

Production, Marketing and Value Chain Mapping of 'Srijana' Tomato Hybrid Seed in Nepal

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ABSTRACT

A tomato variety known as 'Srijana' developed by Nepal Agricultural Research Council (NARC) has been substantially popular among Nepalese farmers and entrepreneurs. To understand the seed value chain of the Srijana hybrid tomato, a survey was conducted in 2014/15 with public research and extension institutions, private seed companies/firms, non-governmental organization and community group including individual farmers, involved in Srijana tomato seed production. The survey covered random selection of 30 agro-vets and 30 farmers in Kathmandu valley, Kavre, Nuwakot, Dolakha and Kaski districts, where production of Srijana tomato seed is mostly concentrated. A focus group discussion was also conducted with commercial tomato farmers in each of the study districts. The study showed a total production of 293 kg Srijana seed having a value of around 47 million Nepalese Rupees (NRs equivalent to US \$ 470 thousands) in year 2013/14. Private sector was the dominant actor sharing about 85% of the total Srijana seed production followed by non-governmental organization (10%), farmers group (3%) and governmental station/farm/centers (2%), respectively. Out of the total Srijana seed produced, about 95% was consumed in domestic market, while 5% was exported to India. The study revealed increasing trend of production, supply and price of Srijana tomato seed. Approximately 0.3 million NRs (US \$ 3,000) profit was estimated through the production of Srijana tomato seed in 0.05 hectares (500 m²) of land area. Agro-vets (private sector seed dealers) were the major actors receiving higher profit margins for supplying the seed from producers to farms. The farmers producing and selling the seed with technical assistance of public agencies received higher producer's share (66.6%) than farmers producing and selling seed through own group (60%), technical assistance of non-governmental organization (53.3%), and in contract with private seed companies (26.7%). Majority of commercial tomato farmers had complaints on supply of poor quality seed in the market. As a result, there was declining faith on the quality of Srijana tomato seed. Limited access to parental lines and poor availability of skilled human resources were the key constraints to produce the quality Srijana seed. Therefore, it is recommended that there should be a provision of efficient quality control mechanisms, and development of human resources including public private partnerships for maintaining the genetic purity of parental lines and also improving the capacities of seed value chain actors for sustainable Srijana seed production in Nepal.

Keywords: Seed Marketing, Srijana Tomato Seed Actors, Srijana Tomato Seed Value Chain Map, quality Seed

