

Seed Management and its Impact on Processing for the Potato Industry

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Abstract

The role of seed potatoes and their management in enhancing productivity and quality is highly significant for both processing and table potatoes. Processing industries require high-quality potatoes, which can only be achieved with the use of high-quality seeds. This paper highlights current practices, challenges, and innovations in seed production, storage, and distribution, evaluating their impact on the potato value chain. The reviews the present status of seed management and its impact on Nepal's potato industry while assessing its future prospects.

Keywords: Potato processing, Seed management, Seed quality, Value chain, Varieties

Introduction

Potato (*Solanum tuberosum*) is one of Nepal's most important cash crops, playing a vital role in food security and income generation. It is cultivated across diverse agro-climatic zones, from the Terai (plains) to the mountainous regions, allowing for year-round production.

Seed management is a pivotal factor influencing potato yield, quality, and resilience to diseases. The use of quality seeds significantly enhances productivity and ensures consistency in final products. However, Nepal's potato industry faces significant challenges, including limited access to disease-free certified seeds, inadequate storage facilities, and fragmented distribution channels. Addressing these issues is critical for the sustainable growth of the processing sector and the overall agricultural economy.

Transforming potatoes into various food products through different manufacturing processes is known as potato processing. The potato processing industry encompasses grading, cleaning, peeling, cutting, blanching, frying, freezing, and packaging. Changing food habits have increased the demand for processed potato products such as French fries, chips, flakes, mashed potatoes, and dehydrated potato products. Processing requires clean seeds of specified variety and specific cultivation practices that meet quality standards for the best final products.

Despite its significance in food security and income generation, the average productivity of potatoes in Nepal remains among the lowest in the world. The major limiting factors include the use of inferior seeds or ware potatoes as seeds by the majority of farmers and the lack of proper production technologies.

Background and Context

Nepal's potato industry has been expanding due to increasing domestic consumption and the growing popularity of processed products like chips and fries. However, the industry faces challenges, including limited access to processing varieties, high-quality seeds, inadequate seed storage facilities, and a lack of coordination between farmers and processing companies. The absence of appropriate processing varieties and the unavailability of quality seeds often lead to lower yields and quality inconsistencies, hindering the development of the processing sector.

With the rising demand for processed potato products, new processing industries are emerging and seeking suitable potato varieties. The National Potato Research Program (NPRP, NARC) has yet to develop many processing varieties, but private sector initiatives, such as First Choice Foods Pvt Ltd (FCF), have introduced some varieties. NPRP and private sectors are now focusing on the development of processing varieties.

Seed System

1. Evolution of the seed system

In 1989, a tissue culture laboratory was established with financial and technical support from the Swiss government. Contract growers were encouraged to form cohesive groups for informal high-quality seed production. Today, source

seed (pre-basic seed) is still supplied by the tissue culture laboratory. Over the past decade, the government has set up one tissue culture lab at the Potato Development Center, Nigale, and supported seven private labs out of eight to meet the national PBS demand of 850,000 PBS per annum. (Table 1).

Table 1: Tissue culture lab and PBS production in Nepal

S.N.	Name	Address	Established	Current status	Capacity	Remarks
Private tissue culture lab						
1	Ficus Bio-Tech Pvt. Ltd.	Budhanilkantha 02, Kathmandu, Gauradaha 02, Jhapa	2075 BS	Working	100 thousand tubers	50% assist by NPDP/GOV.
2	Shreeram Niketan Bio-Tech Pvt. Ltd.	Godawati Mun., Lalitpur	2075 BS	Working	200 thousand tubers	Self-assist
3	Kushal Agriculture Research and Development Center Pvt. Ltd. (KARDC)	Koteshor Kathmandu, Field Side Laxmana Bardiya	2069 BS	Working	100 thousand tubers	50% assist by RISMFP
4	Nepal Krishi Anusandhan Tatha Bikas Kendra	Hetauda 18, Jalari Makawanpur	2075 BS	Partially working	100 thousand tubers	50% assist by NPDP/GOV.
5	One Step Agriculture Solution Pvt. Ltd.	Dhangadi 05, Kailali	2075 BS	Partially working	100 thousand tubers	50% assist by NPDP/GOV.
6	Pragatisil Yuwa Krisak Samuha	Nala, Kavre	2065 BS	Closed	50 thousand tubers	PACT, PMAMP, and District Development Committee
7	Khaddhyanna Biuaalu, Alaichi Falful Narsari Udyog	Panauti 02, Kushadevi Kavre	2075 BS	Working	100 thousand tubers	50% assist by NPDP/GOV.
8	Nepal Biu Utpadan Kendra	Taukhel, Godawari Lalitpur	2060 BS	Partially working	100 thousand tubers	PACT
Government tissue culture lab						
1	National Potato Research Program	Khumaltar, Lalitpur	1989 AD	Working	200 thousand tubers	
2	Seed Potato Center	Nigale, Sindhupalchok	2075 BS	Working	100 thousand tubers	

