ICIMOD
International Centre for Integrated Mountain Development

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

HORTICULTURAL DEVELOPMENT IN THE HINDU KUSH-HIMALAYAS

Report of

International Expert Meeting on Horticultural Development in the Hindu Kush-Himalayas

Organised by International Centre for Integrated Mountain Development (ICIMOD), in collaboration with Ministry of Agriculture, His Majesty's Government, Nepal

and

Food and Agriculture Organisation

Kathmandu, Nepal

19-21 June, 1989

ICIMOD Workshop Series

The International Centre for Integrated Mountain Development began professional activities in September 1984, with the first objective of reviewing development and environmental management experience in the Hindu Kush-Himalayan Region. International Workshops were planned in several major fields to review the state of knowledge and practical experience, and also to provide an opportunity for the exchange of professional expertise with regard to integrated mountain development.

Workshops held included :

- **International Workshop on Watershed Management in the Hindu Kush-Himalaya**
  14-19 October, 1985, Chengdu, China
- **International Workshop on Planned Urbanisation and Rural Urban Linkages in the Hindu Kush-Himalaya Region**
  25-29 March, 1986, Kathmandu, Nepal
- **International Workshop on District Energy Planning and Management for Integrated Mountain Development**
  3-5 May, 1986, Kathmandu Nepal
- **International Workshop on Off-farm Employment Generation in the Hindu Kush-Himalaya**
  17-19 May, 1986, Dehra Dun, India
- **International Workshop on Mountain Agriculture and Crop Genetic Resources**
  16-19 February, 1987, Kathmandu, Nepal
- **International Workshop on Women, Development, and Mountain Resources: Approaches to Internalising Gender Perspectives**
  21-24 November, 1988, Kathmandu, Nepal
- **International Symposium on Mountain Environmental Management**
  11-14 April, 1989, Kathmandu, Nepal
- **International Expert Meeting on Horticultural Development in the Hindu Kush-Himalayan Region**
  19-21 June, 1989, Kathmandu, Nepal
- **International Expert Meeting on Apicultural Development in the Hindu Kush-Himalayas**
  21-23 June, 1989, Kathmandu, Nepal

These Workshops were attended by experts from the countries of the Region, in addition to concerned professionals and representatives of international agencies. A large number of professional papers and research studies were presented and discussed in detail.

Workshop Reports are intended to represent the discussions and conclusions reached at the Workshop and do not necessarily reflect the views of ICIMOD or other participating institutions.

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Report of the

International Expert Meeting on Horticultural Development in the Hindu Kush-Himalayan Region

International Centre for Integrated Mountain Development
Kathmandu, Nepal

Cover photographs:

Top Left : Apple Orchard with Cabbages as an Intercrop: Marpha Horticultural Research Station, West Nepal

Bottom left: Radishes ready for Marketing: Kakani, Nepal

Top Right: Carnations: A New Cash Crop - Uttar Pradesh, India

Bottom Right: Apple Crops in Uttar Pradesh: India

Photographs by S.S. Teaotia

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Foreword

Recognising the severe problems of population pressure on marginal lands in mountain areas, attention is being increasingly focussed on the advantages to be obtained from giving higher priority in national development plans to the promotion of horticulture as an essential component of long-term strategies for sustainable agriculture in mountain areas. This emphasis on horticulture seems particularly relevant in those mountain areas where major investments in infrastructure, especially in roads and energy, have provided an opportunity to develop the essential production, processing, and marketing linkages.

From the country papers presented at the International Expert Meeting on Horticulture from 19-21 June 1989, and the discussions during the meeting,it is clearly apparent that horticulture has spread widely over the Hindu Kush-Himalayan Region and that in certain areas impressive breakthroughs have been made. However, there are always fundamental problems which need to be resolved before horticulture can attain commercial proportions. This includes selection of the right crops and crop combinations from both the technological and economic points of view; availability of support services in terms of research, extension, credit, input supply,and post-harvest and marketing arrangements; and,last, but not least, access to markets at remunerative prices for producers. The 27 papers presented at the meeting and the ensuing discussions among the more than 40 participants greatly contributed to the clarification of underlying issues and led to the adoption of recommendations relating to research, production and productivity, diversification, marketing, storage and processing, as well as follow-up action in terms of networking and information exchange.

For this most encouraging beginning, we have to thank the co-sponsors of this Expert Meeting, the Ministry of Agriculture of HMG (Nepal) and the Food and Agriculture Organisation of the United Nations (FAO). It was a special pleasure to all of us that the inaugural meeting was addressed by the Minister for Agriculture of HMG (Nepal), Mr. Krishna Charan Shrestha, and was chaired by the Assistant Minister of Horticulture, Mr. Janak Bahadur Shah. I would like to express my appreciation of the efforts of the former Director of ICIMOD, Dr. Colin Rosser, for the efficient organisation of the Symposium.

I also express my sincere thanks to Dr. S. S. Teaotia of ICIMOD who acted as Convenor of the Symposium and prepared this Symposium Report. Thanks are also due to all the ICIMOD staff, both professional and administrative, who provided support in the preparation of this publication.

December, 1989

E. F. Tacke
Director

Table of Contents

	Page
FOREWORD	
INTRODUCTION AND OBJECTIVES	1
EXPERT MEETING DISCUSSIONS	3
The Opening Session	3
Production and Productivity of Horticultural Crops	3
Diversification of Horticulture through Ancillary Horticultural Programmes	8
Marketing and Utilization of Horticultural Produce	10
Horticultural Research Requirements	12
CONCLUSIONS AND RECOMMENDATIONS	16
Production and Productivity of Horticultural Crops	16
Diversification of Horticulture through Ancillary Horticultural Programmes	17
Marketing and Utilisation of Horticultural Produce	18
ANNEXES	
1. Workshop Programme	21
2. List of Invitees	22
3. List of Papers	24
4. Summaries of Papers	27

Introduction and Objectives

Throughout the countries of the Hindu Kush-Himalayan Region, there is an urgent need for realistic strategies for progressive, sustainable, and environmentally sound hill farming systems. This is evident in policy discussions within the Governments of the Region as well as within multilateral and bilateral aid agencies.

Due to the problems of relentless population pressure on marginal lands in mountain areas, the emphasis on horticulture is essential in long-term strategies for agricultural development. This is reflected in the development plans of most of the countries in the Region. This emphasis on horticulture is especially relevant in areas which are accessible by roads.

The real challenge is how to get horticulture moving in the hills and mountains. In this respect, knowledge gleaned from past experiences can be analysed, modified, and re-applied in future undertakings.

Against this background, the International Centre for Integrated Mountain Development (ICIMOD), together with the Ministry of Agriculture/Nepal and the Food and Agriculture Organization of the United Nations (FAO), sponsored the International Expert Meeting on Horticulture and Beekeeping from 19th to 23rd June, 1989, in Kathmandu. The purpose of the meeting was to review the present status, future prospects, and constraints and to suggest sound strategies for the development of horticulture and apiculture in the Hindu Kush-Himalayas. This report covers the first part of the meeting (from 19th to 21st June, 1989) which dealt with horticulture. A separate report covering the proceedings on beekeeping (on 22nd and 23rd June, 1989) has already been published.

The specific objectives of the Horticultural Expert Meeting were:

- to facilitate a systematic exchange of experiences in horticultural development in the Hindu Kush-Himalayan Region;
- to facilitate discussion on the linkages involved in production and processing technologies, marketing organization and extension services, and the economic management of input supply and marketing systems;
- to assess the environmental issues in large-scale horticultural development in mountain areas; and
- to examine the role of mountain horticulture, within national strategies, as a component of sustainable farming systems.

The duration of the meeting was for three days. The initial deliberations were concerned with the production and productivity of horticultural crops. This was followed by the diversification of horticulture through ancillary programmes,by marketing and utilisation of horticultural produce, and the finalisation of recommendations evolving from all three segments. A detailed schedule is shown in Annex 1.

The participants in, and contributors to, the Expert Meeting came from various horticultural disciplines and were representative of the Hindu Kush-Himalayan Region. They came from Bhutan, China, India, Nepal, and Pakistan. Representatives of the FAO were also present. Certain experts from Bhutan and India were unable to attend but contributed papers. The list of invitees is given in Annex 2, the list of papers in Annex 3, and Annex 4 contains summaries of the papers.

The salient points raised,together with the ensuing deliberations, are highlighted in the main report under the following headings:

- *Production and Productivity of Horticultural crops;*
- *Diversification of Horticulture through Ancillary Horticultural Programmes;*
- *Marketing and Utilization of Horticultural Produce;*
- *Horticultural Research Requirements; and*
- *Conclusions and Recommendations.*

Expert Meeting Discussions

The Opening Session

The Expert Meeting was inaugurated by the Minister of Agriculture of His Majesty's Government of Nepal, Mr. Krishna Charan Shrestha, and presided over by the Assistant Minister for Horticulture. During the inaugural address, the Minister emphasized the importance of horticulture in the economic development of the Region and the suitability of its agroclimatic conditions for horticultural production. He stated that horticulture had been given priority in the Seventh Five Year Plan of HMG/Nepal. During his address,the Assistant Minister for Horticulture advocated the importance of horticulture for improving economic conditions and preserving the environment. He suggested that the Expert Meeting should focus its attention on users in relation to policies, programme implementation, existing problems, constraints, and resource gaps. He requested the experts to consider how best to mobilize scarce resources.

During his welcome address, Dr. Colin Rosser, the Director of ICIMOD, noted that it was the first International Expert Meeting on Horticulture ever to be held in the Region. Considering the importance of horticulture in the Hindu Kush-Himalayas, the exchange of experiences among the experts would go a long way to help scientific development of such an important agricultural sub-sector. He particularly mentioned the success story in Himachal Pradesh as a useful background for the formulation of Master Plans. He stated that the Bagmati Zone Action Plan should give horticulture appropriate emphasis in economic development because of the optimum location of the area and the existence of infrastructural facilities.

Mr. A.N. Rana, Secretary of Agriculture, HMG/Nepal, and Mr. S.S. Mahdi, Resident Representive, FAO/Nepal, also emphasised the timeliness of this Meeting.

Production and Productivity of Horticultural Crops

Regional Overview of Prospects and Problems

The importance of horticultural development is recognised by all the countries of the Region. In **India, Nepal, Pakistan,** and **Bhutan** priority has been given to horticulture in development plans and this is clearly reflected in their policies and programmes. In **China,** horticulture has found a place in the new *Responsibility System* and further modifications have been suggested to give horticulture better facilities.

The country papers presented emphasised the importance of a scientific approach to the development of mountain horticulture as an essential farming system. They also

highlighted the importance of income generated from horticulture in ultimately checking degradation and promoting environmental improvements.

Climatic conditions are suitable for the cultivation of a variety of horticultural crops such as fruit, vegetables, potatoes, mushrooms, flowers, spices, and medicinal plants. So far, only fruits, vegetables, and potatoes have been grown commercially. In the fruit category, apple cultivation has priority in almost all the countries of the Region. Apples grow well above 2000m under rainfed conditions. The Delicious group is the most popular variety. The principal citrus fruits cultivated are mandarin oranges (*Citrus reticulata*) and malta (*Citrus sinensis*).

Large numbers of farmers, in particular small and marginal farmers, are discouraged from growing horticultural crops because of initial heavy investment and long crop gestation periods. The amount of investment required to produce apples, oranges, vegetables, potatoes, and ginger clearly indicates that, without institutional credit assistance, small and marginal farmers will not be able to establish and maintain cultivation. In certain regions, along with other facilities, horticultural loans are made available on easy terms at subsidised interest and this has encouraged horticultural development. The success experienced by farmers in such regions will, hopefully, be repeated elsewhere. Nevertheless, land holdings in the mountains are small, and farmers find it difficult to find alternative sources of income during the long crop gestation periods.

In some areas intercropping is recommended for both income generation and improvement of soil fertility. For intercropping, leguminous crops are planted usually. However, where irrigation facilities exist, vegetables can be grown. On flat land, short-term fruit crops such as guavas, peaches, plums, and citrus fruits can be grown, especially in sub-tropical conditions. It is essential to remove these plantations before commercial production commences in the main orchard. Intercropping should not interfere with the bearing behaviour of main crops. For example, irrigation during flowering of the intercop may upset the bearing patterns of some fruits. High humidity at this stage helps spread diseases such as powdery mildew and pests such as hoppers. In some areas, pineapples and bananas are successful intercrops in mango orchards. Use of fertilizers is important, however, because these intercrops are heavy feeders.

At higher elevations, in the temperate regions where orchards are planted on terraces, beans are intercropped both for improved soil fertility and additional income. The crop is harvested and the vegetative growth ploughed back into the soil. As it grows in the rainy season, it does not deprive the fruit of moisture. The management of intercrops is a critical factor in orchard development.

In certain areas, spice cultivation (e.g. ginger) is not economical. Crops cannot compete with those grown in the plains where cultivation costs less and yields are more because of favourable environmental conditions. Off-season cultivation, a peculiarity of mountain regions, is more lucrative.

Potatoes are an important mountain crop. Hardy disease-resistant varieties have been introduced but cultivation has become environmentally risky because of faulty cultivation. Mountain areas are suitable for cultivation of disease-resistant potato seeds, however, and these are more profitable commercially than table potatoes. In

some areas, potatoes are cultivated as cash crops. Other crops, such as mushrooms and flowers, are not popular despite favourable agroclimatic conditions.

The varied agro-ecological conditions, which range from sub-tropical to temperate soil types, permit successful cultivation of almost all deciduous fruits and a wide variety of vegetables and flowers. Seeds of flowers and vegetables are also propagated. However, for commercial purposes it is important to examine the ecological zonation before recommending new crop patterns in the mountains. In some parts of the Region broad zonation on the basis of elevation has been recommended and development programmes have been initiated on that basis. This has not been successful in all areas, due to abrupt variation in elevation and temperature of the mountain location. However, while there are other factors also that contribute to a low rate of horticultural production regionally, proper zonation for cultivation purposes is an important factor in the success of horticulture. In addition to elevation, for some crops, such as apples, there is a specific chilling requirement and if that is not present the tree will not bear fruit. In recent years, some low chilling varieties of apples have been propagated for lower elevations (mid-hills) but their quality is not so good. Similarly, there are certain varieties of stone fruits which require specific elevations in order to produce quality fruits.

As far as vegetable cultivation is concerned, there are specific agroclimatic requirements for certain vegetables such as cabbages, cauliflowers, and carrots (v. Nantes) and unless these are met quality and production deteriorate despite the best management. In the Hindu Kush-Himalayas, there are many varieties growing at the same elevation, depending upon aspects and proximity to the snowlines or river basins. Proper location-wise studies are essential in order to maximise horticultural production.

The cultivation of off-season vegetables has increased near the townships in the mountains and in areas from where they can be distributed easily to the plains when temperate vegetables are not available. The mountain sites are also suitable for raising the seeds of vegetables that do not set in the plains because they require a temperate climate. Remote areas that are suitable for vegetables, but are inaccessible, can cultivate seeds. These are of high value and low volume. Such remote areas are ideal for raising hybrid seeds because cross-pollination with other varieties or species can be avoided in the new areas by recommending suitable combinations of crops which are not compatible with each other. There is a specific distance for each crop to eliminate cross-pollination in the hybridization programme

The yield per unit area is very low in comparison to international standards. The main reason for this is that the strains, or the varieties, earlier introduced did not have yield capacity or resistance to pests and diseases of later varieties. Furthermore, there was no research back-up to the programmes and various problems have arisen such as scab disease in apples, brown rot in potatoes, and die-back in citrus fruits. With the establishment of research centres in different regions, to handle basic and applied research programmes, it is expected that the serious problems will be resolved. In the meantime, the industry can import modern technology if proper quarantine measures are adhered to.

The importance of post-harvest technology is not realised, and marketing is carried out in a traditional manner either through commission agents or pre-bloom

contractors. It is estimated that only about 40% of the produce reaches the consumer and this ultimately effects the income of the grower.

Highlights of Individual Country Situations

INDIA

India has placed great emphasis on the development of horticulture in the Himalayan Region, both through the State and Central departments and agencies. Horticultural development takes priority in policy decisions. Various facilities such as supplies of inputs (plant material and seeds; fertilisers, insecticides, and pesticides at subsidised rates, long term loans for plantations on easy terms, and provision of technical services in the production areas) are provided to the farmers to encourage horticulture for economic development.

In recent years, the importance of marketing has been realised and integrated marketing programmes have been introduced in the public sectors in Jammu and Kashmir and Himachal Pradesh. In the North Eastern Region, a cooperative marketing organization has been established. Consequently, a programme of integrated marketing for the hill areas has been established, and it covers all aspects of marketing from quality production to storage and processing. To help farmers in marketing their produce, support prices have been introduced for principal fruit crops in the States of Himachal Pradesh and Uttar Pradesh (Hills). This has been a help to this industry which has been passing through a critical phase due to lack of suitable marketing facilities and systematic support. The problem of packaging is still serious and efforts are being made to find alternatives to wood in order to save the mountain forests.

Research into the development and expansion of horticultural programmes has increased. There are four agricultural universities in the hill regions and horticulture has been given a special place in their programmes. A separate university for horticulture has been established at Solan in Himachal Pradesh and it will handle basic and applied research on all aspects of horticulture. A separate Institute of Horticultural Research has been sanctioned, to be established at Srinagar in Kashmir.

It is expected that in India, by 2000 A.D., apple cultivation alone will produce 200,000 tons.

NEPAL

In recent years, Nepal has given importance to the development of horticulture.In the Sixth Plan a clear policy decision was taken and zonations were created for different crop systems. Priority areas have been marked out in the middle hills. There is, however, no research support for different horticultural programmes on the basis of the progress made.

Marketing is the main problem and this has not improved inspite of demand for different types of fruits and vegetables in the country. A large quantity of fruits and vegetables are imported into the country, while off-season vegetables and citrus fruits are possible exports (Gurung).

With FAO assistance, vegetable cultivation has attained importance in the last decade. The main reason for this is the quality seed production project in which farmers are involved in the production of quality seeds. A new marketing arrangement, under the Kalimati Marketing Project, will encourage the farmers to cultivate vegetables on larger areas. It is estimated that by 2000 A.D., under the Basic Needs Programme, vegetable production will increase and raise rural income, improve nutrition, and create export earnings (Rakhe). A Master Plan for horticultural development is being prepared.

BHUTAN

Similar to Nepal, little work has been done in Bhutan to tackle production related problems of the horticultural industry, due to resource constraints. Being a land-locked country, emphasis has been given to the cultivation of apples, citrus fruits, potatoes, and other vegetables. By taking a farming systems approach, the Government is now initiating a programme that emphasizes the role of horticultural crops as a sub-sector of the whole agricultural industry. It has been decided to implement an Integrated Horticultural Development Plan to encompass the different agroclimatic zones of the country (Wangchuck).

PAKISTAN

In Pakistan, production of horticultural crops is a tradition, especially in Baluchistan and the North West Frontier Province. With the reclamation of lands, harnessing of water resources, and the awareness of the nutritional value of fruits and vegetables in the diet of indigent people, a new dimension has been given to horticultural development. Various schemes have been launched for the production of these crops. However, there is an obvious need for an integrated horticultural programme (Chaudhri).