सारांश

नेपाल कृषि अनुसन्धान परिषद मार्फत विकास गरिएको सिर्जना जातको गोलभेंडा नेपालका अधिकांश कृषक तथा कृषि उद्यमीहरूका बीचमा अत्यन्त लोकप्रिय रही आएको छ। तसर्थ, सिर्जना गोलभेंडाको बीउको मूल्य श्रृंखला सम्बन्धि अध्ययन गर्ने उद्देश्यले यसको बढी मात्रामा बीउ उत्पादन हुने काठमाण्डौं, काभ्रे, नुवाकोट, दोलखा र कास्की जिल्लामा बीउ उत्पादनमा संलग्न कृषक, सरकारी निकाय, निजी कम्पनी, गैर सरकारी संस्था र सामुदायिक संस्थाहरू लगायत ३० वटा एग्रोभेट तथा गोलभेंडा तरकारी उत्पादनमा संलग्न कृषकहरूसँग आर्थिक वर्ष २०१४/१५ मा अन्तरवार्ता तथा समूह लक्षित छलफल गरिएको थियो। यस अध्ययनको नतिजा अनुसार आर्थिक वर्ष २०१३/१४ मा सिर्जना गोलभेंडाको बीउ उत्पादनमा संलग्न सम्पूर्ण पात्रहरू मार्फत ४ करोड ७० लाख नेपाली रुपियाँ बराबरको कूल २९३ किलोग्राम सिर्जना गोलभेंडाको बीउ उत्पादन गरिएको पाइयो। सिर्जना गोलभेंडाको बीउ उत्पादनमा संलग्न सम्पूर्ण पात्रहरूमध्ये निजी क्षेत्रले सिर्जना गोलभेंडाको कुल बीउ उत्पादनको करिब ८५ प्रतिशत हिस्सा ओगटेको पाइयो भने सरकारी संस्था, कृषक समूह तथा सरकारी कृषि अनुसन्धान एवं फार्म केन्द्रहरू मार्फत क्रमशः करिब १० प्रतिशत, ३ प्रतिशत र २ प्रतिशत हिस्सा ओगटेको पाइयो। कुल उत्पादित सिर्जना गोलभेंडाको बीउ मध्ये करिब ९५ प्रतिशत बीउ स्वदेशमै खपत भएको पाइयो भने, करिब ५ प्रतिशत बीउ भारतमा पनि मुख्य गरी गोर्खा बीउ कम्पनी मार्फत निकासी गरिएको पाइयो। यस अध्ययन मार्फत नेपालमा सिर्जना गोलभेंडा बीउको उत्पादन, आपूर्ति तथा बजार मूल्य वार्षिक रूपमा क्रमशः बढ्दै गइरहेको पाइयो। यस अध्ययनबाट सिर्जना गोलभेंडाको व्यवसायिक उत्पादन मार्फत प्रति रोपनी करिब ३ लाख नेपाली रुपियाँसम्म मुनाफा आर्जन गर्न सक्ने देखियो। सिर्जना गोलभेंडाको बीउलाई बीउ उत्पादन स्थलबाट गोलभेंडा तरकारी उत्पादन क्षेत्रसम्म पत्‍याउनमा एग्रोभेट तथा बीउ व्यवसायीहरूको भूमिका अहम रहेको पाइयो। जसले सो कार्य गर्दा निजी कम्पनी मार्फत संकलन गर्दा भन्दा गैरसरकारी संस्था तथा सरकारी निकायहरूको सहयोगमा कृषकहरूले उत्पादन गरेको बीउ सोभै संकलन एवं व्यवस्थापन गरी बेच्दा बढी मुनाफा लिएको पाइयो। बजार मूल्यमा कृषकको हिस्सा सबैभन्दा बढी (६६.६ प्रतिशत) सरकारी कार्यालयहरूको प्राविधिक सहयोगमा बीउ उत्पादन गर्ने कृषकहरूले प्राप्त गरेको पाइयो भने कृषक समूह मार्फत संगठित भएर बीउ उत्पादन गर्ने कृषकहरूले ६० प्रतिशत एवं गैरसरकारी कार्यालयहरूको प्राविधिक सहयोगमा तथा निजी बीउ कम्पनीसँगको सम्झौता मुताबिक बीउ उत्पादन गर्ने कृषकहरूले क्रमशः ५३.३ प्रतिशत र २६.७ प्रतिशत प्राप्त गरेको पाइयो। बजारमा गुणस्तरिन सिर्जना गोलभेंडाको बीउको आपूर्ति प्रति धेरैजसो कृषकहरूले गुनासोका साथै सो कारणले गर्दा उनीहरूको सिर्जना गोलभेंडा प्रविधि प्रतिको विश्वास पनि कमजोर हुँदै गइरहेको पाइयो। सिर्जना हाईब्रिड गोलभेंडा बीउ उत्पादनसँग सम्बन्धित मुख्य समस्याको रूपमा यसको उत्पादनका लागि आवश्यक भाले र पोथी बीउ प्राप्त गर्नमा बीउ उत्पादन गर्न ईच्छुक कृषकहरूको कमजोर पहुँच र दक्ष जनशक्तिको अभाव रहेको पाइयो। यसर्थ, नेपालमा सिर्जना गोलभेंडाको बीउको दिगो र गुणस्तरीय उत्पादनका लागि बीउको गुणस्तर अनुगमन तथा नियन्त्रण संयन्त्रका साथै दक्ष जनशक्तिको विकास र सरकारी एवं निजी क्षेत्र बीचको साभेदारीको सुदृढिकरण गरी सिर्जना हाईब्रिड गोलभेंडाको भाले र पोथीको आनुवंशिक शुद्धता कायम गर्नु एवं बीउ उत्पादनमा संलग्न पात्रहरूको सिर्जना गोलभेंडाको भाले र पोथी बीउमा सहज पहुँच एवं समुचित प्रयोगमा क्षमता अभिवृद्धि गरिनु आवश्यक छ।

INTRODUCTION

Seed is one of the major inputs of agriculture and means for dissemination of new technologies to farmers. Use of quality seeds of improved varieties is necessary to increase productivity and income of farmers (Gauchan et al 2014). Vegetable seed are one of the promising sub sectors for improving agricultural production, poverty reduction and food security (MoAD 2013, CEAPRED 2014). Vegetable seed are high-value and low-volume products and demand for improved and hybrid vegetable seeds are increasing every year due to increasing area under fresh vegetables production both for main season and off-season in Nepal (SCPL 2011). More than 60%

area of the commercial vegetable production pockets are under hybrid seeds with increasing trend due to their high yielding ability against open pollinated varieties (OPV) (MoAD 2013). However, hybrid seed production in Nepal is limited to only few crops, mainly tomato and maize, therefore, import of hybrid seed is increasing particularly in vegetables, rice and maize (MoAD 2013). The estimated vegetable seed demand for 2013/14 is 1,900 Metric Tons (mt) (SEAN 2013) while domestic seed production meets only half (53%) of the total demand, the rest is fulfilled by import. National Seed Vision-2025 formulated by the Government of Nepal (GoN) has emphasised on self-sufficiency, import substitution and export promotion of quality seeds through domestic production for achieving increased seed replacement rate of vegetables from current 67% to 90%, including development of 30 hybrids (20 from public sector and 10 from the private sector) in Nepal (MoAD 2013).

