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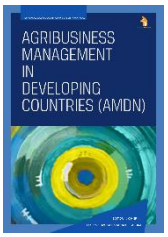

RESEARCH ARTICLE

HISTORY, PRESENT STATUS, SCOPE AND CONSTRAINTS OF VEGETABLE SEED PRODUCTION IN NEPAL

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ABSTRACT

Vegetable seed production plays a vital role in Nepal's agricultural sector by supporting food security, economic development, and environmental sustainability. Despite having suitable agro-climatic conditions, the seed sector continues to encounter major constraints such as inadequate availability of quality seeds, insufficient regulatory mechanisms, and low levels of investment in research and development (R&D). The structured development of Nepal's seed sector began in the 1960s with government-led initiatives, followed by policy reforms and greater private-sector involvement. However, domestic seed production remains inadequate to fulfill national demand, leading to a continued reliance on imports and informal seed sources. The National Seed Vision (2013–2025) was introduced to improve seed production, enhance quality control, and promote hybrid seed development, yet progress has been limited, with only a few hybrid vegetable varieties introduced. Additionally, fragmented production, inadequate genetic resource management, and weak market integration pose significant barriers to growth. Given Nepal's diverse agro-climatic regions and the increasing demand for quality seeds, enhancing seed production through infrastructure improvements, policy interventions, and private-sector engagement is crucial. Strengthening seed value chains, investing in research, and reinforcing regulatory frameworks will be essential for the sustainable growth of the seed sector and reducing dependency on imports.

KEYWORDS

Vegetable seed production, seed policy, hybrid seed development, agro-climatic suitability, seed sector sustainability.

1. INTRODUCTION

Seeds are fundamental to agriculture, playing a crucial role in food security, economic growth, and environmental sustainability. They serve as the foundation for crop production, ensuring genetic diversity and resilience within agricultural systems. According to the International Maize and Wheat Improvement Center (CIMMYT), using improved seed varieties can boost crop yields by up to 30% (CIMMYT, 2016). The Food and Agriculture Organization (FAO) reports that advancements in agronomy, the use of phyto-sanitary products, and plant breeding have collectively contributed to about 50% of the global rise in crop yields over the past 50 years (FAO, 2011). However, many developing countries, including Nepal, face significant obstacles in their seed sectors. These include limited access to high-quality seeds, weak seed regulation, and insufficient investment in seed research and development (R&D) (FAO, 2011). Developing the seed sector is critical for enhancing agricultural productivity and addressing the needs of a growing population. A sustainable and effective seed system is necessary to supply new varieties, multiply, market, and ensure small farmers have timely access to high-quality seeds at affordable prices (Adhikari, 2019). Vegetable seed production in Nepal began in the 1960s when the government started promoting improved seed varieties to increase crop yields. Over the years, various private seed companies emerged, and government-run seed production and distribution programs were expanded (Poudel et al., 2019). Despite these efforts, challenges such as lack of investment, limited access to new technologies, and poor infrastructure persisted. Recently, there has been renewed attention on developing Nepal's vegetable seed sector, with both the government and private sector collaborating to improve seed production and distribution, as well as encourage farmers to use high-quality seeds (Pradhan, 2019; Poudel et al., 2020; Aryal et al., 2022). However, Nepal still struggles to meet the domestic demand for quality vegetable seeds

2. HISTORY OF VEGETABLE SEED SECTOR DEVELOPMENT IN NEPAL

The formalized production and distribution of seeds in Nepal began in the late 1950s and early 1960s with the introduction of improved crop varieties. Initially, government farms and research stations were primarily responsible for seed production, and distribution was handled through agricultural extension services. In 1974, the establishment of the Agriculture Inputs Corporation (AIC) marked a significant development, as it took on the role of procuring and marketing a limited supply of seeds to farmers.

The seed sector saw further advancements in the early 1970s when the Food and Agriculture Organization (FAO) set up a high-capacity facility for seed drying, processing, and packaging in Hetauda for the AIC.In the 1980s, development partners such as FAO, the German Technical Cooperation (GTZ), and the United States Agency for International Development (USAID) contributed to expanding seed processing and storage infrastructure. This included establishing facilities at five AIC regional centers in the Terai region and 20 mini seed houses in the mid-hill areas. Until 1990, the public sector maintained a leading role in the production and supply of agricultural seeds in Nepal. A timeline outlining the development of the seed sector in Nepal is summarized in Table 1.

