RAJASTHAN AGRICULTURAL COMPETITIVENESS PROJECT

Value Chain Analysis

Potato

Prepared by:

Grant Thornton
An instinct for growth™

AGRI BUSINESS PROMOTION FACILITY
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Executive Summary: Potato

Potato is a cool-season vegetable which is at par with wheat and rice, as one of the most important staple crop in the human diet around the world. Potato is a specialized underground storage stem called "tuber." According to FAO, potato is consumed by more than one billion people around the world. It is a high quality vegetable cum food crop used in preparation of more than 100 types of recipes in India. The protein of potato has high biological value than proteins of cereals and milk.

It is utilized in variety of ways, such as preparation of chips, wafers, flakes, flour, starch, potato-custard powder, soup or gravy thickener and pan cake as a processed food, being one of the principal cash crop, gives handsome returns to the growers/farmers due to its demand nationally and internationally for different kinds of utilization.

It is grown in more than 100 countries in the world. At present, China, Russia, India, Poland and U.S.A. contribute to a major share of the total world production. China was the largest producer of potato in 2015 with an annual production of 87,260,000 MT followed by India with less than half of the total potato produced by China. Asia and Europe are the world's major potato producing regions accounting for more than 80 percent of world production. USA, Russia & Germany are the other potato producing countries.

Netherlands, France Germany and China are the major exporter of Potato worldwide. The countries which majorly export prepared or preserved potatoes worldwide include Netherlands, Belgium, USA and Canada. The E.U, United States and China are the major importers of Potatoes in the world.

Potato is one of the main commercial crop grown in India and has emerged as fourth most important food crop after rice, wheat and maize. The dry matter, edible energy and edible protein content of potato makes it nutritionally superior vegetable as well as a staple food throughout the world. Being a short duration crop, its production is more than that of cereals like rice and wheat. Being a bumper crop, lack of post-harvest management, glut situations arises in the market due to the surplus yield every year resulting in the decline of the prices drastically.

Potato is grown in almost all the states of India. The major potato growing states are Himachal Pradesh, Punjab, Uttar Pradesh, Madhya Pradesh, Gujarat, Maharashtra, Karnataka, West Bengal, Bihar and Assam. The state of UP, West Bengal, Bihar and Punjab together account for about 86% of India’s total production. It has been reported by the International Food Policy Research Institute (IFPRI) and International Potato Centre (CIP) that India is likely to have highest growth rate of potato production and productivity during 1993 to 2020. During the same period demand for potato is expected to rise by 40% worldwide.

In Rajasthan, Potato is grown in approximately 10,000 ha of land as vegetables and occupies nearly 0.5% of the total area in the country. The crop is grown by many vegetable growers for local household consumption either in very small area or in kitchen gardens. The contribution is totally rain-fed, under such harsh conditions where soil and water along with climate pose a great threat to
cultivation. The production can be increased to touch the national status if managed properly by following improved agronomic practices under changing climate and global warming situations. Potato is grown in almost all districts excluding Barmer, Jaisalmer and Jodhpur. The major potato producing districts are Dholpur, Bharatpur, Sri Ganganagar, Kota, Sirohi, Jhalawar etc. in the state.

The major commercial varieties of Potato being cultivated in the State are Kufri Badshah and Kufri Pukhraj. The planting period for potato is January/February and are harvested in the month of July/August

Table 1: The SWOT analysis of the Potato value chain may be considered as follows

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>• India is the second largest producer of potato, after China, in the world</td>
<td>• Non-availability of improved &amp; good quality planting material</td>
</tr>
<tr>
<td>• Almost a third of all potatoes in the world is harvested in China and India</td>
<td>• Lack of washing, grading and storage facilities</td>
</tr>
<tr>
<td>• The major potato growing states are Uttar Pradesh, West Bengal, Punjab, Bihar, Haryana, Madhya Pradesh, Gujarat and Maharashtra</td>
<td>• Low market price during harvest time affect value accruals to producers</td>
</tr>
<tr>
<td>• The major districts in Rajasthan producing potato area include Dholpur</td>
<td>• Non-availability of reliable insecticide/fungicide</td>
</tr>
<tr>
<td>• Dholpur is 55 km from Agra which is considered as a potato HUB of India.</td>
<td>• Inadequate infrastructural facilities with producers, traders, processors and at market level results in marketing inefficiencies</td>
</tr>
<tr>
<td>• Availability of many private cold storages around Agra will facilitate potato storage</td>
<td>• Limited value added processing units in the region for potato and its by-products such as potato chips units</td>
</tr>
<tr>
<td>• Potato is a major vegetable (in-fact an essential ingredient in daily food intake) among most Indians, whether rich or poor.</td>
<td>• Inadequate grading &amp; sorting facilities</td>
</tr>
<tr>
<td></td>
<td>• Cloudy weather, rainfall at the time of flowering and seed formation (adverse weather conditions)</td>
</tr>
<tr>
<td></td>
<td>• Infestation of insect-pest &amp; other diseases</td>
</tr>
<tr>
<td></td>
<td>• Heavy rains may damage the crop</td>
</tr>
<tr>
<td></td>
<td>• Bumper production results in lower mandi price where as poor production increases seed prices.</td>
</tr>
</tbody>
</table>

Opportunities

- Scope of establishment of FCSC for potato sorting, grading at cluster level
- Scope of formation of FPC which can take up onward marketing from cold storage
- Scope of direct marketing to large mandis across north India
- Scope for tie up of PCs through FCSC’s with firms like Patanjali, Pepsico, Fritolay etc.
- Scope for tie up of PCs through FCSC’s with potato processing units/ MSME firms
- Scope for facilitation of start-ups from amongst FPC/s members or individual entrepreneurs, in secondary processing of value added products of Potato like chips, potato fingers, etc.
- Scope of establishing cold storage by FPC/s as a part of FCSC’s.
- Promote good agricultural practices with regard to planting, harvesting, use of
Value chain analysis: Potato

<table>
<thead>
<tr>
<th>Activity</th>
<th>Value per Quintal (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retailing: Sale by retailer to consumer</td>
<td>About Rs. 1000 per quintal which makes a profit margin of 17% (Incl of transport, Labor)</td>
</tr>
<tr>
<td>City mandi: Sale to retailers</td>
<td>Rs. 742 per quintal with a margin of 9%</td>
</tr>
<tr>
<td>Sale from Cold store To whole seller in City F7V mandi</td>
<td>Rs. 681 per quintal (Gross value on sale with net profit margin 9.5%, 4% mandi tax)</td>
</tr>
<tr>
<td>Production: Sale to trader after storing for six months in mandi) Cost of production is Rs. 67600 per acre</td>
<td>Rs. 600 per quintal (Gross value on sales is Rs 600/qtl, Cost is Rs 422/qtl and Profit is Rs 177/qtl)</td>
</tr>
</tbody>
</table>

Table 2: The price spread along with margin at every stage of value chain starting from the farmer till retailer

Pre and Post-Intervention Value Chain of Potato

- **Pre Intervention Value Chain: Potato**

The present pre-intervention or value chain for Potato may be viewed as one with two critical production-distribution or activity-marketing channels. The product is largely marketed by farmers through the APMC, local vendors and private food processors. Channel 1 may be viewed in terms of one for the table variety and other for the processed products of Potato like chips, wafers, flakes, flour and starch, etc. The producers market their produce in both value chains through local traders and APMC Commission agents. It is estimated that about 2.8-10% of perishable agricultural products like potatoes are lost after harvesting which are harvested at the onset of summer season. About 50% of these losses can be prevented using appropriate post-harvest measures.

- **Indicative Post Intervention Value Chain: Potato**

The post intervention value chain map for Potato may be visualised as one which is facilitated through a Farmer producer company, purely farmer’s association which would directly procure from the farmers, then take it forward in the value chain instead of local traders and middlemen. The marketing channels would be for raw Potato and value added products of Potato like chips, wafers, flakes, flour and starch, etc. It is also envisaged that PCs of producers with FCSCs is evolved. Such FCSCs undertakes cold storage, washing, grading and sorting and packaging of produce activities. These FCSCs may offer other related services in terms of input facilitation, custom hiring, facilitating B2B connectivity etc. Farmers’ income from Potato cultivation may be enhanced. Presently, the gross average yield per acre is 160 quintals per acre. The average market rate of sale is about Rs.400 per quintal or Rs.64, 000 per acre. The average cost of cultivation is about Rs.28, 856 per acre. The net realization is Rs 34, 144 per acre. Other than good harvest practices, input facilitation (high seed prices during cropping season) needs to be provided.disseminated amongst farmers.

The constraints and intervention plan may be considered in context to 3 stages/activities. These are production, post-harvest and processing stage. The constraints may be viewed in terms of pest and fungus attack in crops and use of obsolete farming technologies by small and marginal farmers. It may be addressed through the provision of providing seeds of resistant varieties to producers through an envisaged FCSC/s, which in addition to input facilitation may also provide custom
hiring services. At the post-harvest stage, critical constraints may be viewed in terms of inadequate cold storage facilities and large no. of intermediaries in the value chain which can be corrected through PCs facilitating service. At the processing stage, due to limited processing units in the regions and state into producing value added Potato products including Potato chips, flakes, flour, starch, etc. Appropriate start-up counselling may address the issue.

<table>
<thead>
<tr>
<th>Sr.no</th>
<th>Constraints</th>
<th>Action</th>
<th>Action by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Many times seed prices rise very high due to speculation during sowing time.</td>
<td>Seed production program using sources of Raj seeds through FPC</td>
<td>FPC/s with support from RACP</td>
</tr>
<tr>
<td>1.2</td>
<td>Many farmers use local seeds for more than 3-4 years causing problems in germination and yield.</td>
<td>FPC to take up seed and other agri input distribution for member farmers</td>
<td>FPC with support from RACP</td>
</tr>
<tr>
<td>1.3</td>
<td>Blight attack can damage the crop</td>
<td>Seed treatment, soil treatment chemicals through FPC</td>
<td>FPC with support from RACP &amp; ABPF</td>
</tr>
<tr>
<td>1.4</td>
<td>Limited awareness about processing varieties of potato varieties like, chipsona which could be cultivated in local climate.</td>
<td>To promote both table purpose varieties and processing purpose varieties</td>
<td>FPC with support from RACP</td>
</tr>
<tr>
<td>2</td>
<td>Post-harvest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Lack of proper grading facility</td>
<td>To make farmer aware about quality parameter of potato for processing like value added products; grading facility as part of FCSC</td>
<td>FPC with support from RACP &amp; ABPF</td>
</tr>
<tr>
<td>2.2</td>
<td>Contractual harvesting of potato</td>
<td>Setting up alternate channel to sell directly from FPC to processor or large retail shops.</td>
<td>FPC with support from RACP &amp; ABPF</td>
</tr>
<tr>
<td>2.3</td>
<td>Due to same harvesting time prices Collapse and hence storage/pack house option could help reduce distress sale.</td>
<td>Storage facility/ mini cold storage for farmers as part of FCSC</td>
<td>FPC with support from RACP &amp; ABPF</td>
</tr>
<tr>
<td>3</td>
<td>Processing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Lack of pre cooling and cold storage facility in the cluster</td>
<td>Setting up pre cooling and/or cold storage facility as part of FCSC or individual enterprise or start ups</td>
<td>FPC with support from RACP &amp; ABPF</td>
</tr>
<tr>
<td>3.2</td>
<td>Limited processed product available in the market which limits the marketing potential of the commodity</td>
<td>Facilitate the entrepreneur development to set up small scale processed product like chips, potato powder, potato biscuits, granules etc. and frozen foods like potato patties, puffs, wedges, pancakes etc</td>
<td>DOA</td>
</tr>
</tbody>
</table>
Chapter-1 Introduction

Origin and Importance

The potato was originally believed to have been domesticated independently in multiple locations, but later genetic testing of the wide variety of cultivars and wild species proved a single origin for potatoes in the area of Southern Peru and extreme northwestern Bolivia (from a species in the Solanum brevicaule complex), where they were domesticated approximately 7,000–10,000 years ago. The local importance of the potato is variable and changing rapidly. It remains an essential crop in Europe (especially eastern and central Europe), where per capita production is still the highest in the world, but the most rapid expansion over the past few decades has occurred in southern and eastern Asia. By 2007 China led the world in potato production, and nearly a third of the world's potatoes were harvested in China and India.

Potato is a cool-season vegetable that ranks with wheat and rice as one of the most important staple crops in the human diet around the world. The white potato is referred to as the "Irish potato" because it is associated with the potato famine in Ireland in the 19th century. Potatoes are not roots but specialized underground storage stems called "tubers." Maximal tuber formation occurs when the soil temperature is between 60°F and 70°F. The tubers fail to form when the soil temperature reaches 80°F. Potatoes can withstand light frosts in the spring and can be grown throughout the country in the cooler part of the growing season, but prefer the northern tier of states for maximal yield and quality.

According to FAO, potato is consumed by more than one billion people around the world. It is a high quality vegetable cum food crop used in preparing more than 100 types of recipes in India. The popular Indian recipes like Samosas and Aloo Paranthas are prepared from potato. The protein of potato has high biological value than proteins of cereals and milk. The biological value of mixture i.e. egg and potato is higher than that of egg. Due to this potato can be supplement for meat and milk products for improving taste, low energy intake and low cost. From the nutritional perspective potato is a wholesome food and deserves to be promoted as a potential quality vegetable cum food crop in the country.

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2https://www.potatogoodness.com/potato-fun-facts-history/

3https://extension.illinois.edu/veggies/potato.cfm
Figure 1: The potato conquest of the world

The potato conquest of the world

World conquering tuber from the Andean mountains

By the 1640s the potato was the only staple crop in Ireland, this led to disastrous consequences in the 1845 potato famine

European planted the first potatoes in North America in the 18th century

Spanish conquers of South America took the tuber back in the 16th century, mostly as a curiosity

Dutch traders introduced potatoes into South Africa in the 17th century

Potatoes had reached India by the 17th century mostly likely on Portuguese ships

Captain James Cook carried potatoes on his ship when he claimed Australia for Britain in 1770

Nutritive Value:
The constituents of potato per 100 grams
- Water: 74.70g
- Carbohydrates (Starch and Sugar): 22.60g
- Proteins: 1.60g
- Fibre: 0.40g
- Fat: 0.10g
- Minerals: 0.60g

The Minerals and Vitamins as available in Potato are given below (In grams):
- Calcium: 7.7g
- Copper: 0.15g
- Iron: 0.75g
- Magnesium: 24.2g
- Phosphorus: 40.3g
- Potassium: 568.0g
- Sodium: 6.5g
- Vitamin C: 14.0 – 25.0g
- Thiamine: 0.18g
- Riboflavin: 0.01-0.07g
- Niacin: 0.4 –3.1g
- Total Folate: 5.0-35.0g
- Pyridoxine: 0.13-0.25g

\[ https://authoritynutrition.com/foods/potatoes/ \]
It is utilized in variety of ways, such as preparation of chips, wafers, flakes, flour, starch, potato-custard powder, soup or gravy thickener and pancake as a processed food. It is one of the principal cash crop which gives handsome returns to the growers/farmers due to its demand nationally and internationally for different kinds of utilization. Further it has been reported by the International Food Policy Research Institute (IFPRI) and International Potato Centre (CIP), India is likely to have highest growth rate of potato production and productivity during 1993 to 2020. During the same period demand for potato is expected to rise by 40% worldwide.

1.1. Global scenario
Potato, popularly known as 'The king of Vegetables' is a major food crop grown by more than 100 countries in the world. Presently China, Russia, India, Poland and U.S.A. contribute to a major share of the total world production. Potato is one of the main commercial crop grown in India and has emerged as fourth most important food crop after rice, wheat and maize. The dry matter, edible energy and edible protein content of potato makes it nutritionally superior vegetable as well as being a stable food throughout the world. It has become an essential part of the breakfast, lunch and dinner worldwide. Being a short duration crop, its production is more than that of like rice and wheat. Being a bumper crop, lack of post-harvest management results in glut situations in the market because of the surplus yield every year resulting in the decline of the prices drastically5.

China was the largest producer of potato in 2015 with an annual production of 87,260,000 MT followed by India with less than half of the total potato produced by China. Asia and Europe are the world's major potato producing regions accounting for more than 80 percent of world production. USA, Russia&Germany are the other potato producing country.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Area</th>
<th>Production (Int $1000)</th>
<th>Production (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>11,470,356</td>
<td>87,260,000</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>7,082,050</td>
<td>41,483,000</td>
</tr>
<tr>
<td>3</td>
<td>United States of America</td>
<td>2,987,382</td>
<td>20,990,738</td>
</tr>
<tr>
<td>4</td>
<td>Russian Federation</td>
<td>2,793,937</td>
<td>29,532,530</td>
</tr>
<tr>
<td>5</td>
<td>Germany</td>
<td>1,665,632</td>
<td>10,665,600</td>
</tr>
<tr>
<td>6</td>
<td>Ukraine</td>
<td>1,598,029</td>
<td>23,250,200</td>
</tr>
<tr>
<td>7</td>
<td>Bangladesh</td>
<td>1,312,276</td>
<td>8,205,470</td>
</tr>
<tr>
<td>8</td>
<td>Netherlands</td>
<td>1,038,951</td>
<td>6,765,618</td>
</tr>
<tr>
<td>9</td>
<td>Poland</td>
<td>989,377</td>
<td>9,091,900</td>
</tr>
<tr>
<td>10</td>
<td>France</td>
<td>972,314</td>
<td>6,340,807</td>
</tr>
</tbody>
</table>


6http://www.mapsofworld.com/world-top-ten/potato-producing-countries.html
The above presented countries contributed 87% of the fresh potatoes exports in 2015. The countries that increased their export value of potato shipments since 2011 were Lebanon (up 214%), India (up 47.2%), China (up 32.9%) and Spain (up 5.1%).

Table 4: Potato Export Share by major countries: Raw

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Countries</th>
<th>Export(In million US$)</th>
<th>Percentage Share(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Netherlands</td>
<td>604.2</td>
<td>18.2</td>
</tr>
<tr>
<td>2</td>
<td>France</td>
<td>459.2</td>
<td>13.8</td>
</tr>
<tr>
<td>3</td>
<td>Germany</td>
<td>275.8</td>
<td>8.3</td>
</tr>
</tbody>
</table>

Potatoes Exports by Country: Raw

The above presented countries contributed 87% of the fresh potatoes exports in 2015. The countries that increased their export value of potato shipments since 2011 were Lebanon (up 214%), India (up 47.2%), China (up 32.9%) and Spain (up 5.1%).
Potatoes Exports by Country: Prepared or Preserved

The frozen potatoes including French fries amounted to $5.8 billion in export sales for 2015, while international shipments of unfrozen potatoes were worth $2 billion.

Table 5: Export Share by Major countries: Prepared or Preserved

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Countries</th>
<th>Export (In US$)</th>
<th>Percentage Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Netherlands</td>
<td>1.4 billion</td>
<td>21.5</td>
</tr>
<tr>
<td>2</td>
<td>Belgium</td>
<td>1.4 billion</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>USA</td>
<td>1 billion</td>
<td>17.1</td>
</tr>
<tr>
<td>4</td>
<td>Canada</td>
<td>891.7 million</td>
<td>12.4</td>
</tr>
<tr>
<td>5</td>
<td>Germany</td>
<td>334.9 million</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>France</td>
<td>302.8 million</td>
<td>4.5</td>
</tr>
<tr>
<td>7</td>
<td>UK</td>
<td>153.3 million</td>
<td>2.9</td>
</tr>
<tr>
<td>8</td>
<td>Poland</td>
<td>113.5 million</td>
<td>2.5</td>
</tr>
<tr>
<td>9</td>
<td>Argentina</td>
<td>57 million</td>
<td>2.2</td>
</tr>
<tr>
<td>10</td>
<td>Spain</td>
<td>6.2 million</td>
<td>0.9</td>
</tr>
</tbody>
</table>

The countries presented in the table above shipped 92.8% of all prepared or preserved spuds in 2015. Among the above countries, the fastest-growing prepared or preserved potatoes exporters since 2011 were Malaysia (up 115.7%), South Africa (up 78%), Spain (up 52%) and United States (up 17.7%). Netherlands led the race of exporters in the international trade of both raw and processed spuds.