Tomato is the third most important vegetable after cauliflower and cabbage in terms of area, and production in Nepal. It is cultivated in about 20,000 hectares (ha) producing about 0.3 million MT tomatoes annually (MoAD 2014). Tomato is though best suited to tarai and mid hills, it is also becoming an attractive option for cash generation in the high hills (Pandey and Chaudhary 2004). Tomato is grown from subsistence to commercial scale; and from the east to far west and Terai to mid hill and mountain regions. Earlier, tomato was used to be grown only in the rainy season in the hills at subsistence level. However, the introduction of improved varieties has made it possible to grow tomato in the spring season as well (Ghimire et al 2001). Although a total of four varieties of tomato are released, and 28 varieties are registered, a large number of tomato variety seeds are available to farmers in Nepalese market due to open border and weak regulatory measures (MoAD 2013). The 'Srijana' is one of the popular varieties of tomato registered by National Seed Board with the effort of Nepal Agricultural Council (NARC) in 2010 (MoAD 2013, NARC 2014). Srijana tomato is mostly preferred by the farmers for its wider adaptability including its suitability for off seasonal production, superior taste, as well as tolerance to bacterial wilt disease. Srijana tomato is particularly recommended and popular among farmers for its farming inside the plastic house (Chapagain et al 2010, Pokharel and Thakur 2012). Thus, plastic house tomato production of this variety is gaining popularity among farmers (Chapagain et al 2010). The Srijana tomato variety has also been identified as one of the potential crop variety for import substitution and export promotion (MoAD 2013).

Presently, governmental and non-governmental actors have emerged and engaged in commercial seed production of the Srijana tomato in Nepal. The parental lines of Srijana tomato is maintained and produced by Horticulture Research Division (HRD), Khumaltar of NARC, and supplied to other actors for producing Srijana hybrid seed. However, there is a gap of information about the actors involved in Srijana tomato seed production, scales and practices of its production and marketing. Similarly, quality concerns on Srijana seed are increasingly raised by the stakeholders in different forums. The identification of the actors involved in Srijana tomato seed production and marketing including its quality issues and bottlenecks associated with its production might help in identifying intervention areas for further strengthening of Srijana tomato value chain. Hence, this study was carried out with the objectives of assessing production, marketing, economics and quality concerns of Srijana tomato seed in Nepal.

MATERIALS AND METHODS

This study applied both qualitative and quantitative research methods for obtaining information on Srijana tomato seed value chain. We identified actors obtaining parental lines of Srijana from the HRD, Khumaltar; as well as actors maintaining and using Srijana parental lines without concerning HRD (such as Gorkha Seed Company). Survey and interactions were made with all the identified actors involved in Srijana seed production. Value chain maps were developed to identify the actors involved and their functions in Srijana seed value chain. The study was done in Kathmandu valley, Kavre, Nuwakot, Dolakha and Kaski districts where production of Srijana seed was mostly concentrated. In addition, survey was also conducted with randomly selected 30 agro-vets involved in marketing of Srijana seed and 30 commercial tomato farmers (six farmers from one location) in those districts to understand the marketing practices and quality concerns of the variety. A focus group discussion was also conducted with the commercial tomato farmers in each of the selected district. A checklist and semi-structured interview schedule were used for collecting the primary data. Secondary data on Srijana tomato were also collected from the various published documents. Cost-benefit analysis of Srijana hybrid seed production, producer's share and marketing margin were analyzed through the collected data. Data analysis was carried out by using Microsoft Excel (MS-Excel) software.

RESULTS AND DISCUSSION

Development, Maintenance and Supply of Parental Lines for Srijana Tomato Hybrid

Srijana is the single hybrid variety of tomato so far developed by NARC through the cross between HRD-1 (female line) and HRD-17 (male line). Female line (HRD-1) is bacterial wilt resistant Hawaiian indeterminate type tomato line with round shaped small fruit size, while male line (HRD-17) is determinate type elite line obtained from The World Vegetable Center (AVRDC), Taiwan with oblong and large sized fruit (HRD 2006, DS Shrestha, personal communication, April 22, 2016). The research work on Srijana hybrid tomato development was started since 2005; when a total of 18 tomatoes inbred collected from various sources were evaluated and crossed in Horticulture Research Division of NARC (HRD 2006). From the series of evaluation of F1 crosses, HRD identified the F1 hybrid obtained from HRD-1 and HRD-17 cross superior in bacterial wilt resistant, yield and yield attributing characters and it was finally registered in the name of Srijana hybrid in 2010. HRD, Khumaltar of NARC is the main actor for maintaining and also supplying the Srijana parental lines to commercial Srijana seed producers and it supplied about 0.4 kg of parental lines to different seed producers in the year 2013/14 (HRD 2014).

