

# Expert Meeting Discussions

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## 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 Representative, 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 intercrop 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 edulis* (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 tuberose 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.