulses	21	21	45	47	46	53	46	44.25
Potatoes	2334	14524	2322	15035	2316	16730	2300	16660
Vegetables	190	1432	211	1597	225	3682	215	3700
Oilseeds	5	4	10	7	12	6	12	9.5
Onions	-	-	10	56	10	55	10	55
Ginger	7	5	5	30	5	31	6	42
Garlic	5	5	5	26	5	27	6	45
Soyabeans	50	52	67	66	60	60	60	61
Chillies	24	21	45	23	22	60	24	74.5
Turmeric	2	12	5	33	5	31	5	30
Fruits (other)	51	-	39	-	34.35	-	23.5	5171
Citrus	-	-	4.2	-	-	-	1.5	143

Source: Department of Agriculture & Agricultural Development Office, Rasuwa, 1988/89, 1989/90, 1990/91, and 1991/92

Although Rasuwa District has some wild species, such as walnuts and pears, fruit cultivation, especially of apples, was started during the F.Y. 2027/28 (1971) after the establishment of a horticulture station in Rasuwa. The total area and production of fruits are estimated to be 847.75ha and 6,725.42MT respectively. Apples are the main fruit with an estimated acreage of 356ha, followed by pears with 169ha (Table 3). Walnuts are also gaining popularity in the district and cover about 72ha. These figures in Tables 2 and 3 do not include the losses caused by wild animals, due to mismanagement and natural mortality.

Table 3: Distribution in Rasuwa District up to the F.Y. 1990/91

Kinds of fruit	Until 1985/86		Until 1989/90		Until 1990/91	
	Area (ha)	Production (MT)	Area (ha)	Production (MT)	Area (ha)	Production (MT)
<u>Other Fruits</u>	<u>651</u>	<u>4480</u>	<u>812</u>	<u>6411.12</u>	<u>832</u>	<u>6592.42</u>
Apple			341	2546.04	356	2693.26
Pear			167	2263.20	169	2263.20
Peach			109	612.48	110	633.20
Plum			52	316.8	53	323.84
Apricot			10	35.20	10	35.20
Walnut			71	195.36	72	201.28
Persimmon			2	-	2	-
Mango			3	26.04	3	26.04
Guava			42	295.68	42	295.68
Jack Fruit			1	7.04	1	7.04
Pineapple			1	16.14	1	16.14
Banana			2	20.10	2	20.10
Papaya			11	77.04	11	77.04
<u>Citrus</u>			15.75	122.32	15.75	133
			827.75	6533.44	847.75	6725.42
32.2 per cent mortality (MPHD)					532.38	4223.56

Source: Fruit Development Division, DOH, 1990/91

Apples are mainly grown in the Goljung, Gatlang, Bridim, Thuman, Syaphrubesi, Chilime, Manchet, and Dhunche villages of Rasuwa District. The dominant varieties of apple are Red Delicious, Royal Delicious, Rich-e-Red, and Golden Delicious (polleniser). The most common variety of pears is Pharping Naspati. In the case of walnuts, thin-shelled varieties are planted.

Apples grown in Rasuwa have already been introduced into the Kathmandu market and fetch better prices than apples from Helambu and Daman. Nevertheless, the majority of farmers in Rasuwa do not give due consideration to horticultural production because of their conservative way of thinking. Further, fruit cultivation takes a long time and relatively high initial investments. Thus, the plantation of fruit crops is mainly at a subsistence level. The few orchards are not well maintained due to the lack of appropriate management practices, e.g., pruning, control measures, fertiliser application, etc. Plant mortality is very high due to lack of care and preference for growing cereal crops. According to the Horticultural Development Master Plan Report, the mortality rate is about 37.2 per cent in Rasuwa. If this is taken as an indicator, the total area under fruits in Rasuwa comes to 532.387ha, with a total production of 4223.56MT.

Nursery Management

The policy of privatisation introduced by the Government for fruit nurseries in Rasuwa District, in order to meet the sapling requirements of the district locally, has resulted in the

establishment of two nurseries for deciduous fruits, although a government-owned horticultural farm exists. If private nurseries help to meet the district's requirement for saplings, the government farm can focus on problem-oriented research as well as on providing technical services. But, due to lack of sufficient interest and training, these nurseries cannot produce enough saplings. The farmers still have to depend on the horticultural farm at Rasuwa. However, the existing private nurseries are not registered.

Vegetable Production

From Table 2 it is clear that vegetables cover a considerable area in the district. Mainly radishes, broad leaved mustard, cauliflowers, and cabbages are grown. The total area covered by these vegetables was 190ha in 1988/89 and 215ha in 1991/92. Until recently, this district used to import vegetables from other districts. At present, the farmers are more interested in growing vegetables. One farmer from Bharkhu earned Rs 9,000/- last year solely from cauliflowers.

The total production of vegetables was 1,432MT in 1988/89 and 3,700MT in 1991/1992 with a productivity ratio of 7.53MT/ha and 17.21MT/ha respectively. This is a clear indicator of high productivity. In addition to these vegetables, there is substantial cultivation of ginger, garlic, turmeric, and chillies. Vegetables are mainly grown in the lower hill areas, i.e., Ramche, Laharepauwa, Bhorle, and areas along the Trishuli River and in the Phalangu Khola Valley.

The climate of Rasuwa can be cold according to the season. In most parts of Rasuwa, off-season vegetables can be grown as cash crops and they can be marketed to Trishuli and Kathmandu as the Trishuli-Somdang road joins Trishuli with Rasuwa.

Potato Production

Traditionally potatoes are one of the main cash crops in Rasuwa District. Even when local varieties were cultivated, Rasuwa used to supply potato seeds and potatoes to Trishuli and Kathmandu. Many farmers in Rasuwa District, including Yarsa farmers in the high mountains, still grow low-yielding, local white varieties of potato. However, now, the farmers from Dhunche, Ramche, Laharepauwa, Saamathali, Bhorle, Dhaibung, and Thulogaun are adopting high-yielding, improved varieties, namely, Kufri Jyoti (white) and Cardinal (red). The improved varieties have a productivity ratio of 15MT/ha. The average production in the district in the year 1989/90 was 6.47MT/ha, with a total production of 15,035MT (Table 2). On about 90 per cent of the total area under potatoes, improved varieties were grown after the ADO started distributing improved seeds in 1979. Prior to 1979, only local cultivars were grown throughout the district.

Institutions

In the late fifties, several horticultural stations were established in Nepal. However, the Government's priority was to promote cereal production. The extension activities also emphasised cereal grain production. As a result of the increasing interest of Nepalese farmers in horticultural crops, as well as the encouragement of a limited number of horticulturists, the

district extension offices also started expanding fruit and vegetable production. The horticultural station at Dhunche was established in 1970 to serve the farmers of Rasuwa. Until recently, the horticultural development programme was planned and supervised by the Fruit Development Division, the Vegetable Development Division, the Potato Development Programme, and the Citrus Development Programme. Some of the institutions in Rasuwa which are involved in horticultural programmes are mentioned below.

i) *Horticultural Farm*

This farm is located in Dhunche, the headquarters of the district, and lies 50km northwest of Trishuli at an altitude of 1,950masl. It was established in 1970 as a horticultural station with the collaboration of the Indian Cooperation Mission. It was renamed the agricultural farm in 1972. It was again renamed the horticultural farm in 1990. Its objectives are (i) production of improved varieties of fruit saplings and vegetable seeds, (ii) research on fruits and vegetables (local problem-oriented research), (iii) distribution of saplings and seeds, and (iv) provision of technical services to the local farmers. This farm has 25ha land out of which eight ha consist of orchards, one ha nursery; four ha vegetables; one ha buildings, roads, and canals; six ha uncultivated land, and five ha forest land.

Activities of the Farm

- a) Orchard. The main fruits grown in the orchard are apples, pears, plums, peaches, and walnuts. There are about 813 plants at present.
- b) Production and Distribution. Fruit plant production was started in 1973/74. Since then, 45,091 plants have been produced, out of which 22,053 were apple saplings (about 50%).
- c) Staff. Altogether there are 12 technical staff (G II-one, G III-one, NG I-one, NG-II-two, and gardeners-seven). The Rasuwa-Nuwakot Integrated Rural Development Project had also provided temporary technical staff.

ii) *Agricultural Development Office (ADO)*

As in the other districts of Nepal, the ADO office was established in 1971 to cater to the needs of the agricultural sector in the district, including the horticultural programme. This office is mainly responsible for providing information on all types of input as well as for educating and encouraging the farmers to adopt new farming technologies. However, this office also provides information on cereal crop farming technologies, despite this district's potential for fruit, vegetable, and potato cultivation. Lack of manpower and of training on specific crops for the JT/JTAs are constraints. The staff consists of one Class II officer and four Class III officers with 12 JTs, 15 JTAs, and nine others. There are eight service centres in the district under the supervision of this office. However, there is no subject matter specialist in horticulture among the four SMS (subject matter specialists) staff.

iii) *Agricultural Development Bank (ADB/N)*

This institution is responsible for providing credit to the farmers. This Bank is also located in Dhunche and five Small Farmers' Development Programmes (SFDP) at Bhorle, Parchyang,

Haaku, and Goljung. Between 1986/87 and 1990/91, ADB/N, together with SFDP, had advanced a loan of Rs 1,924,000/ at an interest rate of 14 per cent. The loan was sanctioned for about 70-80 per cent of the total scheme. Innovative farmers may get approval of about 80 per cent. SFDP advances loans worth 100 per cent of the scheme in some cases.