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Table 1: Timeline of Vegetable seed sector development in Nepal (SQCC, 2013)

Year	Formal seed sector key events
1962	Establishment of seed testing laboratory under Agronomy Division, Khumaltar
1964	Designated membership of Central Seed Laboratory with International Seed Testing Association (ISTA)
1966	Seed testing laboratory moved to Agriculture Botany Division to work closely with breeders as the division deals with the major crop commodity units identified
1974	Agriculture Input Corporation (AIC) was established under Corporation Act 1965
1975	Contract vegetable seed production at farmers level
1980	Seed Production and Input Storage Project (SPISP) funded by USAID
1981	Vegetable Seed Production Project (FAO) financed by the government of Switzerland
1982	Seed Technology and Improvement Programme (STIP) initiated
1983	First National Seed Seminar conducted
1984	Central Seed Science and Technology Division established
1988	Seed Act enacted
1990	Second Seed Seminar organized
1991	Establishment of Seed Entrepreneurs Association of Nepal (SEAN)
1993	Koshi Hills Seed and Vegetable Project (KOSEVEG), funded DFID
1997	Seed regulations enacted
1998	Seed Sector Support Project (SSSP) funded by DFID
1999	National Seed Policy approved
2000	Establishment of SEAN Seed Service Centre Limited (SSSC)
2001	Third seed seminar organized
2001	Seed Quality Control Centre established
2002	National Seed Company Limited established
2004	Vegetable Seed Project initiated with SDC funding
2008	Fourth Seed Seminar organized the first amendment of the Seed Act, 1988.
2010	Seed Science & Technology Division has been reactivated as a central disciplinary unit for seed research within NARC
2011	Accreditation of CSTL by International Seed Testing Association (ISTA) Promulgation
2013	Promulgation of Seed Regulation - 2013

3. Seed Policy and Legislation

The development of Nepal's seed sector began with the enactment of the Seed Act in 1988. Since then, numerous policies, laws, and guidelines have been created and updated to facilitate the sector's growth. A significant transformation in seed policy occurred during the Ninth Development Plan (1997–2002) with the adoption of liberal economic policies. During this period, key initiatives included the formulation of the Seed Policy (1999), Seed Regulation (1997), Community-Based Seed Production Guideline (1998), and the introduction of District-level Seed Self-Sufficiency Programme (DISSPRO) guidelines in 1998. Additionally, the National Seed Company (NSC) Ltd. was established to enhance seed production and distribution.

The Agriculture Perspective Plan (1995–2015) and National Agriculture Policy (2004) significantly influenced the evolution of Nepal's seed system, encouraging the involvement of multiple stakeholders in seed production, supply, and agricultural development. In 2008, the Seed Act (1988) was amended to facilitate private sector participation in the seed industry and strengthen quality assurance mechanisms. Subsequently, the Seed Regulation (1997) was revised in 2013 to align with the amended Seed Act, the Seed Policy (1999), and the National Seed Vision (2013–2025).The National Seed Vision (2013–2025) serves as a strategic framework for seed sector development, aiming to enhance crop productivity, ensure household food security, and improve the livelihoods of smallholder farmers. Revisions to the Agricultural Development Strategy (ADS) and the Agrobiodiversity Policy (2007) have further

supported the sector by emphasizing the conservation and utilization of indigenous genetic resources and strengthening community seed banks to ensure local seed security.

Table 2: Seed policies, legislation, regulation and guidelines addressing seed sector growth (Gauchan, 2019)

Policy	Date	Objective and Focus area
Seed Act, First Amendment	1988 (2008)	Provide legal framework for quality seed production, supply and quality assurance to increase crop productivity and income of farmers
Seed Production Guidelines	1998	Develop and implement guidelines and provide technical support for seed production, processing, storage, and distribution, including the management and facilitation of seed subsidy programs
National Seed Policy	1999	Policy framework for production and supply of high-quality seeds with increased support for participation of farmers and other private sectors
Community Seed Bank Guidelines	2009	Provide support and guidance for the establishment and management of seed banks at the community levels
Seed Regulation	2013	Provides rules for release and registration of crop varieties and production and marketing of seeds with defined quality assurance services
National Seed Vision	2013-2025	A long-term seed sector strategy with the provision of improving availability and quality of seed through increased production and supply as well as conservation of indigenous genetic resources

4. Present Status of Vegetable Seed Production In Nepal

4.1 Area under fresh vegetable production

Seed production is closely linked to the expansion of land allocated for fresh vegetable cultivation. Over the past decade, both the area under cultivation and the productivity of fresh vegetables have shown an upward trend (Fig. 1). This indicates a continuous rise in demand for vegetable seeds each year. However, data from the past two years reveal a decline in the supply of seeds from formal domestic sources (Fig. 2).