As in other countries of the Region, in Pakistan the constraints due to lack of modern production technology, the inadequacy of applied research in the field, and inefficient marketing systems are present. The Government is now giving high priority to horticulture because of the foreign exchange potential that can be realised by exporting to the Middle East, South East Asia, and other countries. It is estimated that due to faulty picking,poor packing and handling techniques, poor means of communication between producing areas and consuming centres, inadequacy of storage facilities, poor marketing information, and out-moded methods in existing market conditions, 25 to 30% of the produce is wasted and written-off as post-harvest losses. Recently, a well coordinated Fruit and Vegetable Marketing and Storage Project was launched (Chaudhri).

CHINA

The Himalayan-Hengduan Mountain Region of China has an abundance of wild fruits both in the temperate and sub-tropical regions. Commercial plantations started after 1950. The major fruits grown are apples and pears. There is no surplus production. It is strongly felt that the Government should support collective orchards and also encourage individual cultivation. Encouragement should be given to strengthen the management of the orchards with modern technology. Potatoes and vegetables are also grown for commercial purposes. Tea cultivation has also been

introduced into the area. It is suggested that the Government should give preference in their policies to the development of horticulture in the *Responsibility System*. Integrated development will take care of marketing and post-harvest operations that are lacking at present in the mountains (Zheng Du et al.).

Diversification of Horticulture through Ancillary Horticultural Programmes

The main emphases, throughout the Hindu Kish-Himalayan Region, have been on fruits, vegetables, and potatoes. The success of different programmes has been variable depending on the existing infrastructure. As most areas of the Hindu Kush-Himalayas are rainfed, the cultivation patterns adopted are based on available technology for prevailing land and climatic conditions.

Crop selection and traditional cultivation practices have caused problems that have direct bearing on the quality and production of crops. The monoculture of apples and potatoes is responsible for the spread of various pests and diseases. Scale disease in apples is spread due to the continuous cultivation of apples in an area without proper orchard management. Similarly, brown rot in potatoes has spread due to continuous cultivation in the same area,without proper crop rotation,and the introduction of diseased seed material. Abnormal weather conditions, such as spring frost and hailstorms, have also affected the production of apples and other fruit crops. Similarly, the continuous cultivation of citrus fruits is responsible for "dieback", due to the incidence of greening virus and other pathological diseases, and this has destroyed the citrus industry in many areas. Further, the heavy initial and maintenance expenditure needed for fruit and vegetable cultivation has discouraged a large number of farmers from making a commercial investment. Avoidance of monocropping and undercropping long-gestation tree crops (such as mangoes) with shorter-gestation fruit crops (such as pineapples, papayas, and bananas) and vegetables, as well as mixed crop combinations, are obvious approaches that can spread the risk and enhance the profitability.

The Himalayan mountains are also a source of various genetic resources that can be used for the economic development of the Region (Tej Partap). Some of the material has scope even for solving problems of cultivation. For example, rootstock can be used to improve existing varieties by breeding for resistance.

Some crops are found in wild form and with modifications they can be adapted for commercial purposes. In **China**, Seabuckthorn, a wild shrub, is an excellent source of alcohol, soft drinks, and many other products (Lu Rong-Sen). It has changed the economy of some areas and its various sub-species can be found over a wide range of climates.

Lastly, cultivation of ancillary crops such as mushrooms, flowers, medicinal plants, and spices, for which the agroclimatic conditions are suitable, can be established with the technology now available. Ancillary crops can become important sources of employment and income generation.

Mushrooms

Cultivated mushrooms are becoming popular and in certain areas they are cultivated under employment programmes with technical facilities and institutional finance provided. The mushrooms thus cultivated are *Volvariell sp.* (tropical paddy straw mushroom), *Lentinus edudis* (shistake), and *Agricus bisporus* (button, a white, European temperate mushroom). *Agricus bisporus* is commercially cultivated in **India**. Under this programme young entrepreneurs are given loans, spawn, and pasteurised compost. They are also trained in different aspects of development. This has created employment opportunities. It does not require land, and this is an advantage because land is already a scarce commodity in the mountains. A modern research institute for mushroom cultivation has been established at Solan in Himachal Pradesh and it conducts proper follow-up activities for the programme.

Other countries of the Region have not entered the market on a commercial scale so far,because of the lack of technology and marketing problems. However, mushroom cultivation could give a new dimension to economic development in the mountains.

Floriculture

Flowers are another well-known resource of the Hindu Kush-Himalayas. Commercial cultivation has not been established because of lack of proper packaging and cultivation practices,scarcity of genuine plant material,and lack of technology for packing and storage.Flowers such as gladioli,roses,carnations,and orchids have export possibilities and their cultivation should be developed.

In certain regions of the mountains, gladioli and tuberoses are grown on a commercial scale and their economic returns are encouraging. Cut flowers are available in the off-season when they are not available in the plains. Further, there is a demand for winter flowers in the plains. Some of the demand for seeds is met by imports from western countries, but they degenerate after cultivation in the plain areas due to the climate. There is, therefore, scope for raising seeds in the hilly regions where the agroclimatic conditions are suitable. There is also scope for raising the bulbs/corms of tulips, irises, lilies, amaryllis, and gladioli for supply to the plains.

Some mountain areas are famous for orchids,but they are not marketed commercially due to a number of limitations, especially lack of proper technology for packing, storage, and transport. In the U.S.A., a large number of hybrids have been cultivated from material collected from the north eastern region of India. The eastern Himalayan region, which is the home of a large number of orchid species, has been ruthlessly denuded because of indiscriminate collection. It is important that haphazard collection of orchids from the forests be stopped and regeneration maintained.

Agroclimatic conditions are suitable for growing certain kinds of flowers, such as geraniums, roses, and lavender, on a commercial scale,for the perfume and oil industries. The quality of products from these plants, grown in the mountains, is superior and preferred in the market. The income derived from such crops is quite high.

Spices

The agroclimatic conditions in the Hindu Kush-Himalayas, especially in the valley areas, are suitable for growing spices such as ginger, turmeric, onions, garlic, chillies, and saffron. Some of these crops, depending on their marketing potential, have been commercially cultivated. However, some of the spices are also successfully grown in the plains. To be commercially viable, therefore, mountain products have to compete with those of the plains. The cost of cultivation is lower in the plains than in the hills. This is the main reason why spice cultivation in the mountains is not gaining momentum inspite of the emphasis given to these crops. In dry regions, saffron cultivation provides a steady source of income.

Medicinal Plants

The mountain regions of the Hindu Kush-Himalayas contain a large number of medicinal plants. Many plants are used, both in fresh and dried forms, as curatives and preventatives for various diseases and ailments. Their importance has, however, increased because of the commercialization of extraction and purification methods. The latter methods are essential for the active ingredients to exert the desired beneficial effects. Due to increasing demands for plants, that are exploited too drastically without concomitant measures for their regeneration, and because of the depletion of natural resources, the present demands cannot be met. In order to meet the demands of the pharmaceutical industry, efforts are made to preserve plant materials and to cultivate them where facilities are available. In Tibet, the wide use of medicinal plants has encouraged their development and conservation (Yang Yangchang).

Marketing and Utilization of Horticultural Produce

Originally, horticultural development in the Hindu Kush-Himalayas was established in an ad hoc manner without considering post-harvest operations and product marketing. Marketing is mostly in the hands of the middlemen or commission agents. These people manipulate operations in such a way that the major share of the consumer price goes to them. The farmer gets only 20-25 per cent of the consumer price and the balance of 75-80 per cent is shared by the middle men (Teaotia). In order to stabilise and enhance agricultural production and income generation in the mountains, marketing must become an important and essential component in horticultural development (Banskota).

Markets

There are no regulated markets for fruit and vegetables. Transactions are carried out in wholesale markets which are managed and operated by associations, fruit and vegetable merchants, or commission agents. In some wholesale markets, transactions are carried out by open auction, whereas in other markets they are done "under cover". In the prevailing marketing system, neither the grower nor consumer derives appropriate benefits. If horticulture is to be profitable for growers, and if consumers are to buy fruits and vegetables at reasonable prices, in comparison to the cost of production, then the present marketing system will need revising.

Unless an alternative system is developed, it will be difficult to replace the middlemen who are already entrenched in the fruit and vegetable trade. Marketing perishables is expensive because of the need for facilities such as post-harvest operations, storage, and transport. These are beyond the financial capacity of the individual farmer. At this stage, an alternative to the current system would be:

- to establish cooperative marketing centres for fruit and vegetable farmers, and
- to establish government-run wholesale marketing organisations in different regions.

This involves long term perspectives because of the problems involved in handling perishables. In addition, a price forecasting system for horticultural crops would help stabilise crop production (Nasol).

Storage

Storage is important for efficient marketing. There should be a definite time for harvesting fruits and vegetables, because after the peak harvesting period the quality and texture of the produce deteriorate. Storage at low temperatures maintains the quality of the fruit for a certain period by retarding the physiological deterioration and reducing water loss (Anand et al.). Cold storage removes field heat but is often not viable as the produce will be transported,ultimately,over long distances to different markets. Field-located cold storage facilities can be used for two to three months of the year. For longer storage periods,facilities have to be located in consumer areas. Such facilities are expensive and require financing from cooperatives or government organisations.

Packaging

Unlike the practices prevalent in the fruit and vegetable-producing countries of the West, there are no standards concerning types of packaging and methods of packing. Since packaging provides protection, in the absence of established standards,packing with whatever materials are available is not only unsuitable but sometimes even harmful to, rather than protective of, the produce. Packing practices need regulating in size of packaging, structural design, methods of packing, proper cushioning, and stacking durability during transit and storage.

In some areas, the expansion of the horticultural industry in the Hindu Kush-Himalayas has precipitated a crisis. In the mountains, soft woods such as silver, fir, and pine (*chir)* are used for packing cases. Silver fir takes about 100 years to mature and pine about 50 years. In **India** alone, about 0.85 million cubic metres of wood is required annually for packing apples and the demand will increase when additional areas are involved in commercial fruit production. The use of such large amounts of forest timber for packing cases upsets the ecological stability of the mountains and indirectly hampers the growth of the horticultural industry. Various "Task Forces" for integrated development in the Himalayas, constituted in **India**, have made a strong case for the need to preserve the environment and check deforestation. In order to encourage horticultural development and maintain mountain environments, alternative packaging will have to be introduced.

- Development of F1 hybrids in cabbages, cauliflowers, radishes, and turnips.

- Intensification of research on seed production and location of new disease-free seed production areas.

Potatoes

- Developing blight-resistant, high-yielding varieties, possessing durable resistance to replace the susceptible varieties.

- Developing brown rot-resistant varieties for hill soils.

- Developing potato-based cropping systems for efficient use of nutrients and to reduce the incidence of soil/tuber-borne diseases.

Citrus

- Limited available nucellar lines of citrus plant material need to be further propagated for wider use. Improved hybridisation techniques would help develop virus-resistant varieties.

- Biochemical changes, occurring in citrus plants because of viruses and die-back disease, need to be studied.

- Programmes for the inspection and registration of viruses from mother-trees need to be revised. In this respect, the study of virus-vector relationships and sterilization of vectors by eradication techniques will be useful,as well as the induction of resistance against severe strains of viruses by cross pollination with milder strains.

- The causes of decline in citrus varieties should be studied in order to recommend a suitable course of action.

- Germ plasmas found in the Himalayan Region should be collected before they disappear through neglect and indiscriminate destruction of the vegetation.

Ginger and Cardamon (Major)

- High yielding, fibreless varieties of ginger should be developed for foreign markets.

- High yielding virus-free cardamon(major) should be propagated.

Mushrooms

- High yielding *Agricus bisporus* spawn should be developed.

Flowers

Flowers are an important resource in the mountains for which there has been little development. For economic purposes several types of study need to be carried out.

Some of the important ones are given below.

- Study on the storage life of locally available cut flowers. This study will include flowers cut at different stages of their growth.

- The storage life of those flowers under different climatic conditions, local, tropical, and in cool temperatures with high humidity conditions.
- Study on the influence of packaging.

- Study on the influence of transport conditions by the quickest mode of transport to the nearest market.

Post-Harvest Technology

- Study of maturity indices and harvesting periods for different fruits and vegetables.

- Post-harvest pathology and wastage control, with suitable fungicides, should be studied.

- Packaging practices should be modified to suit different commodities, taking into consideration structural design, mode of stocking during transit and storage, and provision of proper cushioning to minimise bruising and damage.

- Low-cost drying methods, as well as the selection of cheap packing material for dried products, should be studied.

Conclusions and Recommendations

On the final day of the Expert Meeting participants were divided into three groups. They were as follows:

Group A : Production and Productivity of Horticultural crops;

Group B : Diversification of Horticulture through Ancillary Horticultural Programmes; and

Group C : Marketing and Utilisation of Horticultural Produce.

Extensive and in depth discussions took place in all three groups during the final plenary session. The following summary of the discussions was adopted.

Production and Productivity of Horticultural Crops

1. As the cultivation of horticultural crops has developed under different climatic conditions, throughout the countries of the Region, these experiences should be exchanged periodically by organising conferences and publishing reports and periodicals. Exchanges of orchardists and horticulturalists, from one region to the other, should be arranged, in order to exchange views with those engaged in cultivation programmes. The International Centre for Integrated Mountain Development should take the responsibility for organising these activities.

2. Arrangements should be made by ICIMOD to replicate the successes of suitable technologies from some countries of the Region. This can be done by demonstration effect and by comparing the successes achieved. Training in the new technology should be arranged at ICIMOD or other suitable locations.

3. There is no data base system for horticulture in the Region and this is a bottleneck in the systematic planning of programmes. Such data base systems should be initiated in the different countries of the Region, and information should be exchanged in the interests of horticultural development.

4. Horticultural programmes are generally launched on an ad hoc basis without reference to market development and disposal, and this sometimes results in programme failure.

   Integrated programmes, covering all aspects of horticultural development, should only commence after thorough study. The Master Plan approach may be a solution to many of the problems occurring after the production stage. Marketing and Post-Harvest Technology ought to be an integral part of such integrated programmes.

5. Horticultural programmes should be established according to land use patterns. Proper surveys should be made of the areas involved, taking into consideration the elevation, aspect, infrastructure (that is available or to be developed), and the weather conditions.

   Horticultural development should receive proper emphasis in watershed management. Market analyses should be made before launching specific programmes. Incentives should be used to encourage farmers (small and marginal farmers in particular) to adopt scientific cultivation techniques.

6. Traditional crops should not be neglected but rather modified by new technology and the introduction of new strains and varieties.

7. Pilot testing should be done in the concerned areas before introducing new technologies and successful examples,from other regions,on a commercial scale.

8. The application of insecticides and pesticides is increasing but their deleterious effects are not known. Proper studies should be made before recommending them to farmers.
9. In order to introduce planned programmes to achieve the above objectives and conduct periodical evaluations, international support should be sought.

10. ICIMOD should publish the papers of this Expert Meeting in book form to serve as a reference source.

Diversification of Horticulture through Ancillary Horticultural Programmes

1. Cropping patterns need to be diversified by useful innovations, augmented horticultural activity, sustainability of horticultural activities enhanced,and diverse biological resources made increasingly available.
2. The approach to diversification should commence with exploration, development, and utilisation.

3. Emphasis should be given to linking the conservation of genetic horticultural resources with sustainable development in the field.

4. Research on these resources should focus not only on their identification but also on providing horticultural, genealogical, and biological information about them and assessing their cash crop potential.

5. In harnessing numerous under-utilised biological resources, the guiding principles should be their potential to relieve the severe problems of mountain regions.

6. The group also felt that exchange of information among the countries of this Region and other mountain regions of the world, as well as the creation of a mountain information network, is needed.

7. Horticultural, genealogical, and biological surveys should be organised by ICIMOD in collaboration with national agencies.

8. Specific recommendations were made to establish the following activities on a priority basis for diversification of horticulture in the mountain areas :

   - floriculture,
   - aromatic and medicinal plants, and
   - apiculture.

Marketing and Utilisation of Horticultural Produce

1. There is a need to develop the concept of marketing as a system, from production to consumption. The shift from subsistence farming to cash crop production depends on the efficient marketing of cash crops.

2. Proper locational strategies need to be identified for the development of market places in hill districts. The help of disciplines such as spatial planning are required for this purpose.

3. Supply of price information is an important component for the better organisation and grouping of producers. Price systems have an important role to play in the evolution of marketing systems.

4. Agro-based industries and post-harvest technology have a pertinent role to play in promoting the processing of surplus produce,because of the perishable nature of fruits and vegetables. Agro-based industries also increase off-farm employment opportunities in hill and mountain areas.

