

**Asian and Pacific Workshop on
Whole-Process Mechanization of
Potato Production**

**MECHANIZATION OF POTATO
CULTIVATION IN INDIA**

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CSAM



Content Overview



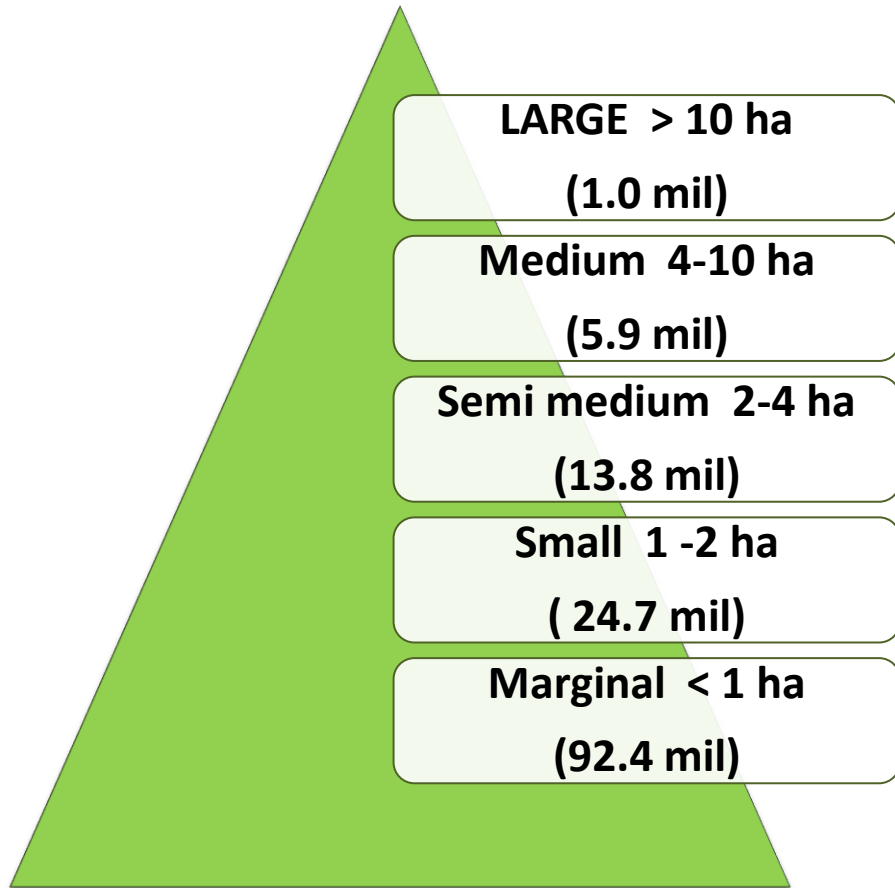
- **Indian Agriculture - An overview**
- **Potato supply chain**
- **Status of mechanization in potato production**
 - ✓ **Seedbed preparation**
 - ✓ **Planting**
 - ✓ **Interculture**
 - ✓ **Fertilizer application & plant protection**
 - ✓ **Harvesting**
 - ✓ **Processing**
 - ✓ **Grading and seed treatment**
 - ✓ **Storage**
- **Challenges and constraints in potato production**
- **Suggestions for regional cooperation**

Indian Agriculture



- Net sown area - 140 million ha (42.6%)
- Agricultural workers - 263 million
- Employs about 52% of the work force
- Provides livelihood to about 60% of the population
- Contributes 13% to the Gross Domestic Product (GDP)
- Yearly production
 - Food grains – 252.7 million tonne (2014-15)
 - Pulses – 18.42 million tonne (2014-15)
 - Horticultural produce – 283.50 million tonne (2014-15)
 - **Potato – 48.00 million tonne (2014-15)**
- No. of land holdings – 138 million