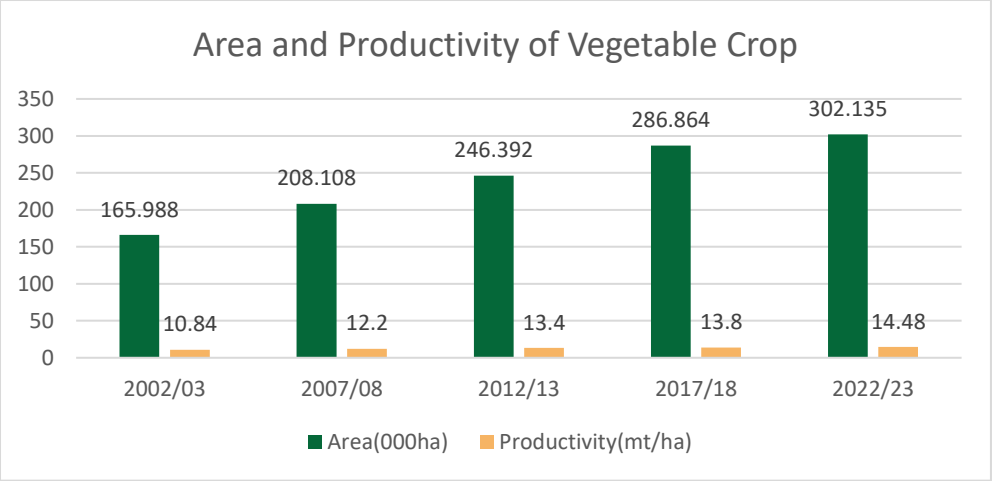

Figure 1: Area and productivity of vegetable crops during the last 20 years at 5 year interval (MoALD, 2013); (MoALD, 2024)

4.2 Vegetable seed production status

The domestic production of improved seeds in the previous year totaled 478 metric tons (Fig. 2) (Poudel et al., 2020). Over the past decade, the data reveals a downward trend in domestic seed production, particularly over the last two years. The detached seed supply chain under the new federal administrative structure has posed challenges to the timely and accurate collection and updating of information on seed availability.

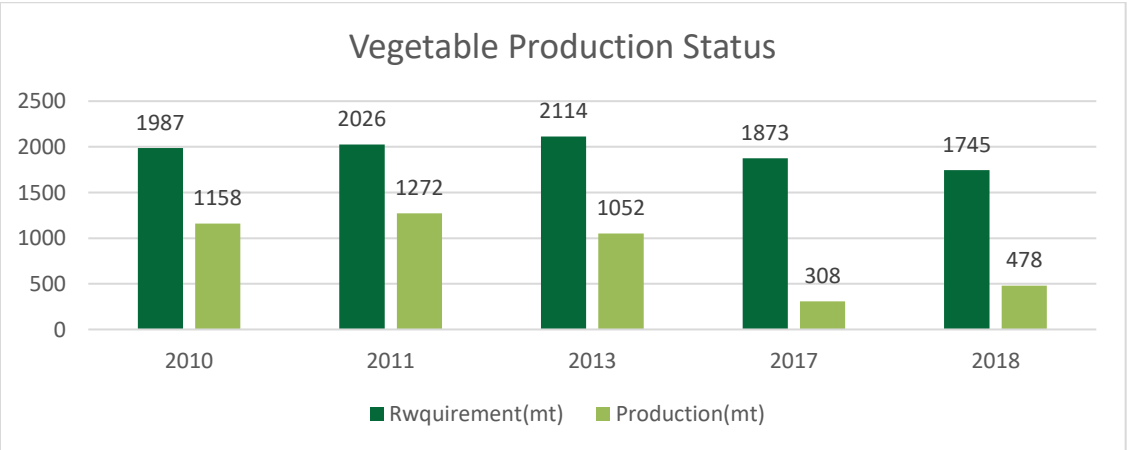

Figure 2: Vegetable seed production status Source: (Poudel et al., 2020)

4.3 Hybrid seed production

The Seed Vision outlined a goal for the public and private sectors to develop 30 hybrid crop varieties by 2025. By now, the projection anticipated the development of 22 varieties. However, progress has been limited, with only three tomato hybrids-Srijana, Khumal Tomato Hybrid 2, and Khumal Tomato Hybrid 3- developed to date (Gotame et al., 2021;Tiwari et al., 2023).