Agricultural Inputs' Corporation (AIC)

This office is located in Dhunche and provides necessary inputs such as fertilisers, insecticides, and fungicides as and when needed. The stock is kept as requested by the ADO. AIC supplies inputs to the village cooperatives on credit to ease the supply of inputs to farmers. *Sajha* (or cooperatives) collect the inputs from AIC.

MAJOR CONSTRAINTS TO HORTICULTURAL DEVELOPMENT IN RASUWA

Development of horticultural crops, such as fruits, vegetables, and potatoes, in Rasuwa faces several constraints such as biophysical conditions, technical conditions, socioeconomic conditions, institutional conditions, etc.

Biophysical Conditions

Adverse Weather

The maximum rainfall occurs from June to August. In general, rainfall is in excess of local requirements. Sometimes fruit plants die as a result of water logging. In winter, there is an acute shortage of rainfall resulting in water shortage during the flowering and fruiting stages. Consequently, there is less fruiting or no fruiting. Although Rasuwa is not a hailstorm-prone district, considerable damage is caused by frost, especially in spring. There are no irrigation facilities for fruit and potato cultivation during the dry winter period.

Soil Conditions

In Rasuwa, 26.99 per cent of the total land area is rocky. Soils in general are mixed with gravel or rocks. Shallow soils have poor soil fertility.

Technical Conditions

Research

Low priority was accorded to fruit research in the past. Horticultural programmes only stressed the introduction of new crops and the establishment of horticultural stations. Recently, the responsibility for research has been given to the Nepal Agricultural Research Council (NARC), but the horticultural farm in Rasuwa is under the administration of the Department of Horticulture (DOH) and does not focus on problem-oriented research.

Saplings and Seeds

There is a lack of high quality saplings and seeds suitable for Rasuwa's climate.

Inputs

Farmers seldom use any fertilisers to cultivate fruit crops. Pesticides are not available when needed. Sufficient compost is not available for field use.

Disease and Pest Control

Disease control and pest control are mostly neglected by the farmers because of lack of information and the unavailability of fungicides and pesticides. Some of the bacterial or viral

diseases are not cured even after spraying. Careful surveillance and control measures are required to reduce the occurrence of pests and diseases.

Skills

Almost all the farmers in Rasuwa are ignorant of proper technical practices such as management methods, pruning, harvesting, plant protection, etc.

Socioeconomic Conditions

- a. Constrained by lack of funds, farmers cannot afford even the most basic inputs, e.g., good quality seeds, fertilisers, and pesticides. Horticultural crops require relatively high initial investments.
- b. Farmers are reluctant to approach moneylenders who charge three to five per cent interest and there is a lack of official creditors (ADB/N or other agencies). The existing ADB/N procedure for granting loans is lengthy and a source of harassment to small farmers. There are no provisions for consumer loans, particularly during the gestation period for fruit crops. Small farmers have practically no access to loans because of lack of collateral.
- c. Traditionally, the Nepalese diet does not normally include fruits. This is the reason why Rasuwa farmers also do not eat more vegetables and fruits.
- d. Single farmers may not be able to find markets for their produce. Only an organised group of farmers engaged in vegetable and fruit production would have access to markets as such farmers have large quantities of produce. Such groups do not exist at present.

Institutional Conditions

- a. Difficult terrain and lack of a transportation infrastructure (from the production area to the road head or to the market) are major constraints.
- b. The lack of a marketing infrastructure is another problem. There is no market information system to disseminate information to producers as well as small traders.
- c. There are no storage and processing facilities.
- d. The prevailing extension services are not able to motivate farmers and fulfill their requirements. Horticultural crops receive low priority. Separate horticultural extension services are critically important.
- e. Post-harvest handling, including harvesting, packing, transportation, and storage techniques are required.
- f. Langtang National Park covers about seven village development committees. The wild animals from this park destroy the succulent crops of the farmers, thereby discouraging farmers from fruit and vegetable cultivation. Some of the farmers from these VDCs are not willing to adopt improved technologies because of this problem.

PROSPECTS OF HORTICULTURAL DEVELOPMENT

Rasuwa lies to the north of Kathmandu and borders Tibet. In spite of its remoteness, it is linked to Kathmandu, a major market, by roads. Apple, potato, and vegetable production has been increasing gradually due to government efforts, although there are many constraints to further expansion of fruit and potato production in Rasuwa.

Comparative Advantages

Land Availability and Climatic Conditions

Almost 98 per cent of the land area is located in the temperate and alpine zones suitable for growing apples, pears, plums, peaches, and walnuts. Off-season vegetable crops can also be grown commercially. Hailstorms rarely occur in Rasuwa, therefore, this area is suitable for high quality apple and vegetable production.

Only 2.8 per cent of the land area lies in the mid-hills where cereal crops are dominant. The remaining cultivated land can be brought under fruit, vegetable/(fresh), and vegetable seed production.

Increased Production Per Unit Area

The principal horticultural crops yield higher returns per unit area than cereal crops. The farmers should be convinced of the benefits in terms of both price and market. A comparison of the returns of different crops grown in Rasuwa is given in Table 4. Apples and potatoes yield 13 and 3.5 times more than millet.

Table 4: Benefits (Gross) of Different Crops Per Hectare in Rasuwa

	Crops	Yield MT/ha	Total income Rs/ha ¹
xx	Apple	7.46	74600.00
x	Potato	6.48	19440.00
xx	Walnut	2.75	68750.00
xx	Pear	13.50	67500.00
x	Paddy	1.95	9750.00
x	Wheat	1.10	5863.00
x	Maize	1.52	4936.20
x	Millet	1.12	5623.80

x Adapted from Table 2, the data on area and production were collected by the District Agricultural Development Office, Rasuwa for 1989/90.

xx Adapted from Table 3 for 1989/90.

¹ Prices for Dhunche taken during mid-production season.

Creation of Job Opportunities

Rasuwa was one of the food deficit districts in Nepal and there were few available jobs. However, with the cultivation of fruits and vegetables (requiring intensive labour during both production and marketing) and also use of different tools and baskets, new jobs have been created for skilled, semi-skilled, or unskilled labourers. Various industries might also be established in the area as a result of horticultural crop production.

Minimising Migration

The 1981 Census showed that Rasuwa was one of the districts in Nepal with a high rate of out-migration. However, the 1991 Census indicated that outmigration may have decreased. There are new job opportunities in the district itself. Table 4 shows that fruits and potatoes yield high returns even with low inputs.

Utilisation of Marginal Land

It can be observed from Table 1 that the land resources of Rasuwa mainly consist of marginal land where the productivity of cereal grains is low, in spite of efforts made in the last three to four decades (Table 3). With little effort, the farmers of Rasuwa can enjoy maximum returns per unit area (Table 3) by cultivating horticultural crops, thereby utilising the marginal land. The marginal land is more vulnerable to landslides and other erosion processes, but such hazards can be minimised through the cultivation of horticultural crops, i.e., apples, peaches, walnuts, and other fruits.

Environment

Environmental degradation is a debatable issue and a major development concern in Nepal. Horticultural programmes offer feasible solutions that can help reverse the present trend of degradation. Environment degradation results in landslides, floods, desertification, air and water pollution, etc. Tillage on high sloping lands for cereal crops also increases soil erosion and causes a decline in fertility.

Suitable fruit crops, if properly planted and managed, can have a strong positive effect on reducing tillage on slopes which, in turn, will reduce degradation, landslides, and pressure on forest land, while increasing soil fertility and species' diversity.

Growing High-value Crops

Rasuwa is linked to Kathmandu by a metal road (72km) and the all-weather gravel Trishuli - Somdang road (105km). However, transportation within the district is difficult. High value crops can be cultivated in favourable pocket areas. These advantages have not been properly harnessed. Vegetables from Kathmandu and Trishuli are still sold in Dhunche and other parts of the district. Therefore, according to the area, soil, and climatic conditions, high-value crops,

such as apples, walnuts, vegetable seeds, fresh vegetables, potato seeds, and tubers, should be produced under a specific programme.

In Rasuwa, apples, pears, plums, peaches, walnuts, and citrus fruits can be grown under favourable climatic conditions, but only high-value crops that can be transported easily or can withstand the long period required for transportation should be considered. Prioritisation of the crops should be considered as follows (Frontispiece).

The areas above 1,800 metres in the temperate zone should be brought under commercial apple cultivation. Rasuwa can easily capture Kathmandu's fresh apple market. Another suitable crop is walnut. This crop also has a very good market in Kathmandu. Walnuts can be transported even a few months after harvest, either the whole nut or only the kernels. Peaches can be grown in warm, temperate areas. This fruit is very perishable in nature, therefore it cannot be transported over long distances but it can be used in distilleries. Rasuwa is a food deficit district, but most of the villagers ferment millet or maize to make liquor. Peaches can be used instead of cereal grains for distillation purposes.

