

STATUS AND PROSPECTS OF POTATO RESEARCH AND DEVELOPMENT IN NEPAL

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ABSTRACT

Potato is an important crop of Nepal. Due to its short vegetative cycle and high cash value, it plays an important role in country's food production and poverty reduction. Despite its significance in food security and cash generation, the average productivity is one of the lowest in the world. Lack of appropriate production technologies in the country and use of inferior seed tubers by majority of the farmers are identified as two of the major limiting factors. With the objectives of generating suitable and stable appropriate technologies and disseminate them to increase the production and productivity for different agro-ecological zones of the country through coordinated research approach, National Potato Research Programme (NPRP) and National Potato Development Programme (NPDP) are in function with the RandD mandates in the country on potato crop. Since the establishment of these two programmes, tremendous progresses have been made. However, the productivity of this crop is far below its potentiality compared to the neighboring countries and even world average. This paper reviews the present status potato RandD of Nepal and attempts to assess its prospects.

INTRODUCTION

Potato is one of the most important crops in Nepal used as a major vegetable crop in mid-hills and terai where as it is one of the staple food crops in high hills. Regarding the scope of this crop, it occupies the fifth position in area coverage, fourth in total production and first in the productivity as compared with the main staple food crops, rice, maize, wheat and millet (Fig. 1). Nevertheless, potato contributes its roles in cash generation and food production per unit area for small holder farmers. With the goal of improving livelihoods of Nepalese farmers through this crop, two different national level RandD programmes namely National Potato Research Programme (NPRP) and National

Potato Development Programme (NPDP) were established in the country. Since then, tremendous progresses have been made in potato research and development in Nepal, which has been mainly because of excellent efforts of these programmes and of course above all untiring efforts of potato farmers and stakeholders.

NPRP conducts experiments within the disciplines of varietal evaluation, disease and pest management, soil fertility improvement, True Potato Seed (TPS) utilization, post-harvest (storage), and value addition of potato and sweet potato crops, whereas NPDP is engaged in technology transfer, capacity building, policy support and overall developmental activities for the promotion of potato industry in the country.

Climatic diversity of the country permits year round cropping of potato from plains (70 m a s l) to the mountains (4400 m a s l). By agro-ecological region, out of the total area under potato crop, around 19% lies in the high hills/mountains, 43% in the mid-hills and remaining 38% in the Terai and Bhabar (Fig. 2). It occupies the fifth position in area coverage, second in total production and first in productivity among the food crops grown in the country (ABSPD, 2014), but still the productivity of this crop is far below to its potentiality.

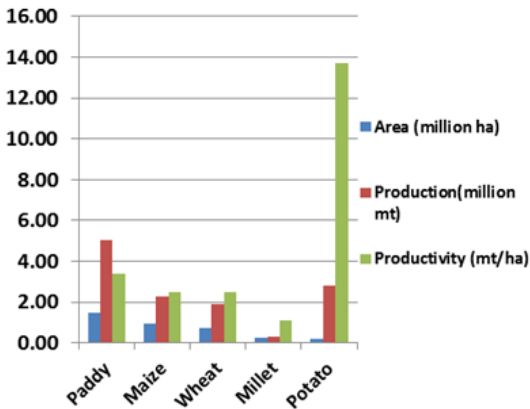


Figure 1. Area production and productivity of major crops in Nepal 2013/14

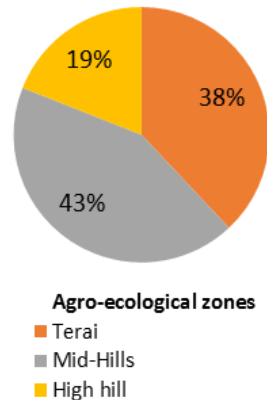


Figure 2. Area coverage under potato crop by agro-ecological zones

Though the introduction of this crop in Nepal is considered shortly after the introduction in Europe, the average yields are still among the lowest in the world (13.6 t/ha). Besides many other reasons, unavailability of seed in terms of desired varieties, quality and quantity with affordable price and low adoption scale of cultivation technologies are the major limiting factors resulting lower yield even though other production inputs are applied at optimal level. There is huge potential of potato crop that could contribute to the national economy within its scope of fresh and processed food demand in the changing socioeconomic contexts. If the problems were managed in an integrated way and yields were improved well, Nepal could benefit its geography being in the middle of two big countries like China in north and India in south.