Actors Involved in Srijana Tomato Seed Production

A number of actors from the governmental, non-governmental and private sectors as well as a farmer's group were involved in production of Srijana hybrid seed in Nepal. The actors involved in Srijana seed production, and their mode of seed production in Nepal is given in Table 1.

Table 1. Srijana hybrid tomato seed producers in Nepal

Name of the institution	Involvement since	Type of institutions	Mode of production
Gorkha Seed & Agro Traders Company Limited Ktm	2007	Private	Own farm
SEAN Seed Service Center Limited, Kathmandu	2011	Private	Own farm & contracting farmers
Kasthamandap Trade Point, Kathmandu	2011	Private	in contract with farmers
Agricultural Research Station, Malepatan, Kaski (seed production in Kaski & Syangja)	2011	Public	Own farm and through farmers
CEAPRED (seed production in Kavre, Parbat, Rukum, Surkhet, Dailekh & Baitadi)	2011	NGO	Farmers groups & Cooperatives
Sub-tropical Vegetable Production Centre, Rukum	2012	Public	Own farm
ANAMOL Seed Company Private Limited, Kaski	2013	Private	Own farm
Agro Shala Nepal, Kathmandu	2014	Private	Own farm
Mero Agro Private Limited, Kathmandu	2014	Private	Own farm
Puspanjali Seed Producer Group, Lalitpur	2014	Farmers group	Own farm

Majority of the actors involved in Srijana hybrid seed production belongs to private sector primarily producing seed either in their own farm only; or farmers' fields through contracts. Gorkha Seed Company, SEAN Seed Company, Anamol Seed Company, Agroshala Nepal, Mero Agro Pvt. Ltd. And Kasthamandap Trade Point was the key private actors involved in Srijana seed production (Table 1). An NGO, Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED) also had involvement in Srijana hybrid tomato seed production and technical supports to some of its farmers/farmers groups and cooperatives located in various districts for the production and marketing of Srijana tomato seed. Among the public sectors, Agriculture Research Station (ARS), Malepatan of NARC and Sub-tropical Vegetable Production Centre (SVPC), Rukum of Department of Agriculture (DoA) were involved in Srijana seed production. ARS, Malepatan produced seed itself within the station and also trained the women farmers in Kaski and Syangja district for production and marketing of Srijana seed. A farmer's group Puspanjali Seed Producer Group, Lalitpur in technical assistance of HRD, Khumaltar started Srijana tomato seed production since 2014.

Production Trend of Srijana Tomato Seed

Our data revealed an increasing trend of Srijana hybrid tomato seed production in the last 7 years (Figure 1). Although Srijana hybrid was formally registered in 2010, technology testing and seed production activities were initiated by HRD Khumaltar since 2005 with technical supports and parental lines to beneficiary farmers (eight women farmers) in Syangja and Kavre and successfully produced small quantity of seed in 2007 (Nepal SIMI 2007). Similarly, Gorkha Seed Company started commercial production of Srijana seed since 2007/08. With the formal registration of Srijana hybrid tomato, other actors also gradually emerged and started commercial seed production after formal agreement with HRD, Khumaltar. In 2007, only about 0.24 kg of Srijana hybrid seed was produced and supplied in the market, but the production and marketing increased to 293 kg in 2013/14 equivalent to about 47 million Nepalese Rupees (NRs) revenue generation.

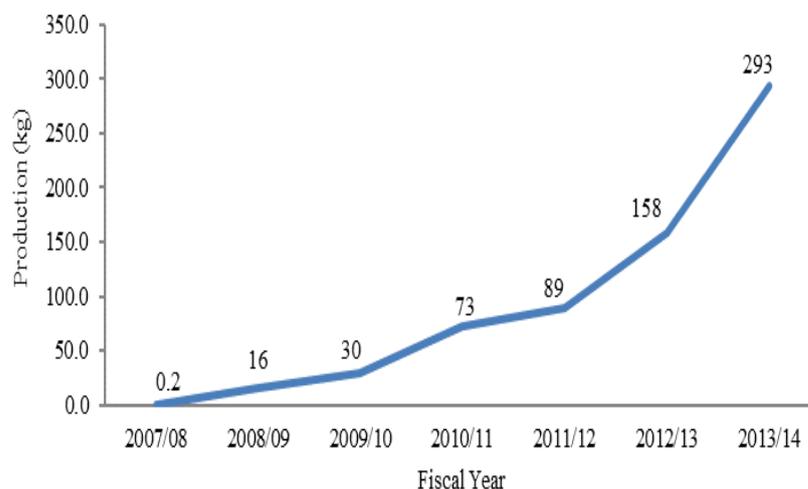


Figure 1. Trend of Srijana hybrid tomato seed production in Nepal.

