# Prospect, Progress and Challenges of Vegetable Seed Crops in Nepal

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## Abstract

Nepal is situated in the temperate region in the southern alp of high Himalayas. Nepal has diverse agro-climatic conditions with four distinct seasons (spring, rainy, autumn and winter) and has five agro-ecology and physiographic regions (High Himalaya, High Mountain, Middle Mountain, Siwalik and Terai). Except Terai other regions have four aspects, which makes at least 30 major agro-climatic zones that favours the seed production of all kinds of vegetable. Nepal has vast number of vegetables biodiversity adopted in different agro-ecology. Monsoon rain from Arabian sea and Bay of Bengal and winter rain from Mediterranean Sea and presence of many rivers, rivulet, lakes, ponds and wetlands makes feasible water managements. Combined with micro-climates and vegetable species and varieties there is huge prospect of seed production to attend self-sufficiency and export on demanded quantity and quality to neighbouring counties and could contribute to reduce trade imbalance. All major food crops grown in the world can be grown in Nepal including vast number of vegetables. Geo-physical settings, agro-ecological variations and vegetable bio-diversities provide vivid prospects for vegetable seed production in Nepal with comparative advantages.

Despite the suitable climate, comparative advantages with long history of vegetable seed, development, the growth of domestic vegetable seed industry has remained slow after 1990, due to policy constrains and organizational anomalies. The research and development work on vegetable and vegetable seed is inadequate and extension program is not effective during recent years. There are different challenges and gaps to propel such huge prospect and to realize the benefit of vegetable seed sector. Governments, donors and development partners are interested in fresh vegetable production; however, they do not give priorities to Nepali Seed but promotes use of imported hybrids. Despite increasing area and production of fresh vegetable during the past three decades, Nepali market largely relies on imports to fulfil national demand of vegetable seed. This paper suggests rectifying the distorted scenario with the reformation of organization and policy with the proactive initiation of the Ministry of Agriculture and Livestock Development.

**Keywords:** Agro-Biodiversity, Challenges, Prospects, Reformation, Vegetable-seeds

## Introduction and Physical Settings of Nepal

Geo-physical settings, agro-ecological comparative advantages and vegetable bio-diversities provides vivid prospects for vegetable seed production in Nepal. However, organizational anomalies, weak policies, strategies and programs are hindering to realize benefit from vegetable seed sector as the main challenges. Nepal is situated in the southern aLp of high Himalayas in Asia at South Asia region. The country is almost rectangular in shape and is enclosed between 26 $^0$22" to 30$^0$27" North latitude and 80 $^0$4" to 88$^0$12" East longitude.

Nepal is surrounded by India on three sides and China's Tibet Autonomous Region to the north. Nepal measures about 800 kilometres from east to west along its Himalayan axis and varies by 150 to 250 kilometres north south across. Nepal has an area of 147,181 square kilometres with the land area of 92.94 % and 7.06 % water areas and 30.91% is under cultivation. Nepal's land altitude varies from 60 m from sea level to 8848.86 m the top of the world, Mount Everest. Nepal has five physiographic regions from vegetable seed production point of view, which are briefly described in the subsequent subsections:

### 1. Himalayan region

This region lies along north east to west with 8848.86 m Mount Everest (Sagarmatha) including trans-Himalayan region with Alpine climate, often semi-arid valleys of Humla, Jumla, Dolpa, Mustang, Manang and Khumbu. The cultivable altitude ranges from 2500 m to 4500 m which resembles with Tibetan plateau with dry and cool valleys. The average daily temperature during winter (December /January) fluctuates between (minus) -9$^0$C to 10$^0$ C. Summer temperature varies from 10$^0$ to 21$^0$C which favour for specific temperate vegetable seed production.

This area provides special comparative advantage for seed production of vegetables like, cauliflower snowball groups, cabbage, carrot, broad leaf mustard (Marpha), radish (Tokinasi) and many other temperate vegetables for lower altitude areas of Nepal and export to India, Bangladesh and even to gulf countries.

## 2. High mountain region

The elevation ranging between 2000 to 2500 m is mostly the top of Mahabharata range. The average temperature during summer varies from 10-15 $^0$C and it goes beyond -0 $^0$C during winter and snow fall and snow cover is common. Seed production of low chiling varieties of cabbage, cauliflower, carrot, radish, broad leaf mustard, etc. can be grown to achieve self-sufficiency in many vegetable crops.

## 3. Middle mountain region

Hills are extended across east to west elevation ranging between 600 to 2000 meters. The summer temperature ranges between 20 $^0$ to 35 $^0$C with hot and warm weather. Winter temperature ranges between 0 $^0$ at higher altitude to 15 $^0$C at lower altitude and generally cool and warm. Seed production of majority of sub-tropical varieties of vegetables are possible. This region has the highest comparative advantage for domestic market and export oriented commercial vegetable seed production to other parts of Nepal and to export to neighbouring counties such as India and Bangladesh.

## 4. Siwalik region

Siwalik regions varies from 300-600m is a highland region between the Mahabharata and Chure mountain ranges in Nepal. The Siwalik hills extend in a narrow east-west belt, only 15–20 km in width, which marks the northern boundary of the plains of Terai and the southern boundary of middle-hill Mountains. Though day temperature resembles with Terai, however, night temperature is cooler than Tarai that favours for cultivation and seed production of vivid crops. Siwalik is the prime source of sediments for the plain of Terai. Torrents flowing down the steep gradients erode material from the fragile rock and transport it downstream. The streams slow down as they flow onto the plain, and in consequence they deposit their burden of silt, thereby filling or clogging the streambeds and raising their levels. This aggravates flooding problems is prominent in the plains. Siwalik is subject to severe erosion that creates gullies and promotes landslides. Line spacing is not uniform.

## 5. Terai, Inner terai and low river basins

The elevation of Terai, inner terai and low river basin areas varies from 60 to 600 meter. The elevation of terai plain varies from 60-300 meter and inner tarai and river basins and large tars, and plain lands varies between 300 to 600 meters. All these areas have high summer temperature ranging between 30$^0$ - 41$^0$C and winter average temperature ranging between 15$^0$ to 20$^0$C with minimum between 5$^0$ to 10$^0$C. Cold wave and foggy days make trembling cold in some parts of Terai sometimes during winter. These areas are suitable for seed production of vegetables such as tomato, eggplant, and sweet pepper, many cucurbitaceous vegetables such as cucumber, many other gourds, peas, beans okra etc.

Nepal has four distinct seasons (spring, rainy, autumn and winter), four aspects of High Mountain, Middle Mountain and Siwalik (East, West, North and South) providing at least 30 micro-climatic zones with agro biodiversity. Nepal receives monsoon rain during summer from Arabian Sea and Bay of Bengal and winter rain from Mediterranean Sea. There are three main production seasons like dry season (mid Feb. to mid-June): rainy season (mid-June to mid Oct): and winter season (mid Oct. to mid Feb). (Rohwerder, 2016.) Many rivers, rivulets, lakes, ponds and wetlands provides vast water management feasibility. In all these ecological zones varied ethnicity with different but coexisting groups of people live in national harmony with eco-cultural interdepended synergy and with ethnobotanical wisdom for food and livelihood. Almost all types of world climate are available in Nepal and a wide range of indigenous crops and livestock co-exist for foods and livelihood. This offers comparative advantages and opportunities to Nepal.

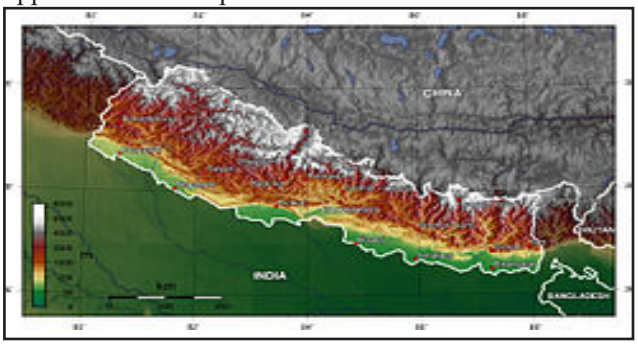



**Figure 1:** Physical map of Nepal

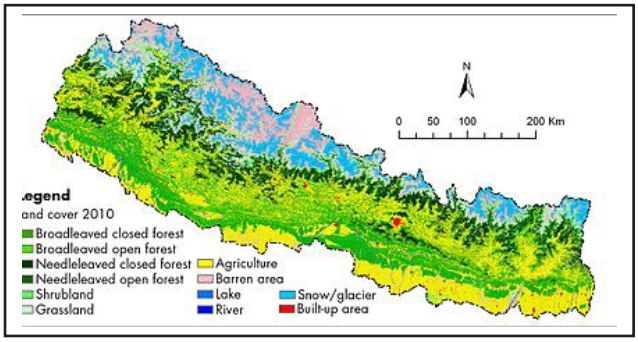



**Figure 2:** Physiographic settings (HMG/Nepal, 1983)

## Vegetable Biodiversity of Nepal

In Nepal a wide range of vegetable biodiversity exist with food plants of 172 families, 296 genera, 599 species and 35 sub-species. Out of 599 species of food plants 400 species belong to horticultural groups of which 200 species are vegetable crops (Regmi, PP 1982). Among 200 species of vegetables, around 50 species were in cultivation during eighties (Pandey, 1995). The recent listing of vegetable species in use have increased to 133 with 57 leafy, 14 stem, 36 fruit, 11 legumes and 15 root and tubers (Pandey I.R and Prahalad Thapa, 2017). The cultivation of these vegetables is omnipresent in different parts of Nepal in different seasons and agro-ecological zones. Many species are maintained and used by people as local land races and their seeds are locally selected, produced and preserved.