Table 6: Major Importers of potatoes

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Imports (In ‘000000$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>European Union (excluding intra-EU trade)</td>
<td>2,244,000.</td>
</tr>
<tr>
<td>2</td>
<td>United States</td>
<td>2,205,000.</td>
</tr>
<tr>
<td>3</td>
<td>China</td>
<td>1,437,000.</td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
<td>987,600.</td>
</tr>
<tr>
<td>5</td>
<td>Japan</td>
<td>629,800.</td>
</tr>
</tbody>
</table>

8)http://www.worldstopexports.com/potatoes-exports-by-country/
1.2. **Indian Scenario**

The potato reached India in the late 16th and early 17th century. India ranks second as the world's largest potato producing nation. Since 1990, per capita consumption has risen from around 12 kg to 17 kg per year. In India, Potato is not primarily a rural staple but a cash crop that provides significant income to the farmers. The value of the 2005 harvest is estimated at $3.6 billion representing exports of about 80,000 tonnes that year. Potato varieties suited to the country's climate - hot summers and short winters - are grown on the Indo-Gangetic plain during the short winter days from October to March while some year-round production took place in relatively high altitude areas in the South. In India, more than 80% of the potato crop is raised in the winter season (Rabi) under assured irrigation during short winter days. About 8% area lies in the hills where production takes place during long summer days from April to October. During rainy season (Kharif) potato is cultivated in Karnataka, Maharashtra, HP, J&K and Uttarakhand.

- **Summer Crop** - March - April - August - September
- **Autumn Crop** - August - September - December - January
- **Spring Crop** - January - February - May - June

### Table 7: Area-000' Hectares, Production- 000'Tonnes, Yield-Kg/Hectare

<table>
<thead>
<tr>
<th>Rank</th>
<th>States</th>
<th>Area</th>
<th>Production</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Uttar Pradesh</td>
<td>603.76</td>
<td>14430.28</td>
<td>23901</td>
</tr>
<tr>
<td>2</td>
<td>West Bengal</td>
<td>386.61</td>
<td>11591.3</td>
<td>29982</td>
</tr>
<tr>
<td>3</td>
<td>Bihar</td>
<td>322.5</td>
<td>6640.6</td>
<td>20593</td>
</tr>
<tr>
<td>4</td>
<td>Gujarat</td>
<td>81.27</td>
<td>2499.73</td>
<td>30758</td>
</tr>
<tr>
<td>5</td>
<td>Madhya Pradesh</td>
<td>108.87</td>
<td>2299</td>
<td>21117</td>
</tr>
<tr>
<td>6</td>
<td>Punjab</td>
<td>85.25</td>
<td>2132.31</td>
<td>25012</td>
</tr>
<tr>
<td>7</td>
<td>Assam</td>
<td>99.77</td>
<td>975.27</td>
<td>9775</td>
</tr>
<tr>
<td>8</td>
<td>Karnataka</td>
<td>44.4</td>
<td>698.3</td>
<td>15727</td>
</tr>
<tr>
<td>9</td>
<td>Haryana</td>
<td>29.47</td>
<td>676.01</td>
<td>22939</td>
</tr>
<tr>
<td>10</td>
<td>Jharkhand</td>
<td>47.21</td>
<td>659.61</td>
<td>13972</td>
</tr>
</tbody>
</table>

Potato is grown in almost all the states of India. The major potato growing states are Himachal Pradesh, Punjab, Uttar Pradesh, Madhya Pradesh, Gujarat, Maharashtra, Karnataka, West Bengal, Bihar and Assam. The state of UP, West Bengal, Bihar and Punjab together account for about 86% of India’s production. However, potato consumption per capita in India (14.8 kg/head/year) is the lowest in the world with not more than 1% of the potato is processed.

Potato is grown in different part of the country depending on the climate condition best suited for the said varieties. i.e. hot summers and short winters - are grown on the Indo-Gangetic plain during...
the short winter days from October to March, while some year-round production takes place in relatively high altitude areas in the south.

The graph presented below shows the trend of major potato producing states in India. Uttar Pradesh and West Bengal contribute 50% to the total potato produced in the country.

**Figure 4: Potato production in India**

![Potato production in India](image)

Source: NHB

**Figure 5: Pictorial representation of potato production in the country**

![Pictorial representation of potato production in the country](image)

Potatoes are grown as a short-duration winter crop between the main summer and fall cereal crops throughout the Indo-Gangetic plain of India. The expansion of potato production since the 90s has been made possible by several factors. These includes the increased availability of high quality seed due to development of the 'seed plot technique' which significantly reduced increase transmission; the breeding and diffusion of high yielding potato varieties, the expansion of cold storage facilities and the introduction of short duration cereal varieties that are incentives to day length. These cereal varieties enable new, cereal/potato multiple cropping system to be developed in irrigated areas. Advanced potato production technology and availability of adequate cold storage capacity made high yielding, decrease-free seed, available on a much larger scale than was previously possible.

Expansion of cold storage capacity also encouraged further production by extending the market for table potatoes in the off-season.

**Export**

The month of November 2016 saw India exporting Fresh-Potato worth USD 205,859.12 while Sri Lanka being the largest importer of Fresh-Potato accounting for exports worth USD 124,742.30 followed by Seychelles and United Arab Emirates which imported Fresh-Potato worth USD 44,366.00 and USD 27,163.48 respectively.

**Figure 7: Pictorial Representation of world export from India**

![Diagram showing export distribution](image)

1.3. **State Scenario**

Potato is grown in almost all districts excluding Barmer, Jaisalmer and Jodhpur. The total area under potato crop in the state is 2,412 Hectares with a production touching 27,797 tonnes. The Bharatpur region has the maximum area (1,442 ha) under potato crop followed by Sri Ganga Nagar region of the state.

The major potato producing districts are Dholpur, Bharatpur, Sri Ganganagar, Kota, Sirohi, Jhalawar etc. in the state.

**Table 8: Major Potato producing districts**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>District</th>
<th>Area</th>
<th>Prod</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DHOLPUR</td>
<td>8728</td>
<td>148400</td>
</tr>
<tr>
<td>2</td>
<td>BHARATPUR</td>
<td>3289</td>
<td>51381</td>
</tr>
<tr>
<td>3</td>
<td>HANUMANGARH</td>
<td>585</td>
<td>11684</td>
</tr>
<tr>
<td>4</td>
<td>SIROHI</td>
<td>284</td>
<td>8520</td>
</tr>
<tr>
<td>5</td>
<td>KOTA</td>
<td>235</td>
<td>2820</td>
</tr>
<tr>
<td>6</td>
<td>SRIGANGANGAR</td>
<td>265</td>
<td>1150</td>
</tr>
<tr>
<td>7</td>
<td>JHALAWAR</td>
<td>140</td>
<td>1082</td>
</tr>
<tr>
<td>8</td>
<td>BUNDI</td>
<td>155</td>
<td>1051</td>
</tr>
</tbody>
</table>
1.4. District and cluster scenario: Production

Potato is sown in 180 ha in Bari and its cropping intensity is 4.69% of the total cropped area. The total production in the cluster is 4500 MT. The productivity of the cluster is 25000 kg per ha and is higher than the district average of 12279 kg/ha i.e. 12721 kg higher than the district average. The proposed area of potato is planned to be increased to 250 ha after watershed development i.e. an increase of 70 ha. The cost economics of potato is as under.

Table 9: Economics of Potato

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Cost of cultivation (Rs./acre)</th>
<th>Productivity (Qtl/acre)</th>
<th>Selling Price (Rs./Qtl)</th>
<th>Revenue (Rs./acre)</th>
<th>Net surplus (Rs./acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato</td>
<td>28800</td>
<td>160</td>
<td>400</td>
<td>64,000</td>
<td>35,200</td>
</tr>
</tbody>
</table>

Table-9.1: Area, Production and marketable surplus in cluster

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Area (Ha)</th>
<th>Production (MT)</th>
<th>Marketable surplus (MT)</th>
<th>Value of surplus</th>
<th>marketable surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bari</td>
<td>180</td>
<td>2880</td>
<td>2736</td>
<td>164 lacs</td>
<td></td>
</tr>
</tbody>
</table>
Table-9.2: Resource mapping for Potato value chain in Bari

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Major mandi/s around cluster</th>
<th>No of FPCs targeted</th>
<th>Nearby cold store with capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bari</td>
<td>Dholpur – 30 km, Agra – 89 km, Bharatpur – 90 km</td>
<td>2</td>
<td>Dholpur – 4505 MT Lots of private cold stores around Bharatpur and Agra</td>
</tr>
</tbody>
</table>

1.5. Approach to Value Chain Analysis

Approach
In order to evaluate the value chain of Potato, consultations were held with major stakeholders in the chain including farmers, Consumers, Processors, traders, supporting public and private service providers and institutions etc. in various parts of the state. Major Potato producing clusters considered for survey within Rajasthan.

Table 10: Surveyed Major markets for the Value chain Analysis of Potato

<table>
<thead>
<tr>
<th>Surveyed Markets for the Value Chain Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within and Outside Rajasthan</td>
</tr>
<tr>
<td>1. 10 Farmers of Baari, Dholpur</td>
</tr>
<tr>
<td>2. Bhagwati aalu bhandar, Muhana Mandi (Trader)</td>
</tr>
<tr>
<td>3. Balaji Trading company, Muhaha Mandi (Trader)</td>
</tr>
<tr>
<td>4. Jagan Dev Trader, Muhana Mandi (Trader)</td>
</tr>
<tr>
<td>5. Central Potato Research Institute, Shimla</td>
</tr>
<tr>
<td>6. Lecturer, Agriculture Collage, Dausa</td>
</tr>
<tr>
<td>7. Procurement Head, Reliance Retail, Agra</td>
</tr>
</tbody>
</table>
Chapter 2- Pre Harvest Management

2.1. Major Commercial Varieties Grown in Rajasthan

The major varieties of potatoes in the state of Rajasthan are as follows\(^\text{10}\) 

1. **Kufri Badshah:**
   
   It is a medium maturing variety suitable for cultivation in north Indian plains as well as plateau regions of India. It is resistant to early blight, late blight and PVX. It has white cream, ovoid tubers with shallow eyes and cream flesh. Its canopy is semi-compact and stem green with red brown pigment highly scattered throughout. Leaflet is ovate-lanceolate, flowers are white and sprouts red-purple\(^\text{11}\).

2. **Kufri Pukhraj:**

   It is an early to medium maturing variety suitable for cultivation in northern plains as well as plateau regions of India. It is resistant to early blight, moderately resistant to late blight and immune to wart. It has yellow, ovoid tubers with medium-deep eyes and yellow flesh. Its canopy is semi-compact and stem green with purple pigment highly scattered throughout. Leaflet is ovate-lanceolate, flowers are white and sprouts purple. It is an early bulker and suitable for low-input eco-system.

Out of the two varieties, Kufri Badash is the most preferred variety in this region including Agra due to its shine. Kufri Pukhraj is mostly from Punjab area and is dull in Shine.

2.2. New Initiatives and Practices

Contract farming is very popular initiative for Potato farming for big processors like Pepsi Co as they require specific size 45-60 mm for processing. Normally this is being done currently in few parts of Punjab and can be upscaled in the region.

\(^{10}\) [http://cpri.ernet.in/other_activity/Potato_varieties.pdf](http://cpri.ernet.in/other_activity/Potato_varieties.pdf)

\(^{11}\) [http://krishikosh.egranth.ac.in/bitstream/1/2054326/1/CPRI126.pdf](http://krishikosh.egranth.ac.in/bitstream/1/2054326/1/CPRI126.pdf)
Case of PepsiCo: PepsiCo’s agricultural operation in India is an example. At present, PepsiCo is earning 26 percent of its turnover from processed agricultural products (such as rice, potato, peanut butter, tomato, chilly, garlic and ginger pastes etc. The company has signed contracts with Punjab Agro Industries Corporation and Punjab Agricultural University for contract farming and research purposes. The company provides inputs and technology to the farmers. Returns to the farmers have also gone up as now farmers supply agricultural products to the company at an agreed price and for a fixed quantity. Direct involvement of company’s agents with farmers ensures good quality for company as well as cover risks to farmers from crop infestation and bad weather etc. (Punjabi 2015).

2.3. Seasonal Availability Pattern
To secure high yields, it is essential to plant the potatoes at optimum time. The best time of planting is when the maximum and minimum temperatures are in between 30°C to 32°C and 18°C to 20°C, respectively. The planting period for potato in the state is January/February which are harvested in the month of July/August.12

![Figure 8: Seasonal availability of Potato](image)

2.4. Land Preparation
The potato produce is best in deep, fertile, sandy loamy to clay loams with good water retention capacity. As the potato has a relatively weak, shallow root system, impermeable layers in the soil limit rooting depth, which restricts water availability to the plant in dry periods. Thus soil compaction can greatly reduce potato yields. Aeration of the soil has a great effect on the set and development of tubers. The potato crop can be grown in all type of soils except alkaline and high clay content soils. Loose sandy loam soils having good aeration and drainage with rich organic matter are preferably best suited. The soils with pH around 5.0 - 6.5 is considered to be best for potato which indirectly affects the availability of plant nutrients. Potato needs well pulverized beds or planting so the fields planting should have fine tilth which can be achieved by giving first deep ploughing to a depth of 25 - 35 m followed by two light ploughings across the slope. Planking has to be performed after each ploughing. It helps in loosening the soil, to break the impermeable layer and thus help in better penetration of roots, improve the drainage and to mix the organic matter in soil as well as to manage the weeds.

Land preparation should begin at least two weeks before planting with the application of 20-25 tons of FYM/ha. At least three ploughings and plantings are needed to get the desired soil tilth for potato planting. Proper ploughing also helps in managing the weeds, insect-pests and diseases to some extent. Deep ploughing exposes the soil to sun-light and break the hard pan. Field should be clean of stubbles and perennial weeds. For the proper drainage of excess water, a gentle slope gradient should be made towards the main drain at the time of field preparation. The field should be divided into small beds. Optimum bed size is 12 feet with a path or drain in between the two beds. It will be helpful in the better intercultural operations, drainage of excess water and crop inspection.

12[http://agropedia.iitk.ac.in/content/potato-planting-and-harvesting-time-different-regions-india](http://agropedia.iitk.ac.in/content/potato-planting-and-harvesting-time-different-regions-india)
2.5. **Sowing, Planting and Cultivation**

The seed requirement depends on the cultivar and soil types. In potato cultivation, seed required per hectare is 1200 to 2000 kg. Planting season depends on region, climatic condition and variety of potato. Spacing of seed is not consistent across the region because of growing condition and market yards. The best time to plant potato is when temperature is between 18 degrees Celsius to 22 degree Celsius. Potatoes are propagated by tubers, planted either whole or cut into pieces. To obtain maximum yields, healthy, disease-free tubers, free from mixture of other varieties, should be used. Seed rate depends on tuber size; 800-1000 kg/ha is generally recommended. The potatoes grown from the improved seed gave better soil coverage, had a lower incidence of virus attack and higher tuber weight and gave higher yields than those from the locally purchased unimproved seed.

The proper seed bed conditions, especially soil temperature and moisture are one of the most important factors in ensuring a healthy stand of potato crop. The ideal soil temperature for planting potato is 20-25 degree C. The temperature encourages quick emergence without promoting the growth of decaying organisms. The seed bed should neither be too wet nor too dry. The available soil moisture ideal for potato planting is 70 -80 per cent. Planting of cut tubers in dry, hot soil (especially sandy soil) immediately after cutting results in poor wound healing and thus in excessive seed rot. Cold stored seed, planted in warm soil often sweats after planting and the moisture film increases the potential for bacterial infection. Some physiological disorders may also result from planting in excessively wet or dry soil. It is useful to wait for warmer, drier and workable weather conditions for planting. Other factors affecting the choice of a planting date include the maturity class of the variety and the time of harvest needed for certain markets.

Planting in furrows at proper depth is essential for successful potato cultivation which is followed by ridging. In the hills, where potato is grown under rain fed conditions, there are chances of drought during the early stages of cultivation. Therefore, deep planting at about 15-20 cm is beneficial as it gives better protection to seed tubers against desiccation and ensures proper emergence. Under normal moisture conditions, seed tubers are placed at a depth of 10-12 cm. Potatoes grown in ridges are better drained than the one grown in flat beds. In the sloppy fields of hills, ridges should be made across the slope so as to minimize the nutrient loss and to improve the water retention. The row to row spacing is to be kept at 60 cm. A simple wooden device (lay outer) having three small pegs placed at 60 cm apart is very useful for marking of rows at a uniform distance. Shallow furrows are opened on the marked lines and FYM + fertilizer mixture is added in each furrow. This is mixed in soil with the help of a hand hoe. Thereafter, seed tubers are placed in furrows at the required depth.
spacing and dibbled at the desired depth with hand hoe at the same place with crown end upward. Afterwards, 15-20 m high ridges are made over the furrow.

Figure 9: Potato plantation

2.6. Climatic and Soil Requirement

Potato is a cool season crop and tolerates frost moderately. The ideal temperature for its growth during initial stage is 25 degree celsius. However, Potato growth reaches a maximum at 21 degree celsius and decreases with temperature increases.

Potatoes are grown in wide range of soils. However, deep well drained and friable soils having good organic matter are ideal for its cultivation. Sandy Soils with little clay or little organic matter with proper irrigation and fertilizer supply would result in high yield and good quality tubers. Usually potatoes are more tolerant to low soil pH when compared to the other crops.
2.7. Nutrients Management

The crop response to fertilizers varies from field to field. The fertilizer ratio of N-P-K often recommended and practiced is usually 120:50:225. However, high yields and enhanced quality of tubers can only be sustained through the application of optimal nutrient doses in balanced proportions.

Nitrogen-
- The amount of nitrogen applied to a potato crop varies from 100 to as much as 300 kg/ha depending on the purpose of the crop and soil characteristics.
- Avoid high or excessive nitrogen dressing as it stimulates haulm growth, delays tuber formation and affects tuber quality (low dry matter content, high reducing sugar content and high protein and nitrate content).
- Apply nitrogen shortly before, or at, planting time. However, if there is a risk of leaching (e.g. with heavy watering on light soils), or if the application of large quantities of fertilizer under dry conditions may cause scorching, a split application may be better. The second nitrogen application should, in general, be given no later than three to five weeks after crop emergence.

Phosphorus-
- Phosphorus contributes to the early development of the crop and early tuberization. It increases the crop’s dry matter content and improves the tuber’s storage quality. Often more than 100 kg/ha is applied, while on phosphorus-fixing soils much higher doses are used.
- Apply the total amount of phosphorus before or during planting.
- Apply phosphorus in the planting furrow in P-fixing soils.

20

Potassium-
- Potassium not only improves yields but also improves tuber quality (size, starch content and storability). An adequate supply of potassium can help reduce internal blackening and mechanical damage, and has been associated with increased stress tolerance.
- Apply the total amount of potassium before or during planting.

2.8. Water Management
In the mid and high hills, potato is mainly cultivated during the summer/rainy season under rainfed conditions. In the low hills/valley areas, where the autumn crop is taken, potato is cultivated under irrigated conditions. Being a short duration crop, the large foliage and rapid bulking behaviour, water needs of potato are much higher than cereals. To have optimum moistures for emergence of seed tuber, a light irrigation 7-8 days before planting or just after planting should be given. If pre-planting irrigation is not given, 7-8 irrigations at 7-10 days interval depending upon the crop requirement should be given.