Share of Actors in Srijana Hybrid Seed Production

Among the various actors involved in Srijana seed production, Gorkha seed company was the major actor producing more than half (55%) of the total seed produced in the country in the year 2013/14 (Figure 2). Other actors such as SEAN Seed Company, CEAPRED, and Anamol Seed Company shared about 19%, 10%, and 5% of the total seed production, respectively. While Agroshala Nepal, Mero Agro Limited, and Puspanjali seed producer group each shared about 3% of the total seed production. ARS, Malepatan shared about 1% while Kasthamandap Trade Point and one of the public farms Sub-tropical Vegetable Production Centre (SVPC), Rukum each shared less than 1% of the total Srijana seed production.

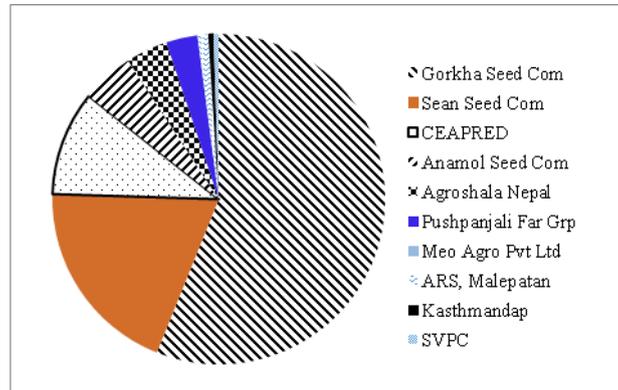


Figure 2. Share of actors in Srijana hybrid tomato seed production in Nepal.

Gorkha seed company, a dominant actor for Srijana seed production and marketing has recently introduced and promoted Samjhana and Sarita hybrid varieties of tomato exclusively in the market. With its increased focus on promotion of these new varieties, its share on Srijana tomato seed production is more likely to decline considerably in the future and the total production of Srijana seed also may go down unless other actors increase their volume of Srijana seed production or get involved in its seed production.

Price Trend of Srijana Hybrid Tomato Seed in Nepal

Srijana tomato seed had the highest price among the vegetables formally developed and registered in Nepal. The study revealed a gradual increase in the price of Srijana tomato seed over the years. During the initial year of Srijana seed production (FY 2007/08), the price per kilogram (kg) was around 80,000 NRs, which gradually increased over the years and reached to NRs. 160,000/kg in FY 2013/14 (Figure 3). There was varying price for Srijana seed for different seed producers in the market. The retailing price for Srijana seed produced and supplied by Gorkha Seed company was the highest (NRs. 175,000/kg) followed by Agroshala seed company (NRs. 165,000/kg), and Anamol seed company (NRs. 162,500/kg), respectively. There was similar price (NRs. 150,000/kg) for Srijana seed produced and supplied by SEAN Seed Company, Mero Agro Limited, Kasthamandap Trade Point and other seed dealers who marketed the seed obtained through farmers assisted by governmental and non-governmental organizations.

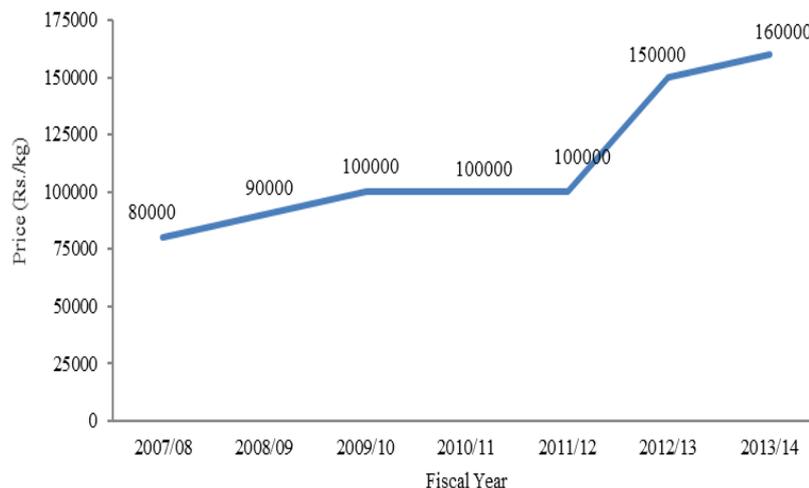


Figure 3. Trend of price (Rs./kg) of Srijana hybrid tomato seed in Nepal.