5. Other important aspects of marketing that deserve further attention are:

   - price mechanisms,
   - organisation of farmers, and
   - the changing role of the public and private sectors in marketing

Annexes

INTERNATIONAL EXPERT MEETING ON HORTICULTURE IN THE HINDU KUSH-HIMALAYA
19th JUNE to 21st JUNE, 1989

DAY ONE

Opening Session

Chairman :	Mr. Janak Bahadur Shah, Asst. Minister for Agriculture, (Horticulture) HMG, Nepal
Welcome by:	Dr. Colin Rosser Director, ICIMOD
Chief Guest:	Mr. Krishna Charan Shrestha, Minister for Agriculture, HMG, Nepal
Welcome by:	Mr. A.N. Rana Secretary of the Ministry of Agriculture, HMG, Nepal
A word from FAO:	Mr. S.S. Mahdi Resident Representative, FAO, Nepal
Vote of Thanks:	Dr. R.P. Yadav Deputy Director, ICIMOD

Session 1

Productivity and Production of Horticultural Crops

Chairman: Dr. Colin Rosser

Horticultural Development in the Hindu Kush-Himalayas: - Prospectives, Constraints and Strategies
Dr. S.S. Teaotia

Public and Private Response to Cash Crop Development in Kakani Panchayat, Nuwakot (Nepal)
S. Basnyet

Session 2

Chariman: Dr. Ram Yadav

Horticultural Development in Nepal - Present Status, Constraints and Strategies
H.P. Gurung

Vegetable Development in Nepal - Present Status, Future Strategies, and Constraints
S.B. Aryal, S.S. Rekhi, and B.B. Shah

The Hill Fruit Development Project - Eastern Development Region, Nepal
Khalil Miyan

Horticultural Development in Bhutan
Dasho Khandu Wangchuk

DAY TWO

Session 3

Chairman: Dr. N.S. Jodha

Development of Horticulture in the Mountain Regions of Pakistan - Progress, Potential, and Constraints
Zahur Alam

Horticultural Development in Pakistan, with Particular Reference to Mountain Regions
Saeed Ahmed Chaudhri

Horticultural Development in the Mountain Regions of India - Progress, Constraints, and Future Strategies
S.S. Teaotia

Study on Horticultural Development in the Himalayan and Hengduan Mountains, China
Zheng Du, Li Gaoshe, and Jiang Hong

Role of the National Temperate Horticultural Research Station (NTHRS) in the Horticultural Development of Nepal
P. Sherpa and M. Rai

Session 4

Diversification of Horticulture by Ancillary Horticultural Programmes

Chairman : Dr. S. A. Chaudhri

Genetic Resources Issues and Horticultural Development in the Hindu Kush-Himalayan Region
Tej Partap

Medicinal Plants of the Tibet Himalayas
Yang Yungchang

Role of Beekeeping in the Development of Horticulture in the Himalayan Mountains of India
L.R. Verma

DAY THREE

Session 5

Chairman: Dr. Deepak Bajracharya

Marketing and Utilization of Horticultural Produce

Marketing Development of Fruit and Vegetables - Some Observations on the Experiences in the Bagmati Zone in Nepal
Mahesh Banskota

The Establishment of an Apple Plantation Base for Promoting Mountain Economy - A Case Study of Xide County in the Hengduan Mountain Region of China
Lin Qingfa

Role of Prices and Markets in Horticultural Development
R.L. Nasol

Session 6

Disscussion Groups :

Production and Productivity
Chairman : S. S. Rekhi

Diversification of Horticulture through Ancillary Horticultural Programmes
Chairman : Dr. Zahur Alam

Marketing and Utilization of Horticultural Produce
Chairman : Dr. Mahesh Banskota

Closing Session

Recommendations

Chairman:	Dr. Colin Rosser
Rapporteur:	Dr. S.S. Teaotia
Report of:	Session I Session II Session III
Thanks by:	Dr. Colin Rosser Director, ICIMOD

Annex 2

List of Invitees to the Expert Meeting on Horticulture

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Mr. P. Sherpa
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Former Senior Horticultural
Advisor(FAO) and Director of
Agriculture, Islamabad

Dr. Zahur Alam
Senior Programme Agriculturalist
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International Agencies

Mr. S. S. Mahdi
Representative
FAO/Nepal

Mr. S. S. Rekhi
Vegetable Expert, FAO, Nepal

Mr. R.L. Nasol
Marketing Expert, FAO, Nepal

Dr. L. C. Sikka
Scientist
International Potato Centre, Lima

Annex 3

List of Workshop Papers

I. Production and Productivity of Horticultural Crops		Page
A. Regional Overview		
1. Horticultural Development in the Hindu Kush-Himalayas: Prospects, Constraints, and Strategies	S. S. Teaotia	27
B. Highlights of Individual Country Situations		
B.1: India		
1. Development of Horticulture in the Himalayan Mountain Region of India-Programmes, Constraints, and Future Emphases	R. M. Pandey	29
2. Horticultural Development in the Mountain Regions of India: Progress, Constraints, and Future Strategies,	S. S. Teaotia	30
3. Horticultural Development in the Mountains of India with Special Reference to Apple Cultivation	Harbans Singh	32
4. Present Status of Horticultural Development in Himachal Pradesh, India	K. C. Azad	34
5. Horticultural Development in the Himalayan Mountains of Uttar Pradesh	J. N. Seth	35
B.2: Nepal		
1. Horticultural Development in Nepal: Present Status, Constraints, and Strategies	H. P. Gurung	37
2. Vegetable Development in Nepal: Present Status, Future Strategy, and Constraints	S. B. Aryal, S. S. Rekhi, and B. B. Shah	40

			Page
3.	The Hill Fruit Development Project: Eastern Development Region,Nepal	Khalil Miyan	41
4.	Public and Private Responses to Cash Crop Development in Kakani Panchayat, Nuwakot (Nepal)	Saroj Basnyet	43
B.3: Bhutan			
1.	Horticultural Development in Bhutan	Dasho Khandu Wangchuk	44
B.4: Pakistan			
1.	Horticultural Development in Pakistan, with Particular Reference to Mountain Regions	Saeed Ahmed Chaudhri	46
2.	Development of Horticulture in the Mountain Regions of Pakistan-Progress, Potential, and Constraints	Zahur Alam	48
B.5: People's Republic of China			
1.	Study on Horticultural Development in the Himalayan and Hengduan Mountains, China	Zheng Du, Li Gaoshe, and Jiang Hong	49
II.	**Horticultural Research and Diversification by Ancillary Horticultural Programmes**		
1.	Horticultural Research in the Himalayan Hill Region of India	K. L. Chadha	52
2.	Role of the National Temperate Horticultural Research Station (NTHRS) in the Horticultural Development of Nepal	Pasang Sherpa and Madan Rai	55
3.	Genetic Resource Issues and Horticultural Development in the Hindu-Kush Himalayan Region	Tej Partap	57
4.	Seabuckthorn Resources and Its Underexploited Potential in the Himalayan Regions	Lu Rong-sen	59

			Page
5.	Role of Beekeeping in the Development of Horticulture in the Himalayan Mountains of India	L. R. Verma	60
6.	Potential of Floriculture in the Himalayan Mountains	Vishnu Swarup	62
7.	Medicinal Plants of the Tibet Himalayas	Yang Yangchang	62

III. Marketing and Utilization of Horticultural Produce

1.	Role of Prices and Markets in Horticultural Development	R. L. Nasol	63
2.	The Establishment of an Apple Plantation Base For Promoting Mountain Economy- A Case Study of Xide County in the Hengduan Mountain Region of China	Lin Qing Fa	65
3.	Post-Harvest Practices that Affect the Marketing of Fruits and Vegetables in the Himalayan Mountain Regions of India	J. C. Anand and O. P. Grover	66
4.	Role of Fruit Processing in the Development of Horticulture in the Himalayan Region (India)- Progress, Constraints,and Strategies	A. G. N. Kurade	68
5.	Role of the Himachal Pradesh Horticultural Produce Marketing and Processing Corporation in the Development of Horticulture in Himachal Pradesh, India	R S Rana	69
6.	Marketing Development of Fruits and Vegetables - Some Observations on the Experiences in the Bagmati Zone, Nepal	Mahesh Banskota	71

Annex 4

Summaries of Papers

I. Production and Productivity of Horticultural Crops

A. *Regional Overview*

HORTICULTURAL DEVELOPMENT IN THE HINDU KUSH-HIMALAYAS: PROSPECTS, CONSTRAINTS, AND STRATEGIES

S.S. Teaotia

The agroclimatic conditions of the Hindu Kush-Himalayas are suitable for the development of horticulture. In certain areas, where infrastructural facilities, such as roads and markets, exist, horticulture has become a commercial undertaking. However, because of the rough terrain and problems of accessibility in the mountains, there must be strong linkages among different components for successful horticultural development on a commercial scale. In this paper, attempts have been made to draw attention to certain problems that should be examined before making large investments in horticulture in the Hindu Kush-Himalayas.

The support of institutional finance is an important prerequisite for establishing an orchard, as the initial investment is very high. Further, the gestation period for fruit crops is long, and it is a problem for small and marginal farmers to meet their living expenses during this period. Present day technology, for horticultural development adopted in the Hindu Kush-Himalayas, is based on borrowed technologies from the West and these do not always suit the agroclimatic conditions of this region. This is the main reason why production per unit area is very low in comparison to western countries.

Due to the perishable nature of certain crops, special care is required in picking, packaging, transport, storage, marketing, and processing and these are not properly developed. Packaging material has become an environmental issue in certain areas as forests have been depleted to provide wood for packing cases.

The climatic conditions of the Hindu Kush-Himalayas are suitable for ancillary programmes such as mushroom cultivation, apiculture, floriculture, medicinal plants, and spices. However, technologies are still to be developed under local conditions before commercial production can be initiated. The following recommendations and strategies have been suggested for the future development of horticulture in the Region.

1. Horticultural development requires initial investment for orchards or adoption of diversified crops. Timely provision of credit facilities ensures that the proper technology is adopted in the initial stages of planning. Short term credit facilities may help facilitate proper packaging practices. Investment in post harvest operations will ultimately help in maintaining the quality of the produce.

2. Development of compact areas for fruit plantations, vegetables, and potato cultivation would be advisable. This will be easier and more economical to organise if post-harvest operations and marketing are organised through cooperatives or other pertinent agencies. In remote areas that are properly connected with roads and other transport systems, cultivation of nuts and production of vegetable seeds can be profitably undertaken. Cultivation of off-season vegetables can result in early economic returns in suitable areas. Introduction of new crops, such as olives, could advance economic development in the mountains.

3. Production of quality fruits can be achieved through the introduction of new technology. Some tested practices are successful for different crops. Timely adoption of these will improve both production and productivity of the crops.

4. Timely availability of inputs will help in the production of quality horticultural produce.

5. Diversification of fruits and vegetables, with incentives to small and marginal farmers for the cultivation of mushrooms, flowers, and the establishment of apiculture will help in the improvement of economic conditions.

6 To organise marketing, market intelligence, surveys, grading, packing, storage, marketing, and proper processing are essential to make horticulture commercially viable.

7. Mountain regions have a variety of locational features and different types of horticultural crops can be grown. Farmers need to know more about crop technologies and proper guidance and training by extension workers will be helpful in creating a good foundation for horticultural development.

8. Plant nurseries should be established as close to farmers as possible. The "Nursery and Seed Act" should be used to ensure that only genuine, good quality stock is produced. It is important to replace old and obsolete varieties of fruits and vegetables with high yielding, good quality stock.

9. There must be strong support of research for horticultural development. There is a gap between the knowledge available in research institutions and that applied in the field. Research centres should initiate a special "Lab to Land" programme, in horticulture, to bridge this gap.

10. Research on post-harvest operations, packing cases, marketing, processing, and transport under mountain conditions is necessary and priority should be given to these areas. A manual on these topics should be prepared for training farmers and extension workers.

11. Studies should be undertaken to determine the best crop combinations under different mountain conditions. The relevant marketing linkages for different horticultural crops should be analysed.

B. Highlights of Individual Country Situations

B.1: India

DEVELOPMENT OF HORTICULTURE IN THE HIMALAYAN MOUNTAIN REGION OF INDIA - PROGRAMMES, CONSTRAINTS, AND FUTURE EMPHASES

R.M. Pandey

Agriculture, including horticulture, is a State subject in India. Until the Fourth Five Year Plan,the entire attention of the Government was devoted to Food Security, whereas horticulture did not receive any attention. A token provision of 0.5 million for fruit and vegetables was made during the Fourth Plan Period in the central budget. Realising the importance of these crops (the economy of the hill region is entirely dependent upon them) the budget allocations were increased subsequently. The Seventh Five Year Plan allocation for horticulture was 330 million rupees and this was raised to Rs 2500 million (anticipated) in the Eighth Plan.

State Sector Programmes.

Among the mountain regions, Uttar Pradesh, Jammu and Kashmir, Himachal Pradesh, Tripura, Manipur, Mizoram,and Arunachal Pradesh have programmes for the development of Horticulture. In addition, there are 3 bilateral projects for apples and other temperate fruit crops.Important programmes being implemented by the States, in the mountain regions, are given below:

- establishment of progeny orchards-cum-nurseries,
- expansion of areas under fruit and vegetable cultivation,
- establishment of experimental stations and training centres,
- supply of critical inputs at subsidised rates, and
- setting up of fruit preservation/canning centres for home and commercial scale production of fruit and vegetables.

Despite this emphasis, the progress is slow because of constraints such as :

- weak data base,
- non-availability of quality planting materials,
- low productivity,
- low quality of the produce,
- long gestation period and heavy initial investment,
- high rate of interest,
- weak post-harvest management infrastructure,
- weak organisational structure,and
- land ceiling.

Keeping the above constraints in mind, efforts are being made to bridge these gaps so that the horticultural industry in the country can be placed on a sound footing.The following steps have already been initiated by the Government.

- Liberalisation of imports of seeds and planting material.
- Placing the food processing industry on a sound footing by allowing the entry of multi-nationals and big businesses involved in establishing the fruit processing industry.
- Liberalisation of technolgy, imports, machinery,and equipment on a preferential basis.
- The establishment of 26 universities for the study of agriculture, including one especially for horticulture and forestry in Himachal Pradesh, one agricultural university in each of the States of Jammu and Kashmir, Himachal Pradesh, Assam, Nagaland, and a Northern-Hills University/ campus with Headquarters at Shillong and stations in almost all the hilly areas of the North-Eastern Region.
- An "All India Coordinated Vegetable and Fruit Improvement Project", for major fruits/vegetables grown in the Mountain region, is already in operation under the aegis of the Indian Council for Agricultural Research.
- Setting up of a National Research Centre on Mushrooms, at Solan in Himachal Pradesh.
- An"Integrated Horticultural Development Project" for the NWHR, through the assistance of the World Bank, is being negotiated.
- Strengthening the data base.
- Regulating the supply of genuine seeds/quality planting material.
- Elimination of *Jhum* cultivation in the North-Eastern Region.
- Encouraging the adoption of modern agro-techniques and strengthening the transfer of technology.
- Strenthening the post-harvest management infrastructure.
- Developing captive plantations around big processing units.
- Setting up a National Institute for Temperate Horticulture in Jammu and Kashmir.

HORTICULTURAL DEVELOPMENT IN THE MOUNTAIN REGIONS OF INDIA PROGRESS,CONSTRAINTS, AND FUTURE STRATEGIES

S.S. Teaotia

The Indian Himalayan Mountain Region runs from Jammu and Kashmir in the west to Arunachal Pradesh in the east. The two important mountain belts of the Himalayas, in India, include the North West Hill Region, comprising the States of Jammu and Kashmir, Himachal

Pradesh, and the Hill district of Uttar Pradesh, located between 28°N and 37°N, and the North East Hill region which consists of the States of Sikkim, Arunachal Pradesh, two districts of Assam, Manipur, Tripura, Meghalaya, Mizoram, and Nagaland, located between 20°N and 29°N. The Western Region lies within the temperate zone and the Eastern in the sub-tropical for the most part. The entire area consists of high, medium,and low rugged mountains as well as valleys that enjoy varying agroclimatic conditions. Rainfall is low to moderate in the west but heavy to very heavy in the east. The agroclimatic conditions are suitable for the production of a number of horticultural crops such as fruits, vegetables, potatoes, mushrooms, flowers, medicinal plants, as well as for apiculture.

Although horticulture is not new , commercial strains of fruit crops were introduced only recently. It is estimated that now 420,000 ha are used for fruit cultivation.A major part of the area has come from grazing lands, forest areas, and other classes of uncultivated lands. Various types of temperate and sub-tropical fruits are grown in the mountainous districts but the major areas for apple cultivation are all in the States of the western region. In the eastern region pineapples and oranges are the main crops. The cultivation of vegetables, especially off- season, both temperate and sub-tropical is also increasing as well as limited production of ancillary crops.

Apple production in India has increased in the last twenty years, from less than 100,000 tons, in 1966-67, to more than 1,000,000 tons in 1985-86. The increase is generally due to an increase in area rather than an increase in yield. Fluctuation in yields in all the apple-growing States depends mainly on seasonal conditions (rain and frost) and,in Jammu and Kashmir and Himachal Pradesh, disease incidence, mainly apple scab. There is, however, a significant difference in the average yields of the three States (Jammu and Kashmir, Himachal Pradesh, and the U.P. hills). The average yield in Jammu and Kashmir is 12 tons, whereas in Himachal and Uttar Pradesh it is only 6.5 and 3.5 tons/ha respectively. All these yields are well below the international level of about 30 tons/ha.

The Red Delicious group is the most widely grown variety of apple and accounts for over 80% of the apples grown in Himachal Pradesh, 45% in Jammu and Kashmir, and 30% in Uttar Pradesh. The present Red Delicious strains are becoming out of date and need to be replaced by new ones with higher yield potentials.

Planting material is provided by a number of nurseries in both the public and private sectors. By and large, rootstocks used are seedlings in origin and not standarised, and selection of scion wood from trees of high merit, within a variety or strain, is not always done. The Nursery Act is in operation but it is not strictly followed.

Orchard management is generally poor and this is mainly due to poor knowledge of new technologies. Extension staff workers are not sufficient to cover the entire area. Research follow-up has also been poor and this has resulted in a number of serious problems in the cultivation of fruits and vegetables. Scab disease in apples is a glaring example of the effects of this deficiency in the area of research.

Despite the development of horticulture in the Himalayan Regions of India, marketing has not received proper emphasis.However, in the last 10-15 years, it has been treated with more concern.The State Governments of Jammu and Kashmir and Himachal Pradesh have established marketing organizations in the public sector. In the North Eastern Region,the Government of India has also created a marketing organization in the cooperative sector. The production of horticultural crops has increased but marketing facilities are inadequate. It

is also realised that the facilities so far created for post-harvest handling of fruit in producing areas, such as grading and packing houses and cold storage, are far below the actual requirements of the industry.

The problem of packing cases has become serious. The change to corrugated cartons for packing will take time. The farmer is hesitant to use the corrugated cartons because of the cost involved. The Government will have to find means to subsidise these cases so that farmers will be encouraged to use them.

The following strategies are suggested for overcoming the problems of the horticultural industry in the Himalayan mountains of India:

- prepare a long-term horticultural development plan that includes crop diversification,
- strengthen the areas of research, extension, and credit,
- improve the quality of planting material available,
- develop adequate and economically justifiable storage facilities, in both fruit production and consumption areas, to extend the marketing season,
- improve packaging, transportation, and marketing distribution,and
- reorient the public sector marketing organizations.

HORTICULTURAL DEVELOPMENT IN THE MOUNTAINS OF INDIA WITH SPECIAL REFERENCE TO APPLE CULTIVATION

Harbans Singh

The agroclimatic conditions of the North West Himalayan Region of India are eminently suited to commercial cultivation of large varieties of temperate, sub-temperate, and sub-tropical crops. A tremendous expansion in area and production has taken place in the last two decades. Out of a total production of 1.35 million tons, apples alone total 1.1 million tons and this accounts for approximately 81% of the area and 96% of the production in Jammu and Kashmir, 42% of the area and 84% of the production in Himachal Pradesh, and 33% of the area and 47% of the production in Uttar Pradesh (eight hill districts)

Apple production has increased on account of expansion of the cultivation area. The production in terms of yield has not been very impressive. The yield of apples, as recorded in India (14 Tons/ha in H.P.) is much below the international standard (30 tons/ha) . There are many factors responsible for the low yield such as unfavourable weather conditions, rapid expansion without the use of appropriate technology, plantations in marginal areas, and propagation of outdated varieties.

In Jammu and Kashmir, net return per hectare is around Rs 11667, which is not very impressive considering the risk involved. Production per unit area, of the existing plantations, can be doubled if orchard management is improved.

The region, as a whole, has to look for a strategy for future apple plantations so that the harvesting and marketing operations overlap to the minimum extent possible. At present, only 10% of the total production of the North Western Himalayan region is early (June and July),75-80% is mid season (August, September, and part of October), and 10-15% is late (later half of October and November). There is scope for increasing harvests in the early and

late seasons, so that there is the minimum possible pressure during mid or main harvest season when gluts are quite common. The possibility of diversifying varieties by harvesting 25% in early season, about 55 in mid season, and about 20% in late season, may be explored for the region as a whole. The marketing period can be extended by means of cold storage facilities.