Indian Agriculture



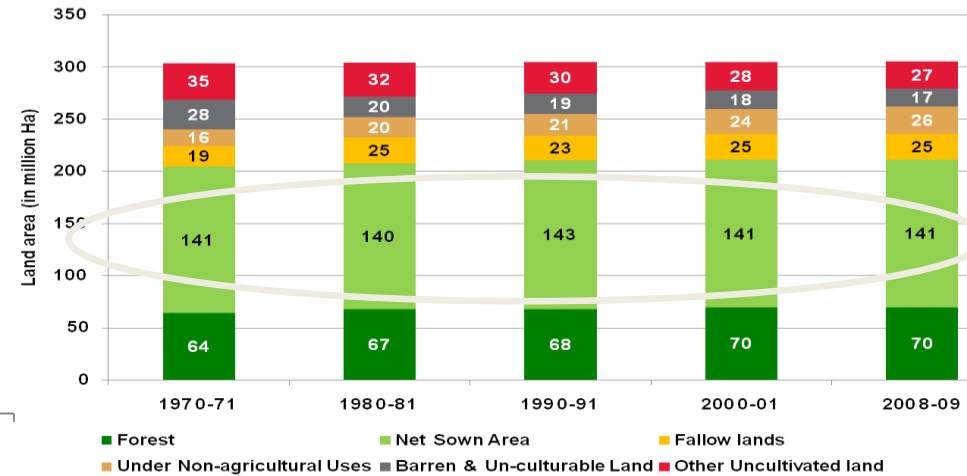
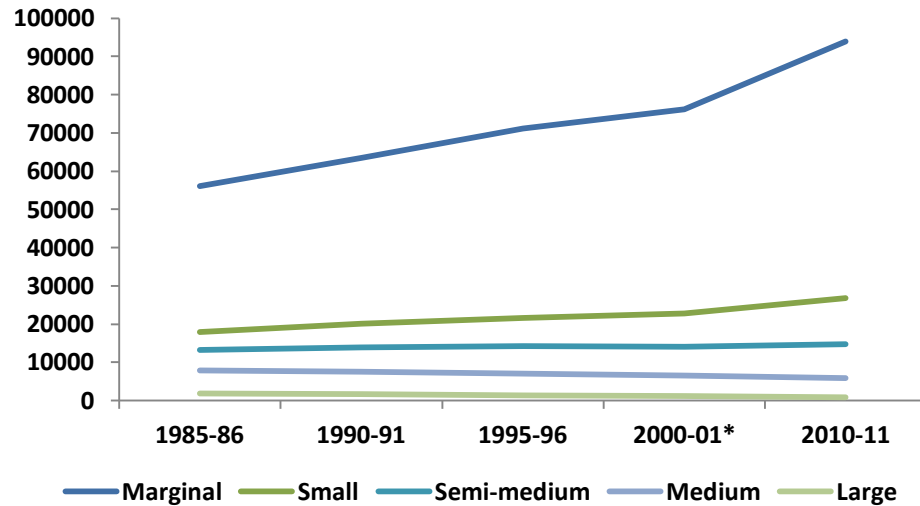
Land holding size and no. of farmers

- **Highest arable land - 47% of total land against Avg. 11% in the world**
- **Round the year cultivation - 15 agro-climatic zones and 46 soil types suited for round the year cultivation**
- **Ranks first in production of Pulses, Sorghum, Jute and allied fibers**
- **Second largest producer of Wheat, Rice, Groundnut, Potato, Tea, Fruits and Vegetables, Sugarcane**
- **Small fragmented land holdings, hill agriculture and shifting cultivation**
- **137.8 million cultivators, over 5.0% own > 4 ha. Avg farm land size < 1.15 ha**

Bottom of Pyramid Country: Affordability and equipment size are key to success.

Emerging - Cooperative ownership model/custom hiring, use of high end equipment

Land Holdings Patterns Call for Smaller Mechanization Solutions...



Source: Agricultural Statistics at a Glance 2011, Ministry of Agriculture, Government of India.