Value Chain Map, Marketing Practice, and Marketing Margin of Srijana Tomato Seed

Several actors were involved in the seed value chain of Srijana tomato. The major actors involved in seed value chain of Srijana tomato include public agencies, private seed companies/dealers/suppliers, NGOs and farmers groups and the individual farmers who perform various functions such as input supply, production, processing, collection, wholesaling and retailing of the Srijana seed (Figure 4).

Input supply: Parental lines including technical training services and other inputs such as fertilizer, irrigation and tools/equipments are essential for the production of Srijana tomato. HRD, Khumaltar being a public and mother organization for developing Srijana tomato technology holds an ownership and authority to provide inputs such as Srijana parental lines and technical trainings to the Srijana seed producers. HRD had developed Memorandum of Understanding (MoU) and supplied parental lines to all the Srijana seed producers and also provided technical backstopping to the seed producers except Gorkha Seed Company (Table 2). There was a linkage and coordination gap between HRD and Gorkha Seed Company. Gorkha Seed Company was found to be maintaining the parental lines of Srijana tomato itself and using them for the seed production although it is legally questionable. Public agencies and NGOs also provided technical trainings and parental lines obtained through HRD to their seed producer farmers.

Table 2. Production and supply of Srijana parental lines from HRD, Khumaltar in last three years

Fiscal year	Total quantity of parental lines provided to seed producers (kg)	Number of actors obtaining parental lines from HRD
2014	0.394	8
2013	0.230	6
2012	0.059	4

Source: HRD 2014, HRD 2013, HRD 2012

Production and Processing: Public agencies (research stations and farms), private seed companies, non-governmental organizations, and farmers/farmers groups were the major actors involved in Srijana tomato seed production. Overall, private sector was the dominant actor having the largest share (85.2%) in Srijana seed production followed by NGO (10.4%), farmers group (3.1%) and governmental station/farms (1.4%), respectively. There was a practice of processing the seed manually by all the seed producers.

Collection and Packaging: After processing, private sectors often had a practice of doing seed testing, truthful labeling and packaging activities by themselves and then the seed was supplied to wholesaling agro-vets, and retailing agro-vets and ultimately to the tomato vegetable growing farmers. While there were a number of emerging private firms (Pokhara Seed Company, NEMACOL, Live Seed) and agro-vets who had a practice of collecting the seed produced by the farmers associated with governmental research station/farm and NGOs and selling it in the market after testing, packaging and labeling.

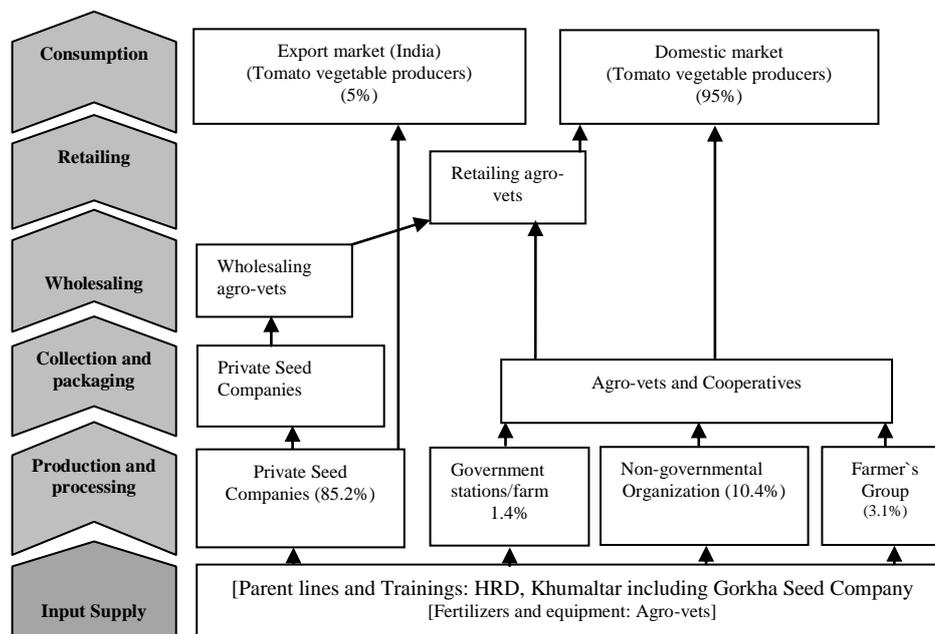


Figure 4. Value chain map of Srijana hybrid tomato seed.