The post-harvest management of horticultural crops has not kept pace with the expansion of production. This has led to lop-sided development and imbalances in the industry. However, some efforts have been made to create a modern infrastructure for the post-harvest handling of apples in Himachal Pradesh and Jammu and Kashmir. A network of packing houses, cold storage plants, and other facilities, along with juice concentrate plants has been established, but the real benefits have fallen far short of expectations. In Himachal Pradesh and Jammu and Kashmir the corporations were expected to handle about 25% and 12% of the production respectively, but they have handled only 2%. Notwithstanding the creation of such infrastructures, the post-harvest management of fruits has remained grossly inefficient.

The processing stages involved for marketing purposes are picking, sorting, grading, stacking, packing, loading, transport, unloading in other markets, sale to retailers, and transport by the retailers to retail shops for consumption. Because of the lack of post-harvest quality control,during processing,a substantial part of the produce is damaged and much below the optimum consistency,flavour,and taste.

Maturity standards, at harvesting, should be fixed and widely disseminated amongst fruit growers. Unripe fruits shrivel and do not develop the requisite flavour. On the other hand fruit, picked at optimum eating maturity, will be over-ripe by the time it reaches the consumers. This situation should be avoided. The storage (long and short periods), long or short distance markets, and other aspects have to be kept in mind.

Packing cases have been causing problems. So far the entire apple industry has been dependent on wooden packing cases. Whereas, in Jammu and Kashmir one ton of fruit is packed in about 0.7 cubic metres of wood, in Himachal Pradesh and Uttar Pradesh about 1 m^3 and 1.25 m^3 are used respectively. The North Western Region requires about 800,000 m^3 of wood annually. This quantity of wood will be supplied by 130,000 ha of natural pines or 8000 ha of planted pines/eculyptus/poplar. These are colossal requirements and have direct impact on the environment.

There is a case for establishing new markets in the production areas themselves. However, it must be understood that aimost the entire crop should be sent outside the production area. The new markets, as in the case of Haldwani in Uttar Pradesh, should not become satellite markets for Delhi, because this will mean another set of middlemen and additional infrastructure. What needs to be ensured is the direct despatch of consignments in accordance with the requirements of cities, towns, and markets.

Cold storage (including pre-cooling) has become an integral part of the production, planning, and post-harvest management system. Increase in cold storage capacity has become imperative because production is already creating a temporary glut.

Transport and marketing problems have increased considerably and the fruit available in the Indian market is in poor condition. The market costs and returns vary considerably depending upon the cost of packages, transport, and other factors. Variations occur from area to area. From a study in Himachal Pradesh, it has been found that the farmer's share in

the consumer's rupee is only 48% (farm gate price). The marketing expenses of the farmers average 23%, expenses of commission agents, 4%, and of related agents, 15%. In addition, retailers charge about 9-10% against losses. In all, the retailer receives 25%. This shows that 52% of the prices paid by the consumer are spent in the market. Out of this, the margins of the middlemen account for 30%.

Given improvement in production, quality, post-harvest handling, marketing, and processing facilities, areas under horticultural crops can be expanded two to three fold in the next 25 years and per unit production of existing orchards improved by 200 percent.

PRESENT STATUS OF HORTICULTURAL DEVELOPMENT IN HIMACHAL PRADESH, INDIA

K.C. Azad

Horticultural Development in Himachal Pradesh has made tremendous progress during the last forty years. The total area under cultivation was about 792 ha during 1950-51 with a production of 1200 tons, and it has now increased to 135,000 ha (about 66% of the total area under cultivation) with a production of 374,000 tons. This forms 93% of the total fruit production throughout the State. Apples are the major temperate fruit crop of the State and cultivation is spreading (38% of the total area under fruit cultivation in the State).It is expected that by 2000 A.D.horticulture in Himachal Pradesh will cover an area of 225,051 ha with a turnover of 500 crores of rupees per annum in the rural areas.

There has been considerable variation in the yield characteristics of certain varieties and unfavourable environmental conditions have also played an important role in low production. However, the yield level of temperate fruits, especially of apples, is below the international standard (30-40 tons per hectare), while in the State it is only 14 tons per hectare. Therefore, there is a need to improve production per unit area. It may be done by improving orchard management and by introducing high yielding strains.

In the case of apples, the major fruit produced in the State, the Delicious varieties, namely Red Delicious, Royal Delicious, and Rich-a-Red Delicious are the most popular with the orchardists. Plantations of pears have also been established by grafting the wild pear with domesticated varieties. Stone fruits such as peaches, plums, and apricots are also popular . Some important varieties of these fruits have performed well under local conditions.

As there is a substantial sub-tropical region in the State, emphasis has also been on growing sub-tropical and tropical fruits such as citrus and mango. Citrus varieties include Kinnow oranges and Blood Red Malta.

Since 1974, the World Bank has been assisting in the establishment of a sound post-harvest management infrastructure. The State has already developed the capacity to grade and package 30,000 tons of fruit, store 5000 tons in the production areas, 8250 tons in the terminal markets (Delhi, Bombay, and Madras), and process 26000 tons within the State itself. The apple juice concentrate plant, established at Parwanoo, is the biggest plant of its kind in the country. A specialised organization, HPMC, has been created solely with the objective of providing marketing and processing facilities to the Himachal fruit growers. The HPMC operates fruit sale shops in all the major fruit markets of the country and has

developed an extensive network for the sale of fruit products all over India. In addition, efforts have also been made for the collection and dissemination of market intelligence by modern communication technology.

There are a number of centres of horticultural activity in the State, 92 Progeny-cum-Demonstration Orchard/Nurseries, 21 Fruit Nurseries, 6 Olive Development Estates, 1 Walnut Development Station, 7 Floricultural Nurseries, 9 Fruit Canning Units, 20 Beekeeping Stations, 64 Plant Protection Centres/Sub-centres, and 3 Plant Nutrition Laboratories.

The State Government has given priority to the development of horticulture in the State. The main emphases are on:

- creation of suitable organizations for the supply of various inputs, services, and technical know-how;
- providing technological support to the State's horticultural industry by promoting local research and development efforts and introducing advanced technology from abroad;
- legislative measures for ensuring increased production of quality fruits and regulation of marketing activities;
- providing price support;and
- providing incentives to involve meteorological experts in the fruit plantation programme.

The Government of Himachal Pradesh has established a university of Horticulture and Forestry, which is the first institute of its kind in Asia, devoted to research and education in this field. The university awards degrees up to the doctorate level, and it has regional research stations in all the agroclimatic regions to take care of the location- specific research needs of various horticultural crops. There is also a National Institute for Mushroom research devoted to the research and training needs of the mushroom industry.

The annual requirement for the manufacture of wooden packing cases,for apples, at the current level of production, has been estimated at 2-300,000m^3 and this will increase with increased production. To solve the problem of forest depletion, the State Government has launched a project for the manufacture of craft paper corrugated cartons at a total cost of 12 million U.S. dollars in the first phase.

HORTICULTURAL DEVELOPMENT IN THE HIMALAYAN MOUNTAINS OF UTTAR PRADESH

J.N. Seth

The hill region of Uttar Pradesh lies between 28^{o} - 32^{o} N and 77^{o} - 81^{o} E. It is comprised of eight districts with a geographical area of 51,125 sq. km^2. The altitude ranges from 400m to 8000m above sea level. Agroclimatic conditions are suitable for the development of horticulture.

Before the commencement of systematic planning in horticultural development, the area under fruit utilization was only 2400 hectares (1952-53). It had became 160,000 ha by the

end of 1987-80. Major developments took place in the cultivation of apples, peaches, plums, apricots, citrus fruits, litchis, and mangoes. Similarly, the areas under vegetable cultivation increased from 34141 ha in 1984-85 to 37783 ha in 1987-89 and under potato cultivation from 11407 ha in 1984-85 to 12361 ha by 1987-88.

For the development of horticulture, both in the State and Central sectors, various schemes have been drawn up. Horticulture has been recognised as a priority Sector which means that the funds alloted for horticultural development programmes cannot be diverted to other schemes. The following are the main programmes for the development of horticulture.

- *Supply of certified disease-free plants, planting material, and seeds through progeny.*
- *Extension services through mobile teams for the supply of inputs.*
- *Research support by establishing Horticultural Experiment and Training Centres.*

The department has its own research organisation which has taken up research in different horticultural crops. There is one main Horticultural Experiment and Training Centre which is the oldest Horticultural Research Station in India (1932-33). The Centre has 12 principal sections covering all the allied disciplines of horticulture. It also has its own sub-centres as well as field stations. For increasing productivity, a large programme has been initiated under which demonstrations are being conducted on the growers' fields and orchards.

To solve marketing problems, the State Government started a price support policy for apples in 1988 and this will be gradually extended to other crops also. In the scheme Rs 1.50 per kg was paid to sell apples at the collection centres and Rs 3 per kg for A and B grade apples. Besides this, the orchardists are provided with a 50 per cent subsidy on transport charges from the orchards to the road head (collection centre) if the orchard is more than 2 Km away from the road head.

The department has prepared a plan whereby one or two species of fruit trees will be planted in a particularly suitable area. This will facilitate marketing operations such as harvesting, packing, grading, and transportation of fruits, because a large quantity of fruit will be available in concentrated pockets. The other important schemes initiated for the development of horticulture are:

- off-season vegetable cultivation,
- vegetable seed production,
- vegetable cultivation around cities and other established settlements,
- floricultural development,
- olive cultivation,
- beekeeping,
- fruit preservation at the house-hold level, and
- food craft courses.

HORTICULTURAL DEVELOPMENT IN NEPAL PRESENT STATUS, CONSTRAINTS, AND STRATEGIES

H.P. Gurung

In Nepal, an extreme variation in topography, ranging from 60m to 8848m in altitude, provides the opportunity of growing a wide variety of fruits, vegetables, spices, herbs, and flowers.

The country began systematic development of horticulture in the sixties with establishment of government horticultural farms. There are now 33 horticultural farms located in different areas and representing diverse agroclimatic conditions. These farms provide improved planting materials, seeds, and technical services as well as testing sites for research and training centres for farmers.

Fruit Production

The southern plains of the Terai are tropical areas suitable for growing fruits such as mangoes, litchis, guavas, bananas, pineapples,and papayas.The sub-tropical areas are suitable for growing citrus fruits, pears, peaches, and plums. In temperate areas, from 1000m to 2000m in altitude, fruits such as apples and walnuts are successfully grown.

Areas and Production

In the absence of organized surveys, reliable statistics on areas and production are lacking. The estimated area under fruit cultivation is about 56,164 ha and the products total 390,200 tons. (1986-87).

Considering the performance of important fruits, and the potential for production of quality fruits, certain districts have been identified for intensifying commercial production throughout the various development regions.

In order to develop citrus fruit cultivation a "National Citrus Development Programme" has been in operation since 1972. Its headquarters are at Paripatley in Dhankuta. The major objective of this programme is to promote the development of citrus fruit in suitable areas throughout the country. Apart from this, H.M.G. launched a "National Priority Programme" for the development of citrus fruits on a commercial scale in 1983-84.

Two special projects for the development of fruits are already in operation. The Horticultural Development Project was implemented in 1986/87 with the financial and technical assistance of the Government of Japan. The main objectives of the project are to develop fruit production techniques for *Junar* (Sweet orange), grapes, and chestnuts through technical development extension work and by training fruit farmers.

The UNDP implemented a Hill Fruit Development Project in July 1988. The project covers eleven hill districts of the Eastern Development Region, and the development of citrus fruits is the main thrust of the project.

Most of the Integrated Rural Development Projects and Integrated Agricultural Development Projects, in Nepal, have fruit development as a minor component. The expansion of horticulture in Nepal, in the hills in particular, is limited by the lack of roads, storage, and marketing facilities. Because of these constraints, commercial fruit growing has been developed in accessible areas, particularly along roads and highways, near urban areas, and areas within 20Km radius around district headquarters.

Citrus

Citrus fruits are the most important group in Nepal. They are extensively grown in the mid-hills, covering an area of 9495.5 ha, with an estimated production of 64,132.0 tons of fruit annually (1986-87).

Mandarin oranges, sweet oranges (*Junar*), limes, and hill lemons constitute the major citrus fruits grown in the hills. Mandarin oranges are the most important and they are cultivated extensively in more than 20 districts of the mid-hill regions. In some parts of Nepal, citrus greening disease has adversely affected the production of high quality fruits.

Mango

Mango cultivation is second in importance and covers an area of 7515 ha with a total production of 54, 209 tons. It is cultivated in more than 15 districts of the Terai. Most of the mango varieties grown in Nepal correspond to those grown in India.

Apple

Among the various fruits, apples have been introduced only recently. Now these are commercially grown in the temperate region of the north-west at altitudes of 2000m or above, having low rainfall and ample snow fall in winter. The cropped areas extend over an area of 5000 ha and the production is over 5000 tons. Apples are grown in more than 11 districts, the important ones being Mustang, Jumla, Dolpa, Solukhumbhu, Rasuwa, and Baitadi. The most popular varieties are Red Delicious, Golden Delicious, and Jonathan. Crab apples are used as rootstock.

Vegetable Production

Because of the diverse agroclimatic conditions in Nepal, there is tremendous scope for vegetable growing. According to the Seventh Five Year Plan, 140,500 ha will be brought under vegetable cultivation, thereby producing 970,000 tons of fresh vegetables. The present production of fresh vegetables is estimated to be 741,600 tons from 138,000 ha (1984/85). The average production is 5.37 tons/ha which is rather low compared to other countries.

Production has been divided into three categories - special, general, and low priority. Thirty districts are covered by a special programme. Some emphasis is given to kitchen gardening.

Vegetable Seed Production Programme

A seed production programme has been launched in different agro-ecological zones. Various seed production pockets, such as Marpha, Bhaktapur, Mushikot, Dhankuta, Sarlahi, and Dolpa have been identified so far. At the central level, the Vegetable Development Division is responsible for the production of foundation seeds. A total quantity of 84 tons of seed was produced in 1986/87.

Potato Production

The potato development programme in the Seventh Five Year Plan aims at increasing the overall potato production and productivity. During this current plan period, with the production area unchanged, the production of potatoes is targeted to increase from 420,000 tons to 521,000 tons and productivity from 6.9 to 8.7 tons per ha. There are significant differences in potato production among Nepal's three ecological belts.

The total area under potato cultivation has increased by 37.8% and the total production of potatoes by 28.7% within the last twelve years (1974-75 to 1986-87). Strangely enough, productivity decreased considerably in that period. Basic seed production, by use of in-vitro and rapid multiplication techniques, is already in operation at the National Potato Development Programme headquarters. Disease-free germplasm seed materials (tuberlets), thus produced, are multiplied by the government farms and their affiliated farmers. Field production of disease-free tuberlets from true seeds is also being conducted. Foundation seeds, thus produced,are multiplied further and distributed. These foundation seeds are made available to farmers through the District Agricultural Development Offices and their extension services.

Mushroom Production

In Nepal, scientific mushroom cultivation began in 1982 and the Department of Agriculture established a mushroom production unit under the Plant Pathology Division at Khumaltar, Lalitpur. According to the Seventh Plan, mushroom production is targeted to increase from 75 tons to 300 tons.

Marketing of Horticultural Crops

There are no separate markets for the sale of fruits or vegetables in the rural areas. However, *'Hat Bazaar'* as periodic markets, mostly on a weekly basis, are in existence. There are no regulated or organized wholesale markets for fresh fruits and vegetables. Inappropriate packaging, improper grading, lack of transportation and storage facilities, marketing information, and marketing facilities are common problems. A number of programmes have been envisaged by the Marketing Services of the Department of Food and Agriculture.

Processing of Fruit and Vegetables

A number of processing factories have been established in the private sector but their scale of operations is moderate.

In Marpha and Jumla, where apples are cultivated on a large scale, the fruits unfit for table purposes are used for making jam, jellies, dried slices, brandy, and wine. Similarly, tomatoes in the *terai* region are processed into tomato ketchup and sauces on a limited scale.

Storage of Fruit and Vegetables

At present, there are 14 cold stores of varying capacities at different locations in the country. The total capacity of these cold stores is about 12,600 tons. Out of the 14 cold stores, three belong to the Agricultural Development Bank and the remainder are owned by private entrepreneurs.

VEGETABLE DEVELOPMENT IN NEPAL : PRESENT STATUS, FUTURE STRATEGY, AND CONSTRAINTS

S.B. Aryal[1], S.S. Rekhi[2], B.B. Shah[3]

Vegetable growing in Nepal is emerging as an important activity with high returns for small farmers, particularly in mountainous areas. In remote areas, however, vegetable seed production is becoming popular due to the high value and low volume nature of vegetable seeds. Climatic variability makes it possible to grow a wide range of vegetables all year round.

Realizing the importance of vegetables in improving nutrition and improving farmers' incomes, His Majesty's Government of Nepal launched a special production programme by mobilising resources such as seed and input supply, demonstrative production, extension, training, follow-up, credit, and support for marketing. As a result, during the last decade, the total area under vegetable cultivation in Nepal increased by 35 per cent, production by 85 per cent, and productivity by 38%.

The per hectare productivity, in the target area under the special programme, reached 15 tons against a national average productivity of 6.8 tons per hectare.

The current production level of vegetables in Nepal is 970 thousand tons, providing 45 kg of vegetables per capita. Nepal plans to double the production by the year 2000 and raise the per capita consumption to 64 Kg.

Nepal has a high potential to produce a wide variety of vegetable seeds of temperate, sub-tropical, and tropical crops. With support from the FAO, Vegetable Seed Production, in the organized sector, increased from 10 tons in 1975-76 to 210 tons in 1989-90. In the next 10 years, HMG plans to increase seed production by 300 per cent and raise the production to 885 tons in the organised sector. According to HMG policy, HMG farms are producing only nucleus and foundation seed. Improved or certified seed is produced by contract farmers. The Agricultural Inputs Corporation (a public sector company) and private seed entrepreneurs procure the seed from contract farmers on agreed terms and at agreed prices. The Vegetable Development Division of HMG/Nepal provides technical supervision, quality control, and seed cleaning facilities.

Due to good quality seed and competitive prices, private seed companies from Nepal have started exporting radish seed to Bangladesh. During 1989, 20 tons of seed were exported. Nepal has also introduced hi-tech seed production such as the hybrid seed production of chinese cabbage and tomatoes for multinational companies.

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The experiences of the FAO supported project on Fresh Vegetables and Vegetable Seeds have been described in this paper. This project was started in 1981 with the main objective of increasing the production of high-quality vegetable seeds. The project supported adaptive research to establish production technology and identify suitable varieties. The infrastructure for seed production, seed cleaning, and storage was established. Trained manpower was developed through training. To popularise the seeds amongst the farmers, the project supported a seed campaign programme through farm/field demonstrations, field days, and short-term training. When this programme became successful, the project initiated demonstrative production in selected pockets. Under the project, support was also provided for second generation problems, such as timely input supply (seed and chemicals) and improved marketing through promoting private entrepreneurs.

Because of the success of this project, a model project approach has been identified under which a proper coordinated approach between research, seed production, promotion of private seed entrepreneurs, seed campaigns, production targets through demonstrative production, and improved marketing has been demonstrated. It is necessary to establish long-range plans providing support to all components of the programme on a sequential basis with appropriate timings.