Figure 11: Water Management of potato

2.9. Weed Management
The presence of adequate moisture, nutrient and light makes weeds grow luxuriantly in the early stages of crop growth, which results in competition with the crop and consequently lower the yields. Therefore, weeding at an early stage is necessary to avoid crop competition with weeds for moisture and nutrients. Weeds also serve as a host for several insects, pests and diseases. Herbicides can also be used for weed control in potato. They check early weed growth, reduce mechanical damage to plants and require less labour. The spray should be done using 500 litres of water/ha. The pendimethalin and fulchloralin are sprayed on soil before planting and incorporated in the soil to reduce volatilization. However, paraquat is given as post-emergence at about 5 per cent plant emergence as directed spray on weeds for effective weed management. Other herbicides are used as pre-emergence spray within 3-4 days after planting. The pre-sprouted seed tubers at planting results in faster emergence than the weeds and thus, potato plant compete more effectively with them. However, such an emergence makes it impossible to use a contact herbicide. Annual broad leaf weeds, because of their growth habit tend to be more competitive than annual grass weeds, particularly in the early stages of crop development. Once, the potato canopy has closed annual weeds are effectively suppressed. Hence, the main requirement of herbicides is to control weed growth for the 7-12 weeks between planting and closing of the leaf canopy.
2.10. Pest & Disease Management

Potato is affected by a large number of fungi, bacterial and viral pathogens in north-western region of India. Late blight is the most important disease followed by mosaic/leaf roll viruses and bacterial wilt.

Potato Aphids: Green Peach Aphid - Myzus persicae Sulzer (Aphididae: Hemiptera)

Figure 12: Green Aphids

They are small (1-2 mm), soft, and usually green in colour. Winged individuals start infestations whereas wingless aphids start colonies on the plant’s young parts and on the lower surface of leaves. Aphids travelling from plant to plant are efficient vectors of economically important potato viruses.

Symptoms of attack: Aphid colonies can be easily identified in plant terminals and on the underside of leaves in the field. They also appear in tuber sprouts in stores, where they can able to transmit the different potato viruses (PLRV, PVY, PVA, PVM and PVS) to seed potatoes. Aphids suck the host’s sap and weaken the plant; sugary excretions favour black fungal growth on the leaves.

Management:
Avoid aphid attack by adjusting planting dates as presented below

15th Oct: North-Western Plains  
25th Oct: Central Plains  
5th Nov: North-Eastern Plains

- Different predatory and Parasitoid insects (such as coccinellid beetles and the Aphidius sp. wasp, respectively) also feed on aphids. Fungi such as Entomophthora sp. is effective against aphids.
- Remove haulms @ 20 aphids/100 compound leaves in case of seed production
- Chemical control: Spraying of Imidacloprid @ 0.004% effective against aphids but relatively safe to natural enemies
Whiteflies: Bemisia tabaci (Aleyrodidae: Hemiptera)

Figure 13: Whiteflies

Several species of the Aleyrodidae family generally known as whiteflies, although they are not actually flies, but causes severe damage to number of agricultural and horticultural crops acting as vector for many viruses. Whiteflies especially Bemisia acts as vector for Gemini virus in potato. The small adult whiteflies can be easily seen on the underside of the leaves and they will quickly start fluttering at the slightest movement of the leaves.

Management: Infestation of potato fields may be prevented by avoiding proximity to crops such as beans that host high leafhopper populations. Resistant or tolerant varieties can be used.

Thrips: (Thripidae: Thysonoptera)

Figure 14: Thrips

Thrips are thin, minute insects (1-2 mm long) that feed on cells on the underside of leaves. The plant thus weakens, its leaves dry, and yields drop. Severe attacks may cause wilting of plants. Symptoms: Pale or brown nymphs and darker adults can be observed on the underside of leaves, where silver spots appear.

Management: Thrips populations increase in number under dry conditions; therefore, adequate irrigation is an effective control method.

Mites: Polyphagotarsonemus latus (Tarsonemidae: Acarina)

Figure 15: Mites

Mites are extremely small, almost microscopic, and feed on the cellular matter of leaves. Polyphagotarsonemus latus, commonly known as white mite, attacks sprout and tender leaves, deforming them. Chlorotic spots caused by mites give leaves a bronze colouring, whereas high infestation will cause leaves dry and wither away resulting in ultimate death of a plant. Other species: Tetranychus spp.

Management: Warm, dry conditions, insufficient irrigation, and excessive use of certain pesticides that destroy the mites natural enemies and these conditions favourable for the mite multiplication must be avoided. Spray the Dicofol 18.5 EC @ 2.0 l/ha or wet table sulphur 80% @ 2.5 kg/ha will help in promising control of mite infested fields.
Potato leaf rolls:

Figure 16: Potato leaf rolls

Potato leaf roll (PLRV) is a major viral disease of potato. All Indian varieties are susceptible to this virus to some extent. PLRV is introduced either by planting infected seed tubers or by an aphid vector that brings the pathogen from an outside source. Infections introduced by the later are referred to as current season infections, which develop late in the season, may cause no visible symptoms, but plants remain latently infected. In early current season infections, young leaves may become chlorotic, yellowish or slightly pinkish, upward rolled and may stand upright.

Late blight:

Figure 17: Late Blight

Late blight is caused by the fungus Phytophthora infestans. It is the most devastating disease of potato with worldwide occurrence. The disease is most serious when the weather is consistently cool and rainy in late summer and fall. Temperature around 10-22°C and RH >80% is most congenial for the disease development. The disease would appear within a week, if hourly temperature ranges from 10-20°C associated with high RH >80% for continuous 18 hours or two consecutive days. Symptoms of late blight appear on leaves as pale green, water soaked lesions. The lesions are often surrounded by pale yellow green border that merges with healthy tissue. The lesions enlarge rapidly and turn brown or purple black. During periods of high relative humidity, the lesions may be covered cotton like white mould growth on the underside of leaf.

Control Measures:

The disease can be controlled by adopting certain prophylactic measures. Firstly, the seed material should be obtained from a disease-free area. They should be examined carefully before planting and also should be pre-treated by dipping in 1 per cent Bordeaux mixture or other fungicides. The plants must be sprayed with copper fungicides, zineb or phenyl compound at 15 day intervals, starting from about a month after planting until the crop matures. Ridomil at 7 kg/ha in combination with Dithane M-45 has given encouraging results. Considerable work has been done in Europe and America to evolve late blight-resistant varieties, utilising Solanum demissum, a hexaploid wild species as one of the parents, newer varieties have been obtained which show high resistance to the disease. The Central Potato Research Station, Simla, has released three varieties i.e. Kufri Kishan, Kufri Sindhuri and Kufri Kuber, which are resistant to late blight.
White grubs:

The white grubs are most destructive and troublesome soil insects, threatening potato production in entire north western hills. They are present in the soil at a depth of 5-20 cm during the crop season and feed on tubers by making large circular holes rendering them unfit for marketing. They live concealed, feed on the roots or decaying vegetative matter and suddenly increase their population in places having enough food and least disturbance of soil. This is a polyphagous pest both in grub and adult stage and inflicts heavy damage on various fruits/forest trees, their nurseries, vegetables, lawns and field crops.

Although white grubs can be a problem every year, the most serious damage occurs in regular three year cycles. The greatest damage to crops occurs the year after the appearance of the adults. During the years of heavy May beetle infestation, deep-rooted legumes, such as alfalfa or clovers, should be planted. If corn or small grains are present, every effort should be made to keep the field free of grass and weed growth to reduce the number of beetle eggs laid. The year following heavy flights of May beetles, planting corn or potatoes should be avoided in fields that were previously under sod or grass.

Late spring or early autumn plowing destroys many larvae, pupae, and adults in the soil and also exposes the insects to predators, such as birds and skunks. For this cultural practice to be effective, plowing must occur before the grubs migrate below the plow depth. No-tillage or reduced tillage crop management encourages grub populations.

Natural enemies that control these white grubs include parasitic wasps and flies in the genera Tiphia and Myzim (Hymenoptera: Tiphidae), and Pelecinus polyturator Drury (Hymenoptera: Pelecinidae), and the fly, Pyrgota undata (Diptera: Pyrgotidae). Also, Cordyceps fungus infects the grubs.

Snails and Slugs:

Snails and slugs are more or less similar in general structure except that the slugs lack the external hard spiral protective shell (Fig. 43) and their mantle is smoother. They live mostly in shady, moist, damp places and feed on vegetable matter either living or dead. They are soft bodied, un-segmented animals having an anterior head, a ventral muscular foot and a dorsal visceral mass. Their body is surrounded by a specialized fleshly area known as mantle. Snails and slugs become serious pest of potato on many occasions. Their occurrence is mainly localized to
especially heavy clay soil. Under the wet conditions, clay soil is cloddy and it is difficult to prepare a fine seedbed for planting of potatoes. Usually they gnaw large irregular holes in foliage, tender stem and tubers during the night and are found in damp dark places.

2.11. **Recommended Good Agriculture Practices (GAP)**

As per recommendation of Hand Book of Horticulture the good agricultural practices for potato are as follows:

- Look for varieties which are pest and disease resistance.
- Frequently apply compost or other organic material (including crop residues) and plant cover crops.
- Apply the required level of fertilizers at the right time.
- Use organic fertilizers and well composted manure.
- Keep fertilizer in a dry, clean and sheltered place.
- Avoid uneven application of water.
- Use bio – pesticides or synthetic pesticides.
- Use registered pesticides.
- Harvest crop at the right stage of maturity.
- Always harvest in dry weather.
- Stop irrigation about two weeks before dehaulming.
- Avoid bruising and skinning of tubers otherwise tubers become susceptible to rot diseases.
- Harvest the crop after 10-15 days of haulm cutting.

2.12. **Harvesting**

Potato is harvested in the month of July and August in Rajasthan. Baby potatoes typically can be harvested 2-3 weeks after the plants have finished planting. Gently dig around the plants to remove potatoes for fresh eating, being careful not to be intrusive. Try to remove the biggest new potatoes and leave the smaller one in place so they can continue to grow.

- The potato must be harvested at the right time of maturity when leaves turn yellow and dry.
- If there is a demand in the market slight early harvesting may be done.
- Irrigation is with held before harvesting and harvesting is done when soil becomes dry.
- Cut the plants at ground level eight days prior to the date of harvesting.
- It is done with the help of kudali or by potato digger or by ploughing with deshi plough
- Care should be taken to dugout the tubers without injury
- Collect the exposed tubers and cleaned off by removing soil, roots, stolons etc.
- The damaged and diseased potatoes are sorted out and discarded.
- Remaining potatoes are graded according to the size and stored in shade to avoid sun injury.
- The diseases free, medium to big size potatoes are selected and stored separately for seed purpose.

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2.13. Pre Harvest Constraints of farmers

In India the major fungal diseases afflicting potatoes are early blight and late blight, followed closely by black scurf and common scab, creating major headaches to the farmers. The other major problems are protecting crops from diseases and pests, high cost of pesticides, unavailability of pesticides in time, availability of spurious products in market, pesticides in market do not provide complete controls. Even animals and birds should be kept away from crop as even they might come for food and spoil the crops.

The constraints faced in cultivation of potato are presented in indicating the severity of various constraints faced by the selected household, some of them major problems faced by potato growers are unavailability of good quality of input, lack of irrigation water, labour shortage and high labour cost.

- Pests and disease problem
  The pests and diseases are not easily controllable. Pesticides and fungicides sometimes fail to control pests and disease. The cost of purchasing pesticides and other medicines is on the higher end, making them inaccessible to the farmers.

- Poor seed quality
  Duplicate seeds or high price of seeds, low quality or low pest resistance power of seeds. Producers face problems regarding the poor seed quality, seed delicacy and low pest resistance.

- High cost of inputs
  High price of pesticides, fungicides, fertilizer and high wage rate. Shortage of farm inputs. Labour not available due to MGNREGA.

- **Low price of output**
  The farmers do not get expected price for their produce, there is a high fluctuation of crop price. Government should interfere in the pricing decision.

- **Water deficiency**
  There is a constant lack of irrigation facility, electricity and water logging in potato cultivation.

- **Others**
  At times the climate is not suitable. The wild animals such as blue bulbs and dry cows destroy the crop. There is even a lack of knowledge in farmers on scientific cultivation.
Chapter 3- Post Harvest Management

3.1. Post-Harvest Losses, Harvesting Care and Post-Harvest Equipment

It is estimated that 2.8-10% of non-perishable, 6.8-12.5% of semi-perishables and 5.8-18% of perishable agricultural products are lost after harvesting. It may be much higher (20%) for a perishable commodity like potato that is harvested at the onset of summer season. About 50% of these losses can be prevented using appropriate post-harvest measures. Establishing on-farm primary processing facilities would assist small farmers in a big way. The family farmers can be trained to undertake post-harvest processing and packaging of farm produce, preferably on-farm or near to the production site. Such technologies would promote entrepreneurship in the rural areas by strengthening forward linkage in agriculture. This would generate additional working days to farm family members, add value to the harvest and generate additional income.

The following areas presented below would be given thrust for lowering the post-harvest losses:

- Development of processing varieties and technologies
- On-farm storage and primary processing units
- Energy-efficient storage structure
- Technologies for cold chipping
- Managing bruising injuries

Under tropical and sub-tropical conditions, the losses due to poor handling and storage are reported to be in between 40-50 per cent. The post-harvest losses of potatoes are defined as qualitative and quantitative losses. The qualitative losses greatly reduce the price of potatoes. The physiological, pathological causes and their remedies are as under. Post-harvest losses of horticultural produce may occur due to a variety of reasons. Some of the common reasons for the post-harvest losses are presented below:

- Mechanical injury
  Mechanical damage during harvest and loading affect potatoes post-harvest quality. This loss can be minimized by controlling incidence of physical damage throughout the harvest and loading operations. Impacts can negatively modify quantitative and qualitative fruits aspects. The main goal of this study was to measure the impact magnitude in two types of harvest (manual and detachment) and during all steps from picking into bags until loading for transport to the processing industry and additionally evaluating.

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17 http://cpri.ernet.in/images/skc_director_desk.pdf
18 http://agmarknet.nic.in/profile-potato.pdf
- **Injuries due to thermal shock**
  Thermal, High Pressure, and Electric Field Processing effects on Plant Cell Membrane Integrity and Relevance to Fruit and Vegetable Quality. High pressure (HP) and pulsed electric field (PEF) processing are commercially applied to produce high quality fruit and vegetable products, both microbial and plant cell membranes are significantly altered following exposure to heat, HP, or PEF.

- **Disease and pest attack**
  In India, every year a huge loss to production occurs due to damage caused by insect pests, diseases and off course physiological disorders. All these factors together cause a great damage to crops; and growers as well as consumers are at disadvantage. The diseases are caused by fungi, bacteria, virus, virus like pathogens etc. which cause severe damage to the potato cultivation.
  Post-harvest losses start right at the farm gate which continues till the produce reaches the consumer. A large number of intermediaries play an important role in the system between farmer and the retailer like local retailer, transporter, wholesalers and distributors and at every step significant waste is noticed.
Table 1: Types of Post-Harvest losses

<table>
<thead>
<tr>
<th>Types of Qualitative losses</th>
<th>Reasons</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological losses (Caused by the effect of environmental conditions)</td>
<td>i) Due to exposure to the extreme temperatures, (high and low temperatures), both before and during storage. ii) Overheating of tubers due to direct exposure to sunlight or during high temperature and non-refrigerated storage. iii) Rough handling of tubers during harvesting.</td>
<td>1. Do not expose tubers to direct sunlight or high temperatures or freezing temperatures. 2. Do not harvest the crop before maturity. 3. Store potatoes at 2-40 C in cold storage. 4. In-case of processing and warehouse potatoes, store at 10-120 C by using sprout inhibitors</td>
</tr>
<tr>
<td>Pathological losses [Caused by the attack of pathogens e.g. fungi, bacteria, insects etc.]</td>
<td>i) Rot and decay accounts for major losses caused due to attack of pests and diseases. It depends primarily on the condition of tubers stored and is linked with pre-harvest factors and aggravated by storage conditions. Such type of losses are low in hills and negligible or small in cold storage</td>
<td>1. Careful attention to pre-harvest management like harvesting, grading etc. is essential. 2. Sorting and removal of rotted and damaged tubers before and after storage.</td>
</tr>
</tbody>
</table>

3.2. Harvesting Care:

Harvesting
- Follow the practice of Dehaulming [cutting of haulms / aerial parts by sickle or killing by chemicals (e.g. Gramoxone) or destroying by machines] when the crop attains 80-90 days and aerial part of the plant turns yellow.
- Always harvest in dry weather.
- Stop irrigation about two weeks before dehaulming.
- Avoid bruising and skinning of tubers otherwise tubers become susceptible to rot diseases.
- Harvest the crop after 10-15 days of haulm cutting.

Drying and Curing:
- Always dry the harvested tuber quickly to remove excess moisture from the surface of tubers for improving their keeping quality
- Always dry the harvested tuber in storage shed, expose to sun causes the greening of potatoes.
- Do not store the tubers immediately if they are exposed to rain after harvest.
- Always follow the curing process at 25 degree celcius with a 95 per cent relative humidity
- For optimum suberization, curing is essential for healing the wounds of tubers resulted from cutting and bruising during harvesting.
- All the damaged and diseased tubers should be removed during sorting.

3.3. 3.1.2. Post-Harvest Equipment

Animal Drawn Potato Digger

Figure 21: Potato Digger machine

It is animal drawn single row equipment for digging potato. It consists of multipurpose tool frame, V shape blade and extension rods on the blade wings to separate soil and dirt from the potato. It eliminates 11 per cent tuber damage resulting in conventional digging.

3.4. Grade Specification & Grading at Producer level

Grading is an important factor in the marketing process of potato. The benefits of grading are as follows:

- Grading helps the potato producer and seller to determine the right price of the produce.
- It reduces the cost of marketing and helps the consumers to get standard potato at fair price.
- It facilitates the scope to widen the avenue for potato export.
- It has a direct influence on utilization point of view, as the small to medium sized tubers are prepared for ‘seed tubers’ and large sized tubers are preferred for processing purpose.

Methods of Grading:
Grading of tubers is done both by hand as well as by graders. The different practices of grading of potato are as follows:

- Grading of potatoes with a set of rectangular sieves having round holes of varying diameters, where a pair of such sieves placed one above the other are shaken to and fro by two persons and the third person continuously feeds the upper sieve.

- Grading of potatoes through sieves hung on chains or ropes and move back and fore. Grading of potatoes by the mechanical grader, where the sieves are mounted on the oscillation of frame as operated mechanically by power. This grader can be operated with 1H.P. electric motor, engine or tractor.

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20 http://agmarknet.nic.in/profile-potato.pdf
21 http://agmarknet.nic.in/profile-potato.pdf
• Grading of potato with power operated potato grader with conveyer attachment gives better grading efficiency (90 per cent) which requires power of 1.5 H.P. It can grade four categories viz. less than 10 gms, 10-25 grams, 25-60 grams, and more than 60 grams.

