

# VEGETABLE DEVELOPMENT IN THE LAST SIX DECADES IN NEPAL

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## **ABSTRACT**

*Domestication and cultivation of vegetables has always been the integral part of agriculture in Nepal since time immemorial. However, the official effort of vegetable research and development could be traced back to mid 19th century when Rana Prime Minister Jung Bahadur Rana introduced European vegetables in Kathmandu valley. Then, another Rana Prime Minister Chandra Samsber established Agricultural Council in 1937 and gave due importance in agricultural research including vegetables. Establishment of experimental and plant introduction farms in Kathmandu valley, Kakani and Parwanipur and seed sale store in New Road, Kathmandu were the initial works. Vegetable research and development took some momentum during 1940 to 1972. However, this sub-sector geared up only after 1972 when agro-eco-zonal strategies were adopted in vegetable research and its fresh and seed production. Nepal celebrated Agriculture Year (1975/76) with two strategies: 1) Commercial/market oriented fresh vegetable production in accessible areas and along the road corridors, and 2) Vegetable seed production in the remote areas. From 1980 onward different donor funded projects contributed in vegetable research, seed and market oriented fresh production. By 1995 some 35 vegetable varieties were released. Seed Entrepreneurs' Association of Nepal (SEAN) was established. Area, production, productivity and per capita availability and consumption of vegetables have increased. During recent time, import of hybrid varieties is in increasing trend replacing Nepalese open pollinated varieties. Government of Nepal has prepared and approved Seed Vision 2013-2025 to increase the varietal replacement rate to 90 % and release additional 30 hybrid varieties (20 by public and 10 by private sector) to increase productivity, meet commercialization target and increase competitiveness of Nepalese vegetable sector.*

## **BACKGROUND**

### **Vegetables in ancient Nepal**

Nepal lies between two large civilizations: Aryans in the south and Mongols in the north. During ancient times cow herders (Gopalbansi)

came to Nepal valley (present Kathmandu) from the Ganges Plains of modern-day India, and sheep herders came from Tibet and inhabited in northern Nepal. The history of Nepal has been influenced by its position in the Himalayas and its two neighbors, India and China. Due to the arrival of different settler groups from outside through the ages, Nepal is now a multi-ethnic, multi-cultural, multi-religious and multi-lingual country. Gopalbansi, Mahisapalaka, Lichchhavi, Kirats, Thakuris, Malla and Shah ruled Nepal since ages (History of Nepal Wikipedia, 2015). All those rulers contributed to shape Nepal in the present state. Nepal's physiographic and agro-ecological setting, due to altitudinal variation and multi-sphere facings, favor for different ethno-biodiversities. The Indo-Aryans from the south and Mongols from the north settled in different altitudes as per their suitability to their climatic requirements. Thus, Nepal is the land of Aarya-Mongol civilization with hybrid cultures. Whosoever came to this part of the earth also brought plant materials including vegetables with them. Thus, domestication and cultivation of different vegetables as integral part of civilization and agricultural system goes back to the era when present Nepal was scattered in many local states and royal units. Whatsoever local states and royal units existed, subsistence agriculture was the means of livelihood. The study of ancient writings and archeological evidences show that vegetables were as an integral part of agriculture and civilizations since more than 2000 years.

The British Empire in India and unification of Nepal in 18th century by Prithvi Narayan Shah had impact on vegetable diversities in Nepal. Modernization of agriculture in India started during British regime showed impact in Nepal as well. Unofficial entrance of some seeds of vegetables to Nepal through pilgrimage and ex-army returnees from India also enriched vegetable diversities in Nepal. However, the recorded reports of some exotic vegetable cultivation in the manorial gardens of Rana, the then de-facto rulers of Nepal, could be traced back to mid 19th century when the then Nepal's Rana Prime Minister Mr. Jung Bahadur Rana and his dignitaries received the European vegetable seeds as gift during his visit to the United Kingdom and Europe. Slowly these vegetable seeds leached out to the local farmers of Kathmandu valley through the gardeners of Rana palaces and the cultivation of temperate

vegetables such as cauliflower, cabbage, onion, turnip etc. became popular in Kathmandu valley. Along with these crops indigenous vegetables like broad leaf mustard (Rayo), Pyuthane radish, pumpkin, gourds, colocasia, yam, cowpeas, beans, etc. were cultivated for family use and for the local markets of Kathmandu (Verma, 1994).

### **Nepal's Vegetable Bio-diversity**

Nepal is the land of wonder with her agro-climatic variability. Almost all types of world climate and a wide range of bio-diversity exist in Nepal. Leaving aside the vast number of micro-flora, the larger plants group alone is believed to be existing at more than seven thousand species (Hara et al., 1978). In case of food plants 172 families, 296 genera, 599 species and 35 sub-species are found in the country. Out of 599 species of food plants 400 species belong to horticultural groups of which 200 species are vegetable crops (Regmi, 1982). Among 200 species of vegetables around 50 species are in cultivation (Pandey, 1994a).

Nicoli Ivanovich Vavilov, a Russian scientist, had conducted his study from 1916 to 1936 and established main eight centers of origin of crop plants. Among eight centers, Nepal is surrounded by five centers of origin: i) Chinese center of origin, ii) Indo-Burmese center of origin, iii) Central Asian center of origin, iv) Asia minor center of origin and; v) The Mediterranean center of origin. Nepal lies in Indo-Burmese center of origin and believed that *Dioscorea alata*, *Lactuca sativa*, *Luffa acutangula*, *Momordica charantia*, *Solanum melongena*, *Trigonella foenum*, *Trichosanthes anguina*, *Brassica rapa*, *Cucumis sativus*, *Cucurbita moschata*, *Phaseolus vulgaris* etc. were found in wild state and believed to be originated from this center of origin.