Nepal's seed production operates under three systems:

- 1. Traditional System:** Small farmers produce potatoes for self-consumption, using leftover stocks from the local market as "seed potatoes." These are often small-sized whole tubers (10-15 gm).
- 2. Formal System:** Government farms produce seed potatoes under strict technical norms and certification rules. However, limited land availability restricts large-scale seed production.
- 3. Seed Producer Group (SPG) Approach:** Launched in 2010, this government-led initiative trains farmers to produce certified seed potatoes under the Seed Quality Control Centre (SQCC). However, economic constraints and inadequate/improper storage facilities hinder the sustainability of this program.

Seed Management Practices in Nepal

1. Seed production and certification

Seed potato production is challenging due to low multiplication rates, high disease pressure, rapid seed degeneration due to virus infections, damage during transportation, and post-harvest losses in storage.

While seed production involves government agencies, cooperatives, and private entities, certification remains inconsistent. Some seed producer groups and private agencies follow Truthful Labelling, but a standardized certification process is crucial to ensuring disease-free, high-quality seed.

2. Varietal selection

Processing quality depends on the selection of potato varieties. Preferred varieties have high dry matter content, low sugar accumulation, appropriate shape and size, and resistance to pests and diseases. Recent experiments show that:

- **Best varieties for French fries' production:** Innovator, Sagitta, Alverstone Russet, Santana, Frysona and Lady Rosetta were introduced by First choice foods Pvt. Ltd.
- **Best varieties for potato chips:** Khumal White-2, Khumal Ujwal, Khumal White-4 were released and recommended by PRP.

3. Storage and distribution

Poor storage infrastructure leads to post-harvest losses and deterioration of seed quality. There is no distinct storage system for seed, ware, and processing potatoes in Nepal. Recently, FCF has developed a cold storage facility specifically for processing potatoes. Investment in low-cost storage solutions and cold chain logistics is essential to maintaining seed quality throughout the year.

Impact on the potato processing industry

High-quality seed directly increases yields and improves tuber quality, essential for processed products. Consistent access to disease-free seed ensures uniformity in shape, size, and taste critical factors for industrial processing. Conversely, poor seed quality leads to irregularities that impact processing efficiency and final product quality. Availability of high-quality seed varieties can also boost export opportunities by enhancing the competitiveness of Nepalese potato products in international markets.

Major Constraints

Key challenges facing Nepal's potato industry include:

1. Limited availability of processing varieties

To date, the National Potato Research Program (NPRP) has focused exclusively on table varieties. Of the 17 varieties released or registered (12 released and 5 registered), only two are suitable for both table and chip processing. No cultivars have been developed specifically for French fries or other processing purposes. Recently, few varieties introduced by First Choice Foods (FCF), a private sector company, have been tested and three varieties among them were registered for French fry production. This limited availability of processing-specific varieties particularly those with high dry matter and low sugar content constrains the potential for industrial processing and value addition. The absence of such varieties poses a significant barrier to the development of a robust potato processing industry in the country.

2. Inadequate human resources and infrastructure

There is a notable shortage of skilled professionals in key areas such as agronomy, seed science, and plant breeding—particularly those specializing in potatoes. In addition, essential supporting infrastructure, including collection centres, curing houses in production areas, disease indexing facilities, and decentralized seed storage units, is either inadequate or underutilized. This is often due to poor planning and substandard construction, especially in regions designated for seed production

3. Inefficient seed production approaches

Nepal continues to rely heavily on traditional and informal seed systems. Many farmers save and reuse their own seed tubers year after year, or use leftover tubers after household consumption or market sales. This practice leads to the accumulation of diseases and the progressive degeneration of seed quality. There is a significant disconnect between the National Potato Research Program (NPRP), private tissue culture laboratories producing pre-basic seeds (PBS), and seed producer groups (SPGs). Consequently, the seed production cycle remains incomplete, and

the adoption of modern seed multiplication techniques for producing improved seed potatoes is minimal to non-existent.