Figure 22: Grading of potato

Agmark Specifications - Under the Agricultural Produce (Grading and Marking) Act 1937, the Table Potato Grading and Marking rules 1950 was formulated and notified by the Govt. of India. The quality factors like size of tubers, conformity to the variety, tolerance limits for under sized and over-sized tubers, percentage of diseased and damaged tubers, and 14 dust and extraneous matters, etc. are taken into consideration. There shall be three/four Grades for Potato fresh and Potato Store i.e. Super, Grade-A and Grade-B. Grade-C shall have any size with defects but saleable. The size requirement for these grades shall be as follows:

Table 12: Grades of potatoes

<table>
<thead>
<tr>
<th>Variant Size</th>
<th>Super</th>
<th>Grade A</th>
<th>Grade B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Store</td>
<td>&gt;65mm</td>
<td>45-65 mm</td>
<td>35-45mm</td>
</tr>
<tr>
<td>Fresh</td>
<td>&gt;65mm</td>
<td>45-65mm</td>
<td>35-45mm</td>
</tr>
</tbody>
</table>

http://agmarknet.nic.in/profile-potato.pdf
Figure 23: Grade Specification of table potatoes

I) **Grade Designations and Definition of Quality of Table Potatoes**  
(Oval or long varieties*)

<table>
<thead>
<tr>
<th>Grade designation</th>
<th>General</th>
<th>Applicable to single tuber's size (Minimum diameter in) millimeters</th>
<th>Definition of quality</th>
<th>Applicable to quantities</th>
<th>Tolerance</th>
<th>Maximum aggregate of all defects under column 5, 6 &amp; 7</th>
<th>Total weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra special</td>
<td>Reasonably clean, healthy potatoes, free from serious defects and suitable for human consumption</td>
<td>41 mm**</td>
<td>At least 95% by weight must conform to the variety</td>
<td>Not more than 2% of the total weight may pass through a sieve having circular holes with a diameter of the minimum size specified (in column 3) for the grade; included in this not more than 0.6% of the total weight may pass through a 25 mm mesh</td>
<td>Not more than 2% of the total weight may consist of appreciably diseased, damaged or unsightly potatoes and included in this amount</td>
<td>Not more than 2% may be total present, the percentage to be calculated on the net weight of screened potatoes.</td>
<td>4% of the total weight</td>
</tr>
<tr>
<td>Special</td>
<td>Reasonably clean, healthy potatoes, free from serious defects and suitable for human consumption</td>
<td>29 mm</td>
<td>At least 95% by weight must conform to the variety</td>
<td>Not more than 2% of the total weight may pass through a sieve having circular holes with a diameter of the minimum size specified (in column 3) for the grade; included in this not more than 0.6% of the total weight may pass through a 25 mm mesh</td>
<td>Not more than 2% of the total weight may consist of appreciably diseased, damaged or unsightly potatoes and included in this amount</td>
<td>Not more than 2% may be total present, the percentage to be calculated on the net weight of screened potatoes.</td>
<td>4% of the total weight</td>
</tr>
</tbody>
</table>

* The word "Oval or Long": shall be marked following the grade name on the AGMARK label by means of a rubber stamp.

** When the potatoes have been passed over a riddle of greater mesh than 41 mm, the minimum size may at the seller’s discretion be appended to the grade name, e.g. "Extra Special" (51 mm, 57 mm, 64 mm etc.) but potatoes which exceed 89 mm in their smallest diameter shall be excluded from grading.

1. Any disease or defect the presence of which may be established by cutting open the potato shall be taken into account, and potatoes having cuts worm and slug holes penetrating into the flesh shall be regarded as damaged.
2. Potatoes affected by greasiness, superficial disease or damaged shall not be regarded as diseased or damaged unless more than 1/10 of the surface is so affected.
3. A potato shall only regarded as being obviously affected with the soft rot, if at the time of inspection, it is squishy or the surface is at some part distinctly broken or wet owing to disease.

3.5. **Major Storage Disease and Pest and their Control Measure**

1. **Black leg - Erwinia spp**
   - Aerial stem rot & tuber soft rot
   - Black leg begins from a contaminated seed piece
   - Stem bases - an inky-black to light-brown decay, extend up the stem from less than an inch to more than two feet
   - These enlarge into a soft, mushy rot that causes entire stems to wilt and die
   - Leaves - roll upward at the margins, become yellow, wilt & often die

   **Figure 24: Black leg - Erwinia spp**

   - Potato tubers with soft rot have tissues
     a) very soft and watery
     b) have a slightly granular consistency
     c) tissue is cream to tan-colored
     d) black border separating diseased from healthy areas
   - In the early stages, soft-rot decay - odorless
   - Later a foul odor and a stringy or slimy decay usually develops as secondary decay bacteria invade infected tissues

   **Management**
   - Plant only certified, disease-free seed tubers
   - Seed treatment
     a) Agallol-3(0.25%) for 5 min
     b) Streptomycin sulphate 0.1 % for 10 min
     c) Streptocycline (100 ppm) and copper sulphate (40 ppm) for 30 min
   - Harvest tubers only after the vines are completely dead to ensure skin maturity
   - Precautions to minimize cuts and bruises when harvesting and handling tubers
- Storage - 55-60 F with 90-95% relative humidity for the first 1-2 weeks to promote wound healing

2. **Dry rot: F. Solani Var. Coeruleum**
   - Dry dark spots appear on the skin which later becomes sunken and wrinkled with irregular concentric rings
   - Spots shrinks and bursts out
   - Internal tissue becomes brown and shrunken with cavities filled with numerous white tufts of mycelium
   - Rotting progress into whole tuber which loses much of water and become dry hard, shriveled and light in weight

![Figure 25: Dry Rot](image)

**Management**
- Avoid injuries to tubers
- Potatoes should be dried thoroughly and then stored in a cool place
- To speed the healing process, hold tubers at 50° to 60°F with good ventilation and a RH of at least 95% for the first 2 to 3 weeks of storage

3. **Brown rot: Ralstonia solanacearum**
   - Bangle blight or bangili
   - Leaf- turns bronze colour, shrivel and die
   - Vascular system of stem, root, stolon and tuber turns brown
   - Ring disease - brown ring in the tuber due to discolouration of vascular bundles
   - Whitish bacterial exudate oozes from the vascular system of cut stems and cut tubers

![Figure 26: Brown Rot](image)
Management

- Crop rotation - potato-wheat
- High degree of resistance - clones of Solanum phureja

3.6. Storage Structures

I. Traditional Storages

- In Situ storage:
  In this system, farmers do not harvest the tubers and allow it to remain in soil. This method is used for short term storage of 2-3 months. In this storage, following practices are found as beneficial:
  
  - Cover the potato beds with grass which provide shade and cooling effect to the potatoes in upland areas.
  - Cover the potato beds with paddy crop which provide shade and cooling effect to the potatoes in lowland areas.

Figure 27: Situ Storage

- Heap Storage
  In this method, potatoes are heaped under the shade of trees, where 6-30 tonnes of potatoes can be stored. The heaps are covered with a layer of available straw material (about 30cm thick). This is a popular storage method practiced in U.P, Maharashtra and Karnataka. In heap storage, following practices are recommended for safe storage:

  - Select storage site in places like under the shade of trees, preferably in orchard.
  - 32 Pit Storage wooden storage structure Âraised sand / soil platform of height of at least 0.2-0.25 mt.
  - Spray Mancozeb (0.3-0.5% solution) on the soil/sand at storage site which helps in reduction of rotting during storage.
• Remove cracked, cut, bruised, damaged, green and rotted tubers before storing.
• Use always the polythene sheet for covering the heaps, which protects the heaps from rains.
• Cover the heaped potatoes with 0.3 mt-0.45 mt. straw material (wheat, paddy), placing two layers of locally made mat (chatai) in crosswise direction which improves the efficiency of heap storage.
• Loading of potatoes may be done in the morning since the temperature is low in comparison to noon.

Figure 28: Heap Storage of Potato

• **Pit storage:**
In this storage system, two types of pits are prepared i.e. katchha and pucca pits. Katchha pit is rectangular in shape measures 4.5 mt. (length) x 3.6 mt. (width) x 14 mt.(depth)* whereas pucca pit is normally circular in shape with a diameter of about 4.2 mt. All the pits are covered with 0.3 mt. thick available straw material (wheat, paddy). The following recommendations are followed for safe storage:
  • Follow all cultural practices, recommendations applicable in the heap storage method.
  • Always store disease free and cured potatoes.
  • Measure the soil moisture level for determinations of depth of pit.
  • Keep the length and width of the pit according to the quantity of potatoes to be stored. Maintain an average temp of 25.00degree celsius and 66 percent relative humidity.
● Wooden storage structure:
In this system, small wooden rooms like stores about 10 ft. heights are built in the field or near residential area. The walls of the store are built by horizontally fixed overlapping wooden planks which help in preventing seepage in store and running off the rain water. The roof of the store is covered with tin sheet and a gap is left between roof and wall for aeration purpose.

● Storage in baskets:
In North Eastern states, potatoes are stored in bamboo baskets known as “polo” which provides better aeration to the tubers. The baskets are made of different sizes. The smallest size holds 10 -12 Kgs and the largest size holds one quintal potatoes. Smaller baskets are suitable for use as they are convenient to carry to the fields.
Chapter 4- Cost of production and Net value accruals to producers

A typical farmer has taken 5 acres of land under potato crop. The variety opted is Kufri 3797. This is a table variety potato. The farmer said he does not opt for Chipsona (Processing variety) as they get wrinkled immediately within 4 hours of harvest and get damaged before putting in cold store. However, the variety he opted has long fresh shelf life of 12 hours from harvest to reaching the cold store. The gross yield per acre is 160 quintals. The price of potato in the month of march is Rs 400 per quintal and if he sells it in March and April, he will incur a loss of Rs 3600 per Acre. Hence he has kept his stock at Dholpur Cold Storage and aims to sell it at least by September when he expects a price of Rs 600 per quintal by which he earns a minimum profit of Rs 28400. He either uses local seeds or takes them from CPRI Shimla every alternate year.

**Cost incurred in the cultivation per acre are:** 15 quintal seed at Rs 300/qtl, i.e Rs 4500. Land preparation Rs 3500, Sowing – Rs 2000, Seed treatment – Rs 1000, Watering – Rs 6000, Plant protection chemicals – Rs 2500, Fertilizers – Rs 7000, Plant cutting before harvesting – Rs 2000 labor, Digging, Cleaning and packing in bag – Rs 10,500, Cost of jute bag (300*Rs 18) Rs 5500, Transportation to Cold store – Rs 8000, Storage charge for cold (Rs 80 per bag of 50 kg for 5-6 months) Rs 24000. Total cost incurred per Acre is Rs 67,600 and potential revenue by Sept 2017 would be Rs 96,000 (at a price of Rs 600/qtl) and estimated profit could be Rs 28400 per acre.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particular</th>
<th>Amount (in Rs. Per ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Income (160 qtls/acre @ Rs 1200/ qtl)</td>
<td>96000</td>
</tr>
<tr>
<td>B.</td>
<td>Cost of Production</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Land Preparation Cost</td>
<td>3500</td>
</tr>
<tr>
<td>2</td>
<td>Seed Cost (15qtl@ Rs 300/qtl)</td>
<td>4500</td>
</tr>
<tr>
<td>3</td>
<td>Input Cost (Fertilizers-7000, PP Chemicals -2000)</td>
<td>9000</td>
</tr>
<tr>
<td>4</td>
<td>Plant cutting before harvesting (Labor charge)</td>
<td>2000</td>
</tr>
<tr>
<td>5</td>
<td>Harvesting Cost</td>
<td>10500</td>
</tr>
<tr>
<td>6</td>
<td>Packing cost (300 bags @ Rs 18/bag)</td>
<td>5500</td>
</tr>
<tr>
<td>7</td>
<td>Transportation Cost to cold storage</td>
<td>8000</td>
</tr>
<tr>
<td>8</td>
<td>Cost store charge for 5-6 months (Rs 80/bag of 50 kg for 5-6months)</td>
<td>24000</td>
</tr>
<tr>
<td></td>
<td><strong>Total Cost of Production</strong></td>
<td><strong>67600</strong></td>
</tr>
<tr>
<td>9</td>
<td>Net Profit per ha</td>
<td>28400</td>
</tr>
</tbody>
</table>
Chapter 5- Supply Chain of commodity

5.1. Seasonal Availability and Price Pattern

5.1.1. Seasonal Availability

The planting period for potato in the state is July. The major harvesting seasons for potato in state are from September to December which is considered as a Peak Period. During Rest of the year supply is from cold storage or godown, hence it is considered as Lean Period.

Figure 31: Gantt chart of Potato

<table>
<thead>
<tr>
<th>Months</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
</tr>
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<tbody>
<tr>
<td>Crop Calendar</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Lean Period</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak period</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.1.2. Market Arrivals and Prices of Potato in Major markets of Rajasthan

Table 14: The market arrivals and prices for major markets of Rajasthan on a specified date 24.7.2017 are as follows

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Major mandi</th>
<th>Arrivals in quintal</th>
<th>Prices per quintal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ganganagar F&amp;V</td>
<td>800</td>
<td>350</td>
</tr>
<tr>
<td>2</td>
<td>Jodhpur F&amp;V</td>
<td>1165</td>
<td>400</td>
</tr>
<tr>
<td>3</td>
<td>Kota F&amp;V</td>
<td>1905</td>
<td>400</td>
</tr>
<tr>
<td>4</td>
<td>Jaipur F&amp;V</td>
<td>5752</td>
<td>475</td>
</tr>
<tr>
<td>5</td>
<td>Bikaner F7V</td>
<td>638</td>
<td>500</td>
</tr>
<tr>
<td>6</td>
<td>Udaipur F&amp;V</td>
<td>1266</td>
<td>500</td>
</tr>
<tr>
<td>7</td>
<td>Ajmer F&amp;V</td>
<td>101</td>
<td>625</td>
</tr>
</tbody>
</table>

The above table indicates, prices of potato in major mandis is varying from Rs. 350 per quintal to Rs. 625 per quintal. Jaipur F&V mandi has the largest demand for potato and Ajmer has the least demand on the reported date. The reason for price variation might be the distance from cold stores from where the potato stock is released.
The retail prices of potato vary across Rajasthan based upon cost of logistics and availability of local produce. The average retail price for Jaipur was around Rs 17 in 2016.

5.2. Existing Marketing Channels
The present pre-intervention or value chain for Potato may be viewed as one with two critical production-distribution or activity-marketing channels. The product is largely marketed by farmers through the APMC, local vendors and private food processors. Channel 1 may be viewed in terms of one for the table variety and other for the processed products of Potato like chips, wafers, flakes, flour and starch, etc. The producers market their produce in both value chains through local traders and APMC Commission agents.

It is estimated that about 2.8-10% of perishable agricultural products like potatoes are lost after harvesting which are harvested at the onset of summer season. About 50% of these losses can be prevented using appropriate post-harvest measures.

5.3. Alternative Systems of Marketing
Marketing information is a key to regulate the competitive marketing processes and to restrict the monopoly or profiteering stakeholders in the market. It is needed by producers in planning production and marketing of their produce, and is equally required by other market

<table>
<thead>
<tr>
<th>Centres</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Ave</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dausa</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>20</td>
<td>35</td>
<td>20</td>
<td>20</td>
<td>22</td>
<td>10</td>
<td>18.5</td>
<td></td>
</tr>
<tr>
<td>Jaipur</td>
<td>10</td>
<td>12</td>
<td>10</td>
<td>17</td>
<td>18</td>
<td>20</td>
<td>28</td>
<td>26</td>
<td>20</td>
<td>20</td>
<td>12</td>
<td>13</td>
<td>17.17</td>
</tr>
<tr>
<td>Jodhpur</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>15</td>
<td>13</td>
<td>18</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>22</td>
<td>15</td>
<td>17.92</td>
<td></td>
</tr>
<tr>
<td>Swaimadhopur</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>-</td>
<td>20</td>
<td>18</td>
<td>15</td>
<td>10</td>
<td>15.5</td>
<td></td>
</tr>
<tr>
<td>Udaipur</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Table 15: Selected Centre-wise Monthly Retail Prices of Potato (FAQ) in Rajasthan in 2016
participants. Farmers need to be fully familiarized in different areas of agricultural marketing in order to improve their price realization. Marketing information is important at all the stages of marketing right from farm level to ultimate consumption level and simultaneously for all participants in these stages i.e. Producer, trader (millers), consumer etc. The Government of India has started Agricultural marketing information network scheme through Directorate of Marketing and Inspection to improve the present market information scenario by linking all agricultural produce markets in the States and Union Territories. This has been established to an extent in Rajasthan.

5.3.1. Direct Marketing

Direct marketing is an innovative concept, which involves marketing of produce i.e. Potato by the farmer directly to the consumer/millers without any middlemen. Direct marketing enable producers and millers and other bulk buyers to economize on transportation cost and improve price realization. It also provides incentive to large scale marketing companies i.e. millers and exporters to purchase directly from producing areas. Direct marketing by farmers to the consumers has been experimented in the country through Apni Mandisin Punjab and Haryana. The concept with certain improvements has been popularised in Andhra Pradesh through Rythu Bazars. At present, these markets are being run at the expense of the state exchequer, as a promotional measure, to encourage marketing by small and marginal producers without the help of the middlemen. In these markets, mainly fruits and vegetables are marketed along with other commodities at present.

5.3.2. Advantages of direct marketing in Rajasthan

- **Strategic Location**
  The 8,380 sq. km. area of Rajasthan falls in the National Capital Region (NCR), which is around 24.50% of the total National Capital Region, the world's second largest urban agglomeration. Rajasthan shares its border with five major Indian states: Punjab, Haryana, Uttar Pradesh, Madhya Pradesh and Gujarat. These states have a combined population of 402 million (year 2011). Industries in the state have to their advantage, access to this enormous market.

- **Excellent Connectivity**
  Rajasthan has the second largest network of National Highways in the country with a total road length exceeding 7,310 km. National Highways provide excellent connectivity to cities like Delhi, Ahmedabad, Vadodara, Mumbai, Jabalpur, Bhopal, Agra, Gwalior, Indore, Amritsar. The railway network connects the state to all major cities in India and links the state to ports in Mumbai, Kandla and Mundra in Gujarat. The State has a fully operational international airport at Jaipur, with direct flights to Sharjah and Muscat. Rajasthan has airports at Jodhpur, Udaipur and airstrips in other major districts. An Air-Cargo Complex at Jaipur, and Inland Container Depots at Jaipur (2), Jodhpur (3), Bhilwara & Bhawal facilitate trade within and outside India.

- **Agro Food Parks**
  RIICO has developed four Agro Food Parks in Kota, Jodhpur, Sri Ganga Nagar and Alwar for the development of agriculture based industries. Another Food Park is being developed near Kishangarh in Ajmer district by M/s Greentech Mega Food Park Pvt. Ltd. under the Scheme of Government of India.

- **Single Window Approval**
The constant endeavour of Government of Rajasthan has been to build a favourable investment climate by systematically reducing administrative bottlenecks and easing the process of investment. The core objective is to ensure lower transaction costs and increase transparency. A Single Window System is operational as a single point interaction mechanism for entrepreneurs to interact with the State for seeking statutory approvals for their projects. Keeping with the times, the entire process of application and monitoring is through web-enabled software called the Single Point Electronic Monitoring and Clearance System. Using this web-interface, entrepreneurs can register, fill and monitor application forms electronically. Forms along with the enclosures have to be submitted at the nodal office physically.

- **Agro Food Processing**

Rajasthan, with its diverse agro-climatic conditions is richly endowed in the cultivation of a variety of crops. The state is the largest producer of guar and seed spices like coriander, cumin, fenugreek, fennel, etc. The state is the largest producer of mustard, second largest producer of oil seeds and third largest producer of soybean. It is also the largest producer of gram and second largest producer of moth bean. Rajasthan has proximity to large consumer markets in the region (close to NCR) which has a large share of food consumption in the country. Infrastructure like Agro Food Parks at Kota, Jodhpur, Sri Ganga Nagar and Alwar has been developed by RIICO. Rajasthan also offers immense opportunities in the areas of organic farming, contract farming and in creation of post-harvest infrastructure such as special ware-houses, cold chains, testing & certification facilities.

**5.3.3. Contract Farming**

In 1998, PepsiCo started Informal Contract Farming in India. In Contract Farming, the farmer is contracted to plant the contractor’s crop on his land. The farmer is expected to harvest and deliver to the contractor, a quantum of produce, based upon anticipated yield and contracted acreage. This could be at a pre-determined price. The contractor may supply the farmer with selected inputs to improve the yield. Contract Farming can be considered as a viable method to enhance agricultural productivity along with the assurance to provide the pre-determined prices to the farmers. PepsiCo India established a model of partnership with farmers and currently works with over 24,000 happy farmers across nine states through the crop lifecycle by providing new varieties, technologies and sustainable farming practices. In PepsiCo, farmers truly have a friend and development partner. The association with PepsiCo India has not only raised the incomes of small and marginal farmers, but also their social standing.