### **Official start of vegetable development in Nepal (1937-1950)**

After Jung Bahadur Rana who contributed in vegetable development in Rana's manorial garden, Chandra Samsher JBR<sup>1</sup> established Agricultural Council as the first government entity for agricultural development in 1937. The council opened agricultural farms in Kathmandu valley in Tahachal and Balaju. At present Tahachal is used for some other purposes and Balaju Nursery converted to Modern Park. Government initiated research and development in vegetable sector since 1940 with

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1 JBR is Jang Bahadur Rana, title given to Ranas as successor

the testing of some exotic and indigenous vegetables in the Central Experimental Farms at Tahachal and Balaju Nursery in Kathmandu since 1942. In these farms seeds of different vegetable varieties such as tomatoes and cabbage were produced. To promote sales of the vegetable seeds thus produced, government opened vegetable seed store during 1942 in New Road near Taleju temple to make the seeds available to the general farmers. In Balaju nursery cabbage seed production was successfully done in 1946 (old record of Agriculture Council). During 1948 first agricultural farm outside Kathmandu valley was established in Parwanipur, Baraas multi crop research station where vegetable research for tropical region was one of the important activities. During 1937 to 1948 vegetable production increased intensively in Kathmandu valley and some special pockets of hills and Terai.

### **The First Department of Agriculture (1951-1965)**

Rana regime ended in February 1951 and new democratic era started in Nepal. The Agriculture Council established in 1937 was converted to the Department of Agriculture in 1952 with Horticulture Section within it and to look after the development of fruits, vegetables and flowers. Horticulture section established two plant introduction units 1) Putali Bagaicha, Singh Durbar and 2) Plant Introduction Unit, Godavari to introduce exotic vegetables and fruits and study their adaptability. During 1952 the first Horticultural farm was established in Kakani to study fruits, vegetables and flowers. United State's Oversea Mission in 1952 and Mountaineering Troops from Japan in 1953 had been the two principle formal sources to import exotic vegetable varieties. Japanese Troop gifted some vegetable seeds of Radish, Carrot, and Turnip etc. to the government and White Neck variety of radish was commercialized in and around Kakani areas of Nepal. Horticultural Section, after studies and trails during 1952-1956, recommended some new vegetable varieties for general cultivation and seeds were made available to common people from seed store at Basantpur, New road, Kathmandu.

### **Initiation of planned development**

Nepal started planned development from 1955/56 when the first five year plan (FYP) was implemented with high priority to agriculture for better and efficient use of resources. Donors like USAID and Indian

Cooperation Mission supported agriculture including horticulture. Since 1956/57 a new program “Tribhuvan Gram Bikash (Tribhuvan Rural Development)” was initiated with block development approach. Block Development Officers (BDOs) and Gram Sewaks and Sewikas (Village Development Workers) were posted at village level for rural awareness and development. This was an integrated community development model including agriculture, health and sanitation, adult education, home science and agriculture. This program introduced different vegetables in rural Nepal with people’s participation. Youth clubs, 4-H clubs, cottage industries, etc. were the components of this program.

During second FYP (1960/61-1964/65), government opened different agriculture/horticulture farms /stations in the different agro-ecological zones of Nepal. During this plan period horticulture units were opened in agriculture farm/stations of Terai. New horticulture farms were opened in Daman/Makawanpur, Dhunibeshi/Dhading and Baitadi with the help of Indian Cooperation Mission (ICM). In the vicinities of these farms/stations, vegetable production were demonstrated and extended. Mainly home gardening was emphasized which slowly developed to produce vegetable for the local markets and haat bazaar. In Terai new agriculture farms were opened in Nepalgunj, Bhairahawa, Janakpur, and Terahara and also in the hills horticultural farm/stations were established in Dhankuta, Kirtipur/Kathmandu, Trishuli/Nuwakot, Pokhara/Kaski and Bhagedada/Doti. These farm/ stations were mandated to test, multiply and sale /distribute the horticultural planting materials (fruit saplings and vegetables seeds). By the end of this plan total horticultural farm stations reached 14. District Agriculture Development Offices (DADOs) were established for agriculture extension and development. In the center horticulture section was under the Department of Agriculture (DoA). The programs of horticulture in the farm/ stations were controlled by horticulture section of DoA. During this plan Rehabilitation Company established new settlements in Terai especially in Chitwan and Doon valleys. Rampur Agriculture Station and Yagyapuri Horticulture Farm were established (the latter is now handed over to Cancer Hospital). All these farm/centers and rehabilitation program promoted vegetable production for home consumption and local sale.

### **Department of Horticulture (1967- 1972)**

The third FYP (1965/66- 69/70) was the turning point in the horticultural development in Nepal. To provide due priorities to different sectors and commodities the Department of Agriculture was reorganized in 1966/67 to 5 different departments (Department of Agriculture Education and Research, Department of Agriculture Extension, Department of Livestock Development, Department of Horticulture and Department of Fisheries). Department of Horticulture was housed in Kirtipur with two major sections viz. Fruit Development Section and Vegetable Development Section. Kirtipur was the main center of research and development for fruits, vegetables, potato and flowers. Horticulture farms of different agro-eco-zones were under the Department of Horticulture (DoH). Vegetable research, seed production and seed sale used to be done by these horticultural farms and some seed were sold from Basantpur seed store as well. District Agriculture Development Offices also purchased vegetable seed from horticulture farms/ stations and Basantapur seed store as there were no other private and government outlets for vegetable seed.

During 1967 to 1970, the Department of Horticulture (DoH) established additional horticultural farms/station in Humla, Jumla, Dolpa, Mustang, Rasuwa, Helambu/Sindhupalchowk, Boch/Dolakha, Panchkhal/Kavre and Nawalpur/Sarlahi to push the horticulture development and the number of horticulture farms reached 23. All these farm/centers contributed in vegetable research, seed production and fresh vegetable production in their command areas and served as the growth centers for fruits and vegetables development.