### 1. Vegetables dombbesticated from wild relatives

Nicoli Ivanovich Vavilov (1936) reported that out of eight Centers of plant origin, five centers are around Nepal and probably the crops may have also originated from Nepal.

| Center of Origin | Major species found (Examples only) |
|---|---|
| Chinese center of origin | *Brassica rapa, Cucumis sativus, Cucurbita moschata, Phaseolus vulgaris, Raphanus sativus, Solanum melongena* |
| Ind-Burmese center of origin | *Dioscorea alata, Lactuca sativa, Luffa acutangular, Momordica charantia, Solanum melongena, Trigonella foenum, Trichosanthus anguina* |
| Central Asian Center of origin | *Allium cepa, Allum sativum, Daucus carota, Coriandrum sativum, Pisum sativum, Raphanus sativus, Vicia faba ,* |
| Asia minor center | *Beta vulgaris, Pisum sativum, Cucurbita pepo,* |
| Mediterranean Center of origin | *Beta vulgaris, Brassica oleraea, var. capitata, Pisum sativum, Allium cepa, Allium sativum* |

### 2. Wild species of vegetable crops recorded in Nepal

36 species of 11 kinds of vegetables domesticated from wild relatives ( Colocasia 3 species, Amaranths 4 species, Chenopodium 2 species, Pisum 3 species, Allium 3 species, Ipomea 5 species, Dioscorea 4 species, Mentha 3 species, Trigonella 3 species, Solanum 2 species, Curcuma 5 species) Still there are 26 wild relatives of 9 families to be recorded and as per gene bank there are many mores.

### 3. The prospects of vegetable seed crops

The agro-climatic boons and vegetable biodiversity if combined and harnessed properly, seed production of vast number of vegetables are possible. High value and highly nutritious vegetables are the most favoured crops. Hence, vegetables are specific agricultural/horticultural commodities, and their promotion could significantly drive rural economic growth and to contribute to food and nutritional security. There is huge prospect of seed production and export of such crops on demand and quality basis to neighbouring counties and trade imbalance could be reduced to minimal. Seed as low volume and high value crops joint venture with foreign seed companies and export to abroad is also possible.

The agricultural sector and food security are important dimensions of Vedic economics. 'Krishi Mulashcha: Jeevanam' (agriculture is the root of life), “Uttam Kheti, Madhyam Byapar, Nicha Nokari (supreme farming, mediocre trade, lowly the civil service)", “Ghokanti Vidhya Dhawanti Kheti" (learning by memorizing, farming by tending) are popular proverbs that characterize the Vedic wisdoms of adorable agricultural and learning values. All the agriculture related activities and functions are described in Veda, under different Kanda, shukta Richa/Mantra and all the procedure from sowing to harvest with good seed in good field as, "सुबिजम् सुक्षेत्रेः जायते सम्पद्येतेः" (Good seed in good field yields abundance) such Vedic Richas are in Veda.

## Review of Vegetable Sector Development and Progress

### 1. Vegetables in ancient Nepal

Nepal has Arya-Mongol civilization with multi-culture and vivid ethnicities. The culture, civilization and history of Nepal has been influenced by its position in the aLp of Himalayas. Comfortable climate is bestowed by nature Nepal has been inhabited by Rishis and noble people since the beginning of civilization. During ancient time cow herders (Gopal Bansi) who came to Nepal valley (present Kathmandu) from the Ganges Plain of modern-day India and sheep herders from Tibet and inhabited in northern Nepal. It is now a multi-ethnic, multi-cultural, multi-religious and multi-lingual country and the people in common are Nepali. Gopal Bansi, Mahisapalaka, Lichchhavi, Kirats, Thakuris, Malla and Shaha ruled Nepal since ages (History of Nepal Wikipedia 2015). Nepal's physiographic

and agro-ecological setting, due to altitudinal variation and multi-sphere facings favours for different ethno-bio diversities. In the later part of the civilization in addition to native people the Indo-Aryans from south and Mongols from north also came to Nepal and settled in different altitudes suitable to their climatic requirements. Thus, whosoever came to this part of the earth also brought plant materials including vegetables. Thus, domestication and cultivation of different vegetables as integral part of civilization and agricultural system goes back to the Vedic era and continued to scatter in local states and royal units. Whatsoever local states and royal units existed, subsistence agriculture was the means of livelihood, and they preserved seeds of crop plants and vegetables.

The British Empire in India and unification of Nepal in 18th century by Prithvi Narayan Shah impacted on vegetable diversities in Nepal. Modernization of agriculture in India started during Mughal regime and it flourished during British regime, and it impacted in Nepal as well. Unofficial entrance of some seeds of vegetables to Nepal through pilgrimage and ex-army returnees from India and world wars also enriched vegetable diversities in Nepal. However, the recorded reports of some exotic vegetable introduction and cultivation in the manorial gardens of Rana (the then *de-facto* rulers of Nepal) could be traced back to mid-19th century when 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 during B.S 1907 (1850). Such vegetables were cultivated in Rana's gardens, however, with permission and grace of Ranas 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, 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, were cultivated for family use and for the sale in local markets of Kathmandu (Swastika Development Consultant, 1994) since long. Individual farmers saved seed by selection and continued vegetable diversities in ancient Nepal.

## 2. History of vegetable research and extension in Nepal

After Jung Bahadur Rana, Chandra Samsher (JBR)[1] contributed establishing Agricultural Council as the first government entity for agricultural development including vegetable in B.S 1978 (1921) Demonstration farm established in Singh durbar during B.S 1994 (1937). During 1997 (1940) agricultural farms/nurseries established in Tahachal and Balaju and testing of some exotic and indigenous vegetables started in these farms. Seeds of different vegetables such as tomatoes and cabbage were produced. At present Tahachal is used for some other purposes and Balaju Nursery converted to modern Park. Government opened vegetable seed store during 1998 (1942) in New Road near Taleju temple to sell seeds to general farmers. During B.S.2004 (1948) first agricultural farm outside Kathmandu valley in Parwanipur/ Bara was established where vegetable research for tropical region was one of the important initiatives.

Rana regime ended on February 1951 and new democratic era started in Nepal. The Agriculture Council established in 1937 was converted to the Department of Agriculture in B.S 2010 (1952) with Horticulture Section within it to look after the development of fruits, vegetables and flowers. During B.S 2010 (1952) 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 the same year the first Horticultural Farm was established in Kakani to study fruits, vegetables and flowers. United States Overseas Mission in 1952 and Mountaineering Troops from Japan in 1953 had been the two principle formal sources to import exotic vegetable varieties. Japanese Mountaineering Troop gifted some vegetable seeds of Radish, carrot, turnip etc. to the government and Radish White Neck was commercialized in and around Kakani areas of Nepal. During 2049 this strategic farm was handed over to another Ministry.

Nepal started planned development from B.S 2013 (1955/56) when the first five-year plan was implemented with high priority to agriculture for better and efficient use of resources. During first five-year plan period from 1952 to 1956, studies and trials conducted by horticultural section recommended some new vegetable varieties for general cultivation and seeds were made available to common people from seed store at Basantpur, New Road Kathmandu. During B.S 2010 (1952) Tribhuvan Gram Vikas was conceptualized and with the first five-year plan Tribhuvan Gram Vikas was implemented since B.S 2014 to 2017. During this period several horticulture farms were established in different ecological belts of Nepal. “Tribhuwan Gram Bikash (Tribhuwan Rural Development)" with block development approach and Block Development Officers (BDOs) and Gram Sewak and Gram Sevika (Village Development Workers) were posted in village level for rural awareness and community development. This was an integrated community development model including agriculture, health and sanitation, adult education, home science. This program introduced different vegetables in rural Nepal with people's participation. Youth clubs, 4-H clubs, cottage industries were the components of this program. During second five-year plan (1962/63-1964/65), government opened different agriculture/horticulture farms /stations in the different agro-ecological zones of Nepal.

During second 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). Near to these farms/stations, vegetable productions were demonstrated and extended. Mainly home gardening was emphasized which slowly developed to produce vegetable for the local markets and haat bazar. In Terai agriculture farms were established in Nepalgunj, Bhairahawa, Janakpur, and Terahara. In the hills horticultural farm/stations were established in Dhankuta, Kirtipur/Kathmandu, Trishuli/Nuwakot, Pokhara/Kaski and Bhagetada/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. The programs of horticulture in the farm/ stations were controlled by horticulture section of (DoA). All these farm centers were responsible for vegetable research, seed production and distributed through extension network and sale directly from farm gate. Farm/centers and DADOs promoted vegetable production for home consumption and local sale. From B.S 2018 to 2023 fruits, vegetable, flowers were under the horticulture section of the Department of Agriculture.

The Department of Agriculture was reorganized in B.S 2023 (1966/67) forming five 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 flower. 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 seeds were sold from Basantpur seed store as well. District Agriculture Development Offices (DADO) also purchased vegetable seed from horticulture farm stations and Basantapur Seed Store for demonstration in the farmer's field.

## 3. Planned growth of vegetable seed sector in Nepal

During B.S. 2023 to 2029 Department of Horticulture established several horticulture farm/stations with the following four major objectives:

- Collection, evaluation and selection from indigenous land races and exotic germplasm to develop vegetable varieties suitable to different agro-ecological zones and seasons.
- Generation of improved and appropriate production technology, plant protection and seed production techniques for developed new improved varieties
- Market oriented fresh vegetable production demonstration in accessible areas and;
- Seed production demonstration in the remote areas where fresh vegetable marketing was difficult.