THE HILL FRUIT DEVELOPMENT PROJECT: EASTERN DEVELOPMENT REGION, NEPAL

Khalil Miyan

His Majesty's Government of Nepal has developed a number of different agricultural enterprises in various geographical regions of the country, based upon their comparative advantages. In the hills, the quality of land is generally very poor, and the majority of farmers are small-holders possessing less than one hectare of land. At the same time, due to excessive population pressure in the hills, there are serious problems of deforestation, soil erosion, decline in soil fertility, and crop yields, resulting in low farm income, malnutrition, and out-migration.

Development opportunities in the hills are limited. Promoting fruit cultivation , wherever conditions are favourable, is beneficial for individual farmers as well as for the national economy. Hence, the encouragment of fruit cultivation in the hills through various programmes and projects. From the current fiscal year (1988-1989), the Hill Fruit Development Project has been implemented in the eleven hill districts of the Eastern Development Region (EDR) with loan assistance from the Asian Development Bank, Manila, and technical assistance from the UNDP.

Throughout the eleven districts of the EDR, there are sharp variations in altitude ranging from about 130m in the South to 8848m (Everest) in the north. The annual precipitation varies from 900 to 4800mm. In general, the project area has a sub-tropical climate in the southern parts and alpine in the north. The total area is estimated to be 2.127 million ha. of which about 18 percent (382,000 ha) is under cultivation, 46.5 percent (983,000 ha) under forest, 8 percent (172,000 ha) under pasture, and the remainder is waste land which also includes areas under permanent snow. The total population is 1.6 million (1981 census) with an annual growth rate of 1.6 percent. The average size of holdings is 1.23 ha and 65 percent of the households possess less than one hectare of cultivated land.

The EDR has a total road network of 1,471 km, and six of the project districts are already connected by motorable roads.In addition, there are a number of district level link-roads. Besides these, several other roads are either under construction or in the planning stages. It is expected that, in the coming years, all the district headquarters in the EDR will be connected by motorable roads. The project districts, at present, are also served by a good network of trails. It is believed that in the next 5 to 10 years all the project districts will be linked and transport of inputs and outputs will be easier.

The headquarters of the National Citrus Development Programme and the Dhankuta Agricultural Station are located at Paripatle in the Dhankuta District, and there is a horticultural farm providing research and technical support facilities for temperate fruits at Phaphlu in Solukhumbu district. In all the project districts, there is an Agricultural Development Section to carry out agricultural extension activities, including those for horticultural crops. There is one branch office of the Agricultural Input Corporation, in each of the project districts, to supply production inputs. Similarly, the branch and sub-branch offices of the Agricultural Development Bank/Nepal, are responsible for the supply of institutional credit to support agricultural development programmes. With proper strengthening of the research and extension base, fruit development can be promoted.

Constraints and Potentials of Fruit Development in the Project Districts

There are a number of constraints limiting the scope of fruit farming, especially for commercial purposes, in the project districts. They are as follows:

- adverse climatic factors, such as high rainfall and hail storms;
- difficult terrain and inadequate transportation facilities;
- lack of organized markets and marketing infrastructure;
- unavailability of appropriate technologies;
- lack of technical know-how and weak extension services;
- shortage of supplies of quality planting materials;
- inadequate supply of production inputs and credit;
- incidence of dieases and pests;
- lack of adequate storage and processing facilities;
- poor economic condition of the farmers; and
- farmers' ignorance of the nutritive value of fruits.

Potentials

A wide range of prevailing climatic conditions provides great opportunities for the cultivation of tropical, subtropical, and temperate fruits. There are some experiences and technologies available for the successful cultivation of some fruit varieties, such as Dhankuta orange, Dhankuta Junar. Terhathum Lime, and many inducted cultivars of apples, pineapples, and bananas.

Fruit farming is a better source of income and additional employment than traditional crops for the hill farmers. Production increase is necessary for import substitution in the short run and for export promotion in the long run. There is comparative advantage in producing fruits in the project districts vis-a-vis those imported from India as well as scope for promoting fruit cultivation in kitchen gardens to raise the nutritional status of the hill people. In addition, fruit cultivation will have a positive inpact on the hill ecology.

The Main Components of the Hill Fruit Development Project

The project has been designed with the objectives of increasing fruit production, promoting employment opportunities, raising income, improving the nutritional standard of the people, and helping to bring about ecological balance in the project area.

The project proposes to bring approximately 5000 ha under fruits, of which 4000 ha will be small commercial orchards (about 20,000), and 1000 ha will be homestead gardens. At full development stage, about 76,000 tons of fruits should be produced from the programmes. To meet the fruit sapling requirements, 21 private nurseries will be established with the credit and technical support of the project. Similarly, about 40 low-cost cellar storages of 5 to 10 tons' capacity each will be constructed for the on-farm storage of fruits.

Strengthening of the research and technical support facilities of the National Citrus Development Programme, Dhankuta Agricultural Station, and Phaphlu Horticultural Farm, through the provision of additional manpower and physical facilities, has been proposed. Similarly, the existing agricultural extension services in the project districts, will be strengthened. The project is also to finance the establishment of 98 demonstration orchards, with the farmers' participation, and the establishment of two diagonistic laboratories for fruit diseases at Bhojpur and Dhankuta. Two demonstration and service centres, at Dharan and Phaphlu, are to be established for processed fruit products on a cottage industry scale.

The project proposes to finance the development of market yards at Dharan, Katari,and Birtamod; and to establish market information services to collect and transmit current data on fruit marketing from relevant market places. The project also provides overseas' training for concerned staff in citrus grading, packaging, market planning, and design.

Future Prospects of Fruit Development in the Project Districts

Through the implementation of the project, a strong institutional base for the research, extension, production of quality planting materials, and marketing is to be created which will help in the continuation of the fruit development activities in the area on a sustained basis. At full development stage, about 76,000 tons of fruits and 300,000 tons fruit saplings are expected to be produced annually from the proposed programmes of on-farm fruit plantation and nursery development.

PUBLIC AND PRIVATE RESPONSES TO CASH CROP DEVELOPMENT IN KAKANI PANCHAYAT, NUWAKOT (NEPAL)

Saroj K. Basnyet

Agricultural land is the most valuable asset in the Nepalese Hills. Ninety three percent of the population depends on it, both for subsistence farming and for cash crop production. Different public and private responses have been provided to change the cropping pattern in Kakani Panchayat.

The dominant economy of Kakani Panchayat is based on the production of radishes and paddy. This Panchayat has been traditionally involved in the production of quality radishes

on outward sloping terraces, located at higher elevations, and paddy on level bench terraces at lower elevations. Before the construction of the Kathmandu-Trishuli Road, radishes and paddy were either exchanged with each other or transported to Kathmandu for marketing.

With the availability of inputs from the Government, farmers have started harvesting two to three crops from the same areas annually, depending upon the suitability of the land holding. The production of radishes has also increased many-fold. Now subsistence farming has been replaced by cash crop products. Improvement in the marketing system and the evolution of the market centre, Ranipauwa, is mainly responsible for the production of cash crops in the Kakani Panchayat. This change in the system is promoting the economic development of the area and ultimately causing the integration of the rural economy into an urban one.

B.3: Bhutan

HORTICULTURAL DEVELOPMENT IN BHUTAN

Dasho Khandu Wangchuk

The Kingdom of Bhutan can be divided into three broad agroclimatic zones, running from east to west. The northern zone is about 30Km wide, with altitudes above 4000m. It is covered by perpetual snow, glaciers, and barren rock. The central zone is 70Km wide and altitudes range from 2000 to 4000m. The climate and vegetation are temperate and the major forest areas are located here. The southern zone is about 50 Km in width and lies in the foothills of the Himalayas, rising to an altitude of about 2000m. The climate and natural vegetation in this zone are sub-tropical and tropical.

Ninety-one percent of the total land area is under forest, alpine pastures, and snow. Only about 410,000 ha (9%) of the land area is suitable for agriculture and 129,000 ha(32%) is cultivated. Most of the area (78%) is rainfed and is classified into dryland,*'sheri'*, shifting cultivation, and orchards. Orchards occupy 14,000 ha (or 1%) of the cultivated area. Vegetables are mostly grown in kitchen gardens.

The Role of Horticultural Crops

Horticultural crops are popular and are the main source of cash income for Bhutanese farmers. A significant proportion of these crops, that are suited to Bhutan's varied soil and climatic conditions, have a high value to weight ratio. As such, they can sustain relatively high road transport costs or justify air freight.In economic terms, these crops facilitate an optimum utilization of Bhutan's scarce resources of land and labour.

Earlier, activities to promote horticultural development were on a piecemeal basis and were focussed on the needs of individual crops. The emphasis was on the distribution of seeds and on marketing aspects. More recent efforts have focussed on the processing and marketing aspects, as demonstrated by the UNCDF - funded Horticultural Produce, Processing, and Storage Project, and on marketing interventions by the Food Corporation of Bhutan (FCB) through price support and purchasing of various horticultural products. The FCB also runs auction yards at Phuntsholing, Gaylegphug, and Samdrupgongkhoz. Equipment has also been provided for the apple plant at Bumthang and for Bondey farm. A

lump sum amount is provided to a Horticultural Revolving Fund for small and medium scale investment in production and processing facilities.

Little work has been done to tackle production-related problems of the horticultural industry and this is due to resource constraints. There is now a need to address the imbalance by reappraising these problems and recognising the need for integration between the production and marketing aspects. Through a farming systems approach, the Government is to initiate a horticultural development programme emphasizing the role of horticultural crops as a sub-sector of the agricultural industry.

The main horticultural crops grown in Bhutan are apples, oranges, potatoes, and cardamon. In addition there are other crops that have commercial potential:-

Temperate tree fruits: There are a number of trial plantations of apricots, peaches, plums, cherries, and pears, and these fruits can be grown successfully in many parts of the country.

Temperate soft fruits: Climatic conditions are favourable in the drier central area, with altitudes between 1800m and 3000m, for currants, gooseberries, blackberries, raspberries, and loganberries. For commercial production, local processing outlets are necessary because of the high perishability of the produce. There is scope for a limited number of plantations as these fruits are in demand.

Tropical and sub-tropical fruits: A wide range of tropical and sub-tropical fruits (mangoes, guavas, litchis, bananas, kiwis, and figs) can be grown successfully at lower altitudes. There are export opportunities, particularly for mangoes if they can be harvested following the mango harvests elsewhere in the region.

Ginger: Ginger is grown in all the southern districts of Bhutan and market information is available. Yields are low (5-10 tons/ha) and there is scope for increasing yields by a factor of at least two.Currently no part of the crop is dried and doing so would solve the problem of market price fluctuations. This would open up export opportunities.

Other spices: In addition to chillies, ginger, and cardamon, a wide range of spices can be grown at low attitudes. Black pepper, in particular, is a prospective crop for inaccessible areas with poor infrastructure.

Lemon Grass and Essential oils: In Mongar, Lhuntsti, and Tashigong districts,oil is distilled from wild lemon grass on a domestic scale. It is, nevertheless, an important source of cash income.

Mushrooms: Initial cultivation has focussed on varieties such as oak or *shiitake* that use locally available materials (oak logs and sawdust).

Nuts: Walnuts grow well under a wide range of climatic conditions and at various altitudes. The potential, for species such as chestnut, hazel, pecan, and macadamia, is yet to be assessed.

Future Plans: Climate, soil, market, and other conditions favour horticultural development on a commercial scale in Bhutan. The Government has decided to implement the Integrated Horticultural Development Master Plan in order to take advantage of this favourable situation.

Major Elements of the Integrated Horticultural Development Programme

Development Objectives

The development objectives of the project are consistent with the country's main Sixth Plan objectives. They are to achieve self-sufficiency in the major food crops, increase the per capita income and nutritional levels of the population, and to increase the contribution of agriculture to the GDP and to foreign exchange earnings. It is hoped that the project will increase the amount and diversity of available food and that, by intensifying high value cash crop production, farm incomes will rise. Export of high value cash crops will assist the Royal Government of Bhutan in its efforts to reduce the external trade imbalance.

Immediate objectives

The immediate objectives of the project are the increase and diversification of horticultural production and farm productivity in an environmentally acceptable way resulting in improved nutritional standards, higher rural incomes, and increased export earnings.

B.4: Pakistan

HORTICULTURAL DEVELOPMENT IN PAKISTAN, WITH PARTICULAR REFERENCE TO MOUNTAIN REGIONS

Saeed Ahmed Chaudhri

Pakistan is producing appreciable quantities of some of the major fruits and vegetables. However, production is just enough to meet the ever-increasing requirements of the rapidly multiplying population, with a small surplus for export. These horticultural crops, besides providing nutritious foods, can play a still greater role in the improvement of foreign exchange earnings.

The mountain regions in Pakistan fall largely in Baluchistan, NWFP, and the northern parts of the Punjab. Cultivation of horticultural crops is an important enterprise which provides job opportunities and is responsible for the economic uplift of these regions. Quetta, Kalat, and the Ziarat areas in Baluchistan are famous for producing excellent quality apples, grapes, pomegranates, almonds, and other deciduous fruits. With the improvement in electrification, ground water has been successfully tapped. Construction of small dams has further improved the availability of irrigation water for raising fruits and vegetables. Potatoes and summer and winter vegetables are produced for Karachi and up-country markets.

Fruit orchards are scattered throughout Pakistan, and their sizes vary greatly from a few trees to many hectares. There are about 21,500 orchards, in an area of 427,200 hectares, which produce fruits such as citrus, mangoes, dates, guavas, bananas, apples, pears, peaches, plums, apricots, grapes, pomegranates, and almonds.

The establishment of a "Deciduous Fruit Development Centre" at Quetta has helped horticultural development in the province. It has created awareness and an atmosphere congenial for the promotion of horticulture on scientific lines.

In the NWFP, Peshawar and Swat Valleys, Abbotabad, and Mansehra are famous for raising pome and stone fruits; potatoes, tomatoes, peas, cauliflowers, turnips, and cucumbers are important vegetable crops in these areas. Tea and mushroom cultivation is also being promoted in the Mansehra and Swat areas.

The Murree Hills, in the Punjab province, produce apples and small quantities of plums, peaches, apricots, and loquats. In 1952, only 140 ha were estimated to be under fruit cultivation in these areas. Since then, there has been a phenomenal increase in area and production of apples in the Murree hills. More than 3,200 ha of apple orchards exist now.

The establishment of a Hill Fruits' Research station in the Murree Hills, in 1952, and the sustained efforts of the Agricultural Department of the Punjab have helped to solve the many problems of fruit production and to promote horticultural activities.

Fruit and vegetable production in the mountain regions is faced with several constraints which contribute to low yields of poor quality produce and affect efficiency in the field of horticulture. The cultivars available are not necessarily the best. There is a preponderance of insect pests and diseases infecting horticultural crops, resulting in substantial pre-harvest and post-harvest losses. Lack of information on improved production technology and adherence to outmoded techniques and methods are serious handicaps. Poor means of communication, inadequate storage facilities, absence of information, and application of improved methods of picking, packing, collection, and distribution, result in huge losses of produce.

The Pakistan Agricultural Research Council, the horticultural departments of agricultural universities, and horticultural research institutes in the provinces are engaged in producing well qualified personnel and in organizing research in the field of horticulture. The main focus of research has been variety improvement and development of improved production technology as well as its dissemination for commercial exploitation. Nevertheless, extension services in the field of horticulture are weak. Fruit and vegetable maximization projects, and the creation of a "Fruit and Vegetable Development Board" in NWFP, are some of the efforts made to streamline and coordinate research development and extension activities. Similar approaches are being envisaged for other provinces.Ancillary horticultural activities, such as floriculture, are yet to be incorporated in horticultural diversification programmes.

Industrial processing is making steady progress. However, much room for improvement exists. Marketing of horticultural produce, within the country and abroad, faces numerous problems. The launching of a Fruit and Vegetable Marketing and Storage Project, aided by the Asian Development Bank, is likely to ameliorate the situation in storage, post-harvest handling, and marketing.

Inspite of many handicaps and constraints the future prospects of horticulture in these mountain areas are promising. The major focus in the future will be promotion of tea cultivation, potato and mushroom production, and raising roses, carnations, and other flowers in the mountain areas of the NWFP. Baluchistan will continue its emphasis on the production of vegetable seed, potatoes, apples, almonds, and grapes.

In the Murree Hills, the necessary inputs for plant protection measures are being provided to maintain the quality of fruit production.Processing facilities are also being encouraged.

DEVELOPMENT OF HORTICULTURE IN THE MOUNTAIN REGIONS OF PAKISTAN- PROGRESS, POTENTIAL, AND CONSTRAINTS

Zahur Alam

Because of seasonal production, the mountain areas of Pakistan have a comparative advantage in horticultural crops and they also earn more income per unit area than cereals. Fragmentation of limited land holdings and increases in population further necessitate the development of horticultural crops in mountain areas for sustainability both of income and agriculture. The present horticultural system is a low input, low output one. Climatically, mountain areas offer unlimited development potential for various horticultural crops and there is excellent cash potential. The varied agro-ecological conditions permit successful cultivation of almost all types of deciduous fruits, a wide variety of vegetables, their seed production, and flowers.

The construction of new highways and readily available transport services further enhance the scope of horticultural development in mountain areas such as Gilgit, Chitral, Baluchistan, North and South Waziristan, Swat, Dir, Parachmiar, Kohistan, Hazara, the Murree Hills, Quetta, Kapat, Pishin, Lorahi, and Azad Kashmir. High mountain areas are also suitable for the production of quality seed potatoes.

Areas cultivating deciduous fruits, potatoes, and onions have increased concomitantly with an increase in production, but yields per unit area have remained low and static. Low priority in government development programmes, non-availability of high quality nursery plants and vegetable seed, poor orchard management, low plant protection coverage,lack of integrated pest management packages, inappropriate crop/variety selection according to agroclimatic conditions and altitude, and inadequate extension services,that lack mobility, in mountain areas are the causes of low production.

To overcome this extension service coverage problem, and reduce the farming community's dependence on outside expertise and help, the Aga Khan Rural Support Programme (AKRSP), in its project area in the northern mountain areas of Pakistan, has developed a model for creating cadres of village-level specialists. These specialists are trained in various fields, provide services in their respective villages, and are adequately remunerated by the farmers for their services and the cost of pesticides and other materials used. Village level farmer-managed nurseries are also being established. Trained nursery specialists are paid through the sale of plants. For essential inputs the AKRSP extends adequate loan facilities.

Provincial agricultural research stations and sub-stations, located in different agro-ecological zones, have conducted excellent research on all aspects of horticulture. At the Federal level, the National Agricultural Research Centre (NARC) coordinates provincial research and provides excellent facilities for basic research.

To increase horticultural production for consumption within the country as well as to boost exports, a number of horticultural development programmes, in various provinces, supported by foreign technical and financial assistance, are underway.