### **Unified Department of Agriculture (1972-1990)**

During the 4th FYP (1970/71-1974/75) the concept of regional development was adopted. Five departments were united to one single Department of Agriculture (DoA). Under the DoA sub-sector development approach was realized in horticulture sector. Accordingly, Fruit Development Division (FDD), Vegetable Development Division (VDD), National citrus Development Program (NCDP) and National Potato Development Program (NPDP) were established. During this plan period 6 new farms viz. Vegetable Seed Production Center Khumaltar,

Vegetable Seed Production Center Rukum, Horticulture Farm Sindhuli, Nucleus Potato Center Nigale/ Sindhupalckok, and Cardamom Development Farm Fikkal/ Ilam were also established. Establishment of VDD and Vegetable Seed Production Center Khumaltar during 1972 was the milestone in vegetable research and development. VDD started functioning with clear mandate of research and development since 1975 adopting the eco-zonal based strategy for vegetable research, vegetable seed production and fresh vegetable production.

### **Agro-ecological approach for vegetable development**

During the 5th FYP (1975/76 -1979/80) Nepal adopted agro-eco-zonal based approach in vegetable development. In Nepal, there are three broader distinct agro-ecological zones viz. Terai/plain, mid hills and high hills with some specific zones in trans-Himalayan region. Within these zones specific micro-climatic situations and special pockets exist due to variation in altitude, slopes, facings, surrounding hills and valleys. Nepal being situated in northern hemisphere in temperate zone, there is four distinct seasons in a year such as spring, summer, autumn and winter. Due to high agro-biodiversity of vegetables, more than 50 kinds of vegetable crops are commercially grown in Nepal. To fit into these agro-ecological zones and micro-climatic pockets for each region and season, at least four sets of adaptable vegetable varieties under each kind of crops and their seed availability is the ideal requirements for the year round supply of a particular kind of vegetable. Thus, it involves two tiers of research viz. fresh vegetable production and seed production. Considering four varieties of each of fifty crops to be developed with fresh and seed production techniques the task appeared to be Herculean. To cope with above task, VDD since 1975 adopted the eco-regional approach for vegetable research and seed production with the following four major strategies:

- Introductions of exotic germplasm; and collection, evaluation and selection of indigenous land races and development of high yielding vegetable varieties suitable for different agro-ecological regions and seasons
- Generation of improved and appropriate crop husbandry, plant protection and seed production techniques for improved varieties

- Commercial/market oriented fresh vegetable production demonstration in accessible areas and along road corridors and
- Technology generation for vegetable seed production in the remote areas where fresh vegetable marketing is difficult.

According to the above strategies, five major centers for vegetable research and farmer's field vegetable seed production zones were adopted. Vegetable Seed Production Center Khumaltar, Horticulture Farm Sarlahi, Agriculture Station Dhankuta and Horticulture Farm Mustang and Vegetable Seed Production Center Rukum were identified as the five major centers for research. Under the technical guidance of these Farm/centers contract seed production of major vegetable varieties were started in Bhaktapur, Nuwakot, Sarlahi, Dhankuta, Tehrathum, Bhojpur, Mustang, Rukum and Salyan. Agriculture Input Corporation (AIC) was given the responsibility of vegetable seed marketing by 1975. Seed buying contract used to be done by AIC and foundation/source seed supply and field supervision by VDD. During 1981 Vegetable Seed Production Center was established in Dadeldhura to expand vegetable seed production and fresh vegetable production along the road corridors of Far Western Development Region.

### **Donor support in vegetable development**

With the beginning of the 6th FYP (1980/81) to gear up the research and development in vegetables, supports from different donors were initiated.

Fresh Vegetable and Vegetable Seed Production Project: This project was funded by the Swiss government through FAO as a Technical Cooperation Project from 1980/81 to 1994/1995 (6th to 8th FYP) and worked in three phases as the counter part of VDD. This project further strengthened the approach initiated by VDD during fifth five year plan and continued till eighth five year plan. The commendable impacts of this period were as under:

### **Variety development, maintenance and seed production**

Seven Farm/Centers as center of excellence for vegetable research, variety development and breeders and foundation seed production were recognized as presented in Table 1.

Table 1: Farm/Centers selected for vegetable research and variety development

S. No	Name of Center	Altitude (M)	Micro-climate	Priority crops for research
1	Horticulture Farm Dhankuta	1200-1400	High rainfall, high humidity	Radish, Mid season Cauliflower, Broad Leaf Mustard, Pea, Cress, Spinach etc,
2	Horticulture Farm Sarlahi	100	High rainfall, high humidity, hot summer, mild winter	Early Cauliflower, Radish, all Solanaceous and Cucurbitaceous crops, Beans, Cowpeas
3	Vegetable Seed Production Center Khumaltar	1350	High rainfall, high humidity, frosty winter	Radish, Cauliflower, Broad Leaf Mustard, Beans, Swiss Chard, Cress, Spinach, Turnip, Tomato, Eggplant, Onion, Chili, Capsicum
4	Horticulture Farm Mustang	2522	Low rainfall, snow in winter, low humidity, mild summer	Late Cauliflower, Cabbage, Carrot, Broad leaf Mustard (Marpha), Late Radish
5	Horticulture Farm Dolpa	2242	Low rainfall, snow in winter, low humidity, mild summer	Late Cauliflower, Cabbage, Carrot, Broad leaf Mustard (Marpha), Late Radish
6	Vegetable Seed Production Center Rukum	1440-1500	Mild rainfall, high humidity, warm summer, chilly winter	Radish, Mid season Cauliflower, Broad Leaf Mustard, Beans, Cress, Spinach, Turnip, Tomato, Eggplant, Sweet pepper, Onion, Peas, Carrot, Squash
7	Vegetable Seed Production Center Dadeldhura	1400	Mild rainfall, high humidity, warm summer, chilly winter	Radish, Mid season Cauliflower, Broad Leaf Mustard, Beans, Cress, Spinach, Turnip, Tomato, Eggplant, Sweet pepper, Onion, Peas, Squash

Besides above seven farms, two British aided farms viz. Lumle Agricultural Center (LAC) and Pakhribas Agricultural Center (PAC) also were linked and coordinated for vegetable research, development and seed production.