The advantage of Rasuwa's proximity to the Kathmandu market should be exploited by using the upper parts of the district for commercial potato production. Potatoes are cultivated from *Phalgun* (February-March) to *Srawan-Bhadra* (August-September) which is off-season in Kathmandu and elsewhere. However, brown rot disease is prevalent as a result of selling all the produce during harvest and bringing in seeds from disease infected areas. Wart disease, however, has not been reported in Rasuwa, although it is prevalent in the Nuwakot district. Therefore, a special programme for potato seed production at higher altitudes in the district can be designed. In this way, seeds required in the district, as well as in neighbouring districts, can be supplied and occurrence of diseases will be minimised.

Another important crop programme which should be implemented in Rasuwa is vegetable seed production. Nepal is currently importing vegetable seeds, e.g., cabbages, cauliflower, carrots, etc from abroad. Dolpa, Humla, and Jumla are also producing cauliflower seeds, especially Snowball, but the cost is higher. Rasuwa can easily grow carrots and Snowball cauliflower seeds. This innovative strategy will certainly benefit the farmers of the district as well as the national economy.

Rasuwa farmers can easily use their apple orchards for growing off-season vegetables, vegetable seeds, and potatoes, but care must be taken to avoid soil erosion.

Demand for Fruits and Vegetables

The consumption of vegetables and fruits in Rasuwa is low. Horticultural products should reach the demand areas, particularly the Kathmandu Valley. Apples and walnuts from Jumla and Mustang seldom reach Kathmandu, but it is an accessible market for horticultural produce from Rasuwa.

A significant number of tourists visit Rasuwa. Therefore, any increase in the production of apples, potatoes, and other vegetables can be absorbed easily by domestic (local population and tourists) consumers as well as by the Trishuli and Kathmandu markets. The requirements of the processing and distillery industries can also be met easily.

Rasuwa has surplus fruit, potato, and vegetable production, however, this district has been rated as a food deficit district (Table 5). This indicates the need to change the food habits of Rasuwa's inhabitants.

Table 5: Fruit, Potato, and Vegetable Production in Rasuwa (1990/91)

Crops	Area (ha)	Production (MT)	Per Capita Production (kg)	National Per Capita Production (kg)	Surplus (+) deficit (-)
Fruits	532.38	4223.56	114.87	24.27	+
Vegetables	225	3682	100.14	50.90	+
Potatoes	2316	16730	455.01	30.35	+

Source: Achievement Reports of the Agricultural Development Office, Rasuwa, the Fruit Development Division, and the Preliminary 1991 Census Report of CBS.

National per capita consumption of fruits, vegetables, and potatoes at the end of the Seventh Five-year Plan (1989/90) was 22.79kg, 53.73kg, and 34.93kg respectively. Taking into account the population of Rasuwa according to the 1991 Census, the computed demand of Rasuwa District comes to 837.94MT - fruits, 1975.54MT - vegetables, and 1,286.30MT - potatoes (Table 6).

Table 6: Demand for Fruits, Vegetables, and Potatoes in Rasuwa District

Crops	Production (MT)	District Demand (MT)	Surplus (MT)	Demand of the Kathmandu Valley and Bidur municipalities (MT)
Fruits	4223.56	837.94	3398.62	13934.96
Vegetables	3682.00	1975.54	1706.46	32853.26
Potato	16730.0	1286.30	15443.70	21357.98

Source: Computed by the author from district production and population data.

The surplus fruits, vegetables, and potatoes can be marketed easily in the Kathmandu Valley and in Bidur. The total demand in the towns of the Kathmandu Valley and Bidur is in excess of the current surplus in Rasuwa.

Cropping System

The farmers of Rasuwa follow a monocropping system. Due to the cold climate, crop rotation is practised (maize or millet or maize-millet or potato), in about 97 per cent of the areas. Some of the farmers grow buckwheat or wheat. They can harvest only one crop in a year. However, at lower altitudes, paddy-potato, or paddy-wheat, or maize-potato are the dominant cropping patterns.

Some of the apple growers follow a multiple cropping system, i.e., apple orchards are intercropped with *kodo* (finger millet) or maize. Recently, farmers have started to intercrop cauliflowers and radishes in apple orchards.

The following areas in the district have been identified as potential areas for horticultural crop cultivation.

Areas	Crops	Growing Season
1. Yarsa, Gatlang, Langtang, Chilime, Ramche, Dhunche, Haku, Syaphru, Thuman, Bridim	Potatoes	February - August
2. Laharepauwa (lower part) Bhorle, Dhaibung, Saramthali, Dandagaun, Thulogaun	Potatoes	December - March
3. Bharkhu & Goljung (in Syaphru VDC), Dandagaun, Dhunche, Bhorle	Cauliflowers and other vegetables	March/April July/August December
4. Bridim, Gatlang, Bharkhu, Yapche, Ramche, Dhunche, Thuman, Syaphrubesi, Chilime	Apples (main), Walnuts	April - August/October
5. Lower part of Dhunche & Ramche, Laharepauwa, Lower parts of Bharkhu, Syaphrubesi	Peaches	April - July

At higher altitudes, two or two and a half crops can be grown in areas where a single crop is grown per year, by intercropping potatoes or vegetables in commercial apple orchards or other fruit orchards. Maize or finger millet can also be intercropped in orchards. However, care must be taken to reduce soil erosion and increase production by practising minimum tillage, using more organic manure, terracing, planting permanent crops on the bunds, etc.

Small Farmers and Rural Development

There are a number of rural development programmes which have implications for horticultural development in Rasuwa. The major programmes are as follows.

Small Farmers' Development Programme

According to the 1991 Census, there were 7,204 households in Rasuwa. The total cultivated land area was 8,993ha. The average cultivated land area per household was 1.24ha. The household size was 5.1. This clearly indicates that the farmers of Rasuwa are poor and primarily small landholders.

The Government has introduced the Small Farmers' Development Programmes (SFDP) in five places in Rasuwa. The SFDP is supposed to disburse loans to farmers in the district in consultation with the Agricultural Development Office (ADO). However, there is a problem in disbursing loans to those engaged in the horticultural sector. The total loan investment for the last five years through the Agricultural Development Bank (ADB/N), including SFDP, was only Rs 1,924,000, which is a very small amount.

The low disbursement of loans in the horticultural sector is mainly due to the long gestation period. SFDP should be more involved in encouraging the cultivation of potential crops in the area, e.g., apples and potatoes.

Loans should be of a specific nature. The interest imposed should be very nominal and the process of sanctioning loans should be simplified. The small farmers of these areas are not educated, therefore the simplest possible procedures should be followed.

Rasuwa-Nuwakot Integrated Rural Development Project

The Rasuwa-Nuwakot Integrated Rural Development Project (IRDP) was started in 1976/77 in order to develop hill agriculture. This project was implemented by HMG with World Bank assistance. The main objectives of the first phase were to increase physical facilities, construct roads and bridges, develop irrigation facilities, and support different agricultural extension services. This project has extended support to the horticultural farm in Rasuwa and the Agricultural Development Offices by building facilities, imparting training to permanent staff, and providing temporary staff. However, this project has failed to identify the actual potentials of Rasuwa District in the horticultural sector. The manpower supplied to ADOs includes subject matter specialists, i.e., assistant agronomists and assistant extension officers. The allocated budget also does not clearly specify the actual budget for horticultural development in Rasuwa, excluding the support services provided to the horticultural farm. A separate unit for horticultural extension services integrated with other sectors such as education, health, livestock, etc will certainly prove to be most effective for rural development. The IRDP should be a two-way bridge between local level agents (governmental and non-governmental) and concerned line agencies and departments to ensure better coordination.

Household Investment

The farmers of Rasuwa have invested very little in fruit cultivation. However, considerable sums are invested in potato and vegetable cultivation. The overall investments required for orchards and for potato and vegetable cultivation are Rs 25,178, Rs 38,045 and Rs 10,538 per hectare respectively. The costs are very high in comparison to the present investments made by farmers (Tables 7-11). The investment costs were calculated on the basis of present prices and discussions with concerned personnel in Rasuwa.

The present income of the farmers is not sufficient to enable investment in fruit and vegetable cultivation. The ADB/N or other agencies should provide the necessary credit for horticultural development. The ADB/N sanctions loans up to 70 per cent of the total scheme for horticultural development. This may not be sufficient for the rural sector. Rasuwa's farmers give top priority to their household needs. Household investments are limited to human labour and farmyard manure.

Costs of purchased inputs, such as planting materials, fertilisers, and chemicals for plant protection, need to be subsidised as an incentive to the farmers if they choose to cultivate fruits requiring a long gestation period. Other costs can be met by granting loans from credit institutions. These loans should be subsidised also, i.e., at least to the extent of 50 per cent of the interest rate.