4. Lack of a proper seed certification system

In Nepal, the Seed Quality Control Center (SQCC) holds full responsibility for the seed certification process. However, due to inadequate staffing within the SQCC and related institutions, the certification system for potatoes is either weak or inconsistently enforced. The absence of standardized inspection protocols, effective quality control, and traceability systems further hampers the availability of high-quality, certified seed potatoes for farmers. This undermines farmer confidence in the seed supply chain and discourages the growth of commercial seed enterprises.

5. Low technical expertise among farmers

Most seed producer groups (SPGs) and farmers in Nepal lack adequate awareness and training in modern seed production practices, including disease management, grading, and post-harvest handling. Extension services remain limited, and access to information on improved agronomic practices, the use of quality seed, and proper storage techniques is insufficient across all provinces. This knowledge gap hinders productivity and the overall quality of seed potatoes.

6. Limited irrigation facilities

Irrigation remains a major constraint in many potato-growing regions of Nepal. In the mid and high hills, rain-fed farming is the predominant practice, making potato production highly vulnerable to climate variability. The lack of reliable irrigation infrastructure limits the ability to expand seed potato production across multiple seasons and regions, thereby restricting productivity and resilience.

7. Poor cold storage infrastructure

Potatoes require controlled storage conditions to maintain quality. However, Nepal faces a significant shortage of well-distributed, energy-efficient cold storage facilities. There is no specialized storage system in place; seed, ware, and processing potatoes are typically stored under the same conditions. Existing facilities are often concentrated in urban areas, making them inaccessible to farmers in higher hills, lower mid-hills and remote areas. This lack of appropriate storage leads to high post-harvest losses and premature or over sprouting, ultimately compromising in quality and market value.

8. Insufficient incentives for industries and farmers

The government provides limited financial support for seed production, particularly for purchasing pre-basic seeds (PBS), irrigation, and mechanization. This support is insufficient, and as a result, seed producer groups (SPGs) and farmers often cannot afford to retain seed tubers through the necessary 34 production cycles required to produce improved seeds. Economic constraints hinder their ability to invest in quality seed production. There is a clear need for targeted subsidies at each stage of the seed production cycle, along with improved access to credit and crop insurance, to encourage greater investment in seed production and supporting infrastructure.

9. Weak coordination between production, marketing, and processing sectors

Currently there is lacks of seed booking system in Nepal, which creates uncertainty in seed production and weakens coordination across the potato value chain. Seed producers, ware potato growers, traders, processors, and policymakers often operate in isolation, resulting in fragmented efforts. This disconnection leads to mismatches between supply and demand, price volatility, and the underutilization of both production and processing capacities.

Future prospects

With urbanization, population growth, and changing food habits, the demand for processed potatoes is increasing. Potatoes' high productivity per unit area makes them crucial for food security and poverty alleviation. Clean seed availability could boost production by up to 49%. Improved seed production, disease control, varietal enhancement, and efficient processing can unlock significant potential for Nepal's potato industry.

Import analysis

Nepal's import of processed potato products has consistently increased over the past five years. Nearly all processing potatoes are imported from India, along with about 10% of the country's table potato consumption (350,000–400,000 tons annually). Despite Nepal's ecological suitability for year-round fresh potato production, inadequate seed management forces heavy reliance on imports.

Nepal's ecological conditions are highly suitable for year-round fresh potato production, making it well-positioned to meet both internal and export market demands. There is active willingness and participation from farmers and cooperatives in seed and ware potato production. The government committed to support essential machinery such as planters, ridgers, and harvesters, facilitating agricultural productivity. Additionally, there are abundant storage facilities in both cold storages and rustic storages, though they are currently utilized at only 50–60% of their capacity. Furthermore, Nepal has sufficient laboratories for quality PBS production.

Despite these resources, a critical question arises: Why does Nepal still need to import table potatoes, processed potatoes, and potato-based products?

Conclusion

Nepal possesses significant potential for potato production, yet the country continues to rely heavily on imports. One of the key challenges is the quality of seed potatoes, which must be addressed to boost domestic productivity. To establish a sustainable seed management system, government policies should prioritize support for seed potato production, storage, processing, and distribution. This includes providing targeted subsidies for seed producers and related industries, enforcing stricter seed certification standards, and revising existing regulations to ensure quality and sustainability across the value chain.

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