The first official attempt to improve potato production was initiated in 1962 under a joint programme between Nepal and India. During its earlier phase (1960-75), potato farms and related infrastructures were developed across the country. With the increased importance of potato crop in national food production, National Potato Development Programme (NPDP) was incepted in 1972 at Kirtipur with a nationwide mandate to conduct potato research and development activities. Two potato farms, one at Jaubari, Ilam and another at Nigale, Sindhupalchowk, were established during 1980s. In 1974, NPDP was relocated to Khumaltar and linkages were established with International Potato Center (CIP) Lima, Peru, which is still effective in various aspects.

MAJOR ACHIEVEMENTS

Both the potato programs are working to resolve different problems on potato through different arrangements in RandD activities in the country and some of them are as following.

Varietal improvement

To date, the following potato varieties have been released for different agro-climatic conditions:

Released Varieties	Agro- climatic zones
Kufri Jyoti	High and mid hills
Kufri Sindhuri	Terai and inner Terai
Desiree	Hills and Terai
Janak Dev	High and mid hills
Khumal Rato-2	Terai and inner Terai
Khumal Seto-1	High and mid hills
Khumal Laxmi	Terai to high hills
IPY 8	Terai to mid hills
Khumal Ujjol	Hills
Khumal Upahar	Terai

In addition, two TPS lines namely TPS-1 (HPS II/67) and TPS-2 (HPS 7/67) are officially registered for commercial cultivation in the country.

Technology Development

- Seed tuber treatment and three times foliar spray of Asuro (*Justicia adhatoda*) and EM mixed suspension at 10 days interval has been effective for increasing tuber yield. Black plastic and paddy straw mulching increase yield under less irrigated and moisture stress condition.
- Improved technologies for potato production (seed selection, planting methods, irrigation methods, fertilizer application, plant protection, seed production and storage) have been developed and recommended.
- Integrated disease management technologies have been recommended to minimize the losses due to major diseases such as late blight, bacterial wilt, and black scurf.
- Screen house has been found more cost effective than glasshouse for pre-basic seed production in the country like Nepal where there are tremendous number of constraints to run sophisticated glasshouses.
- 100,000 to 200,000 virus (PLRV, PVX, PVY, PVS, PVA and PVM) free pre-basic seed potatoes are produced through tissue culture

technology and distributed every year.

- Black polythene mulching and Metribuzin (pre-emergence herbicide) are found highly effective for controlling weeds in potato crop.
- Eight potato cultivars (Cardinal, NPI-106, CIP 388572.1 and CIP 388572.4) have been cleaned for virus free seeds of potatoes. More than 100 local and exotic germplasm are maintained in-vitro for research and production purpose.
- Six major viruses (PLRV, PVX, PVY, PVS, PVA and PVM) free pre-basic seed potatoes are produced through tissue culture technology by NARC and distributed to the seed growers through Department of Agriculture every year.
- In processing part, genotypes PRP 25861.1, Yagana, L-235.4, HPS II/67, NY-123, HPS 7/67, BSU-PtO3, K. Chipsona -2 and Khumal Seto-1 are found promising not only for higher yield but also for processing for chips. The pink-skinned clone named PRP 25861.1 which has high level of late blight disease resistance and high dry matter will be proposed soon for releasing.
- The fertilizer trial conducted on variety Kufri Jyoti showed the highest tuber yield (30.22 t/ha) was obtained in combination of 150 kg N₂ and 60 kg K₂O/ha.