During B.S 2029 (1972) five different departments were merged to one Department of Agriculture establishing four national programs e.g. (1) Fruit Development Section, (2) Vegetable Development Section, (3) National Citrus Development Program and (4) National Potato Development Program with establishment of additional farms e.g. Horticulture farm Panchkhal and Tropical Horticulture Farm Sarlahi, Nabalpur. To strengthen vegetable research and seed production Vegetable Research and Seed Production Center Khumaltar (2030/31), Vegetable Seed Production Center Rukum (2035/36) and Vegetable Seed Production Center Dadeldhura (2038/39) were established. To strengthen vegetable research and seed production program, eight major centers for vegetable research and farmer's field vegetable seed production zones were identified and adopted. Vegetable Seed Production Center Khumaltar, Horticulture Farm Sarlahi, Horticulture Farm Panchkhal, Agriculture Station Dhankuta, Horticulture Farm Mustang and Dolpa, Vegetable Seed Production Center Rukum and Dadeldhura were identified as the eight major centers for research and development. In addition, British aided Agriculture Center Lumle and Pakhribas were also added in the research and seed production. First Agriculture year was celebrated during B.S. 2032. From this year, farmers field contract seed production of major vegetable varieties was started under the technical guidance of these Farm/centers in Bhaktapur, Nuwakot, Sarlahi, Dhankuta, Tehrathum, Bhojpur, Mustang, Dolpa, Rukum /Salyan and Dadeldhura and in the target areas of Lumle and Pakhribas. Agriculture Input Corporation (AIC) was given the responsibility of vegetable seed marketing from B.S 2032. Seed buying contract used to be done by AIC and foundation/source seed supply and field supervision by VDD, designated farm centers seed testing labs and respective DADOs. The eight farm/centers recognized as centers of excellence for vegetable research, variety development, maintenance and breeders and foundation seed production are presented in Table 1.

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

| S.N. | Name of Center | Altitude (masl) | Micro-climate | Priority crops for research/seed production |
|---|---|---|---|---|
| 1 | Horticulture Farm Dhankuta | 1200-1400 | High rainfall, high humidity and warm winter | Radish, Mid-season cauliflower, Broad Leaf Mustard, Pea, Cress, Spinach etc., |
| 2 | Horticulture Farm Sarlahi | 200 | 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, warm spring through summer | Radish, Cauliflower, Broad Leaf Mustard, Beans, Swiss Chard, cress, spinach, turnip, tomato, eggplant, onion, Chili, Capsicum |
| 4 | Horticulture Farm Panchkhal | 865 | High rainfall, high humidity, hot summer, foggy winter | Bean, Rajma bean, Bitter gourd, Cucumber, Squash, Eggplant, Tomato |
| 5 | Horticulture Farm Mustang | 2522 | Low rainfall, snow in winter, low humidity, mild summer | Late cauliflower, Cabbage, Carrot, Broad leaf Mustard (Marpha), Late Radish |
| 6 | Horticulture Farm Dolpa | 2242 | Low rainfall, snow in winter, low humidity, mild summer | Late cauliflower, Cabbage, Carrot, Broad leaf Mustard (Marpha), Late Radish |
| 7 | Vegetable Seed Production center Rukum | 1440-1500 | Mild rainfall, high humidity, chilly winter, warm summer | Radish, Mid-Season Cauliflower, Broad Leaf Mustard, Beans, Cress, Spinach, Turnip, Tomato, Eggplant, Sweet pepper, Onion, Peas, Carrot, Squash |
| 8 | 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- Lumle Agricultural Center (LAC) and Pakhribas Agricultural Center (PAC) also were linked and coordinated for vegetable research, development and seed production.

From the beginning of sixth five-year plan (1980/81) onward different donors supported to gearing up the research and development in vegetable sector. These projects further strengthened the approach initiated by VDD during fifth five-year plan and continued till eighth five-year plan. Ten projects supported vegetable development, some of them worked with the government and some of them worked with other donor funded projects (Annex 1). In addition to the projects listed in annex 1, High Value Agriculture Project (HVAP), Improved Seed for Farmers Program (ISFP), Kishan ko Lagi Unnat Biu Bijan Karyakram (KUBK), Project for Agriculture Commercialization and Trade (PACT), National Agriculture Research and Development Fund (NARDF) and Raising Incomes of Small and Medium Farmers Project (RISMFP) implemented by government also supported in the field of vegetable seed production and marketing.

During B.S 2029 to 2048 the vegetable seed production was under the unified command of the Vegetable Development Division/Directorate (VDD). Quality supervision and seed production chain was maintained and seed balanced sheet used to be prepared by VDD in the coordination and collaboration with farm/centers. Seed field supervision was the joint function of VDD, Seed Quality Division (seed labs), District Agriculture Development Offices (DADO) and Agriculture Inputs Corporation (AIC) to maintain distinctness, uniformity and stability of the varieties in seed production. Vegetable seed production was heading towards self-sufficiency and vegetable seed export was also propelling.

## 4. Seed production crops and varieties identified at different districts

Vegetable seed production is long term enterprise compared to fresh vegetable production. Many vegetables are consumed during juvenile phase and have shorter production period. On the contrary, all the vegetable seed production has longer period and have to pass from juvenile to reproductive phase. Climate is the main decision-making factor for seed production. The climates of Terai, Inner Terai, river basin areas and foothills are suitable for the seed production of tropical and sub-tropical vegetable like cucurbits, okra, chili, tomato, eggplant and many

legumes. Mid-hills are suitable to produce mid- season cauliflowers, radish, peas, beans, spinach, cress, onion, etc. Higher mountain has temperate climate and is suitable to produce high chiling varieties of cruciferous crops, carrot, beet root, etc. Many kinds of vegetable seed can be grown in different parts of the country in different seasons adjusting the sowing and flowering time. There are some vegetables which need both vernalization and long day condition for flowering and maturity.

In addition to climate, accessibility and marketing possibility of fresh vegetable also affects seed production of vegetable crops. Since the beginning, two principals have been adopted (a) accessible areas for fresh vegetable and (b) remote areas for vegetable seed production. Once the seed production areas become accessible it must push further to remote areas. Therefore, though niche districts are there for vegetable seed production, however, seed production pockets are pushed further to remote villages of the district. For sustainability, production should be concentrated to the area where climate is suitable at the same time it should be profitable compared to foregone crops like cereals. Therefore, suitable districts for important commercial vegetable seed production have been identified during past as ongoing and potential seed production districts for future expansion shown in the table 2 and mapped in figure 3 to 5.

With the long experience of vegetable seed production, the districts have been developed as commercial sites for specific crops and varieties for seed production. The specific niche pockets for niche commodities within the districts are always pushing towards remote villages. The niche districts and potential for vegetable seed production districts are presented in Table 2.

**Table 2:** Ongoing and potential niche production districts and niche commodities

| S.N. | Crops | Ongoing niche districts | Potential new districts |
|---|---|---|---|
| 1 | Cauliflower (Snowball Group), Carrot, Radish (Tokinasi), Rayo (Marpha), Beet Root, Brussels's Sprout | Jumla, Dolpa, Mustang | Humla, Kalikot, Mugu, Baglung |
| 2 | Onion (Baitadi Local) | Baitadi | Darchula |
| 3 | Onion (Red Creole and Agri-found Dark Red) | Rukum. Surkhet, Salyan, Dailekh, Palpa | Gulmi, Arghakhanchi |
| 4 | Radish (Mino Early and White Neck) | Dadeldhura, Rukum, Salyan, Surkhet, Dailekh, Bhojpur | Doti, Achham, Terhathum |
| 5 | Radish (Chalis Dine) | Parbat, Surkhet, | Sunsari, Dang, Terai |
| 6 | Cauliflower Kathmandu Local, Jyapu | Rukum, Kavre, | Dolakha, Khotang Sindhupalchowk |
| 7 | Pea, Beans, Broad Beans | Rukum, Salyan, Dailekh, Surkhet, Kavre, Rolpa | Lalitpur, All Terai districts |
| 8 | Cucumber, Bitter Gourd, Bottle Gourd | Parbat, Surkhet, Kavre | Myagdi, Palpa, Gulmi |
| 9 | Tomato (Srijana, ALpsi Gede, CL 1131, Any registered variety | Dolakha, Kavre, Lalitpur | Parbat, Myagdi and low Hill and Terai |
| 10 | Okra, Eggplant, Chili, Sweet Pepper | Surkhet, Sarlahi, Parbat, Kavre, Rukum | Chitwan All Terai districts |
| 11 | Cress, Spinach | Dadeldhura, Baitadi, Kavre, Lalitpur | Nuwakot, Ramechhap, Khotang, Kathmandu valley |

**Note:** Based on the need and the districts and pockets should be added in the above table. Some ongoing and potential districts are presented in figure 3 to figure 5.

| |
|---|
| (**A) High chiling long-day vegetables**: Cauliflower (Snow Ball Groups), Carrot, Radish (Tokinasi), Beet Root, Rayo (Marpha Chauda Pat) |
| **Ongoing districts:** Jumla, Dolpa, Mustang,<br>**Potential districts:** Kalikot, Humla, Mugu, Baglung |


**Figure 3:** Temperate region districts and prioritized vegetables

**(B) Warm temperate vegetables:** Mid-season cauliflower, Beans, Peas, Radish (Mino Early, White Neck, Chalis Dine), Onion (Red Creole, Agri-found Dark Red, Baitadi Loca Rayo Khumal Chauda Pat, Khumal Rato Pat, Manakamana, Tomato (Srijana, Monoprecos, ALpsigede).