### **Variety development**

During 15 years of FAO project support VDD established sound footings for research in different selected farms/centers (first phase of FAO 1980-83). During the second phase (1984-87) the project continued to support for variety evaluation and also developed a sound base for variety maintenance, and the production of breeders/nucleus and foundation seed. Prior to 1980/81, 25 vegetable varieties were already popular among farmers and organized seed production was in place. However, with the project support, new stock seeds were imported to replace deteriorated seed stock. During 1981-91 the project supported the evaluation of 350 new germplasms of different vegetables collected from exotic and indigenous sources and selected 47 superior varieties. Including already popular 25 varieties and new varieties developed, 72 varieties were identified by 1991 and based on these research results, 35 vegetable varieties were released in 1995 and maintenance system was adopted.

However, when NARC was established in 2090/91 and new departmental reorganization was made, the horticultural farm/centers were divided between NARC and DoA. Consequently, vegetable research and variety maintenance were distorted. From 1995 to 2014 only five additional new varieties of vegetables were being officially released but without being linked to variety maintenance scheme and commercial seed production and marketing of those varieties. Thus variety development, maintenance and seed production of Nepalese varieties could not keep pace with market demand and vegetable seed import is increasing.

### **Variety maintenance**

Based on the mode of pollination and breeding behavior of recommended vegetable varieties, the variety maintenance program and methods were developed by VDD and the project during the 6th FYP. To ease the variety maintenance work, varietal (morphological) characteristics of identified varieties with their marked genetic trait,

maintenance methods, and technical procedures for each group of crops were developed and documented for the use and reference. A well defined variety maintenance techniques and system of one farm one variety was adopted. Until 1990, in various agro-ecological zones there were 33 horticultural farms under unified DoA including seven center of excellence for vegetable research and variety maintenance under one command of VDD and thus the maintenance was easy. A variety maintenance chart was developed denoting farm/centers and varieties to be maintained and produce breeders and foundation seed. To clarify the maintenance scheme, as for example cauliflower crop, variety Kathmandu was to be maintained by Khumatar, Rukum and Dhankuta, Snow Ball was to be maintained by Dolpa, Kibo Giant by Dadeldhura and Deepali by Sarlahi; and cabbage variety by Marpha. Similar arrangements were made with other cross pollinated crops as well. However, at present, this arrangement has become non-functional.

### **Seed production**

A sustainable seed production chain consists of three sequential stages: (1) Variety maintenance and breeder's seed production, (2) Foundation/source seed production, and (3) Certified /truthful labeled/improvedseed production. Responsibility for stage 1 rests with the breeders who are independent professionals or associated with an agency. Seed production chain from variety development, its maintenance, breeders and foundation seed production and commercial seed production for good quality seed distribution is of prime importance. VDD and the project adopted the systems and procedures to maintain seed chain. Each farm/center was made responsible to produce quality breeders and foundation seed linking to the farmer's field commercial seed production. During 5th to 7th plan period, VDD was the sole coordinator of vegetable and vegetable seed production.

### **Agriculture Inputs Corporation (AIC) in vegetable seed marketing**

Till 1974 vegetable seed production and distribution were the responsibility of government farms only. Agriculture Inputs Corporation (AIC) was mandated for vegetable seed marketing from 1974. Due to the increasing demand of high quality seed, contract seed production in

farmer's field in different agro-ecological zones was started from 1975. AIC used to make contract agreement for vegetable seed purchase with the farmers as recommended by VDD. Foundation seed and technical supervisions used to be provided by VDD along with the designated farm/centers of the production zones. VDD used to organize breeders and foundation seed production and made available to AIC for improved contract seed production. For the safety, 100 % of breeder's seed and 50 % of foundation seed requirements were used to be kept as buffer stock.

### **Private sector in vegetable seed marketing**

During 1970 one private seed shop was opened in Asan Tole, Kathmandu in the name of Annapurna Beej Bhandar (By Prem Lal Shrestha) which was the first vegetable seed shop in private sector in Kathmandu valley and started selling both local and imported vegetable seeds. There were a few vegetable seed traders in major cities outside Kathmandu valley. Slowly the seed entrepreneurs in Kathmandu valley and main cities of Nepal such as Bhadrapur, Birtamod, Biratnagar, Janakpur, Birgunj, Butawal, Pokhara, Nepalgunj, Dhangadhi and Kanchanpur were also opened. VDD/FAO facilitated to establish Seed Entrepreneur's Association Nepal (SEAN) in 1989 and registered in 1991 as an umbrella organization of seed entrepreneurs with 32 members which now has more than 300 members spread over 37 districts and seed dealing entrepreneurs are more than 2000 and handles more than 90 % vegetable seed trade. These private sector seed entrepreneurs started contract seed production with the support from different donors to meet the demand. However, to meet the increasing demand of quality seed, especially hybrid seeds, imports have also increased during recent decades (SEAN, 2013). The numbers of imported and registered vegetable varieties by entrepreneurs have reached to 20 OPs and 231 hybrids (SQCC, 2010).

### **ADDITIONAL DONOR SUPPORT IN VEGETABLE SEED PRODUCTION**

Along with VDD/FAO fresh vegetable and vegetable seed production project, chronologically the donor support in vegetable seed production and fresh vegetable development can be summarized as follows:

- **Japan International Cooperation Agency (JICA)** supported VDD from 1983-87 to develop new varieties and modern technology in fresh vegetable production and seed production. This project introduced protected cultivation of tomato and sweet pepper in half opened plastic tunnel in Khumaltar with proven success. With passage of time this technology was further replicated by different projects, I/NGOs and have been established as an important off-season production technology by now.
- **Regional Vegetable Research Project-RAS/89/04** Connected with Fresh Vegetable and Vegetable Seed Project, FAO Regional Vegetable Research Project-RAS/89/041 also contributed in germplasm exchange among Asian countries like China, Korea, Thailand and SAARC countries during 1987 to 1988.
- **South Asia Vegetable Network (SAVERNET)**, from 1991-1993, introduced different varieties of vegetables for adaptive test. However, conclusive results could not be obtained due to administrative anomalies among researchers.
- **Vegetable, Fruits and Cash Crops Development Project, (VFC/Rapti)**, from 1984-1990, was successful to scale up seed production and marketing by many folds in Rapti zone through No Frills Consultancy. However, due to its negligence in providing quality foundation seed and quality control services, it lost Nepalese radish seed market in Bangladesh. This project failed to collaborate with research and seed chain maintenance.
- **Koshi Hills Seed and Vegetable Project (KOSEVEG)**, from 1992-1997, was designed to develop an effective, sustainable and market oriented seed and vegetable program for increasing food production and household income. The social mobilization process of the project was notably a successful feature and the creation of local farmers' association was particularly important. It supported in forming KOSEPAN and linked the seed growers with national and regional seed traders for sustainability even after the project phased out.
- **Community Based Economic Development Project (CBED)** from 1997-2002. CIDA funded CBED adopted the demand based

vegetable seed production program linking seed growers with seed traders through regional seed contracting workshops. It was successful in introducing the seed production practice in the far western hill districts of Nepal.

- **Market Access for Rural Development (MARD)** from 1997-2002. USAID funded MARD Project supported farmers groups and cooperatives for vegetable seed production and its marketing in Surkhet, Dailekh and Nuwakot districts. Due to poor linkage with GoN line agencies the impact could not last long.
- **Seed Sector Support Project (SSSP)**, from 1998- 2003, was a successor of the KOSEVEG project and adopted the same approach for seed production and marketing. The approach was based on contractual seed production agreed by seed producer groups and seed buyers during seed planning workshops. The model was later replicated in other districts (Dadeldhura and Achham). SSSP contributed in enhancing the seed industry of Nepal and is also particularly known for private seed sector growth. It supported processing equipments and laboratory establishment of SEAN Seed Service Center (SSSC) at Thankot. It is a well equipped company owned by more than 50 SEAN members.
- **Participatory Vegetable Seed Project (PVSP)**, from 2001-2003 and funded by DANIDA, was the first vegetable seed production project implemented by NGO viz. Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED) in six districts of Nepal including both hill and Terai district.
- **Vegetable Seed Project (VSP)**, from 2004-2014 funded by Swiss Agency for Development and Cooperation (SDC), was implemented by CEAPRED in order to benefit poor farmers in remote areas by diversifying their income opportunities through vegetable seed production and marketing. Main contributions of this project included:
  - Synergistic approach of combining seed production in the remote districts and fresh vegetable in road corridors with focus on poor, women and disadvantaged households for

increased income and food security.

- Institutionalizing farmers' groups into seed cooperatives and linking them with entrepreneurs through Pre-contract Marketing Agreement
- Seed Producers' Central Co-operative Federation Ltd. registered as umbrella organization of primary seed cooperatives that facilitate for demand based production and nationwide marketing of seeds linking with seed entrepreneurs of all over the country for sustainability
- **Internal Quality Control (IQC)** has been established for quality assurance at production level and this needs formalization by DADO and SQCC
- **Other Projects** Apart from those aforementioned, there were other programs or parts of different projects of small initiatives in different aspects of seed. Some organizations are still continuing small support to these initiatives (e.g. NARDF, PACT, IWRMP, HIMALI, JICA etc). At present High Value Agriculture Project and Kishanko Lagi Biu Program, implemented by government, are working in the field of seed production and management.

As cumulative results of all these efforts the increase in vegetable seed production in farmer's field and government farms from 1975 till 2015 is presented in Table 2.

**Table 2: Vegetable seed production trend and domestic requirement from 1975 to 2015**

Year	Government sector	Private sector (farmer's field)	Total production	Total requirement	Gap	Gap %
1975/76	9	1	10	293	283	97
1979/80	12	8	20	343	322	94
1984/85	12	21	33	770	737	96
1989/90	15	190	205	775	570	76
1994/95	11	250	261	855	594	69
1999/00	12	430	442	1310	868	66
2004/05	11	810	821	1569	748	48
2009/10	8	930	938	1840	902	49
2014/15	8	1050	1058	1920	862	45

Source: MoAD (2014) and CEAPRED (2015).

Despite the multifold increment of seed production in Nepal (10 MT in 1975 to 1050 in 2014/15), many seed traders have been importing different kind of seeds from different countries due to shortage of seeds of modern high yielding varieties and specially hybrid seeds in the domestic market. Commercial fresh vegetable growers prefer to use imported hybrid seeds. The projected demand of vegetable seed for the fiscal year 2009/10 was 1840MT which increased to 1920 in 2014/15. The estimated domestic production remained only about 930 MT in 2009/10, a shortfall by almost half of the demand (CEAPRED, 2010). Rest of the demand is met either by farmer-to-farmer exchange of often sub-standard seeds or by import of open pollinated and hybrid seeds. Most of the vegetable seeds produced in Nepal are of OP varieties whereas in some of the crops like cabbage, cauliflower and tomato, the largest part of growth in seed demand is for hybrids (CEAPRED, 2010). Nepal has released only one hybrid tomato variety Srijana and production is not in line with the demand.

## **IMPORT AND EXPORT OF SEEDS IN NEPAL**

Flow of vegetable seed from India has been a common practice since long due to open boarder. It has always been difficult to assess the

amount of seed import from India. Therefore, one of the objectives of vegetable development in the sixth and seventh plan (1980-90) was to substitute the import of vegetable seed promoting domestic production. The domestic seed production of OP varieties increased from 10 Mt in 1975 to 1050 MT in 2014. However, a study carried out by CEAPRED in 2010 and SEAN in 2013 showed that many Nepalese OP varieties are being rapidly replaced by imported OPs and hybrids. The increasing trend of vegetable seed import is presented in table 3.

**Table 3: Trend of vegetable seed import in Nepal**

Year	Total Seed import (MT)	Hybrids (MT)
2002/03	213	12 (6%)
2008/09	680	48 (7%)
2012/13	969	512 (52%)

This trend is expected to continue in future as well.