Increase in Area Coverage Production and Productivity

Potato production has been increased both through the increase in area coverage and productivity (Table 1) driven by development of improved varieties, access to clean seed, enhanced capacity and technology extension. In the year 2012/13, the area under potato was reported to be 197, 234 ha and production of 2,690,421 tons with an average productivity of 13.6 t/ha (MoAD, 2013) and which is about 4.6 percent of total crop area of the country. Increase in area is justified because of its market demand and popularity both due to its food and cash value; and diversity in food recipe. During the last four decades the potato production sifted from remote hills to easy excess areas. It is due to the market demand by urban population. Cropping pattern also changed from traditional seasonal to off-season cultivation. The total production for the year 2013/14 was 2,817,512mt which is nine times

higher when we peep back to the production of 307,483mt in 1974/75 (Figure 3). The productivity has been gone up from 5,700 kg to 13,695 Kg/ha respectively during last 4 decades period. Although, average productivity of 13.64mt/ha in Nepal remained behind (FAO, 2014) compared to India (22.76 t/ha), Pakistan (21.80 t/ha), Bangladesh (19.37 t/ha) and Sri Lanka (15.32 t/ha).

NPRP still manages a full-fledged tissue culture laboratory for the pre-basic seed (PBS) potato production. More than 150 genotypes are in-vitro maintained and about 200,000 minitubers of different varieties are produced each year under quarantined glasshouse conditions at Khumaltar and distribute to seed growers through National Potato Development Programme/DOA. PBS is also further multiplied in Horticulture Farms under NARC and DoA for basic seed production to meet the farmer’s demand of their respective command areas. In the recent years the private entrepreneurs are also producing in-vitro based PBS in with support from NPDP and NPRP.

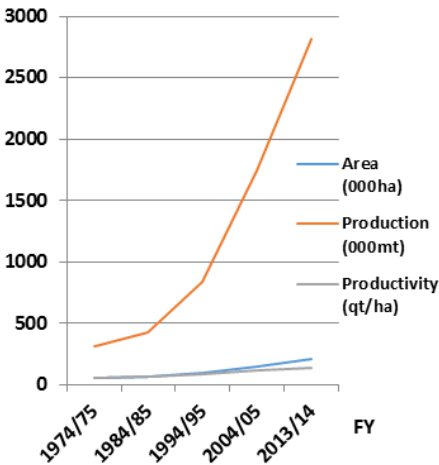


Figure 3. Area, production and yield of potato crop

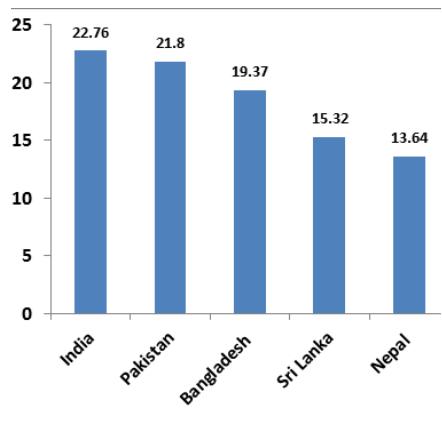


Figure 4. Potato productivity (mt/ha) in SARC countries

Seed System

In 1989, a tissue culture laboratory was established with the financial and technical support of Swiss government and the contract growers were encouraged to form a cohesive group for informal production of high quality seed at that period. Source seed as pre-basic seed is to date being supplied by the tissue culture laboratory.