Marketing is a complex and complicated process. There are three different types of market and different stages are involved in transporting the produce to these markets which

include small rural markets, primary markets at the sub-division level, and wholesale markets at the district level. Regulated markets, or *mandis*, have a controlled schedule of fees and charges. The commission agent, or *arthi*, is the kingpin in the regulated market because it is his function to auction the produce. In mountain areas where production is scattered, and in distant valleys where market surpluses are usually small, it is impossible for small farmers to market their low surplus volume individually and profitably. These areas also lack market information and cash flow. The quality of available fruits and vegetables varies. The AKRSP is fostering group marketing to overcome these critical constraints,to reduce overhead expenditure, and to encourage fair prices.

Export of fruits and vegetables has been erratic and surplus production and assured market outlets are needed. Adequate cold storage space is available, mainly in consumption areas. Such facilities are needed in mountain production areas as well. The fruit processing industry is particularly well developed in the country and produces products of international quality and standard. In mountain areas processing units, specializing in specific products, need to be established.

B.5: Peoples' Republic of China

STUDY ON HORTICULTURAL DEVELOPMENT IN THE HIMALAYAN AND HENGDUAN MOUNTAINS, CHINA

Zheng Du, Li Gaoshe, Jiang Hong

The Himalayas and the Hengduan mountains in China are characterized by unique geo-ecological conditions, sparse population, inaccessibility, remoteness, and lack of infrastructure. Since 1950, as a result of economic development, social progress, and improvement of communications, horticulture has been established over a large area. The major crops grown are fruits, walnuts, tea, potatoes, and vegetables.

The region has an Asian Monsoon climate with alternating wet and dry seasons. The winters are from November to April. There is abundant sunshine and dry weather with rare precipitation, especially on the northern flanks of the Great Himalayas. The winter precipitation,derived from the disturbed westerlies, plays a significant role in the Western Himalayas.

Three major experimental stations for agriculture (including horticulture) were established at Lhasa, Xianze, and Gyangze at the end of 1950 and the beginning of 1960. A lot of research work on horticulture has been done by these stations and information is available on various aspects of agricultural development.

Most of the plantations are situated on terraces and gentle slopes along the valley. In 1971, fruit production was only 150 tons but by 1986 it increased to 4373 tons. Apples account for 83% of the production and pears 27.5%. There are about 100 species of fruit in the region. Temperate fruits include apples *(Malus pumila)* pears *(Pyrus)*, peaches (*Prunus persica*), plums (*Prunus salicina*), cherries (*P. pseudoceraus*), walnuts (*Juglan regia*), grapes (*Vitivine vinifera*), and Chinese pears. Sub-tropical fruits include oranges (citrus species), bananas (*musa basigoo*), lemons (*citrus limon*), pomegranate (*Punica granatum*),

Zanglao (*Actinidia chinensis*), and Chinese flowering quince (*Charnomelis sinensis*). Chinese flowering quince is used as rootstock for apples. It has the tendency to dwarfen the apple tree which also starts bearing early. In the Himalayan mountain areas, there are about 60 species of apple, 20 species of pear, 4 species of peach, and 4 species of grape. Most of the cultivated fruit trees have been introduced from other parts of China.

In Tibet, only apples and pears are of commercial value. The important varieties of apple are Golden Delicious, American Summer, Star King, and Jonathan. There are about 140 varieties of pear which belong to three species, *Pyrus hretschneidi Rhd*, *Pyrus pyrifolia* (Burn) and *Pyrus communus L. Jinchuan*.

White snow pear is a famous brand of large pear, beautiful in appearance, juicy, and spicy in taste. About 300 tons are produced in the region.

Oranges are the most important of the sub-tropical fruits and are mostly grown in the south eastern region. The major apple harvest is in middle or late October. Packing containers are crude and simple.

Marketing and Processing

There is little commercial marketing of fruits because of low production. Most of the produce is sold in Lhasa. There are no processing units in Tibet.

Suggestions for the Increase of Fruit Production

1. Overall Planning based on local conditions.Emphasis should be given to rational selection of fruit crops and their varieties to regulate the market supply.

2. Proper management to increase production.

3. Relaxation of the policy restrictions in the *Responsibility System* concerning the growing of fruit trees.

4. Introduction of varieties suitable to the different regions of Tibet.

5. Establishment of professional institutions to study the production of fruit trees.

6. Introduction of dwarf rootstocks. Their study under local conditions should be focussed on production and resistance against pests and diseases.

Tea

China has a long history of tea cultivation and utilization. However, tea cultivation in the Himalayan and Hengduan mountains has been established for a relatively short time only. In the Himalayas, tea species and varieties were introduced from the Schun and Yunnan provinces.

In the Hengduan Mountains, production is high. In the northeast, there are altogether 9,440 ha of tea gardens and the average production is 525 kg/ha. In the Miaoxi tea garden, fine processed tea leaves can yield as much as 1,170 Kg/ha. However, in the Himalayas, the production is as low as 315 Kg of fine tea and 1125 Kg of coarse tea per ha.

Walnut

Walnut is an important oil and timber producing tree. It has a wide distribution extending from the dry valleys of the Hengduan Mountains in the east to the Jilong area of Tibet in the west and from the mid-mountains in the south to the southern edge of the North Tibetan plateau in the north. At present over 700,000 walnut trees have been planted and produce 1,000 tons of walnuts each year. Jiacha and Nangxi are the most important counties for walnut cultivation.

Geomorphologically,walnut trees are planted at an elevation of 1500-4000m,with the highest point at 4300m. This surpasses the upper boundary of walnut distribution in the northern temperate zone and the eastern zone on the same latitude. According to the records on the upper boundary of walnut distribution, the average annual temperature is 2-4^{O}C. The average temperature in January is -7^{O}C with a minimum temperature of -16^{O}C. It is observed that when anti-cold measures are taken, walnut trees can survive the winter with a minimum temperature of -25^{O}C. There are a number of varieties of walnut in Tibet of which the Kernel-naked, with a thin corpodermis, and Jiamian, with a thick corpodermis, are the most common ones. The Jiamian walnut is the most popular variety.

Vegetables

Before 1950, only common vegetables such as Brassica, Chinese cabbages, rape, radishes, and broad beans were grown. Now, new varieties have been introduced from Eastern China and cultivation has increased due to heavy demand.

Conservatory cultivation in greenhouses, under plastic film cover, and seedling transport are recommended to improve growing conditions. These methods increase the temperature, promote the growing period, and expand the distribution of vegetables. Those vegetables that require warmth, such as tomatoes, cucumbers, and peppers, are grown in greenhouses. In the Lhasa district, fresh vegetables can be grown in greenhouses all year round without heating. Cucumbers are grown biannually, yielding up to 30-60 tons/ha. In the Yanhajing area, vegetable cultivation is made possible at 4200m by use of thermal energy from the thermal power station.

Potatoes

Potato is one of the major crops in the Himalayas and the Hengduan Mountain Region. Cultivation has increased in the middle reaches of the Yarlung Zangbo River, as well as in the broad valley and basin on the northern flanks of the Himalayas. A lot of units and institutions grow potato crops to resolve the shortage of vegetables in the high mountain regions. In Lhasa Prefecture, potatoes are grown on 1,100 ha and 2356 tons per annum are produced.

In the middle reaches of the Yarlung Zangbo River, the temperature in July and August ranges from 15-20^{O}C in the day to 8-10^{O}C at night with a ground temperature of 18-20^{O}C below 10cm of soil. These temperatures are favourable for potato tubers.

In the Hengduan Mountain Region,the potato has two planting periods, one in early spring and the other in summer. Summer planting takes place after the harvesting of early maize and wheat, at the end of June to the middle of July, and the harvest is in October. The early maturing varieties are selected because of the short growing season.

The planting pattern depends on the soil and climatic conditions. Ridge planting is preferable, particularly in irrigated regions, while level planting is done in semi-arid regions with insufficient moisture. The optimum density of potato plants is usually 75-90 thousand per hectare.

Late blight (*Phytophthora infestans*) and early blight (*Alternaria Solani*) affect potato cultivation in Tibet.It is best to let the land lie fallow or sow legumes and cereals before potato cultivation.

II. Horticultural Research and Diversification by Ancillary Horticultural Programmes

HORTICULTURAL RESEARCH IN THE HIMALAYAN HILL REGION OF INDIA

K.L. Chadha

The review of Horticultural Research clearly indicates that now systematic efforts have been made to create a suitable infrastructure for research on temperate fruits and vegetables in the Himalayan region of India. Further, sound research programmes have been initiated to tackle various aspects of crop improvement, crop production, crop protection and, to a lesser extent, post-harvest technologies. This has resulted in the build-up of valuable indigenous and exotic germplasm, identification of varieties for different regions, and release of new varieties, particularly of apples, vegetables, and potatoes. Several long range trials for standardizing agrotechniques have been conducted, particularly for fruit crops. However, the problems facing the fruit and vegetable industry are diverse and concerted efforts are required to solve them. The important areas identified as requiring the immediate attention of horticultural scientists are given below.

New germplasm, particularly new spur-bearing scion cultivars of apples, mutant selections of Delicious (that develop a better red colour even in shady conditions of tree canopy). New apple rootstocks and new cultivars of cherries, peaches, almonds, and walnuts developed in the U.S.A. and Europe should be introduced.

'Delicious' apple cultivars mutate quite frequently, thus efforts should be made to select improved, possibly compact, 'sport' from existing orchards. Similarly, walnuts and almonds that are adaptable to particular environments and to propagation should be selected. Selection of suitable clonal rootstocks from different *Malus spp.* with semi-dwarfing vigour, tolerant to drought, adverse soil and moisture conditions, resistant to root-rot, collar-rot, and woolly-aphid may be made.

Cultivars resistant and tolerant to apple scab, powdery mildew, and woolly aphid need to be evolved through breeding.

The role of pollinisers and pollinators, including honey bees and other insects, needs to be fully assessed to improve the fruit set. Female sterility, prevalent in the Delicious group of apples, also needs consideration.

In-vitro micro-propagation techniques may be employed for the distribution of new and virus-free germplasm.

For flat areas, optimum densities for high density planting need to be determined and suitable systems of training and pruning defined.

Standardisation of macronutrient and micronutrient requirements for young and bearing trees, doses of fertilizer for trees with different crop loads, time, and methods of application, need to be standardised.

Drip irrigation has high potential in increasing scarce water resources in rainfed areas. This system of irrigation could be tried for cultivation of temperate fruits.

Suitable areas for apples and other temperate fruits need to be delineated on the basis of chilling hours, freedom from spring frosts, hail, and rainfall.

Intensive research on the effect of spring frosts, hailstorm, and fluctuating temperatures at the time of flowering and fruit-set needs to be undertaken under different agroclimatic conditions. This should also include use of growth regulators to delay time of flowering in order to escape frost damage and to ensure better fruit set under adverse weather conditions.

The extent of alternate bearing in different cultivars and suitable remedial measures, including blossom thinning during the 'on year', with the help of growth regulators, needs study.

Research on more economic control measures for apple scab, powdery mildew, root-rot, collar-rot, canker complex, San Jose scale, woolly aphid, and defoliating beetles is needed.

The codling moth causes problems in the Trans Himalayan areas of Ladakh. Quantitative measures should be taken to check its spread to other areas.

Reliable maturity standards for apples are necessary for marketing, storing, and processing purposes. Colour and quality grading need to be improved and standardised to ensure better returns. Packing methods should be improved to avoid bruises and injury during handling and transport. Alternative packaging is necessary in order to avoid the excessive use of wood.

On farm air-cooled storage and cold storage should be developed in production areas to regulate the supply of apples and to avoid gluts.

Suitable cold storage, CA. storage, and hypobaric storage facilities should be tested on the pilot level and optimum temperatures and relative humidity for storage of different cultivars determined to ensure their availability to the consumer, in optimum condition, over a prolonged period.

Presently, only apple juice is manufactured in the country. Some diversification in processed products such as apple chips or crisps and alcoholic beverages such as cider or perry, apricot nector, peach nector, and strawberry nector is essential.

There is a lot of scope for research on growth manipulation of horticultural crops.

Apple is currently the dominant temperate fruit. Therefore, there is need to diversify into crops such as pears, cherries, peaches, apricots, nectarines, olives, saffron, figs, and plums. More emphasis should be given to cultivation of nuts, particularly almonds, walnuts, pecan, and pistachio.

The wide gap between available technology and its actual use by the farmers should be bridged immediately by reorganising and strengthening the horticultural departments throughout the hill States.

In accordance with the specific requirements of each area, orchard management, tree canopy management, plantation density, moisture conservation *in situ,* tree nutrition,and integrated pest and disease management technologies should be adapted for transmission to farmers in order to propagate their use.

A national variety foundation (Elite Progeny Orchard) should be established as a repository for all the commercially grown varieties of the hill states. This would serve as a scion bank.

The data base for horticultural crops is inadequate and sometimes not reliable. The data base for area, production, and yield of different crops needs to be developed. The impact of tree crops on ecology and environment may also be quantified.

Vegetable Crops:

There are several constraints to vegetable production in the hills. These include moisture stress, acidic soils, and nutrient fixation, as well as some major diseases and insect pests. The major diseases of cole crops are damping-off caused by *Pythium* and *Rhixoctoria spp.*, black rot (*Xanthomonas campstris*) in commercial crops, cabbage yellows (*Fusarium oxysporum f.conqilution*), and bacterial soft rot (*Erwinia carptovora*) in seed crops. In root crops (*Fusarium oxysporum*), white rust (*cystopus*) and Phyllody are the prevalent disease problems. Among the insect pests cabbage white-butterfly (*Pieris brassicas*), aphids, and thrips cause serious damage. Limited information on management of acidic soils, water management practices, and nutrient fixation is available. Sources of resistance to most of the diseases, apart from black rot of cauliflower and cabbage, are not available.

The following recommendations are made for improving vegetable production in the Region:

- development of varieties resistant to major diseases and stress environments; integrated management of common diseases and insects pests; and

- intensification of research into seed production, vegetable based cropping systems, and a package of agro-techniques for improved varieties.

Besides these, the efficient organisation of essential inputs and marketing services will boost the production of vegetables in this Region.

Potato cultivation in the North Western hills faces several constraints. These include moisture stress during the early phases of growth and excess of moisture during the tuberisation phase; high fixation of nutrients in acidic hill soils and incidence of late blight; and to some extent bacterial wilt or brown rot disease. Also, there are several constraints in tackling these problems such as inadequate information on water and soil management practices, insufficient information on reducing nutrient fixation, especially Potassium, in the acidic hill soils, and non-availability of sources of resistance to brown rot needed to develop brown rot-resistant varieties.

The following initiatives may help provide some solutions:

- soil management practices,
- blight resistant varieties,
- potato-based cropping systems for tuber-borne diseases, and
- management of brown rot.

ROLE OF THE NATIONAL TEMPERATE HORTICULTURAL RESEARCH STATION (NTHRS)IN THE HORTICULTURAL DEVELOPMENT OF NEPAL

Pasang K. Sherpa and Madan K. Rai

This paper describes the activities of the National Temperate Horticultural Research Station (NTHRS) established at Marpha,in 1967, in the Mustang District of West Nepal. The NTHRS promotes horticultural development and through it raises the income of mountain farmers. Situated at an altitude of about 2,575m, this farm experiences a semi-arid and cold climate with an average temperature range from minus nine degrees during January to plus twenty four degrees maximum during July and August.

Research activities at NTHRS are carried out both on fruit and vegetable crops. Introduction, collection,and evaluation of different cultivars of fruits and vegetables and development of production technology and plant protection measures have been the major activities. Post-harvest technology development has also been given emphasis.

Fruit species that are scrutinised carefully in introduction, collection, and evaluation of cultivars include apples, apricots, peaches, walnuts, plums, pecan nuts, olives, hazel nuts, and strawberries. Different cultivars of a wide range of vegetables have been recommended for cultivation by this farm. They include cabbages, cauliflowers, carrots, onions, broad-leafed mustard, radishes, swiss-chard, tomatoes, turnips, peas, beans, cress, coriander,and garlic.

As far as production technology is concerned fruit propagation techniques, inter-cropping and spacing, nutrition, orchard management, training, and pruning have been the major areas of concern. The production technology development activities for vegetables have concentrated upon fresh vegetable production technology.

On the plant protection side, research is carried out on both insect pests and diseases. In fruits, insect pests (found in apples mainly) such as woolly aphid, San Jose scale, red spider, mite, and thrips are serious threats, while in vegetables cabbage aphids and cabbage butterflies have been studied. Diseases of both fruits and vegetables are given due emphasis. Post harvest technology development is NTHRS's greatest contribution as it has developed appropriate technology for post-harvest management of fruits for the remote areas of Nepal.

Extension of research in the field is one of the major activities of NTHRS and has been going on since its establishment. These out-reach services are divided into two parts: (i) Initiation and (ii) Accomplishment

1. *In the Initiation Phase there were four stages:*

Motivating Stage (1967-72):

Strong extension activities in order to popularize fruit and vegetable cultivation in Mustang were undertaken.

Expanding Stage (1973-80):

Extension activities in Mustang District were further intensified with the establishment of an agricultural extension unit in 1974 and an Agricultural Development Office (ADO) in 1976. The ADO, together with NTHRS,conducted the following activities for intensifying fruit and vegetable cultivation in the district:

- door to door technical advice and input supply,
- orchard visits and competitions,
- training,
- involving women in fruit and vegetable cultivation activities,
- establishment of a "Horticultural Association of Mustang", and
- expanding technical support to other districts such as Dolpa.

Product Utilization Stage:

The result of the research and extension activities of NTHRS was the large-scale production of fruits and vegetables in Mustang. However, due to the remoteness of the district and its poor transportation facilities, some specific activities had to be undertaken by NTHRS so that farmers would not suffer the loss of their produce. These activities were:

- home scale processing of fruits and vegetables,
- establishment of fruit processing industries,
- development and transfer of storage technology,
- creation and support of appropriate packaging and transportation systems, and
- advertising the products.

Technology Transfer Stage:

The success of NTHRs activities are known to government and social organizations as well as to individuals. Thus,a large number of requests came from all over the country for technical support and training. The Agricultural Development Office, Mustang, and NTHRS are working together and ADO is mainly involved in the out-reach activities.

The Accomplishments of the Out-reach Programme

In the 22 years of its services, NTHRS has developed many useful techniques and provided services in the field of horticulture in the high hills of Nepal. Some of these achievements are listed below.

Fruit Production: Two hundred and seventy-five hectares of land in Mustang is covered by 80,000 fruit trees, and they are expected to produce 5,000 tons of fruits per year at peak productivity.

Vegetable Production: Thirty varieties of 20 vegetable types are being grown by the farmers in Mustang. Last year 700 tons of fresh vegetables were produced. The Mustang district has the potential to produce even more.

Vegetable Seed Production: a variety of seeds are produced under this programme.

Establishment of Industries: Based on technology and the technical services available at NTHRS, more than 35 distilleries have been established in remote areas of Nepal. These industries have helped to solve the fruit marketing problems as well as reduce the use of cereals in alcohol distilling.

The other services provided by NTHRS have been the development of multi-purpose uses for horticultural produce, storage facilities, and training programmes for farmers and field staff.