In contract farming the farmer gives his land and labour. PepsiCo officials provide the seed - Atlanta and Chipsona - different from the traditional Jyoti or Pokhraj variety and the technology support. They supervise the cultivation and give advice to farmers from time to time. After the yield they take the produce to their own storage. The farmer gets Rs 6 for each kilo of potato. Advantage for the hapless farmers is that they get to know about the procurement price while they start sowing the seeds. They get crop insurance, seeds and loans from PepsiCo agents that they need to pay after the yield.

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5.3.4. Private market yard

Market Yards are a long felt need of the farming community of our country as it goes a long way in ensuring higher remuneration to them through proper weighing, cleaning, grading and better price realisation of their produce. The farmers look forward to a regulated market yard as a dependable infrastructure for furtherance of their economic goal. The advantages of a regulated market yard system are immense and wherever such a system exists, it has been widely appreciated. Today the farmers consider it as a boon to them where they can confidently sell their produce and get an appropriate return for the quantity and quality they produce year after year.

However, the development of regulated market yard infrastructure in our country is very lopped sided and its progress is satisfactory only in a few states like Rajasthan, Gujarat, Maharashtra, Karnataka and Punjab. In all other states it is quite inadequate. The inadequacy of agricultural marketing infrastructure in other states need urgent attention. Even in states where such an infrastructure exists much more needs to be done to provide suitable facilities to the farmers and arrange for a proper information dissemination system to prevent their exploitation. There is a need for co-ordination among all the developmental agencies responsible for creation of market yard infrastructure in a state for drawing a programme and a time bound action plan for creation of regulated market yard systems. At present, market yards can be established as regulated market yards under Agricultural Produce Marketing Committee (APMC) Act of individual states. As and when state governments amend the Act for participation of the private sector and co-operatives in market yard development, financial assistance can be made available for individual/private companies/corporate bodies and co-operatives for undertaking the activity. A few states have already taken the lead in this direction.

http://agmarknet.nic.in/amrscheme/YardsNABARD.htm
Chapter-6: Processing Infrastructure availability and Utilization

6.1. Processing
The food processing is the sunrise sector of India. The importance of the industry is not limited only to the contribution to the GDP, but it also provides many other desirable socio-economic benefits such as increased employment opportunities; improvement in income and lifestyle of the rural people leading to reduction of migration of rural masses to cities; and mitigation of huge post-harvest and storage losses, specially, in fruits and vegetables. India possesses wide agro-climatic conditions and areas suitable for adequate and round the year supply of processing quality potatoes. In addition, now we have potato varieties that are bred according to the requirements of the processing industry.

Potato is a perishable commodity and it’s harvesting time (July/August) coincides with the rise in temperature in Indo-Gangetic plains which contributes about 85 per cent of total production in India. Therefore, the potato produceis required to be shifted in cold storage. It has been observed that all varieties of potato are not suitable for processing. The dry matter and reducing sugar content are two important parameters for selecting raw materials for processing. The varieties namely Chipsona-1 and Chipsona-2 released by Central Potato Research Institute (CPRI), Shimla, have been found fit and beneficial for potato processing. The following are the characteristics of potato meant for processing purposes\(^{27}\).

Table 16: Characteristics of potato fit for processing

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Types of potato Products</th>
<th>Dehydrated</th>
<th>French fries</th>
<th>Chips</th>
<th>Canned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuber size</td>
<td></td>
<td>30</td>
<td>50</td>
<td>40-60</td>
<td>35</td>
</tr>
<tr>
<td>Specific gravity</td>
<td></td>
<td>1.08</td>
<td>1.08</td>
<td>1.085</td>
<td>1.08</td>
</tr>
<tr>
<td>Dry matter (%)</td>
<td></td>
<td>22-25</td>
<td>20-24</td>
<td>22-25</td>
<td>18-20</td>
</tr>
<tr>
<td>Starch (% reducing sugar %)</td>
<td></td>
<td>15-19</td>
<td>14-16</td>
<td>15-18</td>
<td>13-24</td>
</tr>
<tr>
<td>Shape/Sizes Preferred</td>
<td>Medium to large sized tuber</td>
<td></td>
<td>Long oval shaped tubers</td>
<td>Round to Oval shaped tuber</td>
<td>Small sized tuber</td>
</tr>
</tbody>
</table>

The increasing proportion of potato processing in India shall not only avoid glut like situations but also carry forward the potato revolution in India. However, estimation of the requirement of raw material (processing quality potatoes) for potato processing industry is of utmost importance.

\(^{27}\)http://agmarknet.nic.in/profile-potato.pdf
Table 17: Estimate requirement of potato for processing Industry

<table>
<thead>
<tr>
<th>Products</th>
<th>2010</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato chips</td>
<td>2.45</td>
<td>14.22</td>
</tr>
<tr>
<td>Potato Flakes/Powder</td>
<td>0.29</td>
<td>5.44</td>
</tr>
<tr>
<td>Frozen potato products</td>
<td>0.06</td>
<td>5.4</td>
</tr>
<tr>
<td>Total</td>
<td>2.8</td>
<td>25.06</td>
</tr>
</tbody>
</table>

Processing of Potato:

- **Potato chips**
  
  In the making of Potato chips following procedures are carried out for sorting. First, Potatoes are sorted to identify good & bad potatoes. After sorting they are washed with hot water. Once washing is completed it is fed to peeler machine for peeling. After that they are blanched and some drops of sulphur dioxide is added to them and are left for drying and then packed.

- **Potato Fries**
  
  In making of potato fries, first the potatoes are separated from bad potatoes. The fresh potatoes are cleaned with hot water and then peeled using peeler machine. After peeling fresh potatoes are picked and cut by a cutter. Then blanching is done which is followed by Pre-frying. After pre frying de oiling is done for some time and left for cooling. Then these fries are instant kept for freezing so that it doesn’t get spoil and are then packed.

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6.1. **Stakeholder's Share in Consumer Rupee**
The price spread along with margin at every stage of value chain starting from the farmer till the retailer is shown in the table presented below.

**Table 18 Price spread table of Potato**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Value per Quintal (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retailing: Sale by retailer to consumer</td>
<td>About Rs. 1200 per quintal which makes a profit margin of 17% (Incl of transport, Labor)</td>
</tr>
<tr>
<td>City mandi: Sale to retailers</td>
<td>Rs. 742 per quintal with a margin of 9%</td>
</tr>
<tr>
<td>Sale from Cold store to wholesaler in City F&amp;V mandi</td>
<td>Rs. 681 per quintal (Gross value on sale with net profit margin 9.5%, 2% mandi tax)</td>
</tr>
<tr>
<td>Production: Sale to trader after storing for six months in mandi</td>
<td>Rs. 600 per quintal (Gross value on sales is Rs 600/qtl, Cost is Rs 422/qtl and Profit is Rs 177/qtl)</td>
</tr>
</tbody>
</table>

In case of potato, the role of middle men starts mostly from cold storages. Farmers do not immediately sell the crop if prices at harvesting period go below Rs 600/quintal. They instead prefer to store the potato in nearby cold store and release the stock based upon their financial needs or when the market goes up. The wholesalers work with a margin of around 5-10% and the retailers work with a margin of around 10-20% during peak production and off season respectively.
6.2. **Price build up & Marketing Efficiency Analysis**

The price spread and values accrued to stakeholders across the chain reflects the profit margins accrued to different stakeholders. Much of the value accruals are accrued to processors and retailers. Producers’ incomes are apparently dependent on yield as well as their dependency on the type of end product. (eg. Chips, Fries, Wafers etc.). Generally in case of potatoes, farmers realization is around 50-60% of the retail price when retailing is done at Rs 10-12 per kg. The share of farmers however reduces to around 25-30% when the retail price of potato goes up to Rs 20 per kg. The traders enjoy

Due to limited infrastructure facilities at the dispersal of various stakeholders, marketing efficiency is adversely affected.

6.3. **Consumer preference Analysis**

The Potato produced in Bharatpur/Dholpur/Agra region is highly preferred by consumers because of its shiny texture whereas that of Punjab is less preferred because of its dull colour. Potato of 45-60 mm is used for processing industry and other varieties are used mostly for table purpose. In the processed ones, Potato chips, Potato finger chips, fries and potato namkeen are most favourite consumables and consumers prefer to purchase branded items like Lays/FritoLay/ Bikaji etc.
Chapter-7 Existing Institutional support and Infrastructure facility

7.1. Institutional support for potato cultivation:
7.1.1. National Horticulture Board (NHB)

National Horticulture Board (NHB) is the most important support institution as far Potato value chain is concerned. NHB was set up by Government of India in April 1984 on the basis of recommendations of the "Group on Perishable Agricultural Commodities", headed by Dr M. S. Swaminathan, the then Member (Agriculture), Planning Commission, Government of India. The NHB is registered as a Society under the Societies Registration Act 1860, with its headquarters at Gurgaon.

Aims & Objectives of NHB Schemes

The main objectives of the NHB are to improve integrated development of Horticulture industry and to help in coordinating, sustaining the production and processing of fruits and vegetables.

Detailed objectives of the Board are as under:-

1. Development of hi-tech commercial horticulture in identified belts and make such areas vibrant with horticultural activity, which in turn will act as hubs for development of horticulture.
2. Development of modern post-harvest management infrastructure as an integral part of area expansion projects or as common facility for cluster of projects.
3. Development of integrated, energy efficient cold chain infrastructure for fresh horticulture produce.
4. Popularization of identified new technologies / tools / techniques for commercialization / adoption, after carrying out technology and need assessment.
5. Assistance in securing availability of quality planting material by promoting setting up of scion and root stock banks / mother plant nurseries and carrying out accreditation / rating of horticulture nurseries and need based imports of planting material.
6. Promotion and market development of fresh horticulture produce.
7. Promotion of field trials of newly developed/imported planting materials and other farm inputs; production technology; PHM protocols, INM and IPM protocols and promotion of applied R&D programmes for commercialization of proven technology.
8. Promotion of Farm Mechanization in Horticulture through demonstration and its uses at farmers field level to reduce labour cost and increase the productivity of Horticulture crops.
9. Promotion of applied R & D for standardizing PHM protocols, prescribing critical storage conditions for fresh horticulture produce, bench marking of technical standards for cold chain infrastructure etc.

10. Transfer of technology to producers/farmers and service providers such as gardeners, nurserymen, farm level skilled workers, operators in cold storages, work force carrying out post harvest management including processing of fresh horticulture produce and to the master trainers.

11. Promotion of consumption of horticulture produce and products.

12. Promoting long distance transport solution for bulk movement of horticulture produce through rail etc.

13. Carrying out studies and surveys to identify constraints and develop short and long term strategies for systematic development of horticulture and providing technical services including advisory and consultancy services.

The NHB is being supported by state level NHBs for implementing various schemes of the department.

The cold chain scheme of NHB: Capital Investment Subsidy Scheme for Construction/Expansion/Modernization of Cold Storage and Storages for Horticulture Products: NHB to take up projects with Capacity above 5000MT upto 10000MT as per following rates. • @ Rs. 8000/MT for capacity upto 5000 MT • @ Rs. 7600/MT for capacity between 5001 to 6500 MT. • @ Rs. 7200/MT for capacity between 6501 to 8000 MT. • @ Rs. 6800/MT for capacity between 8001 to 10000 MT. Credit linked back-ended subsidy @ 35% of the cost of project (50% in NE, Hilly Areas and scheduled areas) for capacity above 5000 MT.

7.1.2. The Central Potato Research Institute (CPRI)

CPRI is an Indian public research center dedicated to potatoes. It is an autonomous agency attached to the Ministry of Agriculture.

The CPRI was founded in August 1949, about two years after independence from India, with the aim of developing varieties and techniques adapted to local conditions. In 2002, the CPRI had created 35 new varieties, which contributed to the huge expansion of potato cultivation in the country, accompanied by a significant increase in yields 1. The headquarters, first attached to Patna (Bihar), was later transferred to the north of India at Shimla (Himachal Pradesh), where it is currently located, the site of Patna becoming from 1956 a station of regional research 2. The CPRI has seven regional research stations located in Modipuram, Meerut (Uttar Pradesh), Jalandhar (Punjab), Gwalior (Madhya Pradesh), Patna (Bihar), Kufri-Fagu, Shimla (Himachal Pradesh) and Ooty (Tamil Nadu). It also relies on a network of 22 centers of the All India Coordinated Potato Improvement Project (AICPIP), located in the various agro-climatic zones of the country, 5 of which are in research stations of the CPRI, 14 of which are located in State agricultural universities, 2 are seed preparation units located in the Kufri and Modipuram centers, plus a volunteer center on the Ranichauri (Uttarakhand) campus.

CPRI has the following mandate:

To undertake basic and strategic research for developing technologies to enhance productivity and utilisation of potato:

• To produce disease-free basic seed of different notified varieties developed by the institute.
To act as national repository of scientific information relevant to potato.

To provide leadership and co-ordinate network research with state agricultural universities for generating location and variety-specific technologies and for solving area-specific problems of potato production.

To collaborate with national and international agencies in achieving the objectives.

To act as a centre for training in research methodologies and technology for up-grading scientific manpower in modern technologies for potato production.

To provide consultancy in potato research and development.

CPRI operates 7 regional research stations in different potato growing areas in India. These are located in different potato growing areas of the country: Kufri-Fagu (HP), Modipuram (UP), Jalandhar (Punjab), Gwalior (MP), Patna (Bihar), Shillong (Meghalaya), and Ootacamund (Tamil Nadu).

**Potato varieties developed by the centre are as follows**


**Processing varieties -5:** (Kufri Chipsona-1, Kufri Chipsona-2, Kufri Chipsona-3, Kufri Himsona, and Kufri Frysona)

### 7.1.3. All India coordinated potato improvement project:

The All India Coordinated Potato Improvement Project (AICPIP) was established in 1970 with a view to eliminating the duplication in potato research at the Universities, Departments of Agriculture and the Central Potato Research Institute, and expediting the release of new production technologies after their thorough evaluation at the National level. The project was started at 13 centres located in 12 states in the country by CPRI. It has made significant contributions by way of several high yielding varieties; package of practices for potato cultivation for different agro-climatic zones; identifying suitable companion crops and remunerative potato based cropping systems. In addition, pest and disease control measures have been standardized and areas suitable for healthy potato seed production have been identified in different parts of the country. In addition to this, the "AICPIP" also conducted research on regional problems of the crop to find their appropriate solutions. The recommendations based on the research work done by AICPIP have been given out to the extension agencies from time to time. The data of various experiments conducted in the past had, however, remained confined to the Annual Reports of the Project. This necessitated consolidation of entire information generated during past years and presenting it in readily usable form.

### 7.1.4. Department of Agriculture, Government of Rajasthan:
The department of Agriculture, Govt. of Rajasthan also supports potato cultivation through the State Horticulture Department. However, Potato has not been a major thrust area of the department and support is limited to general support to farmers in terms of making available water resources through the farm pond scheme, minor irrigation scheme and micro irrigation scheme of the horticulture department in which farmers are entitled to get subsidy for such structures.

The department has various verticals through which it supports production, productivity and market linkage in the state. It has a well established structure and network of State/District and panchayat level officials to provide extension services to farmers. The department issues licenses to various agri-input marketing companies including seeds, fertilizers and insecticides and ensures quality assurance to farmers through regular reporting from suppliers and random quality checks of agri inputs. The licenses are issued first at the State level by registering input/service providers. The registered companies can only supply inputs to district and regional level distributors who in turn make availability of the products at the retailers. All handlers of agri inputs and produce have to take license from competent authority either at district or state level. Similarly, the department also issues mandi licenses for traders at different APMCs for trading in specific commodities. The same are described below.

- **District level farmer help desk:** Under this head, farmer help line are established at district level with nominated district level officials from the office of Dy. Director, Agriculture Extension to support farmers on various farming related problems. Apart from this, a state level help desk is also maintained whose telephone no is 0141-5102578

- **Agriculture information dissemination:** At the state level, technical dissemination is being done through the daily newspapers, agricultural papers, monthly publication of "Kheti Ri Bataan" bulletin is also being done. Apart from this, information about advanced agricultural methods of major crops during crop season, publishing posters, agricultural guides on various topics, and Rabi / Kharif package of practice books at the block level and farmers, people's representatives and farmers by producing farmer friendly literature. Is being distributed to the institutions related to. From day-to-day basis to all the radio stations of the state, from 7.45 to 8.15, share the information related to farming and phone in these programs is being broadcast on Tuesday, Thursday and Saturday. The program is being sponsored by the Department of Agriculture on Monday, Tuesday and Wednesday for three days a week. "Farming" program on Doordarshan- produced by the Agriculture Department, is broadcast from Doordarshan Kendra, Jaipur on every Thursday from 7.30 am to 8.00 pm. In this program, information about departmental schemes / programs being executed by the Agriculture Department, discussions with experts, problem-solving, confusion-solving, fortnightly work, message, success stories, innovation, short films, eclipse etc. The tax program is made simple, interesting and farm-making. The technical information on agriculture and related subjects to the farmers has been done by the Indian government to provide "Kisan Call Center" in the state through telephone. Farmers can get any kind of information related to farming by making free calls to phone number 1800 180 1551/1551, from basic / mobile telephone to 6.00 pm to 10.00 pm.

- **Water use efficiency promotion:** Under the Farm Pond Program, rain water harvesting is promoted with the provisioning of 50% subsidy or maximum amount of Rs 52,000/- on raw farm pond and Rs 75,000/- on farm pond with plastic lining whichever is less. This scheme is available under the Rashtriya Krishi Vikas Yojana.
For Dighi construction (under National Agriculture Development Scheme/RKVY), 50% of the unit cost or 350 / - per cubic meter filling capacity and 50% of the cost of the unit cost, on the construction of plastic lining (raw) diggings, by constructing a minimum of 4.00 lakh liters of Filler capacity and more than 50% of the unit cost. The amount of rupees 100 / - per cubic meter will be filled up or maximum Rs 2.00 lakh, whichever is less the grant will be payable.

For Water Houze construction under the national Agriculture Development Scheme, support is provided for areas where deep water is used for irrigation. For constructing a minimum of one lakh liters of Fill Capacity water shed Houz for all categories of farmers, 50 percent of the unit cost or Rs. 350 / - per cubic meter fill capacity or maximum Rs. 75000 / - whichever is less is the subsidy element.

Under the irrigation pipeline head (of National Agricultural Development Plan, National Food Security Mission, NMOP) water use efficiency is promoted for irrigation water. Under this scheme, PVC / HDPE of prescribed size for carrying water from source to farm on irrigation pipeline is supported. On the purchase of pipes, the farmers of all categories are given 50 percent of the cost or maximum amount Rs. 50 / - per meter on HDPE pipes or Rs. 35 / - per meter on PVC pipe or Rs. The maximum amount of Rs.15000 / - on the 20 / - per meter HDPE laminated le-flat tub pipe will be payable, whichever is less proportionate.

Under the Fountain Irrigation program through National Food Security Mission; Pulses and Wheat - Under the Fountain Irrigation Program, subsidy is 50% or the amount is Rs. 10000 / - per ha, whichever is less.

Under the Mobile Raingun support program, for irrigation of grains and pulses crops, subsidy of 50 percent of the cost under the Mobile Renganization program or Rs.15000 / - per unit whichever is less, grant is payable. This subsidy is available under the NFSM scheme

- **Agricultural equipment grant distribution program**: Grants upto 40 to 50 per cent are given as per the category of farmers on the purchase of approved agricultural machinery viz. Seed cum Fertilizer Drill, Plow, Threser etc.

- **Gypsum distribution program**: 50% Subsidy is given to farmers on districtwise rate of Gypsum for maximum area of 2 hectare. This support is for soil reclamation of alkali soils.

- **Plant protection inputs**: Segment, viz. Plant Protection Chemicals / Bio Agents / Bio Pesticides / Pheromone Trap / Liyos Distribution, including weeds in crops; 50% of the price or Rs. 500 any less per hectare is payable as subsidy.

- **Plan Protection equipments segment**: Human transport * (napsek, foot sprayer, duster etc.) are given 40-50 percent of the cost or maximum 600-800 / - Per device as subsidy. Under Power Drivesegment * (Nepasek Power Sprayer) are given 50-60 percent of the price or maximum 3000-3800 / - Per device. For tractor mounted sprayers, 50% of the price or Rs 10,000, per device is subsidized. These schemes are as per targets allotted for respective districts.