Wholesaling, retailing, and marketing margins: Seed produced by private seed companies were mostly supplied in the market through the wholesaling agro-vets while retailers (agro-vets, seed dealers) supplied the seed produced by other actors in the market. About 95% of the total seed produced in Nepal in FY 2013/14, was consumed within the country, while about 5% was exported to India. Gorkha Seed Company was the only one actor to export a part of its seed to India (Sikkim) and insisted that they have a growing demand for Srijana tomato seed even in the international market.

Marketing margin is the difference between the value of a product or group of products at one stage in the marketing process and the value of an equivalent product or group of products at another stage. Due to the presence of a fairly good number of seed producers of Srijana tomato, agro-vets had an opportunity to choose the seed supplier and generate higher profit margins (Table 2). Based on the mode of seed collection/purchase, agro-vets/seed dealers obtained varying margins during marketing of Srijana tomato seed. The study revealed a marketing margin of about 17% to 25% taken by the agro-vets from selling of Srijana tomato seed collected from Private seed companies and the margin to them was higher (upto 56%) while collecting, packaging and selling the seed directly from farmers group or farmers assisted through public agencies and NGO (Table 3).

Table 3. Marketing margin for the actors involved in marketing of Srijana tomato seed

Actors producing Srijana tomato seed	Purchasing price of Srijana seed of different seed companies paid by the seed dealers (NRs./kg) (A)	Estimated marketing cost (transportation, cleaning, packaging) to the seed dealers (NRs./kg) (B)	Selling price of Srijana seed by the seed dealers (NRs./kg) (C)	Marketing margin of the seed dealers (NRs./kg) (C)-(A+B)
Gorkha Seed company	1,50,000	0	1,75,000	25,000 (17%)
Anamol Seed company	1,30,000	0	1,62,500	32,500 (25%)
SEAN Seed company	1,20,000	0	1,50,000	30,000 (25%)
Agroshala Company	1,40,000	0	1,65,000	25,000 (18%)
Farmers assisted by CEAPRED	80,000	15,000	1,40,000	62,000 (56%)
(Governmental stations (ARS and SVPC)/farmers assisted by them	1,00,000	15,000	1,50,000	35,000 (35%)
Puspanjali Farmers Group	90,000	15,000	1,50,000	52,000 (50%)

Note: Figure in parenthesis indicates percent share of marketing margin.

Farmer`s or Producer`s Share in Retail Price of Srijana Seed

Farmers share is the ratio of farm gate price to retail price of any product or commodity. It provides an important message on the gap between producer price and price paid by the consumers and can also be expressed as,

$$\text{Farmer`s or Producer`s Share (\%)} = (\text{Farm-gate price} / \text{Retail price}) \times 100$$

The study revealed a variation in the price received by the farmers for Srijana seed based on their mode of production and sale. The farmers producing seed with technical assistance of governmental organization obtained the higher price (NRs. 100,000/kg) followed by farmers producing seed in technical support of NGO (NRs. 800,00/kg) and in contractual arrangement with private seed company (SEAN seed) (NRs. 400,00/kg), respectively. Governmental and non-governmental organizations provided market linkage support to their seed producer farmers/groups and the buyers usually offered a higher price to the farmers/groups producing seed in technical assistance of such organizations as they had a higher trust on quality of such seed. Farmer`s share was found higher (66.6%) for Srijana seed produced by the farmers in technical assistance with governmental stations followed by farmers selling seed through own groups (60%), farmers assisted by NGO (53.3%) and contracted with the private seed companies (26.7%), respectively. There was a huge gap between the price received by the producers and price paid by the consumers (seed users) particularly for the farmers associated with the private seed company. Private seed companies had higher tendencies of making higher profit at the expense of farmers and paying unfairly to their contracted farmers for seed production. Majority of the seed producing farmers were also not satisfied with the price received from such seed company and such an unfair profit distribution is likely to effect on the sustainability of Srijana seed business.

Economics of Srijana Tomato Seed Production

Srijana seed was produced by different actors with different management practices. There was varying management options such as size of plastic tunnel, use of inputs, and intercultural operations practices by different actors across the locations. This study generated information on economics of Srijana seed production based on the cost and benefits associated with Srijana seed production in a plastic tunnel (12m x 5m =60 m²) in farmers field of Kavre district (Table 4). While calculating benefit cost of the Srijana seed production, cost for the durable items such as plastic for tunnel preparation and other materials have been calculated taking their depreciation value (considering their expected life of 4 years).