**Ongoing districts:** Baitadi, Dadeldhura, Rukum, Dailekh, Salyan, Surkhet, Parbat, Kavre, Palpa, Rolpa, Syangja, Kaski

**Potential districts:** Darchula, Doti, Achham, Gulmi, Sindhupalchowk, Lalitpur, Ramechhap,


**Figure 4:** Warm temperate region districts and prioritized vegetables

**(C) Sub tropical vegetables:** Cucumber, Bitter gourd, Bottle Gourd, Tomato (Srijana, ALpsi Gede), Okra, Cress, Spinach

**Ongoing districts:** Parbat, Surkhet, Kavre, Dolakha, Lalitpur, Dadeldhura, Sarlahi,

**Potential districts:** Myagdi, Nuwakot, Nabalparasi, Sunsari


**Figure 5:** Sub-tropical region districts and prioritized vegetables

**Notes:** Pradesh 1= Koshi Pradesh, Pradesh 2= Madhesh Pradesh, Pradesh 3= Bagmati Pradesh, Pradesh 4= Gandaki Pradesh, Pradesh 5= Lumbini Pradesh, Pradesh 6= Karnali Pradesh and Pradesh 7 = Sudurpaschim Pradesh

### 5. Vegetable seed export to Bangladesh

Since B.S 2042 (1985) AIC and some reputed companies started vegetable seed export to Bangladesh. The seeds of Radish Mino Early, Onion Red Creole, Cauliflower Dolpa Snowball, Carrot Nantes Forto produced in Rukum, Rolpa, Mustang, Salyan and Bhaktapur were exported to Bangladesh and India through both formal and informal channels. Seed quality used to be monitored by VDD, DADO and concerned farm/centers as per the standards prescribed by Seed Quality Control Division and seed lab. Specific horticultural farm/centers were designated for specific vegetable variety maintenance, breeder's and foundation seed production and provide source seed to seed producing farmers of their command areas. Quality supervision was done by a joint team of farm /center, horticulturist or agronomist of DADO and representative of AIC. Thus, the seed system was functional. Tri patriate seed buying contractual agreement used to be signed among concerned farm/center, DADO and seed buying agencies e.g. AIC/Private seed companies. The demand of Nepali seed was increasing in Bangladesh, however, after B.S 2050 (1994) organizational set up for seed production and quality supervision mechanism was distorted. Rather maintaining quality and increasing production the exporting agencies/traders started exporting low quality seeds to meet the increased demand in Bangladesh. Bangladesh stopped importing Nepali seed questioning its quality and price and seed business to foreign countries stopped.

### 6. Complexity of vegetable sector

Vegetable sector must address a large number of species and cultivars to develop varieties adaptable to different agro-ecology, seasons, aspects and altitude. The complexity of the sector may be summarized as follows:

- To develop a new variety, materials collected from indigenous species, land races, distinct mutant clones, germplasms collected from National and International institutes and organization, farmer's varieties, materials from released/registered varieties are to be collected evaluated, selected and go through long process of breeding producers.
- In most vegetables culinary parts are leaves, stems, growing tips, roots, flowers and young fruit. To evaluate the yield and quality of these culinary parts a set of research are required
- For seed production, flowering and seed setting requires vernalization and photoperiodism specific agro-environment and micro-climates for seed production research
- The breeding behaviour of vegetables from highly self-pollinated to highly cross-pollinated make complex and crucial to sustain the system maintaining continuity in varietal development, seed production and marketing with Distinctness, Uniformity and Stability.
- Some vegetables are asexually propagated and needs large quantity of planting materials
- To maintain released/registered variety with distinctness, uniformity and stability and to produce different stages of seed (Breeder's seed, foundation seed and improved/commercial seed) is a herculean task of developing new OP varieties and parental lines for hybrid variety development.

Because of the above complexity to develop new varieties, develop parental lines to produce hybrid seeds, many farm centers for isolation and large number of qualified human resource, their dedication and government commitment is required. Unless bureaucrats, technocrats and top political leaders understand this complexity and are committed and determined the self-sufficiency and export of vegetable seeds are day dreams and will not be realized

## Vegetable seed sector challenges

There have been organizational changes in horticulture including vegetable sector since its establishment. Several organizational changes and readjustments took place from B.S 1998 (1942) till today, B.S 2081(2024). The organizational changes and their effect could be summarized as follows:

### 1. Amalgamation of department of horticulture

During (B.S 2023 to 2029) the Department of Horticulture was in existence and established a number of horticulture stations in remote hills. During 2029 this Department was amalgamated to a single Department of Agriculture. This amalgamation did not affect much as four strong units as (1) Fruit Development Section, (2) Vegetable Development Section, (3) National Citrus Development Program and National Potato Development Program and establishment of some additional farm/centers. The Regional Agriculture Directorate (RAD) was also established and administrative and financial control of horticulture stations was delegated to RAD. However, RAD was not sufficiently empowered and remained as CC office (बोधार्थालय) and farm/centres were practically under central management and intact with national system and vegetable and vegetable seed development program ran smoothly.

After 10 years of these arrangements, during 2039 the then Minister of Agriculture Mr. Dev Narayan Yadav realized the slow progress of the horticulture sector and formed an eleven-member committee to expedite the horticulture development under the chairpersonship of Mr. Keshab Bahadur Rajbhandari. The committee reviewed the causes of slow progress and recommended the establishment of a separate Department of Horticulture. However, it did not materialize but some impetus was given to the vegetable sector with project support. During 2047 the interim government of PM Krishna Prasad Bhattarai, Minister of Agriculture and Forestry Mr. Jhala Nath Khanal and Finance Minister Dr. Devendra Raj Pandey established Department of Horticulture and District Horticulture Development Offices in 30 districts. It was a good initiation however, just after one year when new elected government was formed the Department of Horticulture was demolished without proper analysis and concrete reasons. However, during 2040 to 2048 with the support from vegetable seed and fresh vegetable project under the unified command of VDD and other service divisions of the Department of Agriculture, vegetable research, seed production and development was at its apex and was tagged as the golden era of vegetable sector.

## 2. Establishment of Nepal Agricultural Research Council

To give impetus in agricultural research, a separate autonomous organization "Nepal Agricultural Research Council (NARC)" was established in B.S.2048 (2090/91) and new organizational structures were adopted. It would have been better to make NARC as research and development policy making and grant allocating autonomous body. However, NARC was erected as research implementing organization. Though it could have been put under the Secretary of Agriculture, unfortunately it was put under the agriculture minister and NARC system became politically influenced.

While creating NARC the horticultural farm/centers were divided between NARC and DoA and it was a technical blunder. The division of farm/centers distorted vegetable research and variety maintenance program. Most of the specialized vegetables potato and spice crop research and development farms/stations were kept under DoA and senior horticulture/vegetable experts also remained with DoA. To exemplify Central Vegetable Research and Seed Production Center Khumaltar, Tropical Horticulture Center/Sarlahi, Horticulture Farm/Mustang, Vegetable Seed Production Center Rukum and Vegetable Seed Production Center Dadeldhura, Potato Research Farm Nigale, Cardamom Development Farm Ilam etc. were kept under DoA with no research mandate. The National Citrus Development Program and the National Potato Development Program was split between NARC and DoA.

## 3. Farm/Centers handed over to other ministries and occupied by security

After 1990, many horticultural farm/centers were given to other Ministries, Private sector and Hospitals (Yagyanpuri Farm Chitwan, Horticulture Farm Kakani, Horticulture Farm Rasuwa and Horticulture Farm Helambu). Some farms are completely or partially occupied by security units during Mao Badi insurgency by Army and Armed Police and not yet returned to the MoALD.

## 4. Farm/Censers under province

Again, during structural readjustment of government organization after the formation of province some farms from DoA were kept under Provincial Agriculture Directorate. The Farm/Centers under province are also underutilized with limited responsibility of seed, seedling and sapling production without research and variety maintenance mandate. As the result a setback took place in vegetable research and variety maintenance and seed production chain distorted.

## 5. Downsize of District Agriculture Development Office (DADO)

During structural adjustment District Agriculture Development Office (DADO) and Agriculture Service Centers (ASC) were downsized. In place of DADO, Agriculture Knowledge centers (AKC) were set up with reduced and limited human resources. However, one AKC has to deliver services covering two districts. As envisaged the local governments (Metropolitans, Sub-metropolitans and Municipalities) are not provided with sufficient and trained agriculture/horticulture/ livestock technicians and specialist. The testing and demonstrations of developed technology and technical service delivery to the farmers are very weak and ineffective. Whatever research outputs are developed by NARC are not extensively demonstrated and know how is delivered to the farmers for commercialization.