- **Assistance for area specific integrated farming systems** like livestock based, horticulture based and tree based farming systems: Assistance is provided for farmers of selected village/cluster having land from 0.25 to 2 ha area per farmer. It is implemented on cluster basis with 100 ha of land. Subsidy applicable is: 50% of cost or 52500/-for farm pond, 50% of cost or 468/-per SQM for green house, 50% of cost or 30/- per SQM for low tunnel,
40% of cost or 800/- per colony for bee keeping, 50% of cost or 15000/- for diesel pump, 50% of cost or 50000/- for vermicompost unit Pucca @ 125/- per cubic ft, 50% of cost or 8000/- for HDPE vermi bed

- **Organic production**: Organic Barley also has a great potential. For support under the head, Promotion of Organic Farming, subsidies are available for heads like Conversion of land Cropping systems and organic seeds, traditional organic input production unit, botanical extracts production unit, use of phosphate rich organic manure, construction of vermicompost pit, use of liquid bio fertilizer and support for packing labelling and branding material support are subsidized for consecutive two years at a rate specified in the manual.

- **Prime-minister Crop insurance scheme**: Farmer have to pay 2% of insured amount in Kharif, 1.5% of insured amount in Rabi and 5% of insured amount in horticulture & commercial crops, subject to maximum of 7 hectare per farmer. Rest of the premium amount will be borne by central and state government in equal ratio. Beyond 7 hectare, farmer has to pay whole premium amount, i.e. without any subsidy.

- **Soil health card**: Under this, component, district level soil and water testing labs support farmers on soil testing and providing soil health card for integrated nutrient management.

### 7.2. Support at Post-harvest, Primary Processing and Secondary Processing Stage

#### II. Improved Storage:

- **Storage at low temperature**: The low temperature (at 2-4-degree C and 8-10-degree C) is the most common method for potato storage. The following recommendations are adopted in this type of storage: A store seed potatoes at 2-4 degree celcius as no sprouting takes place at this temperature and metabolic process goes down. Besides, low temperature, sweetening is of little importance in case of seed potatoes. A store potatoes for export and processing purposes at 8-10 degree celcius, will not only save a lot of energy but also make the potatoes more suitable for consumption, processing and export. A Use sprout suppressants like CIPC [Isopropyl-N-(Chlorophynyl) carbamate] to check the sprouting while potatoes are stored at 8-10 degree Celsius.

- **Storage at 10-12 degree Celsius**: This storage method is suitable for potatoes for processing and export. Following recommendations are followed:
  - A Store processing potatoes and ware potatoes at 10-12 degree celcius with CIPC treatment
  - A use refrigerated containers for export of potatoes stored at 10-12 degree Celsius with CIPC treatment when the transit time of export is more than 10 days
  - A Ship CIPC treated potatoes stored at 10-12 degree Celsius in non-refrigerated container for exporting to neighbour countries like Sri Lanka and Gulf countries where the transit time is not more than 3-4 days.

#### III. Storage Facilities:

**Farmer's storage**: Farmers generally use indigenous in-situ storage system of without harvesting the tubers and allow them to remain in the soil and also the ex-situ system where the farmers use pits, baskets, wooden structures or in heaps or layers in room to store potatoes.
Private/Co-operative/Public Storage:
In Private / Co-operative / Public Storage sectors, potatoes are stored in cold storages at low temperature situated throughout the country. As on march 2017, the total number of potato cold stores in India is 2853 with a total capacity of 16844872 MT. Among the states, Uttar Pradesh has the highest number of potato cold storages with 1371 numbers which is 48% of the rest of India. Apart from UP, West Bengal, Punjab, Bihar, Gujarat, Haryana and Madhya Pradesh have a combined capacity of another 50% of the total storage capacity. Rajasthan has 19 potato cold stores with a capacity to store 65896 MT of potatoes. The state-wise distributions of Potato cold storage in above sectors are presented as under.

Table 19: State wise distribution of Potato cold storages

<table>
<thead>
<tr>
<th>States/UTs</th>
<th>Potatoes No.</th>
<th>Capacity (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>2853</td>
<td>16844872</td>
</tr>
<tr>
<td>Uttar Pradesh &amp; Uttranchal</td>
<td>1371</td>
<td>8163232</td>
</tr>
<tr>
<td>West Bengal</td>
<td>398</td>
<td>5159967</td>
</tr>
<tr>
<td>Punjab</td>
<td>344</td>
<td>1097609</td>
</tr>
<tr>
<td>Bihar</td>
<td>187</td>
<td>699780</td>
</tr>
<tr>
<td>Gujarat</td>
<td>177</td>
<td>658416</td>
</tr>
<tr>
<td>Haryana</td>
<td>172</td>
<td>225991</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>114</td>
<td>564600</td>
</tr>
<tr>
<td>Orissa</td>
<td>35</td>
<td>114580</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>19</td>
<td>65896</td>
</tr>
<tr>
<td>Chhattisgarh</td>
<td>10</td>
<td>33742</td>
</tr>
<tr>
<td>Karnataka</td>
<td>9</td>
<td>16530</td>
</tr>
<tr>
<td>Jharkhand</td>
<td>6</td>
<td>22500</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>5</td>
<td>9748</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>5</td>
<td>11281</td>
</tr>
<tr>
<td>Chandigarh</td>
<td>1</td>
<td>1000</td>
</tr>
<tr>
<td>Andaman &amp; Nicobar Islands</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Andhra Pradesh (fed)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Arunachal Pradesh</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Assam</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Delhi</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Goa</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>kerala</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lakshadweep</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Manipur</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Meghalaya</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mizoram</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nagaland</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pondicherry</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sikkim</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Chapter-8 Gap & Constraint Analysis

8.1. As Perceived by Producers and Other Stakeholders

**Producer case illustration**

**Potato**

A typical farmer has taken 5 acres of land under potato crop. The variety opted is Kufri 3797. This is a table variety potato. The farmer said he does not opt for Chipsona (Processing variety) as they get wrinkled immediately within 4 hours of harvest and get damaged before putting in cold store. However, the variety he opted has long fresh shelf life of 12 hours from harvest to reaching the cold store. The gross yield per acre is 160 quintals. The price of potato in the month of March is Rs 400 per quintal and if he sells it in March and April, he will incur a loss of Rs 3600 per Acre. Hence he has kept his stock at Dholpur Cold Storage and aims to sell it at least by September when he expects a price of Rs 600 per quintal by which he earns a minimum profit of Rs 28400. He either uses local seeds or takes them from CPRI Shimla every alternate year.

**Cost incurred in the cultivation are:** 15 quintal seed at Rs 300/qtl, i.e. Rs 4500, Land preparation Rs 3500, Sowing – Rs 2000, Seed treatment – Rs 1000, Watering – Rs 6000, Plant protection chemicals – Rs 2500, Fertilizers – Rs 7000, Plant cutting before harvesting – Rs 2000 labor, Digging, Cleaning and packing in bag – Rs 10,500, Cost of jute bag (300*Rs 18) Rs 5500, Transportation to Cold store – Rs 8000, Storage charge for cold (Rs 80 per bag of 50 kg for 5-6 months) Rs 24000. Total cost incurred per Acre is Rs 67,600 and potential revenue by Sept 2017 would be Rs 96,000 (at a price of Rs 600/qtl) and estimated profit could be Rs 28400 per ha.
Discussion with Farmer at village Dadur, Dholpur

Most of the farmers act both as farmers cum processors as they directly store the harvest in cold store after sorting and grading and sells it at appropriate time.

8.2. Swot Analysis of the Pre-Intervention Value Chain

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>• India is the second largest producer of potato, after China, in the world</td>
<td>• Non-availability of improved &amp; good quality planting material</td>
</tr>
<tr>
<td>• Almost a third of all potatoes in the world is harvested in China and India</td>
<td>• Lack of washing, grading and storage facilities</td>
</tr>
<tr>
<td>• The major potato growing states are Uttar Pradesh, West Bengal, Punjab, Bihar, Haryana, Madhya Pradesh, Gujarat and Maharashtra</td>
<td>• Low market price during harvest time affect value accruals to the producers</td>
</tr>
<tr>
<td>• The major districts in Rajasthan producing potato area include Dholpur</td>
<td>• Non-availability of reliable insecticide/fungicide</td>
</tr>
<tr>
<td>• Dholpur is 55 km from Agra which is considered as a potato HUB of India.</td>
<td>• Inadequate infrastructural facilities with producers, traders, processors and at market level results in marketing inefficiencies</td>
</tr>
<tr>
<td>• Availability of many private cold storages around Agra will facilitate potato storage</td>
<td>• Limited value added processing units in the region for potato and its value added-products such as potato chips units</td>
</tr>
<tr>
<td>• Potato is a major vegetable (in-fact an essential ingredient in daily food intake) among most Indians, whether rich or poor.</td>
<td>• Inadequate grading &amp; sorting facilities</td>
</tr>
<tr>
<td></td>
<td>• Cloudy weather, rainfall at the time of flowering and seed formation (adverse weather conditions)</td>
</tr>
<tr>
<td></td>
<td>• Infestation of insect-pest &amp; other diseases</td>
</tr>
<tr>
<td></td>
<td>• Heavy rains may damage the crop</td>
</tr>
<tr>
<td></td>
<td>• Bumper production results in lower mandi price where as poor production increases</td>
</tr>
<tr>
<td>Opportunity</td>
<td>Threat</td>
</tr>
<tr>
<td>• Scope for tie up of FPCs through FCSC with firms like Patanjali, Pepsi, Fritolay etc</td>
<td>• Cloudy weather, rainfall at the time of flowering and seed formation (adverse weather conditions)</td>
</tr>
<tr>
<td>• Scope for tie up of FPCs through FCSC with potato processing units/ MSME firms</td>
<td>• Infestation of insect-pest &amp; other diseases</td>
</tr>
<tr>
<td>• Scope for tie up of FPCs through FCSC with housing societies in urban areas and</td>
<td>• Heavy rains may damage the crop</td>
</tr>
<tr>
<td></td>
<td>• Bumper production results in lower mandi price where as poor production increases</td>
</tr>
</tbody>
</table>
8.3. **Key constraints in Potato crop:**

The constraints observed under potato are divided under from different categories, viz Production related constraints, Post-Harvest related constraints and Processing and market infrastructure related constraints.

**Production related constraints:** Many a times seed prices rise very high due to speculation during sowing time. Many farmers use local seeds for more than 3-4 years causing problems in germination and yield. Blight attack can damage the crop. Limited awareness about processing varieties of potato varieties like, chipsona which could be cultivated in local climate.

**Post-Harvest related constraints:** Lack of proper grading facility. Contractual harvesting of potato. Due to same harvesting time prices Collapse and hence storage/pack house option could help reduce distress sale. Potato crop also suffers from weight loss and damage during transportation, cold storage and is very risky if not properly handled.

**Processing and market infrastructure related constraints:** Lack of precooling and cold storage facility in the cluster. Limited processed product available in the market which limits the marketing potential of the commodity.

**Lack of market intelligence services:** Farmers do not receive information on market prices. Some farmers sell crops through village level traders, because due to which they are not realising fair price.

**Lack of primary processing infrastructure:**

i. There is a non-availability of facilities for primary processing: cleaning, grading & sorting at the farm level.

ii. There is no practice and provision of producer level storage.

iii. There is acute lack of awareness among farmers regarding FAQ (Fair Average Quality) standards.
iv. Farmers do not practice the usage of basic equipment like moisture meter and weighing machine.

**Distant markets:** Due to the distance of APMC from farmers field, they resort to sell the produce to traders at non-competitive prices.

**Seasonal price variations:** Generally during harvesting period, prices are on lower side and reach highest after 5-6 months of harvesting. However, farmers do not have any option but sell immediately at lower prices as they need cash to meet out their expenses. They could realize higher price if they can hold the stock for 5-6 months.

**Malpractices in markets:** Many malpractices prevail in the markets of Potato i.e. excess weighment, delay in payment, high commission charges, delay in weighing and auction, different kinds of arbitrary deductions for religious and charitable purposes etc.

**Infrastructure facilities:** Due to inadequate infrastructural facilities available with the producers, traders, processors and at market level, the marketing efficiency is affected adversely.

8.4. **PIESTEC Framework for Potato Value chain**

Potato can be summarily considered within the adapted PIESTEC framework as follows:
### Political
- Legislation required for FPC formation
- National agricultural policy has given enhanced importance to cultivation of vegetables viz. potato under the aegis of high value agriculture

### Institutional
- FPC model to be developed for strengthening farmers' cause
- KVKs to facilitate supply of inputs viz. HYV seeds, pesticides, etc. to farmers
- Limitations need to be corrected to encourage and up-scale contract farming practices

### Economics
- Sound economics of Potatoes i.e. net profit of up to Rs 19,500 per acre with a productivity of 160 q per acre for Kufri 3797
- In case of contract farming, assured sale price of Rs. 600/qtl, save the money spent on storage i.e. approx. Rs. 24,000/acre.
- Cost of seeds and inputs increase substantially in case of contract farming.

### Social
- Cultivated by mostly small and marginal farmers with little post harvest facility
- Being a high-income crop, potato may be suitable alternative especially in land fragmentation scenario.
- Potato has social significance in terms of snacks such as papads and ready to fry items and used as both as treats for guests and accompaniment for daily meals.

### Technology
- Require farm mechanisation
- Obsolete processing technologies being used in the cluster
- GAP practices should be adopted.
- Integrated crop management required.
- Fertigation required

### Environment
- Dholpur and Bharatpur districts have the most suitable agro-ecological conditions and soil type.
- Decent water availability and sandy-loam soil along with appropriate temperature.
- Heavy black soil and less water availability in Kota affects potato cultivation adversely in many places

### Competition
- Potato produced in Rajasthan faces stiff price competition from potato produced in the Agra region.
- Export require incorporating traceability in production, grading, packing and shipment.

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**Figure 35: PIESTEC Analysis of Potato**
8.5. Impact of GST over potato value chain:
The Goods and Services Tax is one indirect tax for the whole nation. GST is a single tax on the supply of goods and services, right from the manufacturer to the consumer. It will be levied at every stage of the product distribution chain by giving the benefit of Input Tax Credit (ITC) of the tax remitted in the previous stages. Therefore, the final consumer will bear only the GST charged by the last dealer in the supply chain, with set-off benefits at all previous stages. GST will replace all Central level taxes such as excise, service tax, custom duty as well as state level taxes like VAT, CST, entertainment tax among others.

Table 20: Tax Structure

<table>
<thead>
<tr>
<th>Transaction</th>
<th>New Regime</th>
<th>Old Regime</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale within the state</td>
<td>CGST+SGST</td>
<td>VAT+ Central Excise/Service tax</td>
<td>Revenue will be shared equally between the Centre and the State</td>
</tr>
<tr>
<td>Sale to another state</td>
<td>IGST</td>
<td>Central Sales Tax + Excise/Service Tax</td>
<td>There will only be one type of tax (central) in case of inter-state sales. The Center will then share the IGST revenue based on the destination of goods.</td>
</tr>
</tbody>
</table>

The impact on the Food Processing Businesses:
- With the latest information suggesting that the minimum GST rates will be 18% on all products.
- Implementation of the GST is said to increase the prices of agricultural goods. However, the products will be able to reach the consumer faster due to state-level taxes such as Octroi and entry taxes which will significantly reduce the time and hassle of transporting goods across state borders.
- GST will also favour the National Agricultural Market on merging all the different taxation on agricultural goods will improve the marketing and virtual market growth.
- Because GST is a consumption tax, it will be levied only when food products are sold by the manufacturer and not when they are manufactured.
- The Confederation of Indian Industries (CII) has also in its representation called for a zero rate tax on products which have a rate of up to Rs. 10/- and Rs. 20/-. It also demanded that all packaged material used as inputs by the food processing industry should have a zero-percent rate.

Impact on Restaurants and Food Joints:
Service tax liability with the credit of input VAT on goods consumed will get submerged into GST and irrespective of goods and services, the credit of input will be available for adjustment against the output liability. This will further optimize the working capital of these restaurants and consumers can expect the superior quality of goods and services.

Please refer to Annexure 4 for product wise GST rates of Food Products.
9.1. Intervention areas for Value Chain Strengthening

The constraints and intervention plan for various stakeholders, such as farmers, processors, NGO and RACP, in the value chain of Soybean may be considered in context of three stages/activities, namely the production, post-harvest and processing stage. The constraints may be viewed in terms of pest and fungus attack in crops and use of obsolete farming technologies by small and marginal farmers. These may be addressed through provision of resistant varieties to producers through an envisaged FCSC, which in addition to input facilitation may also provide custom hiring services.

At the post-harvest stage, critical constraints may be viewed in terms of inadequate cold storage facilities and enormous intermediaries in the value chain which can be corrected through PCs facilitating service. At the processing stage there are limited processing units in the regions and state into producing value added Potato products including Potato chips, flakes, flour, starch, etc. Appropriate start up counselling may address this issue.