- Land fragmentation has gone up with number of marginal farmers increasing from 56K in 1985-86 to 92K in 2011, an increase of 67.3%
- Land available for agriculture has remained constant around 140 mha since 1970s

Land fragmentation and no new creation of land available for agriculture will call for flexible machinery adaptable to changing crop patterns

Population Dynamics of Indian Agricultural Workers (No. in million)



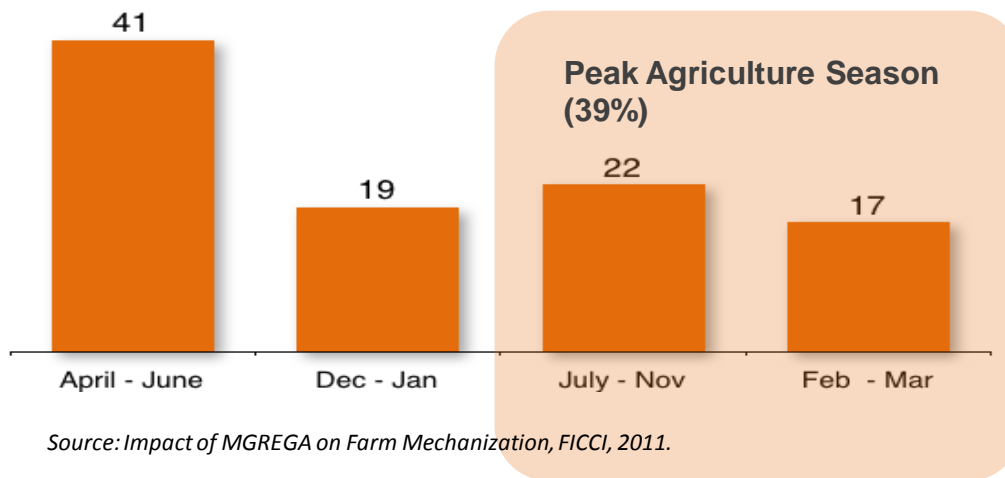
Particulars	2001	2011	2020	2050
Country's population	1029	1211	1323	1612
Total no. of workers	402	482	566	693
No. of workers as % of population	39.0	39.8	42.8	43.0
No. of agricultural workers	234	263	230	202
% of agricultural workers to total workers	58.2	54.6	40.6	26.0
No. of male agricultural workers	143.0	165.7	126.5	81.0
No. of female agricultural workers	91.0	97.31	103.5	121.0
% of females in agril. work force	39.0	37.2	45.0	60.0

Shortage of Agricultural Labour Triggering Mechanization Drive



MGNREGS wages are providing 'choice of work' to casual labour in rural areas

Seasonality in Employment



39% of annual employment under MGNREGS is provided during the peak agricultural season creating shortage of unskilled labor.

Other factors contributing to shortage of labor

- **Shift into services sector for better working condition**
- **Increasing urbanization and migration of villagers in search of greater opportunities**
- **Rise of rural entrepreneurs who are looking to set up businesses of their own**

Shortage of Labor in the Agri Sector will drive need for mechanization and will call for machines with minimal human intervention

Overview of Potato Supply Chain in India

Potato Production in India



- **Potato - fourth most important food crop in India after rice, wheat and maize.**
- **Second largest producer in the world.**
- **Potato is a highly nutritious, easily digestible, wholesome food containing carbohydrates, proteins, minerals, vitamins and high quality dietary fibre.**
- **In India, 85 per cent of the crop is grown during winter season having short photo-period (about 10-11 h sunshine) and crop duration is limited to 90-100 days.**

Area, Production and Yield of Potato



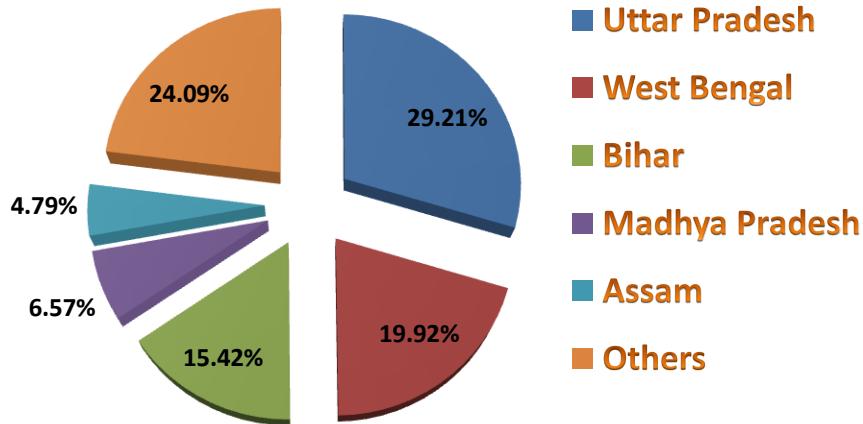
Year	Area (Mha)	Production (Mt)	Yield (t/ha)
1949-50	0.239	1.54	6.59
1959-60	0.362	2.73	7.55
1969-70	0.496	3.91	7.89
1979-80	0.685	8.33	12.15
1989-90	0.940	14.77	15.71
1999-00	1.340	24.71	18.44
2009-10	1.840	36.58	19.92
2014-15	2.076	48.10	23.13