### Vegetable seed export from Nepal

Vegetable seed export to Bangladesh was initiated by AIC in 1987/88. Later SEAN members started export of radish seed to Bangladesh and its steady development is presented in table 4.

**Table 4: Vegetable seed export from Nepal**

Year	Quantity MT	Major vegetables	Countries
1087/88	0.5	Radish	Bangladesh
1988/89	9.8	Radish, Eggplant, Cauliflower	Bangladesh/India
1989/90	20.0	Radish, Tomato Eggplant, Cauliflower	Bangladesh/Germany/India/Japan
1990/91	16.2	Radish, Tomato Eggplant, Cauliflower	Bangladesh/Germany/India
1991/92	14.5	Radish	Bangladesh/Germany/India
1992/93	11.2	Radish	Bangladesh/Germany/India
1993/94	23.7	Radish	Bangladesh/Germany/India
1998/99*	45	Different Vegetable seed	Bangladesh/Germany/India
1999/00*	124	Different Vegetable seed	India
2000/01	30	Different Vegetable seed	India
2001/02	71	Different Vegetable seed	India
2011/12	89	Different Vegetable seed	India

Source: SEAN (2013)

During 1999/00 vegetable seed export from Nepal reached to 124 MT which then declined to 89 MT in 2011/12. There are several factors causing decline in the export of seed from Nepal. The major reasons were low quality and higher price of Nepalese seed. For example, farm gate price of Mino Early variety of Radish costs around Rs.210 per kg in Nepal whereas the seed imported from New Zealand costs around Rs.180 per Kg in Bangladesh.

## **FRESH VEGETABLE PRODUCTION AND MARKETING**

Jyapu in the Kathmandu valley and Koiris in the Terai were the two peasant communities who have specialized in commercial vegetable production and marketing before planned agriculture development started from public sector i.e. government. Before the start of modern agriculture development in Nepal, Kathmandu valley had sustainable organic vegetable production practices (Pandey, 1994 c and NHPC, 2004). Their marketing strategies were to take their produce door to door and at special cross roads and sell individually. Sometimes, they used to go beyond valley to barter or exchange vegetables with cereals. Some of them also sold to local retailers in Kathmandu valley.

With the establishment of Tribhuvan Gram Bikash and latter establishment of Agriculture/Horticulture farm/centers vegetable production demonstration started outside Kathmandu valley near district head quarters and market settlement. Slowly market oriented production of vegetables started to take pace. Horticultural farm/centers and DADOs started promoting home gardening and market oriented production through demonstrations. With beginning of sixth five year plan fresh vegetable production program was classified into two major programs

### **General/home Gardening Production Program**

General program was for home consumption. Mainly kitchen/home garden packets of vegetable seeds used to be made available to the farmers. It was mainly for nutritional improvement. DADOs used to conduct kitchen garden demonstration for its promotion with different types of vegetables for balanced diet and year round production.

UNICEF, ADB and VDD jointly distributed vegetable seed composite packets (one lakh packets per year) through DADOs from 1981 to 1989. Latter this model was adopted by different organizations such as Women Development Program, and other community organizations working in the field of health and nutrition.

### **Market Oriented/special Production Program**

The market oriented production program was implemented along the road corridors. Major road corridors selected at the beginning were mainly Daman-Palung corridors of Tribhuvan high way, Dhunibesi-Mugling and Mugling-Pokhara of Prithvi high way, Pokhara-Bhairahawa corridors of Siddhartha high way and Kathmandu-Trishuli road corridors for fresh vegetable supply to Kathmandu valley and other major cities. Market oriented production demonstrations were carried out jointly by VDD and respective DADOs with intensive training and inputs support to the farmers along East-West high way, near district head quarters and in the vicinity of other market centers.

Technical support from The People's Republic of China was made available through FAO to expedite the market oriented production of fresh vegetable through vegetable seed campaign to promote the use of Nepal produced high quality seed during 1983 to 1985. This campaign conducted trainings and supplied production inputs through DADOs to conduct production demonstrations and farmer's field days. The campaign during its three year time conducted 400 demonstrations in five major road corridors and 9 district head quarters. At the end of three years seed campaign, fresh vegetable production outreach was included as the regular commercial and kitchen gardening program of DADOs in the districts.

During 1985 to 1990, low height plastic tunnel for early growth of cucurbitaceous crops along Naubise- Charaundi road corridor was demonstrated in large number by VDD/FAO project and GTZ project through DADO Dhading which have now become popular for early vegetable production to catch the niche market.

## **Establishment of Fruits and Vegetables Markets**

Till 1973 vegetable production in the country was very small. The practice of shipment of vegetables from one production center to distant urban consumer center was virtually non-existent till 1975. Kathmandu valley used to be self sufficient in vegetables as the population of valley was less and vegetable production areas were huge. The vegetable marketing system was characterized by rudimentary stage of development. However, the efforts of the farms/stations and DADOs increased fresh vegetable production and unorganized markets started to grow in different parts of the country. Realizing the need of organized markets for vegetable marketing, Department of Food and Agricultural Marketing Services (DFAMS) was established in 1973. The first step in vegetable marketing was the establishment of Ranamuktेशwor Fruits and Vegetables Retail Market Center in Kathmandu in 1975.

In the mid 1980s, it was realized that the supply of vegetables from different production centers to Kathmandu valley must efficiently be channelized to meet demand of the capital city. In this context, the then DFAMS initiated the program of establishing and developing a Fruit and Vegetable Wholesale Market at Kalimati in Kathmandu. Establishment of Kalimati Fruit and Vegetable Whole Market (KWM) was initiated by acquiring 2.05 ha land as central market in 1987. The prospective plans and design was prepared by DFAMS. With the continuous effort of Fresh Vegetable and Vegetable Seed Production Project, the United Nations Capital Development fund (UNCDF) provided grant assistance of US\$ 4.6 million for basic construction of KWM and was completed by 1995. The transaction of vegetables in KWM increased from 42,273 MT in 1992/93 to 189,346 MT in 2014/15 (ABP and MDD, 2014).