Finally, specific recommendations have been made for fruit, vegetables, and potatoes. These recommendations are mainly concerned with production, plant protection, and post-harvest technology for fruits; plant protection and seed multiplication for vegetables and species' development, evaluation, and productivity increase for potatoes. General recommendations are made for providing better transportation facilities, financial as well as technical back-stopping for marketing, establishment of a reliable data base, and timely supply of inputs such as seeds, chemical fertilizers, and plant protection chemicals.

GENETIC RESOURCE ISSUES AND HORTICULTURAL DEVELOPMENT IN THE HINDU KUSH-HIMALAYAN REGION

Tej Partap

Horticulture in mountain areas, particularly in the Hindu Kush-Himalayan Region, is an important farming activity. There are several components of horticulture and all of them are based on harnessing plant genetic resources.

The basic objectives of horticultural development in mountain areas are those of bringing economic and nutritional gains to people. Yet another compelling cause for horticultural plantations, in the mountains, is to help stabilize the fragile mountain slopes. Horticultural activities help provide stability to the environment because there is no tillage and plants involved are perennial and deep rooted.

Throughout the previous decades, horticulture has been established in several areas within the Hindu Kush-Himalayan Region and it has helped tremendously in the overall development of some of these areas, notably Himachal Pradesh in India, the Swat Valley in Pakistan, and the Hengduan mountains in China. Encouraged by the success achieved so far, vigorous institutional efforts are being taken in all the Hindu Kush-Himalayan countries to expand horticulture to as many areas as possible. This paper provides an analysis of the approaches and intervention strategies adopted to achieve this goal, from a particular perspective; the genetic resources. It involves critical examination of the extent of concern for genetic resources and biological diversity in horticultural development activities. The aim is to assess these efforts in the light of a concept that seeks sustainable development with conservation of resources; herein biological resources.

Broadly defined, there are three main issues concerning genetic resources. First, increasing dependence on a few species only for horticultural activities whether fruit crops, vegetables, mushrooms, or medicinal plants. This is coupled with the fact that these species, in most cases, are new to the mountains. The implications of such approaches are explained through advancing apple monoculture and the increasingly visible signs of its unsustainability. The choice of species and activity, without consideration of mountain characteristics and farming systems could bring unwanted results. It is explained how benefits of resource development programmes pass on from the target group to unwanted hands simply because of the choice of a particular species. This happens mostly with medicinal plants and mushrooms.

Second, emphasis is given to the role of genetic resources in tackling malnutrition and raising nutritional status. Supported by examples, it is shown that raising incomes through commercial horticulture does not ensure automatic improvement in the nutritional status of people. It might, in some cases, even be counter-productive. The appropriate approach would be to identify alternative horticultural genetic resources, keeping in mind the nutritional requirements of the people of an area and the capability of the plant resource to fulfill it. This category of plant resource and the promotion of kitchen gardens are complementary in concept.

The third issue relates to the use of indigenous under-exploited genetic resources of horticultural significance. Quoting examples of two promising plants, *Hyppophae spp.* and *Prinsepia spp.* of this category, it is emphasized that the Hindu Kush-Himalayan Region contains gene pools of highly promising under-exploited genetic resources. These resources have the potential of becoming better alternative crops in some mountain conditions and also of supplementing the diversity of plant resources in use in our efforts to achieve the overall sustainability of mountain farming systems.

Last of all, by focusing attention on under-exploited genetic resources, the intention is to highlight that the biological diversity of this region contains gene pools that may be more promising than many of our existing horticultural crops for the purpose of fulfilling the three stated objectives of horticulture, i.e. environmental preservation and providing economic and nutritional benefits to the people. In harnessing these plants, as new and better alternative crops for certain specific mountain conditions, or to supplement overall crop diversity, encouraging polycultures will, in return, help preserve them and the overall biological diversity.

SEABUCKTHORN RESOURCES AND ITS UNDEREXPLOITED POTENTIAL IN THE HIMALAYAN REGIONS

Lu Rong-Sen

Seabuckthorn (*Hippophae L.*), a deciduous shrub or tree is widely distributed in the temperate zones of Asia and Europe and in the subtropical zone of Asia at high altitudes. Its berries are rich in nutrients and bioactive substances such as sugar, organic acid, and Vitamins. The Vitamin C content is 5-100 times higher than any fruit or vegetable known.

Growing at altitudes from 60-5200m, *Hippophae* can resist low temperatures of 60^{o}C and does not wither under the summer heat of 40^{o}C. Some species can grow well in regions that only have a precipitation of 300mm and some species can endure inundation. Some species grow in pH 9.5 and soils which contain 1.1% salts.

Hippophae is capable of fixing atmospheric nitrogen. The extensive root system controls soil erosion besides secreting some acidic compounds to improve alkaline soils.

Seabuckthorn can be propagated both by sexual and asexual means. On good soil it often forms mass bushes on the slopes of a hill or along the banks of rivers. With luxuriant foliage and a strong root system it can retain the surface run-off and prevent the erosion of soil by wind and water.

Seabuckthorn is a source of fire wood. On testing it was found that the calorific value of the wood is more than 4000 Kcal/kg.

Resources of *Hippophae* are abundant in the Hindu Kush-Himalayas. According to the taxonomic listing, there are 4 species and 9 subspecies in this Region and the other 5 subspecies are in Eurasia. It is considered that the Hindu Kush-Himalayas, and in particular the Qinghai-Tibetan Plateau, are the main areas of distribution and origin for this genus.

According to statistics, the total natural seabuckthorn area in China is 670,000 hectares of which 49,000 hectares are scattered in the eastern Himalayas (including east Tibet, west Sichuan, and north-west Yunnan). A recent survey estimated that about 22,000 tons of seabuckthorn berries lie hidden and undeveloped in the eastern Himalayas of China alone.

Seabuckthorn berries are collected from natural forests. Because of the number of thorns on the stems or branches, some farmers sell the trees rather than pick the berries. Such methods damage seabuckthorn resources.

In the eastern Himalayas, especially in eastern Tibet and western Sichuan, most seabuckthorn resources are far away from transportation lines and cities, so only some seabuckthorn resources are used commercially.

In order to develop the permanent and stable use of seabuckthorn resources, the Chinese Government has established a series of policies. The focus of the policies is on protecting resources and setting up new plantations.

China is further establishing vast shelter-forests of *Hippophae* in the Northeast, the North, and the North-west.

Seabuckthorn has enabled farmers living in the mountains to earn good income. Many processing factories have been established. Since 1985, in the middle reaches of the Yellow River, the farmers have been earning more than 1.06 million U.S. dollars from seabuckthorn fruits every year.

To sum up, seabuckthorn is a new horticultural crop with tremendous potential. It is, and will be, playing an important role in improving the economic conditions of mountain farmers and sustaining stable development in mountain regions. There are rich resources of *Hippophae* in the Hindu Kush-Himalayan Region.

ROLE OF BEEKEEPING IN THE DEVELOPMENT OF HORTICULTURE IN THE HIMALAYAN MOUNTAINS OF INDIA

L.R. Verma

Apiculture forms an integral component of different farming systems such as agriculture, horticulture, and animal husbandry. It has been estimated that the value of honeybees as pollinators of different agricultural, horticultural, and fodder crops is 10 to 20 times more than their value as honey and beeswax producers. Amongst the Hindu Kush-Himalayan countries, India has taken the lead in enhancing the productivity levels of different cultivated crops through bee pollination.

In this Region, at present, both the exotic, *Apis mellifera* (European honeybees), and *Apis cerana* (Asian hive bees) are used for the purpose of pollination. Keeping in mind the controversy regarding the introduction of *Apis mellifera* into several parts of Asia, including India, it is important to know which of these two species is the better pollinator of agricultural and horticultural crops. Therefore, our research group has made a detailed investigation of the foraging behavior of the native honeybee, *Apis cerana*, and the European honeybee, *Apis mellifera*, in relation to the pollination of apple bloom under different agroclimatic conditions in Himachal Pradesh, and the results are summarized as below.

The insect pollinators visiting apple bloom were of 44 species belonging to 5 orders and 14 families. Frequent pollinators were *Apis cerana*, *Eristalis* sp., *E. tenax*, *E. anqustimarqinalis* and *Halictus dasyqaster*. Among these, *Apis cerana* was the most frequent and abundant pollinator. The tree branches located from 2 to 3m above the ground attracted a significantly higher proportion of insects (40.58%) than the branches above (27.19%) and below (32.22%). The foraging activity of *Apis cerana* was maximum between 11:00 to 12:00 and 14:00 to 15:00 hrs when the temperature of the orchard ranged between 21.5 and 22.8 ^{O}C. However, the peak activity hours for *E. tenax* and *E.anqustimarqinalis* were from 08:00 to 09:00 hrs. at a comparatively lower temperature (16.6^{O}C).

The foraging behavior of *Apis mellifera* and *Apis cerana* honeybees on apple flowers was studied at three altitudes in the north-west Himalayas (1350, 1875, and 2400m above sea level). *Apis cerana* began to forage earlier in the morning than *Apis mellifera* and stopped later in the evening at all three altitudes. Foraging trips by *Apis mellifera* lasted significantly longer ($P<0.01$). In both species nectar collectors outnumbered pollen collectors ($P<0.01$); the mean ratio of pollen to nectar collectors being 1:2.08 for *Apis cerana* and 1:2.78 for *Apis mellifera*. Peak foraging activity for *Apis Cerana* occurred at 09:00-11:30 hrs., when the temperature ranged between 15.5 and 21 ^{O}C, and 11:00-13:30 hr. for *Apis mellifera* when the

temperature was 21 to 25°C. By placing both species in the same orchard the duration of peak activity might be prolonged and better pollination obtained. Foragers of *Apis mellifera* carried significantly heavier pollen loads, touched more stigmas, and remained longer on individual apple flowers than those of *Apis cerana*. Altitude affected the times of initiation and termination of foraging activity and the duration of a foraging trip but not other behavior parameters such as preference for nectar or pollen, peak time of foraging, pollen load, number of stigmas touched, or average time spent visiting a flower.

In self-incompatible varieties of apple, such as Royal and Red Delicious, there was no fruit set in the absence of insect pollinators and it was 10.12 and 8.27 per cent higher in honeybee pollinated flowers compared to open pollinated flowers. However, in self-compatible varieties, such as Golden Delicious and Red Gold, honeybees and other natural insect pollinators were not essential for good fruit set. The fruit drop in Golden Delicious and Red Gold, without any insect pollinators, was significantly higher ($P<0.01$) than in open and honeybee pollinated flowers. The difference in the fruit drop of honeybees and open pollinated flowers of all four varieties of apple was non-significant. Cross pollination by honeybees significantly increased the fruit quality in terms of weight, length, breadth, volume, and number of seeds per fruit.

Some laboratory studies on the toxicity of various biocides used, in apple orchards in Himachal Pradesh,on *Apis mellifera* were also undertaken. As per the norms of the International Commission for Bee Botany, our results suggest that among the fungicides Foltaf, Diethane M-45, Hexacap, Bevestin, Difolitan, and Capstan are moderately toxic to honeybees, whereas, insecticides such as Sumithion, Metacid, and Metasystox are highly toxic to honeybees. Our results also suggest that LD_{50} values, as calculated by probit analysis for *Apis cerana*, were significantly lower than *Apis mellifera*. These findings reveal that the former species of honeybees are less tolerant to the effect of biocides than the latter.

In the Hindu Kush-Himalayan Region, apricots, almonds, peaches, pears, plums, and cherries are other temperate fruit crops and considerable areas are cultivated with these crops. Practically very little is known about the pollination requirements of these fruit crops under the ecological conditions of this Region. However, research work carried out in Western countries, where bee pollination is an integral part of orchard management technology, reveal that honeybees are the primary agents of pollination and that their introduction into the orchard at the time of bloom significantly increases the yield and quality of different temperate fruit crops.

Besides temperate fruits, other mountain crops, that are dependent upon or benefitted by bee pollination, are vegetable oil and fodder seeds. Different components of seed quality,i.e. physical, genetic, and viability, are greatly improved if the flowers in bloom are pollinated by honeybees. For all these crops, cross pollination is either essential or beneficial to enhance seed production. Similarly, cardamons and buckwheat are the other two important hill crops for which bee pollination is essential for good fruit and seed set respectively.

One of the best strategies for increasing the yield and quality of the above cultivated crops, in the Hindu Kush-Himalayan Region, would be to adopt a planned bee pollination programme as one of the essential inputs. This has hitherto not been practised in this Region. The main reason for this is ignorance and the lack of technical know-how on the part of agricultural extension agencies and farmers. Efforts should be made to create awareness among them regarding the beneficial effects of honeybee pollination as this is an important biological input without negative ecological consequences.

POTENTIAL OF FLORICULTURE IN THE HIMALAYAN MOUNTAINS

Vishnu Swarup

The Himalayan mountains are the natural habitat of a wide range of exquisite wild flowers. Several attractive ornamental plants such as Rhododendron, Primula, and Iris have evolved in this Region. These mountains have an immense potential for floriculture. Cut flowers, cut foliage, dried flowers, and foliage; live plants, bulbs, corms, tubers, and seeds can be produced for supply to domestic markets. In the case of cut flowers, priority is given to Orchids, Roses, Carnations, Chrysanthemums, Tuberoses, Tulips, Irises, Gladioli, and Peonies. The multiplication of Gladioli corms, bulbs of Amaryllis, Crinum Hyacinths, Tulips, Narcissi, Daffodils, Irises, Begonias, Lilies (Easter lily and Tiger lily), and Tuberoses can also be remunerative. Rooted cuttings of Carnations, Chrysanthemums, Geraniums, Orchids, African Violets, Fuchsias,and Azalias are in great demand in big cities. The cultivation of the Damask Rose for rose oil and Lavender for oil is also possible in the valley areas.

There is also scope for developing the export trade of floricultural products such as cut flowers of Carnations, Chrysanthemums, and Roses; and live plants of Orchids propagated by tissue culture. The bulbs of tropical flowers, such as Amaryllis, Crinum, Eucharic, Hemerocallis, Harmanthes, and Zyphyranthes can also find markets abroad. These bulbs can be multiplied in the open at a comparatively lower cost of production and can easily be transported to distant markets. However, good quality and a consistent supply on scheduled dates, as per the requirement of foreign markets, are essential in the export trade.

MEDICINAL PLANTS OF THE TIBET HIMALAYAS

Yang Yungchang

The Tibetan Medicinal System is a rich source of Chinese medicine and pharmacology. It is different from the Medicine of the Han and other Chinese ethnic groups. Approximately 70% of the medicinal plants needed are collected from the Plateau of Tibet. It helps the local people in two ways i.e., in supplementing their household income as well as treating diseases and health problems of family members/villagers without cost. Behind the development of such an effective medicine system is a body of knowledge and experience, said to date back several centuries. Evidence available speaks of a widespread and highly developed medicinal system around the 7th and 8th century. Records mention materials used in Medicine as well as the experience accumulated. It was around this time that the foundation of Tibetan Medicine was established.

During the development of this system, other traditional medicinal systems, such as the Han, Indian,and Iranian also influenced it. In recent times, efforts have been made to understand this system and document plant and animal resources used in the clinical system so as to formulate an appropriate strategy for them. Initial efforts have been confined to exploration surveys and ethnobotanical investigations. After these studies are completed, priority lists of these genetic resources for conservation and increased economic harnessing will be prepared.

Several processing methods are applied to change the quality, improve the effect, and decrease the poisonous effects of plants. The paper is devoted to describing 59 such plant resources of medicinal importance. The description includes their distribution, habits, collection time, processing methods,and the native uses.

In the past, almost all the plants were collected wild but, in recent times, the process of domestication and development of medicinal plant farming has also been established. Many households are presently engaged in medicinal plant cultivation in several parts of Tibet. Some widely cultivated plants are: *Rheum, Scopolia, Swertia, Fritillaria,* and *Notopterygium.*

These plants are either grown for their seeds or other vegetative parts and are used in medicinal preparations.

III Marketing and Utilization of Horticultural Produce

ROLE OF PRICES AND MARKETS IN HORTICULTURAL DEVELOPMENT

R.L. Nasol

Most agricultural market information systems, that have been set up and operated in developing countries, consist primarily of the collection and dissemination of market prices, essentially whole-sale prices. This is because prices are easy to monitor and they reflect the supply and demand situation of a commodity in a particular market. However, it is recognised that the availability of supply is an equally important market factor. Traders, processors, distributors, and even government market regulators benefit from such information which helps them in their procurement, sales, and storage management decisions, especially if this facilitates movement of supplies from surplus or production areas to deficit or consuming areas. Such movement of supplies increases demand in surplus areas thus increasing prices. On the other hand,the increase in supplies to the consuming areas helps decrease prices.

Price information on horticultural commodities is still limited. In a study conducted in Nepal, the retail level prices of onions, potatoes, and tomatoes from 1974/75 to 1987/88 have been analysed. It is noted that tomato prices have increased much more than those of onions and potatoes during the last five years. In fact, between 1977/78 and 1982/83 the price of tomatoes increased by only 45 percent. However, in the subsequent five years it increased by 108 percent. Moreover, its seasonal fluctuation is also the highest among the three vegetables. The seasonal index is lowest in January/February and highest in August/September. This reflects the highly seasonal nature of present production patterns. It indicates profit opportunities for some farmers who can grow tomatoes in the off-season. During this period prices are generally higher than the normal season.

Marketing services are performed in moving a product from the point of production to the point of consumption. Certain marketing services,required in moving horticultural products, are important and ultimately decide the price of the product.

Transport

The production landscape of the Hindu-Kush Himalayan Region presents formidable difficulties for the transport of farm products to markets. Types of transport range from human porterage, animals, carts, trucks, minibuses, passenger buses, and even aeroplanes. These facilities are not well designed to transport bulky and easily perishable horticultural products. This causes damage and significant loss *en route* from farm to market. Changes in design of transport equipment and facilities, minimizing damage and loss, would go a long way in improving horticultural marketing.

Containers

Articulated transport containers require improvement. At present the containers used vary widely in size and construction. Improved containers offer obvious benefits in that losses are reduced and the products arrive at the markets in better condition. In Nepal, bamboo crates and baskets, jute sacks, and wooden crates are all used indiscriminately for various kinds of horticultural products and this is an area in which improvement is needed.

Storage

A major characteristic of horticultural products, fruits, and vegetables is their short season. Good storage for perishable commodities would serve to minimize gluts, lengthen the marketing period, improve farm prices, and benefit consumers.

Grades and Standards

As output rises and markets become sophisticated, there is more quality consciousness among buyers. In Nepal, there is a small domestic market for quality horticultural products,but when export markets are considered there are large potential markets.

The maintenance of standard quality products starts on the farm. This problem is compounded by the small farm units in Nepal and the whole of the Hindu Kush-Himalayan Region. Within this framework, the maintenance of a uniform standard of produce would require close supervision of the production system.

Packing

Suitable packaging is essential, especially for long distances. Damage due to improper handling, packaging, and transportation may result in inferior quality products as well as significant losses.

Processing

Processed fruits and vegetables help provide additional markets to farmers during the peak season and also fetch better prices. Moreover, horticultural produce processing also provides opportunities for new export markets.