4.4 Variety release and registration

To date, only 39 open-pollinated (OP) varieties have been released, but seed Vision's target of 70 varieties. In total, 95 OP and 254 exotic hybrid varieties have been registered and notified (SQCC, 2024). These varieties are widely utilized in the major commercial production areas, with tomatoes, cabbages, cucumbers, cauliflowers, and sweet peppers being the most commonly cultivated hybrid crops. However, the release and screening of OP varieties within the country is not in progress after the termination of fresh vegetable and seed production project. Vegetable research has significantly lagged in advancing variety development and improvement. Instead, the observed progress highlights a greater focus on hybrid variety registration and notification, driven largely by private sector interests rather than public initiatives.

4.5 Seed production farms and their roles

Since the 1960s, several horticultural research and production farms and stations have been established across diverse agro-ecological zones. These facilities were designed to conduct basic research, carry out adaptive trials, maintain crop varieties, and produce breeder and foundation seeds. Their mandate included crop and variety selection, screening, recommendation, seed production, and the supply of source seeds within their designated areas.

A recent review of Nepal's public sector vegetable seed production system by NCPVS revealed that currently, only 14 farms and centers are actively managing variety maintenance and source seed production. Presently, 44 varieties from 26 crops are being maintained for foundation seed production, while only 16 varieties from 8 crops are involved in the breeder and foundation seed production chain (NCPVS website). This detached production chain disrupts the flow of improved seed production, highlighting a critical gap in continuity between breeder and foundation seed processes.

Each farm and center under the Department of Agriculture is tasked with maintaining crop varieties, producing breeder and foundation seeds, and conducting adaptive research. Breeder seed production, maintenance, and basic research responsibilities are specifically assigned to NARC, with its farms and stations expected to operate based on the agro-ecological suitability of Nepal's regions. SQCC is responsible to ensure the quality of seeds produced.

5. Scope of Vegetable Seed Production In Nepal

5.1 Agro-climatic Conditions

Nepal boasts a diverse range of agro-ecological zones, from tropical climates to the temperate regions of the inner Himalayas and the alpine cool climates. This diversity creates numerous niche areas, including plains, foothills, valleys, and the Terai region, which are highly suitable for vegetable seed production. These regions not only have the potential to meet domestic seed demand but also to export high-quality seeds to countries such as India, Bangladesh, Pakistan, Sri Lanka, and others (HVAP, 2011).

The high-hill regions, including Karnali and Mustang, are ideal for temperate vegetable crops like carrots, cabbages, Swiss chard, radishes, and cauliflowers. Mid-hill areas are well-suited for growing radishes, onions, beans, peas, cucumbers, tomatoes, and gourds. The Terai region, on the other hand, is favorable for cultivating eggplants, cucurbitaceous crops, okra, and certain tropical radish varieties. The hill regions of Nepal, which account for 55% of the country's total land area and 38% of its cultivable land, are particularly well-suited for vegetable seed production (Aryal et al., 2022). With its varied agro-climatic conditions, Nepal has significant potential to produce a broad range of vegetable seeds (Timsina and Shivakoti, 2018).

5.2 Increasing demand of vegetable seed

Nepal faces a significant gap between the domestic demand for vegetable seeds and the supply from formal sources. In 2017/18, the estimated seed demand was approximately 1,745 metric tons, while domestic production accounted for only 478 metric tons, meeting just 27% of the demand (Poudel et al., 2019; Poudel et al., 2020). This figure indicates a heavy reliance on both imported seeds and informal sources, such as seeds saved by farmers. In 2019, Nepal imported approximately 44.78 metric tons of seeds, including hybrids, valued at NPR 546 million (Poudel et al., 2020). Seed vision 2013-25 has emphasized to increase export by 5% and substitute the import by 20%. Therefore, Nepal holds considerable potential for vegetable seed production, offering opportunities to enhance exports while reducing dependence on imported seeds.

5.3 Huge production possibility

The National Center for Potato, Vegetable, and Spice Crops Development (NCPVS) has projected that, considering the potential production areas, the rise of emerging seed entrepreneurs, and the growing capacity of quality control mechanisms, Nepal's vegetable seed production could reach around 981 metric tons, valued at approximately NRs 4 billion. This forecast suggests that it is possible to nearly double the current internal production of 478 metric tons.