**Table 7: Household Investment for Potato Cultivation
under Present Conditions in Rasuwa**

Items	Quantity	Total Cost
1. Variable Costs		
Planting materials		
Seeds	800 kg/ha	Rs 8000.00
Compost	2000 kg/ha	200.00
Labour	270 mdays/ha	10800.00
	Total	19000.00
2. Fixed Costs		
Land revenue	-	15.00
Farm equipment	-	145.00
	Total	160.00
	Total (1+2)	19000.00 +160.00
	Total investment	Rs 19160.00
Household investment		
Compost		200.00
Labour		10200.00
		11000.00

Source: Field Survey

Table 8: Production Cost of Potato Cultivation Using Improved Methods

Items	Quantity	Total Cost
1. Variable Costs		
Potato seeds	1,200kg/ha	12000.00
Labour *	290m days/ha	11600.00
Ploughing	60 days/ha	4800.00
Manure	2,000kg/ha	200.00
Fertilisers (80.60.80)	200kg	1400.00
Chemicals for plant protection		200.00
	Total	30200.00
	Interest 15%	4530.00
	Total	34730.00
2. Fixed Cost		
Land revenue		15.00
Farm equipment		300.00
Sprayers		3000.00
	Total	3315.00
	Total Cost (1+2)	38045.00

Source: Field Survey

* Labour refers to field preparation, applying manure, digging, manuring, soiling, weeding, plant protection measures, harvesting, etc.
m days = man days

Table 9: Total Cost of Vegetable (Cauliflower) Production in Rasuwa

Items	Unit	Quantity	Rate (Rs)	Total Cost (Rs)
1. Variable Costs				
Ploughing	m days	20	40.00	800.00
Labour*	m days	160	40.00	6400.00
Seeds/seedlings	gm	500	200.00	100.00
Manure	mt	5	700	500.00
Fertilisers	kg			
Complexal		100	630	630.00
Muriate of potash		40	321.0	128.40
Chemicals for plant protection		-	-	-
				<hr/>
				8558.40
				<hr/>
Interest on variable cost - 18%				1540.44
				<hr/>
Total				10098.84
2. Fixed Costs				
Land revenue	ha	1	40	40.00
Equipment (spades, ploughs, etc.)				400.00
Maintenance cost of equipment				
				<hr/>
Total				440.00
				<hr/>
Total (1+2)				10538.84

* Labour includes field preparation, manure/fertiliser application, sowing/transplanting, weeding/intercropping, irrigation, plant protection, and harvesting.

Table 10: Average Production Cost of Fruit/Ha in Rasuwa (Apples)

Items	Unit	Quantity	Rate (Rs)	Total (Rs)
1. Variable Costs				
Labour				
Digging pits	m days	60	40	2400.00
Planting	m days	15		600.00
Pruning	m days	75		3000.00
Manure Application	m days	20		800.00
Fertiliser Application	m days	5		200.00
Spraying	m days	5		200.00
Harvesting	m days	50		2000.00
Manure	MT	5	100	500.00
Fertilisers				
Complexal	kg	800	6.30	5040.00
Muriate of potash	kg	150	3.21	481.50
Chemicals	kg			200.00
Dithane M-45 & others				
Equipment Maintenance (sprayers, secateurs, spades, etc)				200.00
Plants				1950.00
			Total	17571.50
Interest on variable cost - 16%	no	300	6.5	3162.86
			Total	20734.36
2. Fixed Costs				
Land revenue				40.00
Equipment				4000.00
			Total	4040.00
Depreciation cost of fixed cost				404.00
			Total	4444.00
			Grand Total	25178.36

Source: Field Survey

Note:

- The farmers of Rasuwa generally do not prune apple plants.
- Very few orchards are pruned.
- Chemical fertilisers are not used except in mixed cropping (vegetables + apples).
- Spraying is not carried out for pest and disease control.
- Computation of apple production cost is indicative of average conditions because planting and harvesting operations cannot be carried out simultaneously.
- Manure and fertiliser doses are different for one-year old plants than for ten-year old plants, therefore, computation was based on the average plant age.
- Equipment once purchased can be used for about five years on an average.

Table 11: Production Cost of Maize in Rasuwa District

Items	Unit	Quantity	Rate (Rs)	Total (Rs) 1 ha
1. Variable Costs				
Labour				
Ploughing	m days	20	40	800.00
Labourers*	m days	100	40	4000.00
Seed	kg	25	40	1000.00
Manure	MT	2		400.00
Fertilisers	-	-		-
Plant Protection	-	-		-
Total				6200.00
2. Fixed Costs				
Land revenue				40.00
Maintenance of farm equipment				100.00
Farm equipment				4000.00
				5040.00
Total (1+2)				11240.00

Source: Field Survey

Labour includes field preparation, manuring, sowing, weeding, harvesting, etc. m days = man days

POST-HARVEST PRACTICES

Production is meaningless unless consumers have access to produce. Post-harvest practices include all the stages from harvesting to consumption. Wills et al. (1989) reported that 25-80 per cent of fresh fruits and vegetables are lost after harvest. Systematic harvesting and other post-harvest practices are not followed in Rasuwa District. Therefore, there are probably more losses than reported. Post-harvest practices include harvesting, handling, grading, packing, transportation, storage, processing, and marketing. These practices are very new in Nepal, although farmers and traders do adopt these practices, knowingly or unknowingly. Extension activities in Rasuwa do not include a specific programme for post-harvest practices.

Harvesting Techniques

In Rasuwa, farmers harvest fruits (apples) and vegetables as and when needed. They are ignorant of appropriate harvesting methods and the proper harvesting period. For example, farmers harvest the apple crop during *Janai Purnima* even if the fruits are green or are just developing colour. Farmers just pick the fruit from the trees without using ladders, irrespective of whether it is for immediate consumption, storage, or processing purposes. As a result, the harvested fruits are unripe, sour, tasteless, and difficult to transport as well as to store. Such fruits tend to decay or shrink very quickly.

In the case of apples, especially the Red Delicious variety, a harvesting index, i.e., change in the colour of fruit, total weight, solidity, firmness, or stages from flowering to harvesting must be considered. The colour of Red Delicious should be reddish during harvesting. Golden Delicious is reddish but at the time of harvesting the colour becomes green to yellow. They can be easily picked during harvest, however, a ladder must be used to harvest all varieties of fruit. Tree-shaking or other harmful harvesting methods should be discouraged.

Packing and Grading

As mentioned earlier, the harvesting techniques used in Rasuwa are very primitive, and grading and packing are not carried out properly either. The practice of grading fruits and vegetables does not exist. Irrespective of grade, harvested fruits are sent to the market. A proper grading system should be developed or systems developed elsewhere (preferably India) should be taught to the farmers and carefully followed.

Farmers pack fruits in bamboo *doko* (bamboo baskets) and gunny sacks. Rough handling of fruits during harvesting and packing results in bruising and early decay. However, fruits cannot be stored for long periods or transported over long distances. Even if *doko* are used, improvements can be made by covering the sides of the baskets as well as the space between fruit piles with moss and straw.

Storage

In Rasuwa, fruits, especially apples, are harvested prematurely during the *Janai Purnima* festival in order to sell the produce to the pilgrims travelling to Gosainkund. The fruits are sour and tasteless. They shrink and decay during storage if unsold.

Properly stored fruits can be marketed during the off-season. Price reduction, resulting from glut production, can be minimised. Fruits can be marketed by following the pattern of demand. Rasuwa lacks proper storage facilities. The Department of Food and Agriculture Marketing Services (DFAMS) had constructed five storage cellars. Rasuwa is a temperate region where the temperature can be regulated to even 4-5°C or less until March-April. However, the farmers could not maintain the storage facilities and only one remains at present. The farmers felt that since the Government constructed the cellars, they should be maintained by the Government no matter how useful the storage facilities were.

Farmers should be made aware of the fact that storage facilities, e.g., cellars can be very useful for storing fruits, potatoes, and onions for long periods until market prices increase. Consequently, the produce will yield better returns. Therefore, farmers should invest in the construction of storage facilities as an incentive for proper maintenance of these facilities.

Transportation

At present, Rasuwa is linked by an all-weather gravel road to Trishuli and by a metal road from Trishuli to Kathmandu. The total length of the road from Kathmandu to Trishuli is 72km, from Trishuli to Dhunche 48km, and to Somdang 105km. This road links almost half of Rasuwa District. All VDCs except Langtang can be reached in about four to five hours' walk from the road.

For marketing highly perishable goods such as fruits and vegetables, transportation is of critical importance, especially in areas located in the interior. Construction of a ropeway system from the production sites to the roadhead should be considered in order to transport perishable goods more quickly and easily to the roadhead and thereon to the consumers.

Processing

In Rasuwa, some vegetables, e.g., radishes, are processed traditionally. Fruits and potatoes are not processed locally. In recent years, apple brandy has been made by the local people by mixing apples and sugar (molasses).

Rasuwa is nearer to the Kathmandu market, therefore emphasis should be placed on marketing fresh fruits and vegetables. However, in some cases, processing can be carried out if proper fruit varieties are selected.

More perishable fruits, e.g., peaches, should be used for distillation of alcoholic beverages. Apples could be used to reduce fermentation of millet and other cereals.