After the success of KWM, different wholesale markets emerged up in different parts of Nepal. Agricultural Wholesale Market Birtamod, Jhapa was constructed for food grain trading in 1979 by UNDP/FAO. Later it spontaneously emerged as a satellite wholesale market of KWM and also developed as vegetable and fruit market. The Hill Fruit Development Project (HFDP) provided additional facilities to cater some of the needs of vegetable marketing. In addition to Birtamod, HFDP also supported wholesale market development in Dharan, Basantpur and

Katari/Udaipur.

In addition to KWM in Kathmandu, the UNCDF also supported construction of three vegetable marketing sheds in Lalbandi, Sarlahi. Similarly, UNCDF funded Small Marketing Infrastructure Development Project supported construction of more than 20 collection centers in different parts of Nepal where vegetable production were increasing. These small market infrastructures are functioning even today at different nodes of East-West highway and niche points of hills and other cities of Nepal.

Kapurkot market in Salyan was another turning point for fresh vegetable marketing in the hills of mid-western region. It used to supply vegetables to different markets of Nepal and also export to India. Secondary Crops Development Project also contributed in developing wholesale markets in mid and far western region where fresh vegetable marketing was growing and taking pace fastly.

The area, production and productivity of fresh vegetable increased from 1975/76 to 2014/15 steadily (table 5).

**Table 5: Area, Production and productivity of fresh vegetables from 1975/76 to 2014/15**

Year	Area ha	Production MT	Productivity MT/ha
1975/76	82,000	410,000	5.00
1979/80	96,000	528,000	5.50
1984/85	138,200	743,000	5.38
1989/90	140,524	967,167	6.88
1991/92	140,500	1,227,884	8.03
1995/96	144,368	1,327,298	9.20
2000/01	157,162	1,652,979	10.50
2004/05	180,823	2,065,193	11.40
2009/10	235,098	3,003,821	12.70
2014/15	245,000	3,629,000	14.80*

Source: VDD, 2014/15; \* Projected for 2014/15.

During 1975/76 the area under vegetable was estimated to be 82,000 ha with production of 410,000 MT and conservative productivity of 5.00MT/ha. In 2009/10, the area increased to 235,098 ha with the production of 3,003,821 MT and average yield of 12.77 MT/ha. The

projected production for 2014/15 is 3,629,000 MT from an area of 245,000 ha with an average yield of 14.8 MT /ha. (VDD, 2014)

Nepal with a wide range of agro-ecological variation creates a comparative advantage for the production of different vegetable crops. The production of seasonal and off-season vegetables, utilizing these ecological niches, has been extremely beneficial in the context of nutrition, employment, and income generation. The Nepal government is also emphasizing the production of offseason vegetables in the hills of Nepal as an important cash crop that could enhance the income level of farmers and thus help reduce the incidence of poverty (APP, 1995). Due to the higher return per unit of land, the area, production, and productivity of vegetables are increasing day by day.

### **Off-season Vegetable Production in Nepal**

During late sixties Horticulture Research Station, Kirtipur initiated tomato cultivation in Dhunibesi/ Dhading to meet the demand of tomato in Kathmandu during winter. It did work due to warm climatic condition of most part of Dhading along the highway. Similar experiences of solanacious vegetables cultivation in Terai plains brought positive outputs. During seventies, cultivation of cauliflower and cabbages during summer in high hills and mountains were also successfully demonstrated by VDD, LAC and PAC in different regions. Based on these successes and experiences the terminology of “Off-season vegetable” was included in Agriculture Perspective Plan (APP, 1995).

In general term, off-season vegetable farming refers to the production of vegetables before or after their normal season of production. However, in the present context it is wider and beyond the normal terminology. Off-season productions now a days are accomplished by using different agro climatic conditions, adjusting the planting time, selecting and improving the varieties, and/or creating controlled environments (by making plastic tunnels, polythene houses, permanent glasshouses, etc.). Mostly off-season vegetable is defined in relation to consumption or demand of the centers of destination market. For production areas it is normal season production, but for demanded destination market it is off-season commodity. Examples are as

- Tomato, chili, eggplant, beans are the winter vegetables of the Terai plains and are off-season commodity for high hill regions.
- Cabbage, cauliflower, carrot, broad leaf mustard, radish, etc. are winter vegetables by nature but these are produced in high hills during summer rainy season as normal production but are off-season commodity for mid hills, lower hills and plain areas.

Utilizing the agro-climatic comparative advantages both hills and Terai produce vegetables for off-season markets. During 1960 to 1990 the sole contributors in the development of fresh vegetable production and marketing included Ministry of Agriculture, DoA/VDD, farm/stations under it and aid supported projects like PAC and LAC and different Integrated Rural Development Projects. The most important project that supported DoA/VDD is the HMG/FAO vegetable and vegetable seed production project which coordinated all three sub-sectors of vegetable development viz. vegetable seed production, fresh vegetable production and vegetable marketing infrastructure development from 1981 to 1995.

During later 25 years from 1990 to 2015 the players and contributors in vegetable sector included both public and private sectors. New horizon opened after restoration of democracy in 1990. Different I/NGO appeared as main players in fresh vegetable production. CEAPRED was the first norm setter for fresh vegetable commercialization along north south road corridor such as Dharan-Dhankuta and Arniko highway. Many other areas such as Panchkhal (Kabhre), Tistung, Palung and Daman (Makwanpur); Ranipauwa (Nuwakot); Basantpur, Hile and Sidhuwa (Dhankuta); Madanpokhara (Palpa), north south road corridors of Dadeldhura, Ratanangla/Dailekh and Kapurkot/ Salyan are some of the examples for off-season production and are expanding each year due to the potential of off-season marketing. Currently, Bangladesh and northern border-side markets of India hold the greatest potential for Nepalese off-season produces. Over the last decade, the attraction of off-season vegetable production has increased. For income generation and poverty reduction fresh vegetable production in accessible areas and vegetable seed production in the remote areas have become the proven strategies.