Srijana tomato hybrid seed production is though a painstaking job, the study revealed it as one of the important option for employment and income generation to the farmers. More importantly, it was the women who were mostly involved in Srijana tomato seed production and their involvement in production and marketing practices of Srijana seed was also helpful for their socio-economic empowerment. While producing Srijana tomato seed, 81% of the total cost was incurred in labor followed by tools/equipment (11%) and inputs (8%), respectively. It is estimated that an employment for 80 labor days is generated for producing about 1 kg of Srijana tomato seed. It is estimated that farmers can generate an income of about 0.3million NRs (US\$ 3,000) from one ropani (about 500 m²) of land area. The average production of seed in a plastic tunnel (12*5 square meters) is about one kilogram.

Table 4. Economics of Srijana tomato seed production in a plastic tunnel (12m x 5m = 60 m²)

Particulars	Amount (NRs.)
Input cost: seed (parent lines), chemical fertilizers, FYM/Compost, Micronutrients and pesticides	3,395
Labour cost: tunnel and field preparation, intercultural operations, crossing activities, harvesting, seed extraction, cleaning, drying, packaging and marketing	32,800
Tools/equipment cost (after depreciation): plastics, bamboo poles/sticks, jute ropes, irrigation tank and pipes, sprayer, forceps, scissors, petridish	4,450
Total cost	40,645
Average production of seed	1 kg
Price per kg of seed	80,000
Net profit from seed production	39,355
Benefit-cost ratio	1.96

Quality Constraints Associated with Production of Srijana Tomato Hybrid Seed

Srijana is one of the most popular varieties of tomato among the farmers in Nepal. The demand and supply of the seed of this variety is increasing gradually; however, majority of the farmers showed their concern on supply of poor quality Srijana seed in market resulting into economic loss and their declining trust on Srijana variety seed. There was involvement of wide range of actors in Srijana seed enterprise with varying skills, knowledge and capacity. In such circumstances, it seems complex to manage the quality seed production unless the quality control mechanisms are effective. The present quality control mechanisms and regulations such as field inspections, seed testing, and seed certifications from the public sector are known to be very poor and less effective. Moreover, the seed producers do not have easy access to seed testing services particularly in the hill and mountain regions. The seed certification and quality assurance practice from formal sector agencies is also poorly adopted for vegetable seeds. Similarly, there is also very limited capacity building and other support activities to Srijana seed actors by the public sector. Such conditions provide space for production and supply of poor quality seed and that eventually effects on trust of farmers towards the technology or Srijana variety. Therefore, it is very necessary to take initiatives and measures (such as field inspection, seed testing and certification, public-private-community linkages or partnerships, monitoring and capacity building of the seed producers and suppliers) to enhance the quantity and quality of Srijana seed production. The seed producing actors are facing the problems of limited access to the parental lines including poor availability of skilled human resource for crossing of parental lines, and increasing incidence of diseases hindering quality production of Srijana seed. The HRD, Khumaltar supply parental lines only to publically recognized organizations such as private seed companies or NGOs. Srijana parental lines are not supplied to every individual farmer interested in its seed production and other informal organizations. Such policy of the public agencies has prevented the access of many interested farmers to the parental lines for commercial Srijana tomato seed production. Therefore, apart from ensuring seed quality control mechanisms and capacity building activities, it is necessary to develop regulatory measures to enable easy access and availability of Srijana parental lines for assuring the sustainable and efficient production and supply of Srijana hybrid tomato seed.

CONCLUSIONS AND RECOMMENDATIONS

Tomato is one of the top vegetables grown in Nepal. To support the increased production and productivity of tomato in the country, NARC has developed Srijana tomato hybrid, which embraces various attributes that are increasingly preferred by the farmers and is increasingly becoming popular among the farmers and entrepreneurs. The present study revealed an increasing production, supply and price of Srijana seed over the years. Farmers and entrepreneurs involved in production and marketing of Srijana seed also received high price and profit margins from Srijana hybrid seeds. Although, several actors were involved in Srijana seed production, private sector had the largest share in Srijana hybrid seed production and marketing. The increased production and supply of Srijana tomato seed has undoubtedly contributed in increasing employment and income generation and import substitution of the tomato hybrids. However, due to poor quality control measures, concerns on quality of Srijana seed are increasing. On the other hand, poor access and availability of the parental lines, limited skilled human resources and limited support from the public agencies to the hybrid seed producers are limiting the production of quality Srijana hybrid seed in its full potential. Therefore, it is very necessary to strengthen seed quality control mechanisms and developing human resources for assuring quality production of Srijana hybrid tomato seed. One of the options would be to develop mechanism by public sector research and development (R & D) agencies for increased production and genetic purity maintenance of the parental lines, regular monitoring of hybrid seed production and marketing assuring quality testing services in rural hills and remote locations. Similarly, strengthening linkage and partnership among public and private agencies including farmers is also vital for enabling easy access and quality use of parental lines by the seed producers and assuring sustainable hybrid seed production and supply in Nepal.

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