MARKETING

Existing Marketing System

Fruits and vegetables are highly perishable in nature, therefore these commodities should be marketed immediately after harvest and the utmost care should be taken in doing so. A price information system would help farmers to decide when to harvest and market. The present marketing system is conducted by farmers, retailers, middlemen, and businessmen. There is no permanent market in Rasuwa. Dhunche, the so-called big market, is not organised. Only a small portion of the produce is sold in the small bazaars like Bharkhu, Syaphrubesi, Kalikasthan, and Betrawati. The present market flow pattern is as follows.

The retailers or farmers bring produce directly to the consumers through small markets or through the Dhunche market. Most of the vegetables, apples, walnuts, peaches, plums, and potatoes are marketed in this manner. However, potatoes (including seeds) and apples are also purchased by middlemen, contractors, or businessmen. These commodities are then taken to Dhunche, Trishuli, and Kathmandu. The existing marketing system is shown in Figure 1.

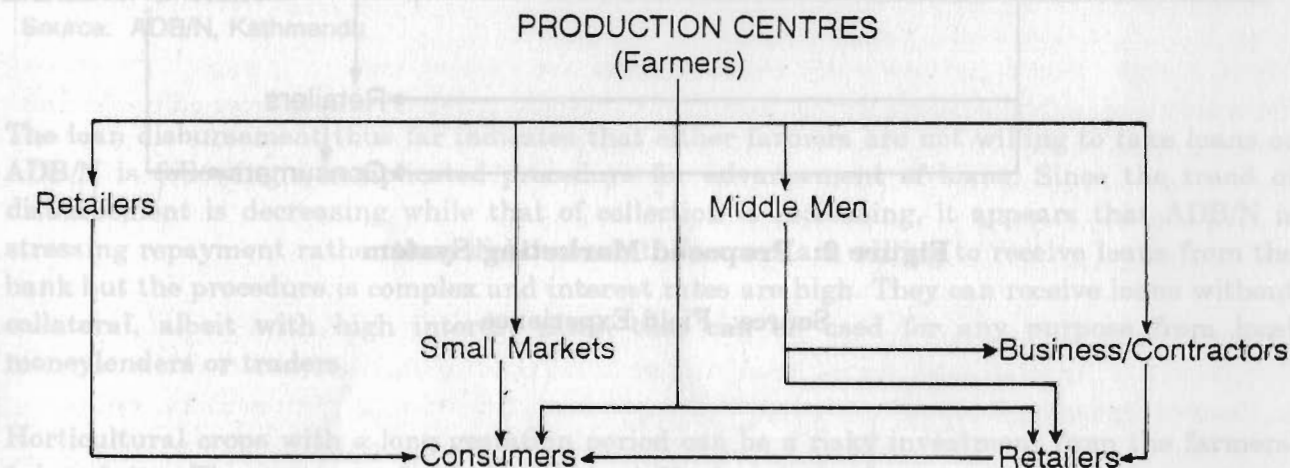


Figure 1: The Existing Marketing System

Source: Field Experience

Proposed Marketing System

The demand for fresh fruits and vegetables has increased in the district itself as a result of the influx of tourists, road development, urbanisation in Dhunche, the existence of a military base, and also the increasing population of Trishuli as well as Kathmandu. Rasuwa can play a

significant role in meeting this demand by increasing the area under crops, production, and productivity.

The present marketing system needs to be improved so that fresh, cheap produce is available for consumers, thereby yielding more benefits to producers. This system should target the Kathmandu wholesale market, reducing the role of middlemen or contractors as shown in Figure 2.

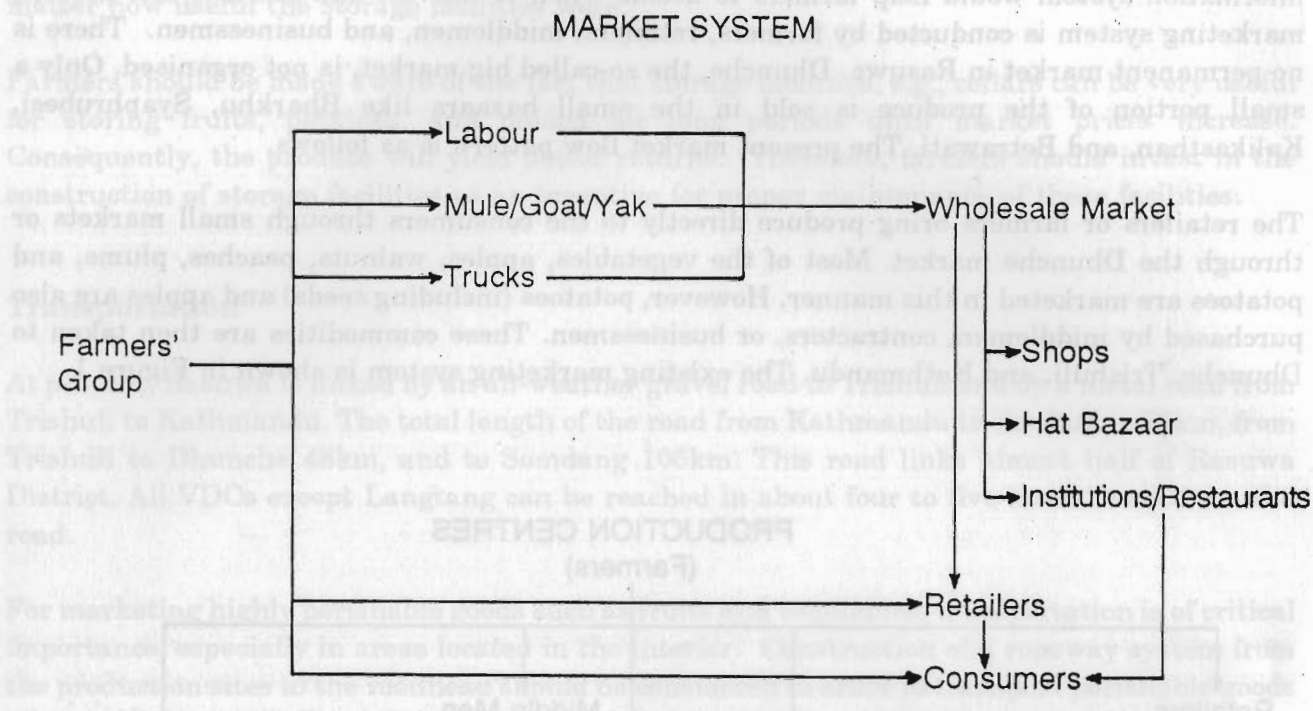


Figure 2: Proposed Marketing System

Source: Field Experience

All the farmers cannot sell their produce in the wholesale market. Therefore, the formation of Farmers' Groups should be encouraged in the form of associations or cooperatives to monitor the marketing system at all levels, i.e., from the production sites to the markets. This system will certainly increase efficiency and reduce post-harvest losses, including price fluctuation, since reliable price information will be received from all sectors. These groups can manage the storage facilities in the areas where they are needed. To support these groups, there should be (1) collection of information on the prices of all commodities, either periodically, or weekly, or daily; as well as on the supply and demand situation in concerned areas; (2) market research, promotion, and development at various stages; and (3) establishment of collection centres and *hat bazaar* in the production pockets of districts and markets.

In order to carry out these functions, the Department of Food and Agriculture must be active. DFAMS should also prepare legislation for the marketing of horticultural produce (perishable goods).

CREDIT

The Agricultural Development Bank (ADB/N) is responsible for advancing loans for fruit and vegetable production in the district. As can be observed from Table 12, the bank has disbursed Rs 1,920,000 for fruit and vegetable cultivation. This amount seems to be quite small for five years, in view of the development potential of fruits and vegetables in the district.

**Table 12: Loan Disbursement for Horticultural Crops
in Rasuwa District for a Five-year Period**

Fiscal Year	Disbursement (Rs '000)	Collection (Rs '000)
1986/87	363	25
1987/88	571	39
1988/89	531	74
1989/90	353	36
1990/91	102	58
	----	----
	1920	232

Source: ADB/N, Kathmandu

The loan disbursement thus far indicates that either farmers are not willing to take loans or ADB/N is following a complicated procedure for advancement of loans. Since the trend of disbursement is decreasing while that of collection is increasing, it appears that ADB/N is stressing repayment rather than disbursement. Farmers are willing to receive loans from the bank but the procedure is complex and interest rates are high. They can receive loans without collateral, albeit with high interest rates, that can be used for any purpose from local moneylenders or traders.

Horticultural crops with a long gestation period can be a risky investment from the farmers' point of view. There are no subsidies on interest. For innovative farmers, loan advancement may be approved for about 80 per cent of the scheme with collateral by the ADB/N. However, the collateral cannot be sold.

Horticultural crops require a high initial investment and this is difficult for most resource-poor farmers. Clear-cut policies, i.e., (1) 100 per cent loan advancement; (2) subsidised interest rate for fruit cultivation; (3) interest charge only after fruiting; (4) consumers' loan, particularly during the gestation period; (5) production loans for fruits and vegetables; and (6) exemption from the collateral system for small farmers are urgently required.