## FUTURE PROSPECTS AND WAY FORWARD

Fresh vegetables play very important role in nutrition security, food security, income generation and livelihood improvement. Increased production and productivity of vegetables depends on high quality seed including hybrids. Lessons learned from successes and pitfalls have resulted in shaping the future prospect and way forward. As we move along the path of progress, several opportunities will appear and these needs to be utilized for the benefit of wider farm families.

### Variety development

A large proportion of improved seeds particularly hybrids in vegetables are being imported, particularly from Japan, India, Thailand, Korea and China. Nepal must collect, evaluate and develop pest resistance and stress tolerance varieties from local germplasm for climate resilience. In order to reduce the import of hybrids, NARC should have Hybrid Research Unit (HRU) under National Commodity Programs and Divisions with adequate funds and human resources as envisaged in Seed Vision, 2025. It is envisaged that 30 hybrids comprising 20 by public sector and 10 by private sector would be developed and released to increase vegetable production and productivity as well as seed replacement rate from 68 to 90 % by 2025. Furthermore, different classes of vegetable seed production have also been quantified as presented in table 6.

**Table 6: Status of 2010 and projection of different classes of seed by 2025**

S. No	Classes of seed	Projected requirement (MT)			
		2010	2015	2020	2025
1	Breeder's seed	0.55	0.878	0.955	1.204
2	Foundation seed	22	35.12	38.18	48.14
3	Certified/labelled/ improved (OP) seed	1,100	1,756	1,909	2,407
4	Hybrid seed	30	40	70	90
	Total	1,152.6	1,832	2,018.2	2,546.4

Source: SQCC, 2012.

To achieve the goal set (Table 6), emphases on variety development

must be given utmost priority.

### **Variety maintenance**

Variety maintenance is an important component of quality source seed production. Maintenance of crop varieties in their original ecological domain is essential to produce quality source seed and retain original genetic vigour and unique characteristics of the varieties. However, currently, there is a limited use and compliance of zoning concept in maintenance of varieties. Variety maintenance chart for vegetables prepared during eighties by VDD and recently revised by NSB has to be implemented based on agro ecological zones, domains of the research centres and farms. Original genetic vigour and unique characteristics of some of the vegetable varieties have been published by CEAPRED, 2014. Present status of breeder seed production and its projection in Seed Vision is discussed in seed multiplication section since breeder seed is an output of the variety development chain, which is also an input for the seed multiplication chain (SQCC, 2013).

### **International and national linkages and collaboration**

At present, the linkage and collaboration of national commodity programs with international institutions and private R and D organizations is limited. Except for major food crops (rice, maize, wheat, legume and potato), virtually there are no linkages and international support for developing new varieties in vegetables. Development and strengthening link is essential for increased germplasm exchange and sharing of information and technology. Similarly, linkage of domestic plant breeding programs with national gene bank is weak. As a result, flow of new germplasm, modern technological information and the use of locally diverse genetic resources available are limited. It is suggested that gene bank operational guidelines need to be developed and implemented with special reference to vegetable crops. Research collaboration and partnership among NARC, AFU, DoA and NARDF needs reorientation and working towards national goal of hybrid variety development in vegetable crops. Researches of M. Sc. and Ph. D. students and faculty

members must be linked with National Seed Vision, and National Agricultural Research and Development Fund (NARDF) should play supportive role.

Linkages with international institutions and Universities, and joint ventures for new variety development and hybrid seed production should be given high priority by both government and private sector.

## **CONCLUSION**

Vegetable is a complex sub-sector as it has to address a wide variety of vegetable species and cultivars and develop varieties suitable to varying agro-ecological environments. Thus, research inputs from both public and private sector (Seed companies, non-governmental organizations and farmer's research) are very crucial to meet the target set in Seed Vision and Agriculture Development Strategy (ADS). Considering the fact that there has been rapid replacement of OP varieties by hybrids, the need for research has crucially emerged for identification of indigenous cultivars and demonstrating their commercial value, developing new OP varieties and parental lines for hybrid variety development. Public sector research could be led by NARC in collaboration with Vegetable Development Directorate and University of Agriculture and Forestry. Private sector research could be done by private seed companies and NGOs in partnership with public sector in participation with farmers.

Production, consumption and marketing of fresh vegetables have been increasing during recent decades. Farmers are demanding imported hybrid vegetable varieties that are high yielding, short durational and suitable to different agro-ecological environment and different season. However, this should not be at the cost of Nepali OP varieties which possess immense potential in terms of farmer's acceptance, adaptability to local climatic stress and tolerance against several pests and diseases. Therefore, investment in farmer's preferred priority vegetable crop research for new OP varieties and parental lines development for hybrid seed production, and proper maintenance of released and registered varieties must be stream lined. Sustaining the seed value chain from breeder's (nucleus) seed to improved/labeled seed production is needed with proper quality assurance through truthful labeling under a

collaborative action involving all related government, non-government, private and cooperative stakeholders. It is also necessary to increase competitiveness of Nepali seeds both in domestic and international markets through quality assurance, branding and packaging.

Fresh vegetable production and marketing is always led by supply of good quality inputs, mainly seeds, and market management. Safe products with no or within the limit of pesticides and mainly hazardous pesticide free products are in demand. Clean, well branded, nicely packed and well displayed fresh vegetable products are in increased demand. Fresh vegetable market functions and trader's behavior should be changed to benefit both fresh vegetable producers and consumers with well planned production program, regular supply chain and heading towards international standards of fresh vegetable market development.

The comparative advantages both for vegetable seed production and fresh vegetable production have to be harnessed in all the ecological zones of Nepal for year round commercialization of fresh vegetable production. Vegetable seed production of temperate to tropical crops from Terai to high hill must be done with proper zoning of seed production. Hills and high hills are suitable for temperate vegetable seed production whereas Terai, inner Terai and low hill basins are suitable for solanaceous, cucurbits, okra and legume seed production.

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