5.4 Cheap labor availability

Despite a decline in male labor availability due to high levels of migration abroad, the remaining male labor force is relatively inexpensive compared to other off-farm employment opportunities. Vegetable seed farming, being labor-intensive, relies heavily on skilled female labor, especially for post-harvest seed handling tasks. Encouragingly, over 60% of female farmers are currently involved in the seed business (KUBK, Annual Progress Report, 2018). This presents a strong opportunity to harness the available human resources for vegetable seed production initiatives.

5.5 Economic sustainability

Vegetable seed production has the potential to enhance agricultural productivity and food security in a sustainable manner while offering farmers higher income opportunities compared to conventional food crops. According to a study by (CEAPRE (2015), vegetable seeds can generate income that is 3 to 5 times higher than that from alternative cereal crops (CEAPRED, 2015).

5.6 Involvement of private sector

Seed processing, storage and seed testing facilities are developed at private sector. SEAN, CEAPRED, LIBIRD, FORWARD etc. conduct various programmes for supporting the seed sector.

6. Constraints of Vegetable Seed Production In Nepal

Vegetable seed production plays a crucial role in ensuring food and nutritional security for the population. With growing public awareness, the demand for fresh vegetables continues to rise. A significant challenge in Nepal's vegetable seed sector is the timely availability of quality seeds for efficient crop production. While the private sector now controls more than 90% of the seed business, its capacity in areas such as quality control, processing, testing, and safe marketing remains insufficient. Reviews have highlighted several key bottlenecks affecting the vegetable seed sector in Nepal, including:

6.1 Huge gap in the demand and production of vegetable seeds

There is a significant gap between the demand for formal seed supply and domestic production. In the fiscal year 2017/18, only 478 metric tons of the 1,745 metric tons of required seed were produced domestically, with an additional 44 metric tons sourced from abroad. This highlights that approximately 70% of the seed supply is obtained from informal sources. In this scenario, saved seeds from farmers play a prominent role, and there are also instances of illegal seed imports from India due to the porous border.

6.2 Weak production planning and seed chain for seed production and distribution system

Seed production planning, along with a proper disposal mechanism, remains underdeveloped. The seed production process and fresh production practices for farmers and other stakeholders are largely similar, with the primary distinction being the supply of source seeds. Good Agricultural Practices (GAP) for seed production have not yet been effectively integrated into farmers' fields through the extension system. Additionally, seed marketing contracts and buyback systems are typically informal, relying on individual agreements that lack proper coordination and trust.

6.3 Scattered production, low quality and high cost of production

The presence of scattered production patches is a common characteristic in seed-producing regions. This leads to challenges in providing adequate public infrastructure and maintaining quality control. The lack of concentrated input sources within a specific area increases production costs. Additionally, the scattered nature of production discourages traders

and companies from engaging in marketing, which negatively impacts the vegetable seed production industry.

6.4 Deterioration in the genetic and physiological quality of the source seed

Varietal maintenance is an ongoing responsibility that follows the release and recommendation of a variety. This task is essential for all farms and centers, ensuring that crops and varieties are maintained according to the specific ecological zone where they were developed. Assigning qualified personnel to carry out these mandatory duties is crucial. However, the role has become less appealing in horticulture farms due to limited funding and inadequate physical infrastructure provided by the government since the 1990s. As a result, many farms were led by junior technical staff with insufficient expertise in variety development and maintenance. This has led to disruptions and significant setbacks in maintaining the continuity of these critical tasks.

6.5 Others

Price fluctuation, production of high-quality seeds (including varietal purity, germination rates, viability, genetic stock, drying, and packaging), and the demand for hybrid seeds are key challenges facing the vegetable seed sector in Nepal (Timsina and Shivakoti, 2018).

7. Conclusion

Vegetable seed production in Nepal holds immense potential for economic growth, food security, and sustainability, given the country's diverse agro-climatic conditions and increasing demand for quality seeds. Despite significant progress in policies, infrastructure, and private sector involvement, challenges persist, including a wide gap between demand and supply, weak production planning, poor quality control, and inadequate technical expertise. Addressing these constraints requires strengthening seed production systems, improving policy implementation, fostering public-private partnerships, and investing in research and infrastructure. By combining its advantages, scope and overcoming current limitations, Nepal can substantially enhance its vegetable seed production for both domestic use and export, contributing to agricultural and economic development.

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