INPUTS

Planting Materials

When fruit cultivation was introduced in Rasuwa, all the saplings that were distributed were supplied by outside sources. After the establishment of the horticultural station, a portion of the planting materials that were required was supplied by the station. Within the last five years, two private nurseries have been established, but these have not been able to use their full production capacity.

Fertilisers

Fertilisers are generally not used by farmers for fruit and vegetable cultivation. Use of chemical fertilisers, particularly for cultivating potatoes and vegetables, should be encouraged; in addition to compost and FYM (farmyard manure). Fertilisers are available from the Agricultural Inputs' Corporation (AIC) through co-operatives and dealers or directly from the AIC.

Pesticides and Fungicides

There is no evidence that pesticides and fungicides are applied, excluding some big orchards. This may be due to the lack of expert technical advice or poor extension services. The AIC also does not keep sufficient amounts of these substances.

Tools and Implements

Tools that are locally made by blacksmiths are used, apart from secateurs and pruning saws. Secateurs and pruning saws are imported and are not easily available. These tools are not used in most of the orchards.

FUTURE HORTICULTURAL DEVELOPMENT PROGRAMMES IN RASUWA DISTRICT

Area and Production

The projection of the situation up to 1990/91 is given in Table 13; 37.2 per cent was assumed as the mortality rate (MPHD), and, according to this, the area under walnuts, peaches, and other fruits was estimated. The production figures seem to be exaggerated in the case of fruits. However, this computed figure was taken as the base for area and production while calculating and formulating plans for the next 10 years.

Fruits

The fruits grown in Rasuwa include apples, pears, plums, walnuts, citrus fruits, guavas, and mangoes. The area under fruits, in the district should not be increased. In view of the climate and market and transportation facilities, apples should be given priority. The expected area increase in the coming 10 years is 250 ha. This area will not yield any returns during that period, but by introducing better and scientific management practices, and with substantially improved facilities, productivity can be increased up to 15MT/ha. Production will reach 2,092MT at the end of 1996/97 and 2,792MT at the end of 2001/2002. However, these estimates are very conservative and farmers may not adopt all of the recommendations for improvement of orchards.

Apple varieties should be limited to the Delicious variety, as it has already been introduced into the area.

The estimated increase in the area under walnuts is limited to five ha/year. The productivity reported does not appear to be correct. However, production may increase to six MT/ha, thus the reported productivity could be maintained.

Peaches are recommended for cultivation in warm temperate zones. Marketing fresh fruit may be difficult because of its highly perishable nature. Varieties for processing (non-clinging type) should be introduced for canning purposes in future. The varieties introduced at present will produce peaches suitable for fermentation which can be used instead of millet. The area increase in the coming 10 years will be only five ha every year. The total area will be 119ha with a production of 450MT (Table 13). However, peach productivity may increase up to 10-12MT/ha under ideal conditions.

Vegetables

Rasuwa has a temperate climate which is suitable for the cultivation of off-season vegetables and high-value vegetable seeds. The vegetables produced can easily be marketed in Kathmandu. Therefore, cauliflower varieties such as Pusa Depali and Nuzerkiwase - as early varieties, Kathmandu Local - as mid-season varieties, and Snowball-16 - as late varieties can be grown in areas along the roadside as off-season vegetables. These areas can supply cauliflowers from

April to October. In addition, cauliflowers, cabbages (Copenhagen Market, KK Cross) and green pod peas (Sikkim, Arkel, NLP) can also be grown. Peas sown during July-August will be ready for marketing during September-November.

Table 13: Expected Area and Production of Fruits, Vegetables, and Potatoes in Rasuwa District

Commodities	Existing Situation until 1990/91			Expected Area and Production									
				1992 - 1997					1997 - 2002				
	Area (ha)	Production (MT)	Productivity (MT/ha)	Additional Area (ha)	Prod. (ha)	Prod. (MT/ha)	Total Area	Total Prod.	Additional Area (ha)	Prod. (MT)	Prod. (MT/ha)	Total area	Total Prod. (MT)
Apple	224	1691.36	7.55	125	2092	9.33	349	2092	125	2792		474	2792
Walnut	45	126.40	2.80	25	130	2.88	70	130	25	130	2.88	95	130
Peach	69	397.90	5.76	25	415	6.01	94	415	25	450	6.52	119	450
Other fruits	194	2007.89	10.35	-	-	-	-	-	-	7500	21.42	200	2007.89
Vegetables	225	3682	16.36	300	5400	18.0	300	5400	350	41400	18.0	350	7500
Potato	2316	16750	7.23	2300	27600	12.0	2300	27600	2300			2300	41400

* This figure is computed from Table 3 on the basis of a 37.2% mortality rate.

The estimated increase in the area under vegetables for the next 10 years is 350ha only, near and around the roadside. Intensive cultivation technologies can increase production up to 7,500MT (Table 13). The vegetables can be intercropped in apple orchards.

Carrot, cauliflower, and cabbage seeds can also be grown. Presently, these seeds are either imported from abroad or grown in Dolpa, Jumla, or Marpha in limited amounts.

Potato Cultivation

Potatoes are the main crop grown in Rasuwa. Local varieties of potato used to be grown in Rasuwa and supplied to other districts.

If appropriate technologies are used by the farmers, productivity can increase to as high as 30-40MT/ha. However, in the next 10 years, productivity may be expected to increase up to 12MT/ha on an average or 41,400MT every year (Table 13).

The potatoes produced in the district are marketed immediately after harvest at low prices, due to lack of storage facilities and lack of knowledge of local, improved methods of storage. Therefore, storage facilities should be improved.

Under normal conditions, potato seeds are flown from higher altitudes to lower in order to reduce the risk of occurrence of viral diseases. Viral diseases negatively affect the seed quality, thereby the yield decreases. In the past, potato seeds were sold from Rasuwa to Nuwakot. To exploit this advantage, a proper seed production programme should be implemented in the

district. The natural climate can be manipulated to construct cellars at low cost for storing seeds. Even a sophisticated cold storage can be built in Rasuwa. Entry of seeds from other districts should be restricted. Wart disease has been reported in Nuwakot, and this is dangerous as it remains in the soil even up to a period of 20 years.

The popular varieties grown in Rasuwa are Kufri Jyoti (White) and Cardinal (Red) only. Cardinal is susceptible to late blight. Other varieties, such as Hybrid - 14, CFM and Deserve, should also be introduced. Local varieties could be replaced by these high-yielding varieties.

Institutions

To implement the above-mentioned programmes more efficiently, institutions must be developed. At present, the Agricultural Development Office (ADO) is conducting a cereal programme and has subject matter specialists (SMS) in agronomy. Therefore, considering the potential of horticultural crops, the ADO should be converted into a Horticultural Development Office (HDO), or a separate HDO should be established to look after the horticultural sector only. The HDO should have a Horticultural Development Officer (GIO) responsible for horticultural crops (fruits) and administration, assisted by two vegetable and potato development officers (GIII). Nine Junior Technicians (JT) are recommended for placement in four to five service centres. Three administrative (Junior) staff and three peon-level staff are also recommended.

Similarly, the horticultural farm should be improved so that it can provide diagnostic services and information on basic seed production. The Government is presently considering privatising this farm or converting it into a national park.

Tourism

Since Rasuwa is linked by an all-weather road to Kathmandu, the flow of tourists is increasing every year. There are about seven to eight thousand foreign tourists every year in addition to Nepalese pilgrims travelling to Gosainkund. Horticultural development in the area will attract more tourists as there will be an abundant supply of fruits and vegetables to cater to trekkers' needs. Tourism can provide a boost to horticultural development as is evident in the Jomsom-Marpha area of Mustang.

Government Farm vis-a-vis Private Nurseries

To produce an additional 25ha of apples, five ha of walnuts, and five ha of peaches every year, 7,500 apple saplings, 1,200 walnut saplings, and 1,500 peach saplings are required per year. The saplings should be produced in the district itself.

Private nurseries are producing only 429-1,500 saplings every year. Private nurseries should therefore be promoted so that the required number of saplings are produced.

The horticultural farm should not be involved in the production of saplings. Therefore, this farm should involve itself in the following activities.

a) More than 1,50,000 plants have been planted in the district. In future, a programme for intensive horticultural development should aim at increases in area, production, and productivity. Diagnostic services, high quality saplings, as well as foundation seeds are required. Therefore, the farm should concentrate on the following objectives.

1. Providing diagnostic services.
2. Conducting problem-oriented research and adaptive research.
3. Producing quality saplings of newly introduced fruit varieties.
4. Producing foundation seeds of vegetables for supply to seed growers in the district as well as in other needy districts.
5. Producing basic potato seeds from tissue culture tuberlets.
6. Collecting and maintaining locally grown potato varieties.

Investment

Investment in the horticultural sector is very nominal. Investment made by the ADO in the horticultural sector is negligible and not clearly known. Agricultural Extension is investing Rs 625,350/- and Rs 892,450/- for programmes and manpower respectively every year. The horticultural farm has invested Rs 5,559,520/- in the last 20 years for research and development, with a total revenue of Rs 384,348.