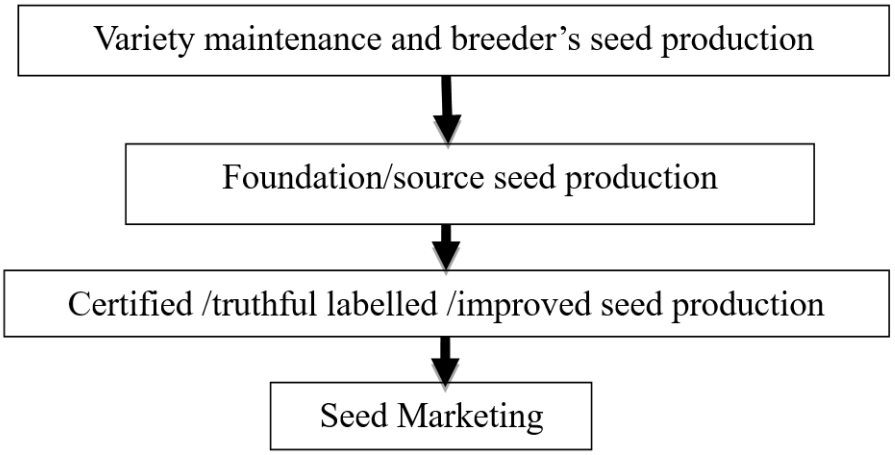
## 6. Challenges of variety maintenance

The main challenges in variety maintenance appeared when farm/centers were divided among DoA, NARC and provincial directorate and some farms were handed over to other Ministries and organization and occupied by security units. The total 40 vegetable varieties released and registered also not properly maintained because of budgetary and mandatory constraint in DoA/NCPVSCD and Provincial Agriculture Directorate. National Horticulture Research Center (NHRC)/NARC have limited farm/centers and limited human resource.

Variety development, release and registration has no meaning, if not maintained, produced breeder's and foundation seeds and linked to commercial seed production and marketed to fresh vegetable producers. Variety maintenance in designated and appropriate farm/center and breeder' and foundation seed production and its storage and distribution through a coordinating organization is very important for successful vegetable seed production program. During eighties, a common variety maintenance chart was developed denoting farm/centers and varieties to be maintained and procedures to produce breeders and foundation seed in 18 farm/centers (Annex 2). This maintenance scheme implementation was under the command of the then VDD. To facilitate the maintenance of these varieties the variety released year and main distinguishing characters of released varieties were prepared and published as presented in Annex 3. However, such arrangements are not implemented as present and released /registered varieties are at the verge of extinguished. At later stage, with changed context, SQCC has denoted organizations responsible for maintaining crop varieties as presented in Annex 4. This Annex 4 chart is incomplete and suggests only five crop varieties to be maintained such as Tomato, Radish, Rayo, Onion, Pea and Cauliflower Kathmandu Local. Analysis revealed that officially released Nepali vegetable varieties are 40 only and imported registered varieties are 333 (VDD annual Report 2072/73). The detailed list of released and registered varieties is given in Annex 5.

## 7. Challenges to maintain seed production chain

A sustainable seed production chain consists of four sequential stages: (1) Variety maintenance and breeder's seed production, (2) Foundation/source seed production, (3) Certified /truthful labelled seed production and (4) Marketing of seed with proper bagging and tagging. Responsibility for stage 1 rests with the breeders who are independent professionals or organization. In stage 2, farm/centers and licence holder private companies and producer's organizations such as cooperatives are authorized to produce foundation or source seeds using the nucleus or breeder's seed from authorized agencies (DoA and NHRC/NARC). For stage 3, which is very critical to sustain the seed system, trained farmers of community seed producer groups/cooperatives are the main players. Stage 4 is seed marketing with proper seed handling by business companies. The scientific seed production chain are as follows:




Seed production chain from variety development its maintenance, breeders and foundation seed production and commercial seed production for good quality seed is of prime importance. VDD adopted the system and procedures to maintain seed chain. Each farm/center was made responsible to produce quality breeders and foundation seed production linking to the farmer's field commercial seed production. This chain is very weak rather broken during recent years.

## 8. Challenges to maintain seed value chain

Variety development, release, registration and maintenance and linking of these results to organized seed production and marketing are the key components of the vegetable seed value chain. Many forms of value chains are operational, however, there is a challenge to establish the appropriate one. Sustainability of the seed value chain is still questioned as key issues. The key issues related to sustainable seed value chains are: (i) inadequate linkage and trust between producers and traders, (ii) marketing of loose seeds by producers without lot number, proper packaging and labelling, (iii) lack of formal seed production and market information channel, (iv) inadequate quality assurance service to producers and traders, (v) inadequate number of seed marketing cooperatives or organizations at local level, (vi) prohibitive cost of seed production for export, (vii) inadequate enabling policy environment, (viii) inconsistency in the supply of source seeds, and (ix) poor capacity of private sector for domestic on-farm quality seed production

and coming into the mainstream of national seed system. Private sector seed production is often undertaken on contractual basis involving individual farmers, and chances of breach of the contract are very high by both parties which distorts the value chain.

## 9. Challenges and Gaps in Demand and Supply

Fresh vegetables produced in the accessible areas have readily available markets. It gives 3-5 times higher income compared to the cereal crops within a short period of time. Farmers are demanding the varieties that are high yielding, short durational and suitable to different agro-ecological environment and season. Farmer's attraction towards hybrid varieties with guaranteed quality increased because hybrid seeds make the best use of resources, produce high yield and maintain uniform quality of the produce. Such hybrid varieties are not developed in Nepal in highly demanded crops like cauliflower, cabbage, cucurbits and solanaceous crops (except one Var. Srijana and two pipeline varieties in tomato).

The available OP varieties of Nepali seeds also have poor quality, lack farmers of trust, irregular supply. The old varieties in many crops neither selected properly nor replaced by new varieties. Even the seeds of highly self-pollinated crops like peas and beans which can easily be produced in Nepal are also imported and sold in the name of hybrids (sometimes). The reasons for demand and supply gaps may be summarized as follow:

- Development of vegetable hybrid varieties are slow in Nepal because of inadequate vegetable breeders and well-organized hybrid seed development programs
- Dedicated farm/centers divided among NARC, DoA and Province and these farm/centers have functional anomalies due to prohibitive mandate, insufficiency in budget and human resources.
- Limited-Service providers and limited qualified technicians in the seed production areas for supervision for quality assurance and quality checking
- Due to quality deterioration of Nepali seed, import of foreign seed is increasing and farmers are attracted more towards hybrid and imported OP seeds
- The government bureaucracy and political leadership is disconsolate and indolent/passive to rectify the situation.
- Private seed companies are more interested in importing and marketing foreign seed due to better profit margin.

## 10. Slow progress of National Seed Vision 2013-2025

Government of Nepal has launched National Seed Vision 2013-2025. It has set specific targets to be achieved in hybrid variety development by 2025 as follows:

- Thirty hybrid vegetable variety developed of which 20 by public and 10 by private sector
- Seed replacement rate to reach 90 % by 2025 from 65 % during 2013 by improved seed

National Seed Vision set targets to develop 30 hybrids. However, it has not identified the crops for hybridization in vegetable crops. The target crops for public sector and private sector are not specified. The slow progress of National Seed Vision is due to this unclarity, and low priority given by government. The budget and human resource management is not sufficient in government sector vis a vis to coordination and collaboration with the private sector. The progress of Seed Vision is slow as the government is not providing adequate budget and human resources and appropriate support and collaboration with private sector. The import of huge quantity of hybrids and OP varieties the Nepali varieties are endangered and are at the verge of extinguishment.

## 11. Challenges to continue past achievements

More than 10 different projects supported vegetable seed sectors in the past (Annex 1). Most of these projects worked as infrastructural projects (building, road and bridge) in project mode. Agricultural projects should work in program mode. Farmers need continuous advice, support and service delivery in agricultural process. Till the donor funding is there, all technical and financial support is provided to the producer farmers and market actors. Linkage of the program with government's regular program and national grid lacked in most projects. After projects phaseout, the achievements made during the project periods decline. For the continuation of the donor supported efforts it should have been functionally collaborated with the line agencies of government program since inception of the project which lacked in most projects due to project design and direct financial arrangements. During the project period government line agencies are dealt as guest artists and after project phaseout vegetable seed producer

cooperatives/groups and private companies face the financial and technical service delivery problems for organizing production and marketing workshops and the preparation of sustainable business model and its implementation. As a result, production, marketing and quality assurance of the vegetable seed production slowly decreased or in some areas it is completely stopped after seed project phaseout. In the market seed demand is increasing, however seed production of Nepali varieties is decreasing after project phaseout.

### 12. Challenges of quality assurance and import substitution

There are many small-holder farmers in seed production system. The assemblage of such individual farmers produced seeds without strong internal quality control system, seed lots are mixed with both good and bad quality seeds. Thus, Nepali seeds are losing quality assurance and quality confidence. The reasons being:

- Low volume of production and mixed quality standards
- Collection of seed by many middlemen and poachers,
- Poor post-harvest handling and no dry chain followed in the seed supply chain
- Dis-honour of marketing buy-back guarantee by both producers and traders
- Frequent market price fluctuation and contract breach
- Inadequate coordination among concerned line ministries for seed production and export.
- Strong competition with imported vegetable seeds with domestic products.
- Absence of quality certification procedures for export (Quality Standards, Phytosanitary Certification and Quarantine Order Agreeable to importing countries)
- Low investment in vegetable seed research, post-harvest management, including storage and dry chain transportation facilities for vegetable seed (As make it dry and keep it dry)
- Inefficient and ineffective extension and quality maintenance service delivery
- Inadequate supply of quality source seeds and planting materials.