Following would be the roles and responsibility of various stakeholders in the value chain. In the production stage, RACP will facilitate partnership with nearby ATC for technology demonstrations, seed propagation, training of farmers on improved PoP and technology transfer for multiplication of certified seeds through FPC members. RACP would facilitate financing for FPC formation, ABPF to facilitate with policy and process guidelines for FPC formation and establishing FCSC, local NGO to mobilize farmer members and facilitate collection of member equity and help in initial running of FPC. Seed availability is a major challenge for Potato as farmers have to resort to source seeds from Punjab or Himachal Pradesh. In this context, a seed production programme needs to be launched availing the services of local or nearby ATC. FPC would take up bulk purchase of agri inputs at distributor price and sell member farmers at wholesale price. The FPCs formed would need mentoring, hand holding and business planning support. This would be provided by ABPF with support from local NGO and RACP from time to time. ABPF would organize various campaigns like buyer seller meets and FPC/FCSC members training to achieve this objective. ABPF would also provide establishment guidance for FCSC as per guidelines issued by RACP.
## Table 21: Intervention Plan of Value Chain of Potato along with Stakeholder matrix

<table>
<thead>
<tr>
<th>S.no</th>
<th>Stakeholder</th>
<th>Roles &amp; Responsibilities</th>
<th>Pre-intervention Constraints</th>
<th>Post Intervention Action</th>
<th>Action By</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Farmers</td>
<td>- Land Preparation</td>
<td>- Limited awareness of farmers</td>
<td>- To promote both table purpose varieties and processing purpose varieties as well as •</td>
<td>Agriculture University, Agriculture Research Institute &amp; Station, Seed Companies, Extension team of RACP</td>
<td>Y1Q1- Y1Q2 (6 months after registration of FPC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Cultivation of crops</td>
<td>- Availability of improved &amp; good quality varieties of Potato among producers</td>
<td>- Farm Information Dissemination through District level exhibition, Kisan Melas, Printed materials, electronic media.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Harvesting of crops</td>
<td>- Many farmers use local seeds for more than 3-4 years causing problems in germination and yield.</td>
<td>- FPC to take up seed and other agri input distribution for member farmers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sell the raw produce</td>
<td>- Blight attack can damage the crop</td>
<td>- Seed treatment, soil treatment chemicals through FPC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Farmers are trained with production-led extension approach till date</td>
<td></td>
<td>Market led extension approach is necessary to increase farmers income.</td>
<td>Extension team of RACP and Processors (through ABPF)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Traditional package of practices followed by farmers</td>
<td>Increasing Research – Extension – Farmers linkages by organizing farmers–scientists interaction, Field Days and Kisan Goshties, Farmers’ Field Schools.</td>
<td></td>
<td>Extension team of RACP, Scientists from Agriculture universities and ABPF agribusiness experts</td>
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<td></td>
<td>- During harvesting time, prices collapse and hence cold storage/pack house option could help reduce distress sale.</td>
<td>Storage facility for farmers as part of FCSC</td>
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<td>RACP, KVK and ABPF</td>
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<th>Action By</th>
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<td></td>
<td>Lack of appropriate post-harvest equipment</td>
<td>Promotion of small scale units with harvesting and shelling facility; also may be part of FCSC</td>
<td>RACP and ABPF</td>
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<td>Due to inadequate facilities of transportation at the village level, producers are forced to sell local merchants or traders directly at low prices</td>
<td>Provision of Pick-up van as part of FPC services to the farmers.</td>
<td>ABPF, RACP</td>
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<td>Lack of scientific sorting system and cleaning/grading facilities</td>
<td>To make farmer aware about quality parameters of Potato for processing like value added products; washing/Cleaning &amp; Grading facilities as part of FCSC/s. Additionally, mini pulveriser plants could also be established as part of FCSC/s</td>
<td>RACP, SPs with inputs from ABPF</td>
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<td>Higher level of dirt and impurities in harvested Potato</td>
<td>Provide cleaning and grading facility to farmers as part of FCSC</td>
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<td>Processors</td>
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<td>Process the raw produce Value addition Packaging of value added product</td>
<td>Limited adoption of direct procurement and contract farming</td>
<td>Large Processor/ Buyer and ABPF, RACP</td>
<td>Y1Q3-Y2Q2 (6 months after registration of FPC)</td>
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<td>2</td>
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<td>Limited processed product available in the market which limits the marketing</td>
<td>Setting up alternate channel to sell directly from PC to processor or large retail shops.</td>
<td>ABPF, RACP</td>
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<td>Facilitate the entrepreneur development to set up small scale processed product like Potato chips, papad, RTE</td>
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| 3    | NGO         | • Extension services to farmers  
• Disseminate RACP Schemes to the farm level  
• Distribution of seeds and farm kits as per various schemes  
• Hand holding support to the farmers regarding | potential of the commodity  
• Many existing processors and budding entrepreneurs are not aware of schemes of the GoI Including CLCSS, cluster Development scheme or “Sampada” for technology upgrading. | • Awareness seminars for processors  
• Training of NGO field staff on market led extension services  
• Business planning training  
• Monthly/Fortnightly review meetings with RACP  
• Feedback of farmers from service area  
• Exposure visits of NGO staff to successful FPCs | ABPF, RACP | Y1Q1-Y2Q4 |
| 4    | RACP        | • establish the feasibility of sustainably increasing agricultural productivity and  
• Lack of clarity on the form of FPO-Cooperative or FPC  
• Selections of capable leaders for | | • Create basic understanding among the RACP PMU staff about concepts of FPC  
• Clear understanding on fundamental differences | ABPF, RACP PMU Line staff NGO | Y1Q1-Y2Q4 |
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<th>Pre-intervention Constraints</th>
<th>Post Intervention Action</th>
<th>Action By</th>
<th>Timeline</th>
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<tbody>
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<td>farmer income</td>
<td>• integrate agriculture water management and agricultural technology, • Establish farmer organizations (FPCs) and market innovations in selected locations</td>
<td>the proposed FPO • Low level of awareness among the PMU staff and farmers regarding the concept of FPC • Poor or no Market linkages of the value chain crops in clusters • Lack of active NGO staff deployed in the cluster</td>
<td>• between FPC &amp; Cooperative • Create market linkages by bringing more big players and processors to the cluster • Conduct training of the potential farmer leaders about FPC and its functioning • Capacity building training of the NGO staff regarding the extension services to be provided to the farmers</td>
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9.2. Indicative Post-Intervention Value Chain Map

The post intervention value chain map for Potato may be visualised as one which is facilitated through a Farmer producer company, purely farmer’s organization which would directly procure from the farmers, then take it forward in the value chain instead of local traders and middlemen. The marketing channels would be for raw Potato and value added products of Potato like chips, flakes, flour and starch, etc. It is also envisaged that PCs of producers with FCSCs is evolved. Such FCSCs undertakes cold storage, washing, grading and sorting and packaging of produce activity. These FCSCs may offer other related services in terms of input facilitation, custom hiring, facilitating B2B connectivity and contract farming services for companies like Pepsi Co. etc.
9.2.1. Intervention through FPC Model in Potato value chain:
Aggregation is the proposed solution of the constraints farmers are facing at present. It is proposed to form Farmers Producers’ Company by bringing farmers together in the form of voluntary groups of about 15 to 20 active farmers and federating 20 to 25 such groups into a Producer Company. These Producer Companies will be functioning on behalf of member farmers and will strive to undertake a range of activities which will result in added value accruals to farmers and value to farmers produce. To form a producer company, producer groups will be mobilized (in some cases, this initiative may have already been completed by NGO’s).

It is envisaged that an elected committee of members of Producers Groups will form a management committee and oversee the performance of an incentivized manager/CEO. The manager will be trained in technical issues of post-harvest management, marketing and in operating a transparent accounting system. The ABPF will support the operation of the Producer Company, and accelerate the cross learning of best practices.

The FPC development approach may be viewed as depicted below:

Table 22: FPC Development Approach

Following are the steps to be followed for formation of the FPC:

- PRI of the MTG: The MTGs will be made aware on the FPC model through PRI and individual farmers will be motivated to join the FPC as shareholder through respective MTGs.
- Initial discussions with MTG leaders: After PRI is done, initial discussion will be done with the MTG leaders for further orientation on FPC concept.
- Identification of MTG leaders: MTG leaders who show inclination to the concept will be selected in the executive committee for FPC formation.
• Resource mobilization and FPC planning: The executive committee will meet 2-3 times to plan further activities of FPC viz. crops, strategy for business etc.

• Election of BoD and Share collection: 10-12 BoD will be identified along with 2-3 expert directors one each from Agri, Horti, AH and WS dept. The BoD will decide on share value and initiate collection of share through MTG leaders.

• FPC registration: Following identification of FPC BoD, registration will be done. This may take 1-2 months as DIN no of BoD has to be generated first. Care should be take that all elected BoD should have PAN no so that there is no delay in paper formalities for registrations.

• FPC business: Following registration of FPC, ABPF will prepare business plan for the FPC and facilitate market linkage for input and output.

• Setup of processing/ financing – ABPF will further facilitate establishment of processing unit setup along with feasibility studies and planning business linkage with market players.

Policy and Management
A FPC will function within the overall policy and regulatory framework as per the Producer Company Act. The management of a FPC will vest with the elected Board from amongst the members. The provision about constitution of managing committee will be made in the byelaws.

The management of FPCs will be by an elected Board of Directors. Therefore, the representatives of farmers will actually oversee and manage the affairs of a FPC.

The selection criteria for membership of FPC may be viewed as follows:
8. A member will express his willingness to become a member of MTG.
9. A member will actively participate in all functions and activities of MTG
10. A member will contribute his equity to the FPC
11. A member will bring all or part of his produce to the FPC for sale.
12. A member will purchase all or part of his farm inputs through the FPC.
13. A member will produce and prepare his produce for marketing as per directions of FPC.
14. A member will contribute his share to the Producer Association as upfront payment for the business development plan of a FPC as needed.
15. A member will contribute his share to the Producer Company towards the reserves of FPC as needed.

Illustrative list of components of a common facility of a Producer Company (Food Grain)

• Godown for storage, drying platforms
• 2-3 MT per hour grain cleaning, grading, and packing machinery with shed
• Additional need based Agricultural Equipment
• Computer with internet connectivity for market information
• Display Board with Accessories
• Auction Hall
• Input Suppliers Shops
• Toilets
• Drinking water & Electricity

Note: Though the illustrative infrastructure proposed is shown in the above tables, the actual infrastructure to be developed will be need based and on participative consultation process.
Typically, start-up may be involved in secondary and tertiary processing activities while FPC’s may be involved in post-harvest and primary processing activity. In many cases, start-up may emerge firm within FPC members.

The evaluation of success should be evaluated on the parameters as under:

I. FPCs operating without financial support by the end of 36 months.
II. The FPC operates with a reserve fund to cover short term cash flow deficit and with potential for reinvestment in various activities
III. The FPC has an effective governing structure.
IV. The FPC has a transparent accounting system.
V. The FPC can function as a working example for other farmer organizations to observe and learn from.
VI. Contribution towards increasing farmers’/members incomes.

**FPC Revenue model**

The revenue model for typical FPCs may be viewed in terms of revenue from:

1. Input facilitation services (this could imply revenue by virtue of service such as dealership/distributorship for seeds, pesticides or fertilizers). About 50% of the dealer’s discount may be perhaps is retained by FPC and 50% be passed on to FPC farmer member as to reduce their input costs.
2. Processing and storage services through FCSCs to be offered to FPC members and other providers in the region and user/service change collected (typically) at perhaps the rate of 1 to 3 percent of value of commodity.
3. Marketing service may be offered in terms of facilitating charges typically @ between 1-2 percent of sales value.
4. MSP facilitation service in terms of facilitating procurement and supply to NAFED/SFAC etc. after, a 1 percent service charges is levied for such activity by FPCs.
5. NCDEX related farmers trading may be facilitated by FPCs as a risk hedging option and user charges collected at a negotiated rate with members.
6. Custom hiring services may be provided either through tying up with service providers or including equipment as part of FCSC.

Working capital service would be in terms of FPC providing and marketing of produce from member farmers. Here, the FPC may retain the price spread as service charge.

**9.2. Conclusion**

This value chain analysis of Potato clearly brings out that unlike any other enterprise, agriculture is critically dependent on external factors like the bounties of nature for its success; be it unseasonal rain, hailstorm, delayed monsoon, less rain, no rain, or excess rain, all of which makes agriculture a high risk and vulnerable proposition. This perpetual environment of high risk and vulnerability has significantly lowered farmers’ confidence and suppressed their entrepreneurial instincts as was amply reflected in the discussions held over cluster level meetings.

Till date, farmers have benefitted mainly from government’s input driven schemes while market access interventions such as mandis have created more barriers (middlemen) than benefits and resulted into market inefficiencies that eventually exploited farmers. Despite being at the receiving end of market barriers and inefficiencies for generations, individually, small farmers may perhaps never muster enough strength to overcome market challenges. In such a scenario, the intervention
of establishing Farmer Producer Companies in the clusters has potential to unleash their suppressed energies and to promote rural entrepreneurship. It would encourage farmers to collectively delve into market operations to compete and design specific market solutions such as aggregation and sales of produce, operate custom hiring and composite input sales centres.

For the farmer, increase in input costs, without corresponding increase in output prices, has rendered agriculture unviable. And, in the absence of any other locally available alternate livelihood options farmers cannot even move away from agriculture. Thus, RACP along with the market driven intervention of ABPF also aims towards integration of farmers and help them join hands for a collective cause, assist them to move up the agriculture value chains as to actively participate in market functions, an unexplored but lucrative territory for them so far. This would spur vertical business integration and diversify their market portfolios to reduce their vulnerabilities.

Value chain actors or stakeholders decide sale prices of their produce/products and compete effectively in the markets whereas farmers often depend on Minimum Support Price (MSP) fixed by government agencies to sell grains. Trader’s cartelisation ensures that MSP becomes the Maximum Gain Price (MGP) fetched by farmers, further squeezing their revenues. The end result has been a declining contribution of agriculture to the national economy. It is also true that given farmers’ inability to deal effectively with market forces, in the absence of MSP, farmers would have been possibly in an much worse off situation.

Thus in the Common facility centre of FPC, cleaning, grading and packaging would primarily be done, leading to uniform grades of potato seeds with appropriate quality and packaging. Moreover, the moisture content would be monitored to avoid any infestation during storage. Moreover, the harvesting process would also be more mechanized, which reduces losses due to post harvest farm activities (threshing, separating, etc.). Storage would largely be done in the large silos/bins which are monitored & treated regularly to prevent losses from pest attacks. The transportation would primarily through closed locked and tracked vehicles. This reduces both the natural losses and pilferage.

The major role of ABPF- GT would in this circumstance also be to carry out capacity building initiatives of the potential leaders (BoDs) of the FPC, NGO staff and PMU staff line, conducting value chain studies of the crops (market led), plan interventions to improve the returns to the farmers in the 17 project clusters, develop the business plan for registered producer companies in clusters, support and assist agri start-ups in the region, and thus develop overall market linkages. The formation of FPC supported by RACP ABPF, local NGOs and facilitation centres like KVKs, provides the much needed opportunity to farmers to favourably and positively change their outlook in years to come.

**Proposed Outcome:**
- 1.3% direct benefit due to direct procurement through FPC, 7.1% benefit through profit accumulated by FPC
- 2.5% price benefit on cost of inputs
- 1% saving on cost of transportation to APMC and associated charges
- Increased competition in input and output market resulting in higher earning potential for farmer
- Increased bargaining power of farmers
• Sustainable operations through community institution and assets through FPC and FCSC

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• http://www.potatopro.com/india/potato-statistics
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• http://www.iresearchservices.com/5-common-factors-influencing-consumer-behavior/
Annexure 1: Stakeholder’s consulted over the study

1. **10 Farmers of Baari, Dholpur**
   - Vishambhar Singh, Ranpura, 7378115349
   - Diwan Singh, Ranpura, 9694802073
   - Ashok Singh, Ranpura, 7297015922
   - Vishram Singh, Ranpura, 9799213964
   - Puran Singh, Ranpura, 9717841987
   - Ramesh Sharma, Ranpura, 9694331856
   - Lokenu, Ranpura, 8003633105
   - Balistar, Ranpura, 7891686411
   - Omveer Singh, Ranpura, 7340473780

2. Bhagwati aalu bhandar, Muhana Mandi (Trader), Jaipur, 9414044156
3. Balaji Trading company, Muhaha Mandi (Trader), Jaipur, 9828163153
4. Central Potato Research Institute, Dr. S.K. Charaabarti, Shimla, 0471-2598431
5. Dr. Sashi Bairwa, Lecturer, Agriculture Collage, Dausa, 7462213207
6. D K Singh, Procurement Head, Reliance Retail, Agra, 8171145539
7. Mr. Joginder Rahlan, North India Head, Arya Collateral Services, 9971908306
8. Mr Aman Chaudhary, CGR Mandi, 9414090063
9. Mr Dinesh Mallik, Azad Agro Enterprises, 9587263999
Annexure 2: List out Central Warehousing Corporation (CWCs) in Rajasthan

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<td>Rajindra Prasad</td>
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<td>Rajmal Meena</td>
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<td>Plot No. G-162 to 165 &amp; F-166 to 171, Brij Ind. Area, Behind Nafed Plant, Phase-II, Hathni Road, Bharatpur</td>
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<td>M P Sharma</td>
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<tr>
<td>Anupam Kumar</td>
<td>C/o ARDC Godown, Mizewali Road, Kesarsinghpur Distt. Srigangan</td>
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<td>S.K. Sharma, Plot No.SPL-1296,EPIP SITAPURA, Ind. Area, Jaipur-302002</td>
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<tr>
<td>SITAPURA-II</td>
<td>Manish Tayal, Plot No.SP-1,RIICO Industrial Area, SITAPURA, Jaipur</td>
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<td>SRIGANGANGR-I</td>
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</tr>
<tr>
<td>SRIGANGANGR-II</td>
<td>Dhanwant Singh, Udyog Vihar Plot No. E-194 to202, SRIGANGANGR-II, 335001</td>
<td>Manager</td>
<td>Ganganagar</td>
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<tr>
<td>SRIMADHOPUR</td>
<td>B L Meena, Hanspur Road, Srimadhopur-332715</td>
<td>Manager</td>
<td>Sikar</td>
</tr>
<tr>
<td>TIBBI</td>
<td>Pyare Lal, 10, GGR, Hanumangarh Road, Tibbi Distt. Hanumangarh</td>
<td>Manager</td>
<td>Hanumangarh</td>
</tr>
<tr>
<td>UDAIPUR</td>
<td>Manish Kumar, Opp-FCI Depot, Udaisagar Road, Udaipur-313001</td>
<td>Manager</td>
<td>Udaipur</td>
</tr>
<tr>
<td>NAI KA TALAB</td>
<td>S N Meena, Nai Ka Talab, Bundi</td>
<td>Manager</td>
<td>Bundi</td>
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</table>
Annexure 3: List of Cold stores in Rajasthan

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name &amp; Address Of Cold Storages</th>
<th>C.S.O. License No.</th>
<th>Capacity (In MT)</th>
<th>Sector</th>
<th>Products Stored</th>
</tr>
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<tbody>
<tr>
<td></td>
<td><strong>AJMER</strong></td>
<td></td>
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<tr>
<td>1</td>
<td>Laxmi Cold Storage Bewar Road</td>
<td>RJST/3215</td>
<td>3000</td>
<td>Private</td>
<td>Potato Flower Egg, Jaggery Multipurpose</td>
</tr>
<tr>
<td>2</td>
<td>Vijay Ice &amp; Cold Storage Old Industrial Area</td>
<td>ALR/1081</td>
<td>801</td>
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<td>Multipurpose</td>
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<tr>
<td>3</td>
<td>Jayanti Cold Storage, Rajgarh Rd., Gram Dadar</td>
<td></td>
<td>3533</td>
<td>Private</td>
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<tr>
<td></td>
<td><strong>ALWAR</strong></td>
<td></td>
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<td></td>
<td><strong>BARMER</strong></td>
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<tr>
<td>1</td>
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<tr>
<td></td>
<td><strong>BHARATPUR</strong></td>
<td></td>
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<tr>
<td>1</td>
<td>Akash Cold Storage Pvt.Ltd., Kumehar Road</td>
<td>RJST/3121</td>
<td>2708</td>
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<td>Bharatpur Cold Storage (P)Ltd. Sewar PO</td>
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<td>3</td>
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<tr>
<td>4</td>
<td>Ganesh Pvt. Ltd. Seware Road</td>
<td>RJST/2826</td>
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<td>5</td>
<td>Fauzi Cold Storage Krishna Nagar</td>
<td></td>
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<tr>
<td>6</td>
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<td>1600</td>
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<tr>
<td>7</td>
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<tr>
<td>8</td>
<td>Tantpur Enterprises Hora Baii</td>
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<td>2640</td>
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## Value chain Analysis: Potato

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<tr>
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</thead>
<tbody>
<tr>
<td>9</td>
<td>Golden Cold Storage</td>
<td>8000</td>
<td>Private</td>
<td>Potato</td>
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<tr>
<td>10</td>
<td>Brijwasi Cold Storage, V&amp;PO Brijwasi Tehsil, Bawer</td>
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<td>Potato</td>
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<tr>
<td>11</td>
<td>L.R.J. Cold Storage</td>
<td>3593</td>
<td>Private</td>
<td>Potato</td>
</tr>
<tr>
<td>12</td>
<td>Pratap Ice &amp; Cold Storage</td>
<td>5213</td>
<td>Private</td>
<td>Potato</td>
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<tr>
<td>13</td>
<td>Nadabi Cold Storage, Teh..Nadwai Vill. Bilora</td>
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</tr>
<tr>
<td>14</td>
<td>Deeg Cold Storage, Rambagh</td>
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### Bikaner

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<tr>
<td>1</td>
<td>Chitra Ice Factory &amp; Cold Storage P.O. Bhinsarr</td>
<td>1858</td>
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<td>Multipurpose</td>
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<tr>
<td>3</td>
<td>Pareek Cold Storage Kami Ind. Area</td>
<td>3184</td>
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<tr>
<td>5</td>
<td>Rajasthan Cold Storage Pvt.Ltd.</td>
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<td>Nagarjuna Rashala Ranibagh Industrial Area</td>
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<td>7</td>
<td>Shri Bikaner C.S. Kami Ind. Area</td>
<td>233</td>
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</tr>
<tr>
<td>8</td>
<td>Nakha Cold Storage, B-5A, RICCO Ind.Area</td>
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### Bundi

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<tr>
<td>1</td>
<td>Shankar Sheetalaya Cold Storage Ice Factory, Vill. Govindpur Baroi Post Talera</td>
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### Jaipur