The projected investment from the government sector for 10 years is Rs 15,302,500 for horticultural research and development (Rs 5,492,700), for the horticultural extension programme, Rs 3,400,000, and for manpower for horticultural extension, Rs 4,409,800 at the current rupee value (Table 13). In Rasuwa, a Rs 2,000,000 investment has been proposed for market establishment.

The proposed investments for extension services and for the horticultural farm do not include investments in vehicles and construction of buildings. Construction of storage facilities for farmers to store their excess produce and potato seeds requires additional funds as well as additional investment for granting production loans.

Farmers in Rasuwa are unable to invest much on the production side, except for locally available labour and compost. The estimated increase in production loans for 10 years is Rs 6,891,250 for fruits, vegetables, and potatoes. For production of saplings, Rs 10,392 per nursery is required. Two cold storages and 10 cellar storages require Rs 83,928,500 and Rs 1,600,000 respectively for construction. The total investment by both the Government and the private sector is Rs 124,861,350 (Table 14).

The Government should subsidise the full interest on production loans provided by the ADB/N for five years as the plants do not bear any fruit during that period.

Table 14: Investment for Horticultural Development in Rasuwa

(in Thousands)

Investment Sectors	Total Expenditure until 1990/91	Budget for 1990/91	Proposed Investment			Remarks
			1991-96	1997-2002	Total	
A. Government Sector						
1. Horticultural Farm* (Research & Development)	5559.52	549.27	2746.36	2746.35	5492.7	
2. Agril. Extension		1517.80				
Programmes	NA	625.35	-	-	-	
Manpower & others	NA	892.45	-	-	-	
3. Horticultural Extension			3904.90	3904.90	7809.80	
Programmes	-	NA	1700.0	1700.0	3400.0	
Manpower & others	-	-	2204.9	2204.9	4409.8	
4. Market establishment	-	-	1000.0	1000.0	2000.0	Local level
Total	5559.52	2067.07	7651.26	7651.26	15302.5	
B. Private or Other Sectors*						
1. Storage investment						
Cold storage (2)			41964.28	41964.28	83928.5	Cold Storage Capacity 1000mt
Cellar storage (10)			800.00	800.00	1600.0	& Cellar Storage Capacity 7-10mt
2. Production loans						
Fruits			3445.62	3445.62	6891.25	For additional area only
Vegetables			967.5	1128.75	2096.25	
Potatoes			7417.5	7417.5	14835.00	
3. Nursery management			103.92	103.92	207.85	For two nurseries
Total			54698.82	54860.07	109558.85	
Total (A+B)	5559.52	2067.07	62350.08	62511.32	124861.35	

Figures in parentheses are numbers.

- * Revenue Rs 384348/98 (from 028/29 to 2047/48)
- * Loans' requirement was derived from the Master Plan for Horticultural Development in Nepal (HMG/ADB 1990). Market establishment investment was also derived from the Master Plan.

RECOMMENDATIONS

Based on the above discussion, the following recommendations have been made for horticultural development in Rasuwa.

Fruit Cultivation

1. The apple orchards that are located in Goljung, Gatlang, Bridim, Syaphrubesi, and Chilime village development committees should be improved.
2. Suitable areas should be selected for cultivation of delicious apple varieties like Red, Royal, and Golden Delicious in the above villages. Golden Delicious should comprise at least 25 per cent of the orchard area as a polliniser.
3. Commercial orchards should have easy access to inputs such as planting materials, fertilisers, insecticides, fungicides, tools, implements, and credit.
4. The established fruit nurseries should be registered and should operate according to the Nursery Act. These nurseries can meet the demand for apple saplings in the district. There is no Nursery Act as yet and it is necessary to formulate one.
5. The horticultural farm in Rasuwa should conduct research on apple scab, powdery mildew, papery bark, woolly aphids, and Son-J-scale diseases on a priority basis as the prevalence of these diseases and insects in the district is a major problem.
6. Regular and careful surveillance should be carried out and a plant protection campaign should be started. Management practices, pruning, and proper harvesting techniques should also be highlighted in the campaign.
7. Cellar storage for apples should be built by individual farmers or cooperatives.
8. Wild animals from the National Park cause damage to crops. This has dampened the enthusiasm and zeal of the farmers. An alternative arrangement is urgently required to avoid further damage.
9. In areas where climatic conditions are favourable, peaches, plums, pears, and citrus fruits should be cultivated in kitchen gardens. Peaches can replace finger millet for distillation purposes.
10. The food habits of the local people may need to change in order to substitute cereal consumption, as Rasuwa is a food-deficit district. Awareness should be created among the local population regarding this issue.

Soil Management in Fruit Cultivation

11. Hilly soil should be carefully handled because it is susceptible to degradation. Soil loss can be reduced by cultivating fruits as the plants have deep roots that prevent soil degradation.

12. The soils of commercial orchards should be tested periodically and nutrient requirements should be recommended accordingly. Rasuwa's farmers do not apply chemical fertilisers, although some apply a small amount of compost.
13. Composting and compost preparation programmes should be encouraged in the villages. Compost helps to improve soil texture and structure as well as to increase the water-retaining capacity. Compost application will reduce the need for importing chemical fertilisers.
14. Low-cost drip irrigation could be introduced in the area.

Vegetable and Potato Production

15. Off-season vegetables such as cauliflowers, cabbages, carrots, and green pod peas can be grown during the off-season for the Kathmandu market (April to November.) These crops can be intercropped with fruits (apples) or grown as mono crops.
16. In the case of intercropping, supplementary nutrients must be added to the soil. Farmers must be made aware of this aspect.
17. Potatoes are the main crop but they are susceptible to infection. Brown rot is one of the most common diseases. Therefore, seed potatoes should not be brought from Trishuli and other places into Rasuwa without a certificate from the National Potato Development Programme.
18. Cold storages should be constructed in the remote production pockets in order to avoid production glut and low market prices. These storages could be used for preserving potato seeds also.
19. Rasuwa should produce potato seeds and supply the excess produce to other districts. Farmers need to be trained properly in crop rotation, fertiliser application, and storage of potato seeds.
20. High-value cash crops, such as walnuts, good apple varieties, potato seeds, carrot seeds, and Snowball cauliflowers, have good prospects in Rasuwa. These seeds are available at present in Nepal and are supplied either from Jumla, Dolpa, and Mustang, or from abroad.

Extension and Training

21. The extension workers in Rasuwa have many tasks to perform although they have little knowledge of most crops. The poor performance of farmers in the management of apple orchards, potato production, and seed production is due to lack of appropriate extension services. Crop-specific extension services should, therefore, be promoted.
22. There should be regular refresher courses and follow-up training programmes for extension workers. Training to farmers on various aspects of orchard management, seed production, and off-season vegetable production should also be regular and specific.

Institution Building

23. The Agricultural Development Office is responsible for overall supervision of extension activities in the district. This office lacks trained manpower. The ADO is cereal-oriented, and thus, gives top priority to cereal crops. In Rasuwa, there is a subject matter specialist in agronomy only. Hence, it is recommended that horticultural extension should be carried out by horticulturists for promotion of specific technologies in the district.
24. The establishment of a horticultural development office is required for horticultural extension. This office should carry out the following activities:
 - visit farmers to impart training and transfer technology;
 - select suitable pocket areas for fruit, vegetable, and potato cultivation; and
 - make inputs and credit available to farmers.
25. This system should function at the service centre level. Horticultural service centres should be established in pocket areas. They should not be limited to nine districts (*ilakas*) as in the case of agricultural extension (the present ADO), but on the basis of potential horticultural production.
26. The Horticultural Development Office should hold demonstrations on orchard management, seed production of vegetables and potatoes, exhibitions, and production competitions, i.e., orchards and vegetables.
27. As can be observed from Figures 3a and 3b, coordination between farmers and institutions is very weak.

This indicates that the linkages between the Department of Horticulture and horticultural extension activities in the districts are weak. Weak linkages do not result in good coordination, thereby the programme's objectives cannot be achieved.