The above reasons impede smooth and regular seed production all over the existing and potential seed production districts. The trend of seed import is increasing year after year. The major reasons being increased demand and less supply of domestic seed. Seeds of 36 different vegetables were imported during 2016 as reported by SEAN 2017 (Annex 5). Import of seed of non-registered vegetable variety was found two third (74.67%) through porous border of India as compared to registered vegetable varieties (25.33%). Therefore, there is ample space prospects of producing seeds of open pollinated vegetable varieties with proper labelling and packaging to decrease seed import in future as two third of import is occupied by open pollinated varieties. Protecting Nepali vegetable varieties and developing Nepali hybrids are the key issues to achieve self-sufficiency in vegetable seed.

## Conclusion and Recommendation

Nepal has high prospect and comparative advantages to produce different kinds of vegetable seed, however, the domestic production is not meeting the increased demand of vegetable seed. Almost 50 percent of vegetable seeds in the market are coming from other countries. Farmers are looking for high yielding, high quality vegetable seeds mostly the hybrids. Even the OP variety seeds like peas and beans which has great potentiality of seed production in Nepal are also imported. To achieve modernization of the whole agricultural system reformation and transformation of the present organizational structure and positive attitude of politicians and bureaucrats and their commitments are expected. Instead of blaming Nepali seed importing counties, Nepal first must improve its vegetable seed qualities, maintain standards and seed chain to promote export to reduce the gaps in trade balance and attain self-sufficiency.

Agriculture Perspective Plan (APP), Agriculture Development Strategy (ADS) and have identified fresh vegetable and vegetable seed as priority outputs. High quality seed is the prime technology input for the growth of vegetable sub-sector.

Considering the fact of rapid replacement of Nepali varieties by imported OP and hybrids, research need has crucially emerged for developing new OP varieties and parental lines for hybrid variety development. Popularity of imported hybrids cannot be ruled out in the context of open global economy and the requirements of off-season vegetables. However, this should not be at the cost of Nepali varieties and local species which possess the immense potential of farmer's acceptance and sustaining the seed system and resilient to climate change effect.

Nepal has Himalaya like challenges and herculean tasks to improve and sustain vegetable seed industry. The

physiography, altitudes, aspects and seasons provide comparative advantages and agro biodiversity. The vast number of vegetable species, varieties, land races, and indigenous vegetables are the basis of prospects. Selection, adaptation and development of vegetable crops made so far are the progress made in crop maintenance and seed production are the wealth of nation

Nepal's geographical position, physical setting, varying altitude, aspects provide agro-environment and comparative advantages. Large number of vegetable bio-diversities. However, organizational anomalies and farm/canter's mis management, distorted seed production and value chain, could not meet the demand of seed for different agro-ecology and seasons. Imported OPs and hybrids are rapidly replacing the Nepali varieties and land races.

To rectify the organizational anomalies and convert challenges into opportunities and to improve the functioning of farm/centers, reformation/readjustment of present organizational structure is required. Therefore, the following actions are recommended:

- Form a strong Research, Education and Extension Reformation Committee (REERC) at apex level under the chairpersonship of Secretary MoALD, represented by Director General DoA, Executive Director NARC, Chief SQCC, Dean UAF, Dean IAAS/TU, Chairperson SEAN, and Chief / NCPVSCD as Member Secretary.
- REERC and MoALD should formulate organizational readjustment, research, extension and education collaborative system, farms/center management policy/guideline to avoid structural anomalies and streamline vegetable and vegetable seed research and development as one of the priority programs for seed import substitution, attain self- sufficiency and promote export of Nepali vegetable seed
- All farm/centers should be kept under the command of central government with full mandate of research, variety maintenance and different stages of seed production
- Farm/centers are the face of MoALD and should demonstrate modern technology and should be developed as the ***show case and Center of Excellence***
- In all 753 local government units, specifically trained agriculture, horticulture technicians and subject matter specialist in Agriculture Knowledge Center in each district should be posted
- Increase investment in vegetable seed research, post-harvest management, including storage and dry chain transportation facilities for vegetable seed (As make it dry and keep it dry).

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**Annex 1:** Summary of Donor Support in Vegetable and Vegetable Seed Sector with Major Contribution and Achievements

| S.N. | Name of Project | Donor | Project year | Main achievements |
|---|---|---|---|---|
| 1 | Fresh vegetable and vegetable seed production project | Swiss Assistance through FAO as technical cooperation | 1981-1995 | During these 15 years 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:<br>• Supported VDD for variety development evaluating 350 new germplasm and improving already popular 25 varieties and total 72 varieties identified<br>• Based on the mode of pollination and breeding behavior of identified vegetable variety maintenance chart (Annex 2) was developed denoting farm/centers and varieties to be maintained and produce breeders and foundation seed<br>• To ease the variety maintenance work, varietal (morphological) characteristics of identified varieties with their marked genetic trait of the identified documented for the use and reference (Annex 3).<br>• VDD/FAO facilitated to establish Seed Entrepreneur's Association Nepal (SEAN) 1989 and registered in 1991 with 32 members which now spread all over Nepal and seed dealing entrepreneurs are more than 2000.<br>• Supported AIC and strategic government farms to establish seed processing and air-conditioned seed storage facilities |
| 2 | Japan International Cooperation Agency | Japan | 1983-1987 | Introduced protected cultivation of tomato and sweet pepper in half opened plastic tunnel in Khumaltar and proven success |
| 3 | Regional Vegetable Research project | RAS/89/4 | 1987-1988 | Contributed in germplasm exchange among Asian countries like China, Korea, Thailand and SAARC countries during |
| 4 | South Asia Vegetable Network (SAVERNET) | Taiwan | 1991-1993 | Introduced different varieties of vegetables for adaptive test, however the conclusive results could not be reached due to administrative anomalies among researchers. |
| 5 | Vegetable, Fruits and Cash Crops Development Project, (VFC/Rapti) | USAID | 1984-1990 | 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. |
| 6 | Koshi Hills Seed and Vegetable Project (KOSEVEG) | DFID | 1992-1997 | Aimed to develop an effective, sustainable and market-oriented seed and vegetable program for increasing household income. The social mobilization process of the project was notably a successful and it supported in forming KOSEPAN and linked the seed growers with national and regional seed traders for sustainability |

| S.N. | Name of Project | Donor | Project year | Main achievements |
|---|---|---|---|---|
| 7 | Community Based Economic Development Project (CBED) | CIDA | 1997-2002 | 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. |
| 8 | Market Access for Rural Development (MARD) | USAID | 1997-2002 | MARD Project supported farmers groups and cooperatives for vegetable seed production and marketing in Surkhet, Dailekh and Nuwakot districts. Due to poor linkage with GoN line agencies the impact could not last long. |
| 9 | Seed Sector Support Project (SSSP) | DFID | 1998-2003 | As 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/cooperatives 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 equipment and laboratory establishment of SEAN Seed Service Center (SSSC), Thankot a well-equipped company owned by more than 50 SEAN members. |
| 10 | Participatory Vegetable Seed Project (PVSP) | DANIDA | 2001-2003 | Vegetable seed production project implemented by NGO – Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED) in six districts of Nepal including both hill and Terai district. |
| 11 | Vegetable Seed Project (VSP) | SDC | 2004-2014 | Implemented by CEAPRED, to benefit poor farmers in remote areas by diversifying their income opportunities through vegetable seed production and marketing.<br>Synergistic approach of combining seed production in the remote districts and fresh vegetable in road corridors focusing poor, women and disadvantaged households<br>Institutionalizing farmers groups into seed cooperatives and linking them with entrepreneurs through Pre-contract Marketing Agreement<br>Seed Producers' Central Co-operative Federation Ltd registered as umbrella organization of primary seed cooperatives that facilitates for demand-based production and nationwide marketing of seeds linking with seed entrepreneurs of all over Nepal |

**Annex 2:** Released Vegetable Varieties and Their Distinguishing Characters

| S.N. | Crops and varieties | Released year | Distinguishing Characters |
|---|---|---|---|
| 1 | Cauliflower | | |
| | Sarlahi Dipali | 1994 | Plants are medium tall of erect habit, green and waxy leaves having rounded apex. Curd is somewhat round, white to creamy white, compact, medium sized weighing 600-700g. Average yield is 15 t/ha. |