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<tr>
<td>1</td>
<td>Annapurna Cold Storage V.K.I.A. Jaipur</td>
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<td>Private</td>
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<td>2</td>
<td>Baba Ganesh Aloo Bhanders Malviya Indl. Area</td>
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<td>Private</td>
<td>Potato</td>
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<tr>
<td>3</td>
<td>Bhagwati Udyog Cold Storage &amp; Ice Factory, Location C-177 r Road No. 9 J V.I. Industrial Estate</td>
<td>7995</td>
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<td>4</td>
<td>Core Fionance Ltd. E-705-6 Sitapur Indl. Area</td>
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<tr>
<td>5</td>
<td>Hira Cold Storage &amp; Ice Factory D/192 VKIA</td>
<td>RJST/2779</td>
<td>5894</td>
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<td>6</td>
<td>Jan Arihant C.S. Sitapur Ind. Area</td>
<td>3598</td>
<td>Pvt Multipurpose</td>
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<td>J&amp;N Cold Storage Sitapur Indl. Area</td>
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<td>8</td>
<td>Kotadmola Agro Cold Storage Delhi Road Jaipur</td>
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<td>Private Multipurpose</td>
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<td>9</td>
<td>Jhura Mal Cold Storage B-10 (B&amp;C) Malviya Industrial Area</td>
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<td>3063</td>
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<td>10</td>
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<td>11</td>
<td>Narain Cold Storage &amp; Ice Factory, B-121 Vishvakarma Ind.Area</td>
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<td>M/s Arawali Industries</td>
<td>3232</td>
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<td>16</td>
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<td>Pink City Cold Storage Jotwara Ind.Area</td>
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<td>18</td>
<td>Pawan Oil Extraction Ltd. Sitapur Ind. Area</td>
<td>9150</td>
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<td>19</td>
<td>Rajasthan cold Storage &amp; Allied Ind.(P) Ltd. F-129 Malviya Ind.Area</td>
<td>RJST/2447</td>
<td>1263</td>
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<tr>
<td>20</td>
<td>Rajasthan Rajya Sahakari Kriya Vikraya Sangh Ltd.Bhawani Singh Rd.GolimarGarden</td>
<td>RJST/2619</td>
<td>1861</td>
<td>Cooperative Potato</td>
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<td>21</td>
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<td>22</td>
<td>Sarju cold Storage Vishwakaram Ind. Area</td>
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<td>3106</td>
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<tr>
<td>No.</td>
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<td>Address</td>
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<td>Type</td>
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<td>----------------------------------------------</td>
<td>----------</td>
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<td>24</td>
<td>Sobh Raj cold Storage &amp; Factory E-41 Road No.1 V.K.I.A.</td>
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<td>25</td>
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<td>26</td>
<td>Vishan Das Cold Storage</td>
<td>Achrawala</td>
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<td>Sitapur Cold Storage Sitapur</td>
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<td>28</td>
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<td>Storage</td>
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**DHOLPUR**

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<th>Location</th>
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<tr>
<td>1</td>
<td>Jagan frozen Foods</td>
<td>(P)Ltd.,Khasra No.303-304 vill. Edalpur, Teh.Mania- Dholpur</td>
<td>4505</td>
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**JHALAWAR**

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<th>Type</th>
<th>Location</th>
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<tbody>
<tr>
<td>1</td>
<td>Surindra Cold Storage &amp; Ice Factory Bhawani Mandi</td>
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<td>Multipurpose</td>
</tr>
<tr>
<td>2</td>
<td>Surindra Ice Factory &amp; C.S. Indl. Area Jhaira Pastan Jhalwar Distt.JODHPUR</td>
<td>RJST/2629</td>
<td>565</td>
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<td>3</td>
<td>Ganapati Cold Storage Bhadwasi Mandi</td>
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<td>4</td>
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<td>660</td>
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<td>5</td>
<td>Parvati Cold Storage E-114 Ind. Area</td>
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<tr>
<td>6</td>
<td>Shiv Cold Storage Bhadwasia Mandi</td>
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<td>Multipurpose</td>
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<td>Surya Nagri C.S. Mandore Indl. Area</td>
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<td>Steel Plast Corp. C-91/A Industrial Area Marudhar</td>
<td>RJSI/2733</td>
<td>1084</td>
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<tr>
<td>11</td>
<td>Tej Pars Associate Mandoe Indl. Area</td>
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<tr>
<td></td>
<td>Facility Name</td>
<td>Area (sq ft)</td>
<td>Ownership</td>
<td>Purpose</td>
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**KOTA**

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</thead>
<tbody>
<tr>
<td>1</td>
<td>Chitresh Cold Storage Pvt. Ltd. Borkhera</td>
<td>RJST/3217</td>
<td>6400</td>
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<td>Mahalaxmi Association Cold Storage &amp; Ice Factory Old Dhanmandi</td>
<td>KTA/440</td>
<td>1582</td>
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**PALKI**

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<th>Purpose</th>
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<tbody>
<tr>
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<td>Mayur Cold Storage Mabara Bazar</td>
<td>1000</td>
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<td>Multipurpose</td>
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<tr>
<td>4</td>
<td>Suvidha Cold Storage Ramganj mandi</td>
<td>4018</td>
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**SRIGANGANAGAR**

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<th>Area (sq ft)</th>
<th>Ownership</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>GIC Ice Factory &amp; Cold Storage Pvt. Ltd. Plot No. SP_ID Industrial Area Suratgarh</td>
<td>RJST/3214</td>
<td>1077</td>
<td>Private</td>
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<tr>
<td>2</td>
<td>Guru Nanak Cold Storage &amp; Gernal Mills, Rai Singh Nagar</td>
<td>RJST?2655</td>
<td>1447</td>
<td>Private</td>
</tr>
<tr>
<td>3</td>
<td>Indian Cold Storage &amp; Ice Factory Near Vinobha Basti Guru Nanak Road</td>
<td>SRG?1889</td>
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<td>Private</td>
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<td>4</td>
<td>Janta Cold Storage &amp; Ice Factory Chak-6 Padampur Road</td>
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<td>765</td>
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<td>5</td>
<td>Sriganganagar Cold Storage (P) Ltd. Suratgarh Road</td>
<td>GNGR/422</td>
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**UDAIPUR**

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<tbody>
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<td>Maharaja Cold Storage 119-120 Udyog Vihar</td>
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<td>2</td>
<td>Mewad Sheet Griha Factory Sardarpura</td>
<td>UDR/874</td>
<td>2337</td>
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<tr>
<td>3</td>
<td>Rajasthan Coop. Dairy Fed. Govardhan Village</td>
<td>RJST/2693</td>
<td>104</td>
<td>Cooperative</td>
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</table>
Annexure-4: Product wise GST rates of Food Products

- **GST-28%**
  1. Molasses
  2. Chewing gum/bubble gum and white chocolate
  3. Cocoa butter, fat and oil
  4. Cocoa powder
  5. Cocoa chocolates
  6. Malt extract (other than for infant use and mixes and doughs of bakers)
  7. Waffles and wafers coated with or containing chocolate
  8. Extract, essences and concentrates of coffee
  9. Mustard flour and sauces thereof
  10. Sugar, lactose and glucose syrups
  11. Food flavouring material
  12. Churan for pan
  13. Custard powder
  14. Aerated waters containing added sugar or other sweeting matter

- **GST-18%**
  1. Condensed milk
  2. Malt, whether or not roasted
  3. Refined sugar, sugar cubes
  4. Sugar confectionery
  5. All preparations of cereals, flour, starch or milk for infant use and sold retail
  6. Pasta, spaghetti, macaroni, noodles
  7. Corn flakes and other cereal flakes
  8. Waffles and wafers (other than chocolate coating)
  9. Pastries and cakes
  10. Extracts, essences and concentrates of tea or mate
  11. Soups and broths
12. Ice cream and other edible ice
13. Instant food mixes, soft drink concentrates, sharbat, betel, supari, packaged food
14. Water, including natural or artificial mineral waters and aerated waters not sweetened
15. Ethyl alcohol and other spirits
16. Vinegar and substitutes
17. Curry paste, mayonnaise and salad dressing; mixed condiments and mixed
   ➢ GST – 12 %

1. All meat in unit containers put up in frozen, salted, dried, smoked state
2. All meat and marine products, prepared or preserved.
3. Butter, ghee, butter oil, cheese
4. All goods under Chapter 20 (preparations of vegetables, fruits, nuts or other parts of plants, including pickle, murabba, chutney, jam, jelly)
5. Ketch-up & sauces, Mustard sauces
6. Dry fruits
7. Starches
8. Animal fats and oils
9. Fruit and vegetable juices
10. Roasted chicory and coffee substitutes
11. Yeasts and prepared baking powders
12. Namkeens, bhujiya, mixture, chabena
13. Bari made of pulses including mungodi
14. Soya milk drinks
15. Fruit pulp or fruit juice based drinks
16. Tender coconut water (in unit container with brand name)
17. Beverages containing milk
   ➢ GST – 5 %

1. All fish variants (except seeds of fish, prawn& shrimp) processed, cured, frozen state
2. Ultra-high temperature milk
3. Milk and cream including skimmed milk powder but excluding condensed milk
4. Yoghurt and other fermented milk and cream
5. Chena or paneer in unit container and branded
6. Egg yolk, fresh or dried
7. Natural honey in branded unit container
8. Vegetables frozen or preserved (but unsuitable in that state for immediate consumption)
9. Edible fruits and nuts; peel of citrus fruit or melons, in frozen or preserved state
10. Coffee, tea, pepper, vanilla, cloves, cardamoms
11. Seeds of anise, coriander, cumin
12. Ginger (other than fresh ginger), saffron, turmeric, other spices
13. Cereal groats, meal and pellets in branded unit container
14. Cereal grains worked upon (hulled, rolled, flaked)
15. Meal, powder, flakes, granules and pellets of potatoes
16. Meal and powder of the dried leguminous vegetables (pulses, sago, tamarind)
17. Wheat gluten
18. Soya beans
19. Ground nuts
20. Copra
21. Linseed, rape seeds, sunflower seeds, other oilseeds like mustard, poppy,
22. Flour and meals of oilseeds
23. Sugar beet and sugar cane (frozen and dried)
24. Vegetable fats and oils (Groundnut, Olive, Palm, Sunflower oil etc.)
25. Beet sugar, cane sugar, khandsari sugar
26. Cocoa beans, shells and paste
27. Mixes and doughs for preparation of bread, pastry and other baker’s wares
28. Pizza bread
29. Seviyan
30. Rusks, toasted bread
31. Sweetmeats
32. Flours, meals, and pellets of meat, fish meant for animal consumption
33. Cashew nuts and cashew nut in shell
34. Raisin
35. Ice and snow

➢ GST – Nil %
1. Meat (Other than in frozen state and put up in container)
2. Bones and horn cores, bone grist, bone meal etc., hoof meal, horn meal, etc
3. Fish, prawn and shrimp seeds
4. All fish, fresh or chilled (but not processed, cured and frozen)
5. Fresh milk, pasteurized milk but not concentrated, sweetened
6. Eggs (in shell)
7. Curd, lassi, buttermilk
8. Chena or paneer (except in unit container with brand name)
9. Natural honey (no container-no brand)
10. Fresh fruits and vegetables, roots and tubers (except in frozen state or preserved)
11. Dried fruits
12. Leguminous vegetables, shelled or unshelled
13. Dried leguminous vegetables, shelled, whether or not skinned or split (pulses)
14. Coffee beans, unprocessed tea leaves, fresh spices
15. All cereals (no container-no brand)
16. Cereal grains hulled
17. Flour
18. Atta, maida, besan (no container-no brand)
19. Wheat or meslin flour
20. Cereal flour, groats and meals (no container-no brand)
21. Flour of potato, dried leguminous vegetables (no container-no brand)
22. Oilseeds of seed quality
23. Cane jaggery (gur)
24. Palmyra jaggery
25. Puffed, flattened and parched rice
26. Pappad (except when served for consumption)
27. Bread (branded or otherwise) (except when served for consumption and pizza bread)
28. Prasadam
29. Water (other than aerated, sealed etc)
30. Non-alcoholic toddy
31. Tender coconut powder
32. Acquatic, poultry and cattle feed
33. Salt, all types
Annexure-5: Detailed PIESTEC of Potato Value Chain

- **Political circumstance**
  Agriculture is the largest direct source of income for households in India. Therefore, farmers and their families constitute the single largest voter segment and occupy a large portion of the political mind space at the union and state levels. Among the farming households, 4/5th belong to the marginal and small holder categories i.e. having land less than 2 ha. Agriculture development policies have given primacy to these categories while designing financial and technical support systems for agriculture development. Such focus has remained stable irrespective of the ruling political party running either at the union or state levels. Such political attention has resulted in huge public investments towards productivity enhancement and regulation of market mechanisms to ensure adequate income for the farmers. However, implementation anomalies have often curtailed the benefits at the farmer levels even having no positive impact in many cases. During the past decade, specific focus of agriculture development is on reducing cultivation costs, post-harvest losses and higher remuneration through better integration of farmers with markets. Towards this, formation of farmer’s collective’s and their legal organisations have been accorded primacy. This is expected to assist farmers’ in reducing costs and enhancing negotiation powers while dealing with the markets. Collectivisation, aggregation and value addition at farmers level are the mechanisms for assisting the farmers. In recent years, the national agricultural policy has given enhanced importance to cultivation of vegetables under the aegis of high value agriculture found to be especially suitable for the marginal and small holder farmers. Several publicly funded organisations and programs viz. NABARD, SFAC, NRLM along with are working toward further the above objectives. However, marginal and small holder farmers are often not able to leverage the benefits of the above initiatives due to lack of capabilities to invest in and adopt better farming technologies, nor aggregate adequate volumes of commodities as to develop alternate marketing channels away from typical APMC or multiple-trader led channel in vogue. Therefore, the need for aggregation of such farmers into FPOs / FPCs becomes more prominent so that such FPOs / FPCs may have a combined holding of 1000-1500 acres with adequate marketable volumes.

- **Institutional context**
  FPOs/FPCs have been mandated under various government programs and a special category of companies called producer companies have already been institutionalised under the company’s act to safeguard the rights of farmers. In addition to the above, model contract farming rules have been devised by the Govt. of Rajasthan to safeguard farmers interests and create a level playing field. This is highly pertinent for the potato growers because many companies have taken the route of contract
farming to ensure availability of quality raw material (potato) for making packaged food items like chips, French fries etc.

In its ideal form, contract farming agreements create a win-win proposition for the farmers and the companies because farmers get access to better technology and inputs and receive assured prices for their produce while companies are assured of good quality raw materials with a stable price outlook. However, the stipulated norms and rules of the Contract Farming Act and mechanism in Rajasthan may act as a hinderance for large scale uptake of this mechanism as companies and farmers may be wary of some of the clauses as mentioned below.

A. Rule 5 – “The agreement shall be written on stamp paper of the value of Rs.100.”
B. Rule 9 – “Separate registration form shall be filled for each agreement.”
C. Rule 15 – “The contracting price shall be higher than the minimum support or the model price, whichever is higher, for the contracted agricultural produce during the previous harvest season, in the market committee concerned.”
D. Rule 17 - “In case the contract farming buyer fails or refuses to purchase the agreed quantity of the agriculture produce from the contract farming producer, he shall pay the amount of the difference between the agreed price and the actual sale price of the contracted produce in the market committee concerned to the producer.”
E. Rule 19 – “The contract farming buyer shall furnish an undertaking equal to 20% of the value of the contracted amount.”
F. Rule 20 – “In case the contract farming producer fails or refuses to provide agricultural produce to the contract farming buyer as specified in the agreement, he shall be liable to make payment of the amount of difference between the agreed price and the average market price of the contracted produce during the agreed period of supply in the market committee concerned to the buyer.”
G. Although Rule 20 is to protect the contract farming buyer in case contract farming producer defaults however as per rule 16, producer has the legal excuse of natural calamity. Therefore, there is a scope to look at mechanisms wherein FPOs can enter in agreement with potato processing companies and represent the farmers interests instead of individual agreements between farmers and companies.

- Economics

There is sound economics in potato cultivation given that environmental factors remain conducive. Farmers generally prefer growing table varieties of potato compared to processable varieties that are only cultivated by farmers under contract farming. Typical statistics for cultivation of 1 acre of table variety like Kufri 3797 are as follows.

1. Seed rate: 15 quintal/acre
2. Cost of seed: Rs 4500
3. Field operations & material Cost: Rs. 22,000
4. Harvesting, cleaning and packing cost: Rs. 18000
5. Transportation and Storage: Rs. 32000
6. Total cost/Acre Rs 76,500
7. Estimated production: 160 Quintal
8. Estimated sale price: Rs. 600/qtl
9. Estimated revenue Rs 96,000
10. Estimated profit Rs 19,500

In case of contract farming, the farmer is assured of a sale price of Rs. 600/qtl. They also save the money spent on storage i.e. Approx. Rs. 24,000/acre. However, the cost of seeds and inputs increase substantially in case of contract farming. Therefore, the income levels are almost same in both cases under ideal environmental conditions. The benefit of contract farming results from the
stability in sale price as opposed to open market rates that vary between Rs.200 to Rs.800 per quintal at different times of the year. Other benefits of contract farming for the farmers include timely availability of quality seeds and inputs at their doorstep and access to GAP and timely advisory services from the technical teams of the contracting companies. Therefore, there is a compelling logic for undertaking potato cultivation even by replacing more popular crops like wheat.

- **Social**
  Typically, the small and marginal farmers in Rajasthan go in for wheat than potato. However, potato being a high-income crop, this may be suitable alternative especially when land fragmentation is growing during to growing family size and their bifurcations. Potato acts as a staple and is a rich source of carbohydrate. Therefore, it may be a partial substitute to other cereals and grains in time of crises especially from the aspect of nutrition security. The longer shelf life of potato makes it suitable for storage and ensures available for table purposes for almost 4 months after harvesting. It becomes an important source of nutrition for certain sections of the society who undertake long periods of religious fasting exempting cereals and pulses from their diets. Potato has social significance in terms of snacks. It is processed at homes for making papads and ready to fry items and used as both as treats for guests and accompaniment for daily meals. ‘Ready to eat’ items like fried potato fingers (French fries) and chips are sold by several food processing companies and have high demand especially among children and travellers. In most of the upscale quick-service restaurants like McDonalds, Burger King, KFC Narula’s etc French fries are a standard feature in the servings.

- **Technology**
  Adoption of GAP by farmers has the potential to reduce their costs while increasing productivity by 25% - 50%. Such adoption will also ensure quality enhancement and lead to better rates in the market. Quality planting material is rare to come by for farmers in general. There are dedicated potato seed producing units available with the agriculture universities and regional research stations. Farmers may procure seeds through advance arrangements especially by engaging through FPOs/FPCs. They can also undertake seed production activities under select government programs like RKVY. Technical support and handholding can be availed through KVKs, ATMA and SRLM especially the FFS programs run through these initiatives. ATCs could play a big role in facilitating the technology linkages to farmers.

- **Environment**
  Dholpur and Bharatpur districts have the most suitable agro-ecological conditions and soil type for potato cultivation. These districts have decent water availability and sandy-loam soil that are appropriate for potato cultivation. The temperature during the rabi cropping season is also reasonable and does not go down very low as in other parts of the state. Kota is another district that has suitable agro-ecological conditions for potato cultivation. However, the heavy black soil and less water availability in Kota affects potato cultivation adversely in many places.

- **Competition**
  Potato has a unique place among the horticulture crops. It is considered a staple and finds in most types of food preparations. It has the uniqueness of being edible with minimal cooking additives and processing. Therefore, it does not face competition from other vegetables and cannot be substituted by any other vegetable. Potato produced in Rajasthan faces stiff price competition from potato produced in the Agra region. Therefore, there is need to adopt GAP to bring down production costs and enhance qualities. This will create a premium market for the potato of Rajasthan and allow the farmers to fight on the price front. Further, linkage with large institutional buyers (processors of chips, fast service restaurant chains etc.) through FPOs/FPCs will allow farmers to get a stable sale price and reduce their exposure to vagaries of the market.