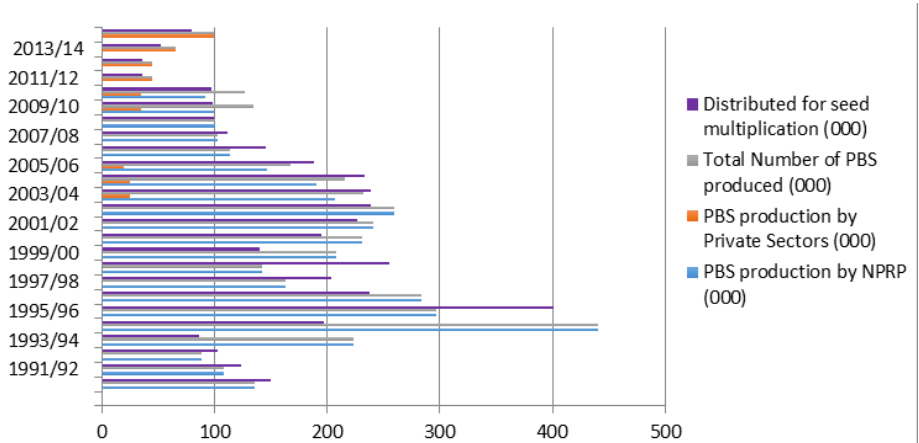


Figure 5. Production and distribution of PBS by private and government sectors from FY 1992/93 to 2013/14

In Nepal, seed production programs are operating in three systems

- Traditional system – The remaining stock of potato after table purpose is being used or marketed as “seed potato” which are mostly small sized (10-15gm) whole tuber.
- Formal system– Seed potato is mainly produced by government farms following specified technical norms, specification, rules and regulations. It is guided by the seed certification rules embedded in the prevailing “Seed Act”.
- Seed producer group (SPG) approach– A group of trained and well experienced potato farmers are engaged in seed production program through a formal group. The seed production program is technically supported by designated technicians throughout the crop season including post-harvest management. Recently, visualizing the scope

and demand of seed potato in the country the government has decided to produce clean seed potato by using such farmers' group within the broader umbrella of seed act. A self-sufficiency seed potato program has been launched since 2010 reaching 38 districts in current year 2015. These groups are empowered to produce quality seed which is certified by the Seed Quality Control Centre (SQCC) under MoAD, Regional Laboratories and trained seed inspectors.

Above model of on-farm informal seed production through SPG approach has been well documented and accepted by MoAD to further scale-up to the semi-formal seed potato production program in the country.

Utilization of True Potato Seed (TPS) for Seed and Ware Potato Production

Production of seedling tuber as a quality seed material by sowing TPS in nursery bed and seedling transplanting for ware potato production are two major methods of TPS utilization in Nepal. TPS is an alternative low cost technologies especially for those areas where bulky seed tuber becomes expensive and either not available on time. Transfer of TPS technology to Nepalese farmers, for the first time was initiated during 1993-94 season designing a "Technology Verification Demonstration" approach (Lama, 2001). Farmers' acceptance of the technology resulted initiation of seeding tuber production (first tuber generation from TPS) to fill the gap of seed potato requirement in specific environment of its potentialities.

To fulfil the growing TPS demand both government and private sectors are engaged in production of TPS in the country. Average TPS utilization in Nepal is about 50 kg per annum.

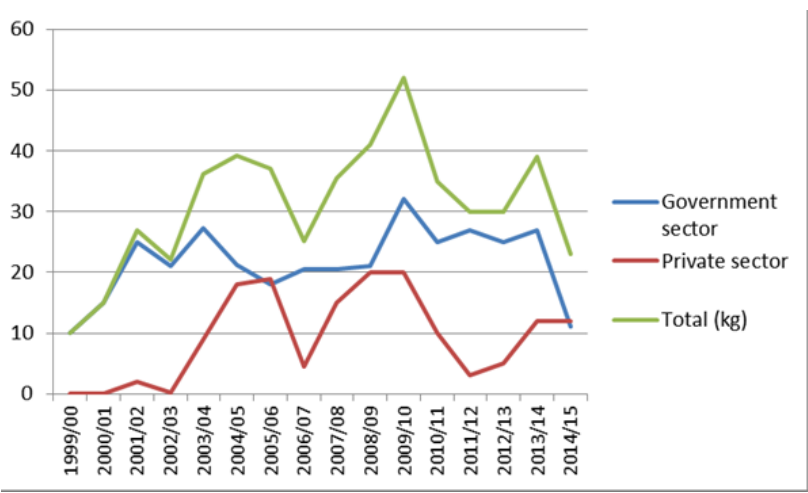


Figure 6. Production of TPS by private and government sectors

Integrated Disease Management (IDM) of Potato through Farmers Field School (FFS)

In 1999/2000, NPDP in collaboration with CIP and Users’ Perspective with Agricultural Research and Development (UPWARD) initiated IDM practice on potato through FFS approach simply to enhance farmer’s decision making capacity in utilizing their resources judiciously making potato farming as a profitable enterprise (PDS, 2001).