| S.N. | Crops and varieties | Released year | Distinguishing Characters |
|---|---|---|---|
| | Dolpa Snowball | 1994 | Late variety maturing in 130 days after transplanting, curd round, white, smooth, weight 1.5-2 kg. Suitable for autumn transplanting and spring harvest. A selection from Snowball-16. |
| | Kathmandu Local | 1994 | A well-adapted mid-season variety maturing in 110-120 days after transplanting. Wide adaptability to the different conditions. Excellent white to creamy white, flattish compact curd, fine grained, semi-self-protected by outer leaves. Curd weight 1.5-2 kg. |
| | Khumal Jyapu | 2014 | Matures 65-80 days after transplanting and have around 1 kg size with better taste, developed by Horticulture Research Division, Khumaltar. |
| 2 | Radish | | |
| | Chalis Dine | 1994 | Variety early, maturing 35-45 days. Roots white 15-25 cm long, pungency very low. Leaves are upright, erect, light green, non-hairy, sweet and shining white. |
| | Pyuthane Rato | 1994 | Late season variety, maturity 70-80 days after sowing, root red with white flash, 20-30 cm long, thick tapering. Red neck with light red or whitish red root end. |
| | White Neck | 1994 | Maturity 60-65 days. Roots 35 cm long, 6-8 cm diameter, cylindrical, pure white and smooth. Flesh white, mild pungency. Leaves upright, light green in color, top green. Yield 30-40 t/ha. |
| | Mino Early | 1990 | Early variety, maturity 45-50 days. Roots pure white, tapering rooted, have tendency to grow above ground level. Pungency mild. Leaf grayish green having deep cuts with spreading habit. Yield 30-40 t/ha. |
| 3 | Rayo | | |
| | Tangkhuwa Rayo | 1994 | Light green leaf with cream white leaf vein, very smooth and wavy leaf margin. |
| | Khumal Rato Pat | 1994 | Late variety, matures for first harvest in 60-70 days after transplanting; leaves are green with purple-red pigments, puckered, non-hairy, petioles curved and leaves are also curved to a cup-shape, fleshy, 25-30 cm long and 20-25 cm wide, bolts later than Khumal and Marpha broad leaf; yields 25-30 t/ha green leaves. |
| | Khumal Chaudapat | 1994 | Mature for first harvest in 40-50 days after transplanting and continues for another 100-120 days, leaves dark green, fleshy, non-hairy and puckered, 40-50 cm long and 25-30 cm wide, yield 30-40 t/ha green leaves. |
| | Marpha Chaudapat | 1994 | Mature for first harvest in 55-65 days after transplanting; leaves light green, non-hairy, puckered, 40-50 cm long and 20-30 cm wide with flat petioles; late bolter; yield 25-30 t/ha green leaves. |
| 4 | Turnip | | |
| | Purple Top | 1994 | Leaves dark green with deep cuts, roots globe shaped white with purple exposed crown. Flesh white, maturity 60-70 days after sowing. Plants top erect. Suitable for autumn plantation. |
| | Kathmandu Rato | 2015 | Early variety, root matures in 50-55 days of sowing. Root globe to flattish, outer color red, flesh white, strong flavor. |

| S.N. | Crops and varieties | Released year | Distinguishing Characters |
|---|---|---|---|
| 5 | Onion | | |
| | Red Creole | 1990 | Deep red skinned thick flat bulb, white flash, medium late variety, bulb matures in 160-180 days after transplanting. Bulb weight about 175 g. |
| 6 | Tomato | | |
| | Srijana (Registered) | 2010 | Hybrid variety developed by NARC, bacterial wilt resistant, fruit ovate and 60-80 g weight, uniform and red and heavy yielder, indeterminate variety. |
| | Roma | 1994 | Mid-season variety; fruits ready for first harvest in 60-70 days after transplanting. Fruits smooth, uniformed fleshy thick, bi-chambered, less seed content, leaves broader, potato type, plant determinate and bushy. |
| | Monprecos | 1995 | Medium early variety, fruit ready for first harvest in 80- 90 days after transplanting, fruits globe shaped, smooth, uniformly red, bi-tri-chambered, firm flash seed content low, plant vigorous, indeterminate, erect. |
| | NCL-1 | 1990 | Heat resistant and wilt tolerant variety, fruits ready for first harvest in 65-75 days after transplanting, fruits plum shaped to flattish round, firm, thick skinned, yellowish red with a slight green shoulder when ripe, suitable for rainy season and autumn season harvest. Plant semi-determinate to indeterminate depending upon climate. A selection from CL-1131 cultivar. |
| | Pusa Ruby | 1990 | Fruits ripe in 60-65 days after transplanting fruits flattish round, uniform red, smooth surface, seed content comparatively higher, determinate growth habit. |
| 6 | Carrot | | |
| | Nantes Forte | 1990 | Very high-quality roots. Suitable for autumn and spring plantation. Excellent internal and external color. Roots 15-20 cm long, cylindrical blunt tipped. Matures in 90-100 days after sowing. |
| | New Kuroda OP (Registered) | 2010 | Well adapted variety for tropical and sub-tropical conditions. Roots 15-20 cm long with conical flat shoulder, tapering towards the root end. Bright orange colored surface with few deep eyes. Matures in 80-100 days after sowing. |
| 7. | Cabbage | | |
| | Copenhagen Market | 1994 | Mid-season variety; mature 70-90 days after transplanting, head round, blue green, 1.5-2.5 kg, good for school garden. |
| 8. | Cowpea | | |
| | Sarlahi Tane | 1994 | A bit early variety. Pods ready for first harvest in 50-60 days after sowing. Plants climbing, pods 25-30 cm long, light greenish white, seed black when ripe. |
| | Khumal Tane | 1994 | Climbing long podded type, pods 30-45 cm long white to greenish white, seeds red when ripe. Needs warm climate for successful results. Yields 6-8 fresh pods t/ha. |
| 9 | Pole bean | | |

| S.N. | Crops and varieties | Released year | Distinguishing Characters |
|---|---|---|---|
| | Trishuli Simi-1 | 1994 | Popular climbing type pods 20-25 cm long. Green fleshy, long curved ('S' shaped), fibreless at prime picking period. Seeds light to coffee brown with purple eye ring. Yield 6-8 t/ha. Suitable for autumn and spring through summer harvest. |
| | Jhange Simi-1 | 1994 | Bush type variety; resistant to common bean mosaic. Maturity 50 days after sowing. Pods dark green and 15 cm long. Yield 5-6 t/ha. |
| 10 | Peas | | |
| | Sarlahi Arkel | 1994 | Early variety, ready for first picking in 60-65 days after sowing; pods deep green 7-8 cm long, well filled with 7-8 grains seeds wrinkled on drying; yields 5-7 t/ha green pods . Suitable for late autumn sowing and early spring harvest. |
| | New Line Perfection | 1994 | Mid to late season variety, flowers in 60-65 days of sowing, pods are ready for first picking in 85-90 days of sowing; plant medium tall and vigorous in growth; leaves are dark green and broader; flower borne in double; pods straight green, 7-8 cm long, well filled with 6-7 grains seeds wrinkled on drying. Suitable for autumn plantation. |
| | Sikkime | 1994 | Late variety, flowers in 80-85 days and pods ready for first picking in 105-110 days after sowing; plants are tall and vigorous; leaves are light green with very wide leaf lets; pods light green, well filled, short with 6-7 grain; seeds are bold, creamy whitish with black helium, smooth on drying, suitable for rainy season in high hills. A selection form Sikkim Local variety. |
| 11 | Capsicum | | |
| | Californe | 1994 | Fruits ready for first harvest in 80-90 days after transplanting; plants 70-75 cm tall, erect somewhat busy; leaves single entire broader than normal chili, dark green with pointed tip, fruits are 3 to 4 lobed generally. Yields 25-30 t/ha. |
| 12 | Chili | | |
| | Jwala | 1994 | A high yielding variety with long slender fruits, brilliant red when ripe. Selection of Pusa Jwala variety. Slightly earlier than other commercial varieties. |
| 13 | Brinjal | | |
| | Nurki | 1999 | Plant medium, stem and leaves pinkish in color, Thorne less leaves and stem but thrones in fruit petiole. Fruit 15-25 cm long, soft, 4-5 fruits in a bunch. Maturity 60-70 days. |
| 14 | Sponge gourd | | |
| | Kantipure | 1994 | |
| 15 | Cucumber | | |
| | Kushle | 1994 | Early variety, fruits ready for first harvest in 75-80 days after sowing. Fruits straight 15-25 cm long with 6-10 cm diameter; fruit light green with whiter towards distal end |
| 16 | Squash | | |

| S.N. | Crops and varieties | Released year | Distinguishing Characters |
|---|---|---|---|
| | Ashare Squash | 1994 | Fruits are medium sized; flesh is tender and delicious at immature stage when it is used as vegetables. Duration 60-80 days. Yield 20-35 t/ha. |
| 17 | Swiss chard | | |
| | Susaag | 1994 | Duration 60-70 days. Yield 20-35 t/ha. |
| 18 | Bitter gourd | | |
| | Hariyo Karela | 1994 | Fruits are dark green, Duration 90-100 days. Yield 20-25 t/ha. |
| 19 | Lady's finger | | |
| | Parbati | 1994 | An early heavy yielding variety, more tolerable to yellow vein mosaic virus. Plant medium tall. Fruits fleshly, medium green in color. Well, adapted for spring, summer and rainy season harvest. A selection of Parvani Kranti variety. |
| 20 | Spinach | | |
| | Haripate | 1994 | Plants ready for harvest in 50-60 days after sowing, leaves erect, smooth, vigorous, and green to dark green, petioles and lower base pinkish. Suitable for autumn and spring sowing. |