Wholesale Markets

As the economy develops, wholesalers become critically important in the assembly and distribution of food products, especially perishable horticultural products. Wholesalers are

usually located in major markets and often at a major transport nexus where they, or their agents, undertake the primary assembly of horticultural produce. It is here where products are often graded, packaged, distributed to local markets, and shipped to distant markets, both domestic and export. In Nepal, there are no formally organized wholesale markets for fruits and vegetables, except the Kalimati wholesale market in Kathmandu.

THE ESTABLISHMENT OF AN APPLE PLANTATION BASE FOR PROMOTING MOUNTAIN ECONOMY - A CASE STUDY OF XIDE COUNTY IN THE HENGDUAN MOUNTAIN REGION OF CHINA

Lin Qingfa

Xide County is situated in the South Western part of Sichuan Province. It is identified as one of the poorer counties in the Hengduan Mountain region. Surrounded by hiils, it is topographically dominated by middle mountains with predominantly gentle slopes. The highest point is 4500m above sea level and the lowest 1600m. It covers an area of 2206 km^2 with a population of 113727.
Although Xide County possesses favourable natural conditions for the development of agriculture, forestry, animal husbandry, and other subsidiary occupations, natural resources have been subject to serious damage, owing to unreasonable exploitation. As a consequence various natural hazards have accelerated.

Horticulture has been given priority in development programmes and apple cultivation has been established on a commercial scale. The diverse agroclimatic conditions make it possible to plant 2,600 ha of land with apples. Now apple cultivation has been extended and,in the last ten years, more than 1 million apple trees have been planted. Out of the plantations, about 400,000 have gone into production. The majority of the orchards are set on sloping land, or debris-flow affected alluvial fans, where the gradient is relatively high and the soil rather poor. When maize is grown on such poor soil, the per hectare yield is normally around 2,250 kg, but if apples are cultivated the per hectare yield is about 15,000 kg and little management is needed.

Socioeconomic Benefits

The economic return from apples is ten times more than that of maize. At present annual production exceeds 2000 tons. Quite a number of households have become well-off, or so-called *2,200 dollar-households*, in the apple producing areas. This has helped eradicate poverty. The income potential of apple orchards enables the mountain farmers to expand production on commercial lines. Furthermore, rural-urban linkages are strengthened and food habits changed so as to improve peoples's health.

Ecological Effect

Apple trees are bigger in size and have deep roots. They can conserve water and prevent soil and water loss.

Policy Aspects

In order to encourage apple production, the county Government has allocated 15% of the funds out of the agricultural budget to remove the constraints on horticultural development. Under the *Responsibility System* farmers are given awards for the best performance in production and maintenance of orchards.

Technical Measures

Both scientific and technical processes are behind in this mountain county. With the development of horticulture the technical component has been strengthened. Training courses have also been started to train the local people.

Market-Transportation, Storage, and Packaging of Horticultural Produce

Presently apples are sold in the local markets of Xide county but the full demand cannot be met by the present production. Travelling traders come before the fruits are mature and purchase them in advance. As there are no storage facilities, the fruits are directly transported, in bamboo baskets,to different markets.

To meet the marketing needs of increasing apple production, the Government of the county has established a processing factory and created a transport system. It will,in fact, help in the expansion of horticulture for which the agroclimatic conditions are very favorable.

Chengdu

In a previous study of the Hehuachi wholesale Market,it was found to cater to 4000 square kilometers of orchards and function as a collection centre for apples, pears, water melons, and bananas. Horticultural produce comes early to this market and prices paid are fairly reasonable. The daily business is about 100 tons and a maximum of 250 tons was recorded in 1986. The volume of business was 4.25 million U.S. dollars. The fruits are sent to the less accessible provinces of the country from this market. Various projects have been initiated to improve production. Dry and fresh fruits are transported from over a dozen provinces to Hehuachi wholesale market for sale. Local tangerines and oranges are purchased and forwarded to their respective destinations. This shows that fruits have a ready market throughout the country when they are efficiently marketed.

POST-HARVEST PRACTICES THAT AFFECT THE MARKETING OF FRUITS AND VEGETABLES IN THE HIMALAYAN MOUNTAIN REGIONS OF INDIA

J.C. Anand and O.P. Grover

The Himalayan Mountain Regions of India are in two locations i) the North-Western Hill Region comprising the States of Jammu and Kashmir, Himachal Pradesh, and the hill districts of Uttar Pradesh and ii) the North-Eastern Hill Region consisting of the States of Sikkim, Assam, Arunachal Pradesh, Manipur, Tripura, Meghalaya, Mizoram, and Nagaland. Both regions grow temperate and sub-tropical fruits.

Apples are the prevalent fruit grown in the NWHR[1] and production exceeds one million tonnes. Other important fruits in this region include plums, apricots, peaches, and cherries, as well as nuts such as walnuts and almonds. In the NEHR[2],the important fruits are bananas, pineapples, and citrus fruits. The principal vegetables grown in both regions are potatoes, tomatoes, cabbages, cauliflowers, chillies, and ginger. Horticultural crops in the mountain regions provide an important source of income and employment generation besides supplying a valuable source of nutrition to the country as a whole.

Most of the areas consist of hilly terrain, mountains, and valleys. Fruit cultivation is spread throughout in far-flung locations with poor road connections. After harvest, fruits, such as apples, have to be carried on human backs/heads, or on mules over long distances to reach improvised field sheds where they are graded and packed. There are very few regular packing houses with modern facilities.

The apples grown belong to the Delicious group and include the Golden and Maharaji varieties. They are graded manually on the basis of size, colour, and freedom from disease. Efforts are being made to standardise these grades for marketing. A small number of sizing machines has been installed for the benefit of growers, but the response to these machines is still poor.

Packing of fruits and vegetables is mainly done in bamboo and reed baskets, wooden baskets, and jute bags. Apple packing has so far been done in wooden boxes and vegetables are packed in bamboo baskets or jute bags. Acute shortage of timber and its rising cost has prompted the trade to attempt to substitute wooden boxes with corrugated fibre board (CFB) tray-pack cartons. To save forest resources and maintain the ecological balance, the Himachal Pradesh Government, through HPMC[3], is supplying CFB cartons at subsidised rates to keep their prices lower than standard wooden boxes of the same capacity. Several packaging alternatives are also being innovated and tested.

The cold storage capacity of about 2500 stores, in India, is about 5 million tons, but 90% of this space is ear-marked for potato storage in potato growing areas or terminal markets. With World Bank assistance, storage facilities for apples with a total capacity of 17,000 tons, has been provided in production centres in J&K and HP[4]. Storage facilities for apples need to be augmented to avoid market gluts and regulate the supplies. To ensure the marketing of quality apples, a cold-chain concept in production, transportation, and apple management has to be encouraged, especially for the Delicious variety which does not have a long shelf-life. In areas with high temperatures and low humidity, evaporative cooling (EC) systems offer a simple and cheap alternative to expensive refrigerated systems. EC systems can be effectively used both for pre-cooling and movement of perishables by road. In hilly areas, where night temperatures are low, air-cooled stores have been successful.

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1. North Western Himalayan Region

2. North Eastern Himalayan Region

3. Himachal Pradesh Marketing Corporation

4. Himachal Pradesh

Transportation is in ordinary multipurpose trucks and rail wagons. There is a marked preference for trucks as they take less transit time and provide door-to-door services. In trucks and rail wagons, the radiant heat of the sun and the respiratory heat of the produce accumulates, causing great damage to the perishables. It is estimated that rail transport is more efficient than road transport and hence should be used more extensively. Both trucks and rail wagons have to be suitably modified to provide internal temperatures conducive to the health of perishables.

In India, hardly 0.5 per cent of fruits and vegetables grown are processed, compared to 40-60% in the developed countries. In the Himalayan Region, only an insignificant proportion of apples and pineapples are processed. Apple juice concentration plants set up by the J&K-HPMC and HPMC work much below their installed capacity, due to lack of demand for the concentrate. Apple juice blends with other juices and pulps can promote its sale. Several sun-dried products in the hilly regions, such as apricots, raw-pomegranate seeds, raw mango powder, and mushrooms have gained commercial importance. Low-cost, simple technologies need to be encouraged in order to improve the quality of food in the countryside and increase employment.

Efficient marketing is the key to success but lack of suitable infrastructure for grading, packing, transport, storage,and processing of fruits results in substantial losses. Market conditions,both wholesale and retail, are far from satisfactory. Most of the terminal markets are antiquated, improperly designed, and ill-equipped to handle increased loads. Market information services are still in their infancy and are unable to guide the farmers on matters such as the optimum time and place for the disposal of their produce.

With increases in the production of fruits and vegetables, simultaneous efforts are needed to ensure their optimum consumption. In fact, what is likely to happen is that an increase in production will result in an increase in proportionate losses, due to the fact that marketing procedures are inadequate to handle the extra volume. As a result,prices may decline to the determent of the producer. Blindly following sophisticated systems and technologies, that have been successful elsewhere,may have little relevance to our needs. Efforts should be made to develop need-based, simple, low-cost technologies for handling perishables and their application should be encouraged with the help of trained and dedicated manpower.

THE ROLE OF FRUIT PROCESSING IN THE DEVELOPMENT OF HORTICULTURE IN THE HIMALAYAN REGION (INDIA) - PROGRESS, CONSTRAINTS, AND STRATEGIES

Anand G. Naik Kurade

Fruit processing has resulted in several benefits to the economy of the Himalayan region in India. Direct benefits accrue to the horticultural growers. At present, for want of farm storage facilities, horticultural growers are compelled to sell their produce immediately. This results in gluts in the market that could be avoided by advance renting and leasing of coolhouses, cold stores, and warehouses. Establishment of more processing plants will help in the utilization of a reasonable percentage of culls and prefalls' produce in the region. Stone fruits can be sold to processing plants at better prices.

Grading-cum-packing centres improve the quality of fruits, reduce the wastage, ensure better prices to growers, and better quality products to consumers. Processing plants

generate employment on a regular basis as well as on a casual basis. Advance renting and leasing of cool houses, warehouses, and cold stores, for the processing of fresh fruits for direct sale in the consumer markets, are expected to have a desirable effect on the economy of the region. In addition the quality of fruit for consumption will improve if they are harvested and graded at optimum maturity.

Present Status of the Fruit Processing Industry

In Jammu and Kashmir, there are 55 processing plants; two are large-scale and two home-scale units. These are licensed for synthetic sweetened carbonated beverages and the remaining 51 have a total capacity of 65,970 tons. In Jammu and Kashmir, the HPMC now has an apple juice concentrate plant. The yearly installed capacity is 10,000 to 12,000 tons of fruits (inputs) per year for processing. The privately-owned processing factories currently manufacture fruit cocktail and canned soft fruits such as pears, peaches, cherries, and also canned mushrooms.

In Himachal Pradesh, 62 units are licensed. All are fruit processing units and their total capacity is 9400 tons. The HPMC has been able to provide infrastructural facilities and an efficient system of orderly marketing and processing for apples, peaches, apricots, pears, plums, vegetables, and mushrooms. Jams, juices, and concentrates are also produced.

In the Uttar Pradesh hills, the preservation industry is not developed.

In the North Eastern Hill Region, the North Eastern Corporation has established a pineapple juice concentrate plant in Tripura State. Modern Food Industries (India) has also established a fruit juice concentrate plant in Assam.

ROLE OF THE HIMACHAL PRADESH HORTICULTURAL PRODUCE MARKETING AND PROCESSING CORPORATION IN THE DEVELOPMENT OF HORTICULTURE IN HIMACHAL PRADESH, INDIA

R.S. Rana

The commercial component of the Integrated Marketing Project includes packing houses, cold storages, apple processing plants, and trade shipment centres and, under the non-commercial component, includes construction of roads, procurement of road maintenance equipment, training, and technical assistance. The commercial component is to be implemented by the newly established State-owned company known as Himachal Pradesh Horticultural Produce Marketing and Processing Corporation (HPMC), whereas the latter component is to be established by the respective State departments. The total project cost was estimated at US. $ 21.7 million with US. $ 13 million as IDA credit to cover the entire foreign exchange component and 35 per cent of local costs. The project was established for the over-all welfare of fruit growers in the State.

Under the project the following infrastructure has been created:

- six packing houses, each with a capacity to grade and pack 5,000 tons of apples per season,

- five cold storages in the apple producing areas, each with a capacity to store 1,000 tons of fruit,and
- one apple processing plant with a capacity to process 18,000 tons of apples and 400 tons of peaches per season.

Apart from the above facilities, the Corporation operates various other units. They include an apple processing unit with a capacity to process 2000 tons of apples per season, two cold storages in terminal markets, two transit warehouses, located in strategic locations, and two grading houses set up in the tribal areas.

A sales' network has been developed within the State, as well as in the major markets of the country, to undertake the marketing of fresh and processed fruit products. Over 400 juice vending machines have been installed at international bus terminals, railway stations, airports, busy shopping complexes, and at other important institutions. Chilled, reconstituted, ready-to-serve apple juice is available at a nominal price.

During the period from 1974-82, the Corporation devoted itself to developing the essential infrastructure for post-harvest handling. However, some marketing activities were initiated. At first, the performance was not encouraging. However, outstanding results are now being achieved and will give the project fresh impetus. HPMC has now become a leading national industrial institution and it has helped the growers organise the scientific marketing of their produce. The following is a brief summary of benefits accruing to the farmers:

- ensured prices for low grade fruit which otherwise has no alternative use/value; the Corporation directly purchases from the growers at support prices,
- fruits are properly sorted and graded; those of good quality are cold-stored in open, plastic, field boxes, while those not suitable for storage are used in the fruit processing plants, thus regulating flow and creating an optimum market situation;
- HPMC provides improved marketing services in terminal markets, providing an alternative to the unregulated market system, balancing the profiteering tendencies of private traders, and ensuring competitive prices for growers;
- construction of roads in the project areas has increased commercial activities and brought about savings in time and transport costs;
  introduction of corrugated fibre board (CFB) cartons, as a substitute to traditional wooden boxes,has helped conserve the rapidly depleting natural forests; a complete change to CFB cartons would save over 200,000 m^3 of wood per annum;
- the Corporation has introduced over fifty thousand plastic field boxes as returnable containers for marketing;
- a sizeable amount of fruits are purchased at support prices and used for processing; and
- the project has contributed immensely towards the generation of employment opportunities.

Deficiencies

Initially, HPMC could not achieve the anticipated targets. This was mainly due to the volatile nature of the apple industry and was dictated primarily by the climatic conditions and poor response of growers to alien technology. The over-estimation of capacity utilization, during the project appraisal, was to the extent of 85 and 100 per cent in the first and second year respectively.

The technology of centralised grading and packing introduced, similar to those adopted in Europe and other horticulturally advanced countries, does not work properly in difficult terrains with small and marginal farms. Alternatively, there should have been a network of ropeways connecting the packing houses from all sides. These factors adversely affected the working of packing houses and cold storages established in the producing areas.

The project envisaged the installation of sizing machines (mechanical graders) and essential equipment, such as washing, brushing, and waxing machines, was not provided thus causing dissatisfaction among the farmers.

The demand for apple juice concentrate could not keep pace with the production resulting in a 'carry-over' of stock.

Technical deficiencies have also been observed in various components of the project. However, the project helps a large number of farmers in the disposal of their horticultural produce and with suitable modifications could be repeated elsewhere.

MARKETING DEVELOPMENT OF FRUIT AND VEGETABLES - SOME OBSERVATIONS ON THE EXPERIENCES IN THE BAGMATI ZONE, NEPAL

Mahesh Banskota

Marketing assumes the integration of many different activities. It emphasizes that smooth linkages exist between producers, processors, and consumers. With the development of marketing there is also a greater mutually supporting relationship among agriculture, industry, and services. Successful marketing development is an important reflection of the process of economic transformation itself. As long as subsistence production prevails, none of the linkages between sectors and areas manifest themselves.
From the point of view of mountain development, marketing development and entrepreneurial innovations have been very important in the context of horticultural development in Himachal Pradesh, India, and Tourism Development in Nepal.

While the Government has played an important supportive role, through investments in infrastructure and implementation of suitable economic policies, it has been primarily the private sector entrepreneurs that have played a key role in development of these sectors. In the context of horticultural development in Nepal, some of these experiences, both within and outside Nepal, should be more carefully evaluated. Tourism, as compared to horticulture, appears to be more capital intensive, urban biased, and high technology oriented, and has limited domestic multipliers. On the other hand, horticulture, being more rural based, has relatively greater employment and income linkages in rural areas but also favours those with land. Such issues ought to be systematically evaluated, in order to understand why some activities are sustainable in some areas and others are not.

Over the years, development investments have been made in the Bagmati Zone in road construction, establishment of agricultural support services, and other institutional infrastructures. Inspite of relatively higher development investments and improved transportation, the development of subsistence agriculture has been relatively slow and many anomalies continue to persist.

There is an increasing urban demand for fruit and vegetables and much of this is met through imports. Urban opportunities for local production remain untapped. The prices of many hill products are very low, because many of the products compete directly with those from the Terai. The obvious problem here is the absence of off-season advantages in what is being produced. The bulk of the agricultural marketing in the Zone is still directly carried out by farmers individually and is not organized to improve the bargaining capacity of farmers or to enhance marketing investment. The hill farmer, even here, faces the problem of how much of his land and other resources should be allocated to market oriented productions when he has no guarantee of long term purchases or off-farm employment opportunities. Many of the smaller farms still find the production of commercial crops far too risky.

However, some changes are evident along the major transport corridors, and these clearly indicate that accessibility and choice of products are very critical. This limited pace of change in the development of horticulture and agricultural marketing is quite surprising, in the context of Nepal's long espoused regional development strategy to promote horticulture in the middle hills.

The reasons for this sorry state of affairs are not hard to find. It becomes immediately apparent that this policy to promote horticulture has not received any meaningful operational thrust. As a matter of fact, emphasis has been all along on the promotion of cereals and not horticulture. In the case of the Nepalese hills, the absence of appropriate institutional mechanisms seems to be the weakest factor in the failure to bring about the basic transformation of hill agriculture.

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Founding of ICIMOD

The fundamental motivation for the founding of this first International Centre in the field of mountain area development was widespread recognition of the alarming environmental degradation of mountain habitats, and consequent increasing impoverishment of mountain communities. A coordinated and systematic effort on an international scale was deemed essential to design and implement more effective development responses to promote the sustained well-being of mountain communities.

The establishment of the Centre is based upon an agreement between His Majesty's Government of Nepal and the United Nations Educational, Scientific, and Cultural Organisation (UNESCO) signed in 1981. The Centre was inaugurated by the Prime Minister of Nepal in December, 1983, and began its professional activities in September, 1984.

The Centre, located in Kathmandu, the capital of the Kingdom of Nepal, enjoys the status of an autonomous international organisation.

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Deputy Director : Dr. R.P. Yadav

Participating Countries of the Hindu Kush-Himalayan Region

- Afghanistan
- Bangladesh
- Bhutan
- Burma
- China
- India
- Nepal
- Pakistan

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