Integrated Diseases management (IDM) practice is driven by FFS approach which is one of the recent participatory RandD methods benefiting farmers “doing better science together”. This approach is a new dimension for enhancing farmers’ capacity to understand the agro-ecosystem to apply appropriate management practices through informed decision making process. Basic principle of these approaches is to grow a healthy crop profitably applying sustainable and environmentally safe technologies. IDM practitioners significantly decreased the frequency and quantity of chemical pesticide application with increased income. It also contributed to reduce pesticide hazards to human as well as environment health.

Increased Potato Storage Facilities

In higher elevations above 1500masl ambient temperature is favorable for potato storage in zero energy Cellar or Rustic stores. On the contrary in lower elevations in Terai and Dun/Bhabar potato is harvested during beginning of hot and dry summer making it difficult to store potatoes under ordinary environmental conditions and potato is stored in cold stores. At present there is total storage capacity for storing 87,700mt of potatoes in the country (NPDP, 2013/014) and central region occupies about 70% of the space.

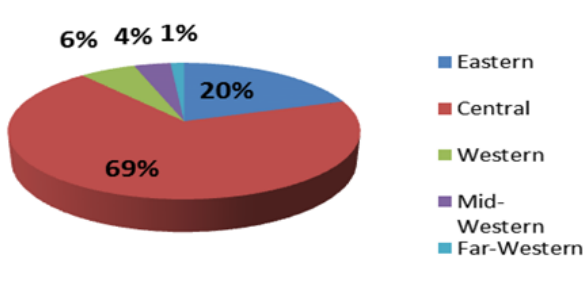


Figure 7. Available storage space (%) in the region share of total 87700mt.

IMPORT-EXPORT

Nepal is importing potato mainly from India and China both fresh and processed forms. The major items are seed, ware, starch, chips and potato prepared or preserved otherwise than by vinegar or acetic acid. It is estimated that Nepal spends more than NRs 2.5 billion annually for importing such products (NPDP report 2013).

MAJOR CONSTRAINTS

Some of the major constraints in potato research and development to enhance overall potato industry in Nepal are as below:

- Inadequate human resource and physical facilities for RandD
- Wider gap in seed production and demand
- Low level of technical know-how
- Degrading soil fertility
- Limited irrigation facilities

- Insufficient cold storage facilities
- Less incentives to encourage farmers and intermediaries
- Increasing agriculture labor scarcity in rural areas
- Weak market information system (MIS)
- Lack of coordination/linkage among production, marketing, and processing

FUTURE PROSPECTS

In the context of rapid urbanization, fast growing population and changing food habit of the people, potato could be an important demanding commodity in daily dietary menu with higher transaction the growing future market. Since potato produces more food per unit area and per unit time, it bears full potential to contribute to food security and poverty alleviation in the country, however, existing production constraints (management of clean seed, diseases and insect pests, variety improvement and processing system) must be realized, given focus and resolved (Khatri, 2000).

CONCLUSION

Larger potential benefits are likely to come from improved control of late blight, virus disease and improved supply of quality seed as recognized as one of the major constraints remained to improve in Nepal. The ecological opportunity in Nepal is far more suitable and gifted for year round fresh potato production to full fill the increasing demand of internal as well as export market. Furthermore, consumers' awareness on hazardous pesticide use in agriculture sector should be considered in potato cultivation as well for safe and healthy product applying integrated disease management (especially of virus and fungal diseases), integrated pest management and marketing systems improvement should be the highest priority needs. Benefitting farmers, intermediaries and consumers is a collective agenda of both research and development agency which needs to be supported by national and international donor and scientific communities strengthen potato RandD to cater future need and hope.

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