**Annex 3:** Crop and Variety-Wise Maintenance Chart at Various Farms and Stations Developed During Sixth Five-Year Plan

| S.N. | Farm/Station and Crop | Variety |
|---|---|---|
| **1** | **VSPC Dadeldhura** | |
| | Knol Khol | White Vienna |
| | Radish | Mino early |
| | Turnip | Improved White |
| | Broad leaf mustard | Khumal Red Leaf |
| | Tomato | Monprecos |
| | Peas | NLP, |
| | French bean | Contender, Kentucky Wonder, |
| | Cucumber | Local, |
| **2** | **VSPC Rukum** | |
| | Cauliflower | Kathmandu Local |
| | Radish | Mino early |
| | Turnip | Purple Top White Globe |
| | Broad leaf mustard | Khumal Broad Leaf |
| | Cress | Local |
| | Onion | Red Creole |
| | Sweet pepper | California Wonder |
| | Tomato | Pusa Ruby |
| | Peas | Arkel |
| | French bean | Contender |
| | Squash | Black Zucchini |
| **3** | **H. Farm Pokhara** | |
| | Radish | Mino Early |
| | Okra | Pusa Selection I |

| S.N. | Farm/Station and Crop | Variety |
|---|---|---|
| | Sponge gourd | Pusa Chillo |
| **4** | **H. Farm Marpha** | |
| | Cauliflower | Snow Ball |
| | Radish | Tokinasi |
| | Turnip | Purple Top White Globe |
| | Broad leaf mustard | Marpha Broad Leaf |
| | Peas | Arkle |
| | Bean | Carlos's favorite |
| | Cress | Local |
| | Cabbage | Large Late Drum Head, Copen Hagen Market, Pride of India |
| | Carrot | Nantes Forte |
| | Swiss Chard | Ford Hook Giant |
| | French bean | Kentucky Wonder |
| **5** | **AS Lumle** | |
| | Knol Khol | White Vienna |
| | Cauliflower | Kathmandu Local |
| | Radish | Pyuthane Red, 40-days |
| | Spinach | Patane |
| | Peas | Arkle, Sikkime |
| | Coriander | Local |
| | Fenugreek | Kasuri |
| | Eggplant | PPL |
| | Squash | Grey Zucchini |
| | Cucumber | Bhaktapur Local, |
| **6** | **VSPC Khumaltar** | |
| | Cauliflower | Kathmandu Local |
| | Radish | Mino Early |
| | Turnip | Purple Top White Globe |
| | Broad Leaf Mustard | Khumal Broad Leaf |
| | Peas | New Line Perfection, Sikkime |
| | French beans | Kentucky Wonder |
| | Tomato | Monprecos, |
| | Okra | Pusa Sawani |
| | Spinach | Patane |
| | Squash | Grey Zucchini |
| | Cress | Local |
| | Broad bean | Local |
| | Chili | Dandicut and Kathmandu Local |
| | Swiss Chard | Ford Hook Giant |
| | Fenugreek | Kasuri |
| | Cowpea (Asparagus bean) | Khumal Tane (Red seed) |
| | Cucumber | Bhaktapur Local, |
| **7** | **H. Farm Sarlahi** | |
| | Peas | Arkle, Boonville, NLP, |

| S.N. | Farm/Station and Crop | Variety |
|---|---|---|
| | Tomato | Pusa Ruby, Roma, CL 1131, Pusa Early Dwarf |
| | Okra | Pusa sawani, Parwani Kranti |
| | Sweet pepper | California Wonder |
| | Beet spinach | All green |
| | Cucumber | Poinsett |
| | Eggplant | Nurki, Sarlahi Green |
| | Watermelon | Sugar-baby |
| | Cauliflower | Pusa Deepali |
| | Radish | Pusa chetki |
| | Fenugreek | Kasuri |
| | Chili | Pusa Jwala |
| | Eggplant | Nurki, PPL, Sarlahi Green |
| | Cowpea | Sarlahi Black |
| | Pumpkin | Local |
| | Bitter gourd | Pusa Domousami, |
| | Bottle gourd | Pusa Summer Prolific Long |
| | Sponge gourd | Pusa Chillo |
| | Ash gourd | Local |
| **8** | **Agriculture Station Dhankuta** | |
| | Cauliflower | Kibo Giant |
| | Radish | White Neck |
| | Broad leaf mustard | Khumal Broad Leaf |
| | Peas | New Line Perfection |
| | Beans | Contender |
| | Tomato | Monprecos |
| | Capsicum | California Wonder |
| | Onion | Red Creole |
| | Turnip | Purple Top White Globe |
| | Cress | Local |
| | French bean | Kentucky Wonder |
| **9** | **AS Pakhribas** | |
| | Broccoli | Green Sprouting |
| | Cauliflower | Kathmandu Local |
| | Radish | Mino Early, 40-days |
| | Broad leaf mustard | Khumal Broad Leaf, Tangkhuwa |
| | Cress | Local |
| | Table beet | Detroit Dark Red |
| | Chili | Akabare |
| | Sweet pepper | California Wonder |
| | Peas | Boonville, Sikkime |
| | French bean | Kentucky Wonder |
| | Cowpea | Kathmandu Red |
| | Bitter gourd | Coimbatore Long |
| | Squash | Black Zucchini |
| | Sponge gourd | Local |

| S.N. | Farm/Station and Crop | Variety |
|---|---|---|
| **10** | **H. Farm Panchkhal** | |
| | Eggplant | Pusa Kranti |
| | Cucumber | Kusume, Bhaktapur Local |
| | Bitter gourd | White Long |
| | Bean | Four Seasons |
| **11** | **H.S. Parawanipur** | |
| | Peas | Arkle |
| | Pumpkin | Local |
| | Tomato | Marglobe |
| | Eggplant | Sarlahi Green |
| | Bottle gourd | Pusa Summer Prolific Long |
| **12** | **Agriculture station Jumla** | |
| | Cabbage | Golden Acre |
| **13** | **Agriculture station Dolpa** | |
| | Cauliflower | Snow Ball 16 |
| | Carrot | New Kuroda |
| | Broad leaf mustard | Marpha Broad Leaf |
| **14** | **H. Farm Janakpur** | |
| | Radish | Chetki |
| | Peas | New Line Perfection |
| | Okra | Pusa Selection I |
| | Chili | Cyanne |
| | Eggplant | Pusa Kranti |
| **15** | **Ag. Farm Palpa** | |
| | Cauliflower | Early Snow Ball |
| | Radish | Pyuthane |
| | Onion | Nasik Red |
| **16** | **Ag Station Nepalgunj** | |
| | Tomato | Money Maker |
| | Eggplant | Pusa Purple Cluster |
| **17** | **H. Farm Dailekh** | |
| | Broad Leaf Mustard | Marpha Broad Leaf |
| | Onion | Agri-found Dark Red |
| **18** | **H. Farm Sindhuli** | |
| | Chili | Yatsufusa |
| | Eggplant | Pusa Purple Round |

**Annex 4:** Organizations Responsible for Maintaining Crop Varieties in Nepal as Proposed By SQCC

| Crop | Variety | Variety maintenance organisation |
|---|---|---|
| Tomato | Sirijana hybrid | Horticulture Research Division, Khumal, NARC |
| Tomato | Pusa Ruby | Sarlahi Horticultural Farm (DoA) |
| Tomato | NCL | Horticulture Research Station, Malepatan, NARC |
| Radish | Mino Early | Agriculture Research Station Dailkeh, NARC |
| Radish | Pyuthane Red | Horticulture Farm (DoA), Palpa |
| Radish | 40 days | Regional Agriculture Research Station Lumle |
| Radish | Tokinashi | Horticulture Research Station, Jumla (NARC) |

| | | |
|---|---|---|
| Rayo | Marpha Broad Leaf | Horticultural Farm Mustang (DoA) |
| Rayo | Khumal Red Leaf | Vegetable Seed Production Center, Dadeldhura |
| Rayo | Khumal Broad Lead | Horticulture Research Division, Khumal, NARC |
| Onion | Red Creole | Agriculture Research Station Dailkeh, NARC |
| Pea | Sarlahi Arkel | Regional Agriculture Research Station Nepalgunj (NARC) |
| Pea | Sikkime | Regional Agriculture Research Station Lumle |
| Cauliflower | Kathmandu Local | Horticulture Research Division, Khumal, NARC |

**Annex 5:** Number Of Released and Registered Vegetable Varieties

| S.N. | Crops | No. of Released Nepali varieties | No. of Registered imported varieties | Total |
|---|---|---|---|---|
| 1 | Cauliflower | 4 | 46 | 50 |
| 2 | Radish | 4 | 14 | 18 |
| 3 | Turnip | 2 | 1 | 3 |
| 4 | Broad Leaf Mustard | 4 | 4 | 8 |
| 5 | Onion | 2 | 6 | 8 |
| 6 | Tomato | 4 | 29 | 33 |
| 7 | Carrot | 1 | 5 | 6 |
| 8 | Cabbage | 1 | 31 | 32 |
| 9 | Asparagus bean | 2 | 4 | 6 |
| 10 | French bean | 2 | 1 | 3 |
| 11 | Peas | 3 | 0 | 3 |
| 12 | Sweet pepper | 1 | 2 | 3 |
| 13 | Hot pepper | 1 | 15 | 16 |
| 14 | Eggplant | 1 | 7 | 8 |
| 15 | Sponge gourd | 1 | 7 | 8 |
| 16 | Cucumber | 2 | 36 | 38 |
| 17 | Squash | 1 | 11 | 12 |
| 18 | Swiss Chard | 1 | 0 | 1 |
| 19 | Bitter gourd | 1 | 20 | 21 |
| 20 | Okra | 1 | 2 | 3 |
| 21 | Spinach | 1 | 3 | 4 |
| 22 | Broccoli | 0 | 11 | 11 |
| 23 | Water Melon | 0 | 3 | 3 |
| 24 | Pumpkin | 0 | 3 | 3 |
| 25 | Bottle gourd | 0 | 5 | 5 |
| 26 | Ridge gourd | 0 | 3 | 3 |
| 27 | Coriander | 0 | 5 | 5 |
| 28 | Asparagus | 0 | 1 | 1 |
| 29 | Parsley | 0 | 3 | 3 |
| 30 | Knol-khol | 0 | 2 | 2 |
| 31 | Pakchoi | 0 | 4 | 4 |
| 32 | Lettuce | 0 | 4 | 4 |
| 33 | Sugar beet | 0 | 1 | 1 |
| 34 | Chinese cabbage | 0 | 4 | 4 |
| | **Total** | **40** | **293** | **333** |

**Source:** Annual Report of VDD 2072/73 page 128-142