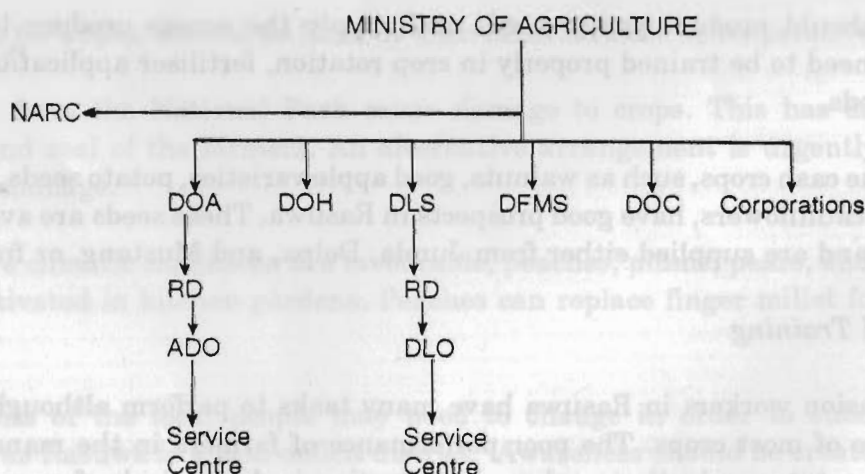


Figure 3a: Present Organisation of Ministry of Agriculture in Reference to Rasuwa

Source: MOA/HMG, 1991

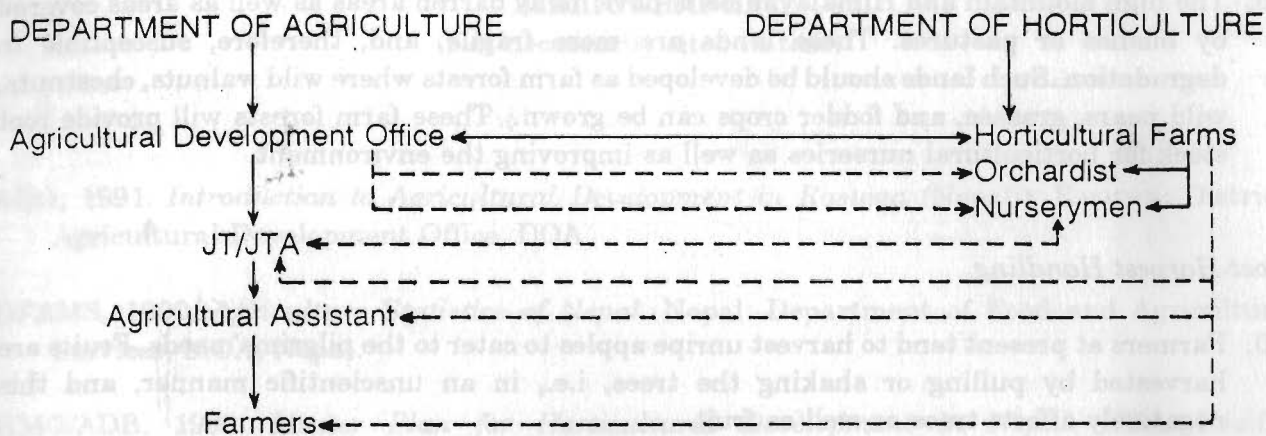


Figure 3b: Linkages among the DOA, DOH, and Farmers

Source: Adapted from MOA/HMG, 1991, and field experience

28. A single agency should be responsible for research, extension, and development. A person who is engaged in research on trees for 15-20 years will have sufficient experience to teach the farmers. Unlike cereals, there are many varieties of horticultural crops. A single extension worker cannot be familiar with all these varieties, including cereals. Therefore, a cadre of specialised extension workers is required for commercial production of fruits, vegetables, and potatoes. For this purpose, a district horticultural development office should be established as indicated in Figure 4. The limited agricultural extension needs (cereals) of Rasuwa can be taken care of by the ADO, Nuwakot.

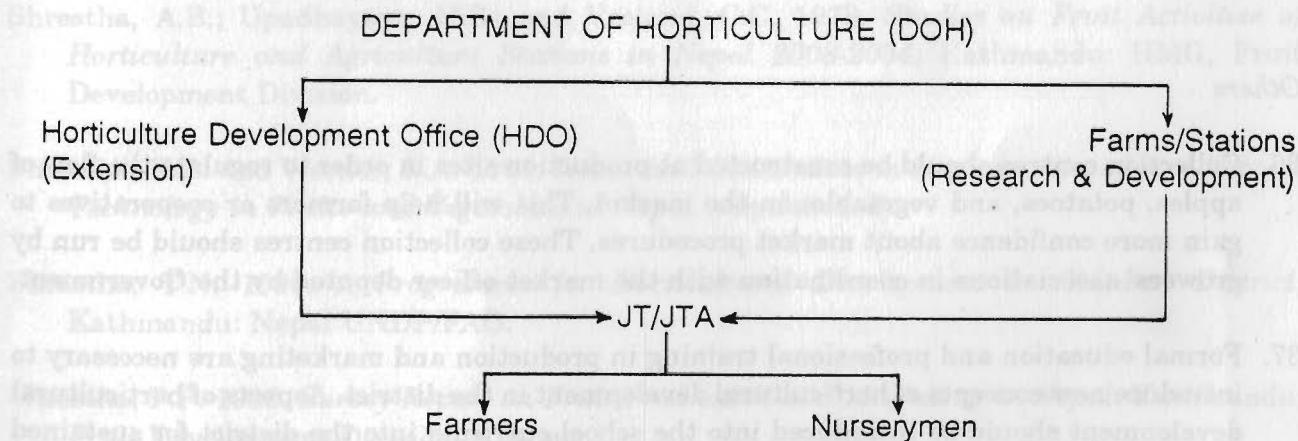


Figure 4: Proposed Extension Services in Rasuwa District

Source: Author

29. The high mountain and Himalayan belts have many barren areas as well as areas covered by bushes or pastures. These lands are more fragile, and, therefore, susceptible to degradation. Such lands should be developed as farm forests where wild walnuts, chestnuts, wild pears, grasses, and fodder crops can be grown. These farm forests will provide root stock for horticultural nurseries as well as improving the environment.

Post-Harvest Handling

30. Farmers at present tend to harvest unripe apples to cater to the pilgrims' needs. Fruits are harvested by pulling or shaking the trees, i.e., in an unscientific manner, and this negatively affects trees as well as fruit.
31. Common grading and packing facilities should be developed in production pockets so that farmers can learn how to grade and pack their produce properly.
32. A policy to encourage and assist the private sector in the construction of cold storage facilities should be implemented in Rasuwa in order to reduce glut production, thus lengthening the marketing period.
33. Until adequate transport facilities are available to farmers or cooperatives for transporting their produce to the market, the Government should develop a systematic transportation system to meet market demands as well as to encourage apple and vegetable growers.
34. Cold storages for vegetables should be constructed in the district.
35. Post-harvest losses are more costly than losses during production. These losses occur during harvesting, packing, storage, and transportation, due to lack of appropriate packing materials, and so on. These losses are also borne by the consumers in the form of price increase. Priority should be given to minimising post-harvest losses.

Others

36. Collection centres should be constructed at production sites in order to regulate the flow of apples, potatoes, and vegetables in the market. This will help farmers or cooperatives to gain more confidence about market procedures. These collection centres should be run by growers' associations in coordination with the market officer deputed by the Government.
37. Formal education and professional training in production and marketing are necessary to introduce new concepts of horticultural development in the district. Aspects of horticultural development should be introduced into the school curricula in the district for sustained promotion of horticulture.
38. Monitoring, supervision, and evaluation should be regularly carried out by the Horticultural Service Centre; Horticultural Development Office, Rasuwa; Central Fruit, Vegetable, and Potato Development Divisions; and the Department of Horticulture.

BIBLIOGRAPHY

(Not necessarily cited in text)

- ADO, 1991. *Introduction to Agricultural Development in Rasuwa* (Nepali). Rasuwa: District Agricultural Development Office, DOA.
- DFAMS, 1990. *Agriculture Statistics of Nepal*. Nepal: Department of Food and Agriculture Services, MOA, Nepal.
- HMG/ADB, 1990. *Master Plan for Horticultural Development in Nepal*. USA: Pacific Management Resources Inc. and Nepal: East Consultants (P) Ltd.
- ICIMOD/FAO, 1989. *Horticultural Development in the Hindu Kush-Himalayas*. Report of the International Workshop on Horticultural Development in the Hindu Kush-Himalayas. Kathmandu: ICIMOD.
- Munankarmi, R.B. 1990. *Kumaon Apples of India - Implications for the Apple Sector of the Far Western Hills of Nepal*. Nepal: No-Frills Consults (NFC).
- Pandey, I.R. 1991. "Policy Considerations and Institutional/Operational Aspects of District Horticultural Planning in Nepal. Paper presented at the National Workshop on District Agriculture Planning, November.
- Pokharel, M.N. and Shrestha, K.B. 1984. *Report on Evaluation of Vegetables, Vegetable Seed Production, and Fruit Development Programme of IHDP*. Nepal: IHDP/No-Frills Consults.
- Progress Report of Horticulture Farm, Rasuwa. Different dates.
- Shrestha, A.B.; Upadhyaya, N.S.; and Vreland, C.C. 1978. *Studies on Fruit Activities of Horticulture and Agriculture Stations in Nepal 2008-2034*. Kathmandu: HMG, Fruit Development Division.
- Shrestha, K.B. and Werner, R.A. 1991. *Issues and Constraints in Improvement of Post-harvest Technology in Fruits and Vegetables in Nepal* (unpublished).
- Shrestha, T.N. 1990. *A Programme for Horticultural Development in Chitwan District*. Kathmandu: Nepal UNDP/FAO.
- Shrestha, P.P. 1983. *Survey Report on Fruit Production and Marketing in Nepal*. Kathmandu: Fruit Development Division, Kirtipur.
- Wills, R.B.H.; McGlasson, W.B.; Graham, D.; Lee, T.H.; and Hall, E.G. 1989. *Post-harvest - An Introduction to the Physiology and Handling of Fruits and Vegetables*. Australia: New South Wales University Press.

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