Source: Directorate of Economics & Statistics, Govt. of India

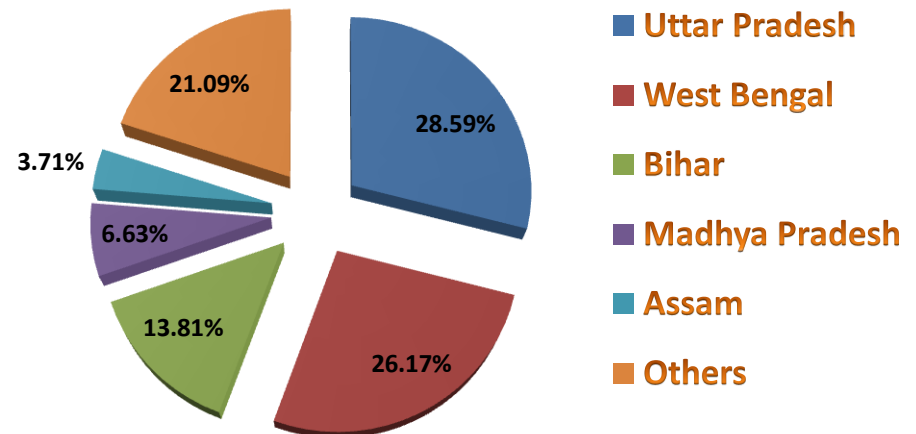
State-wise Area and Production of Potato in India (2014-15)



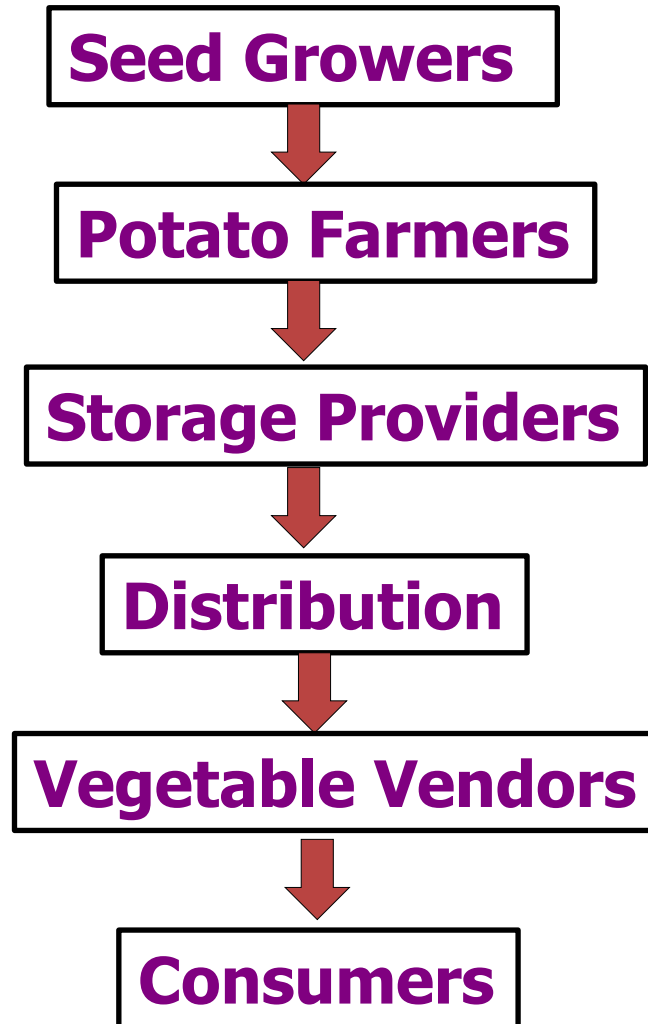
Area



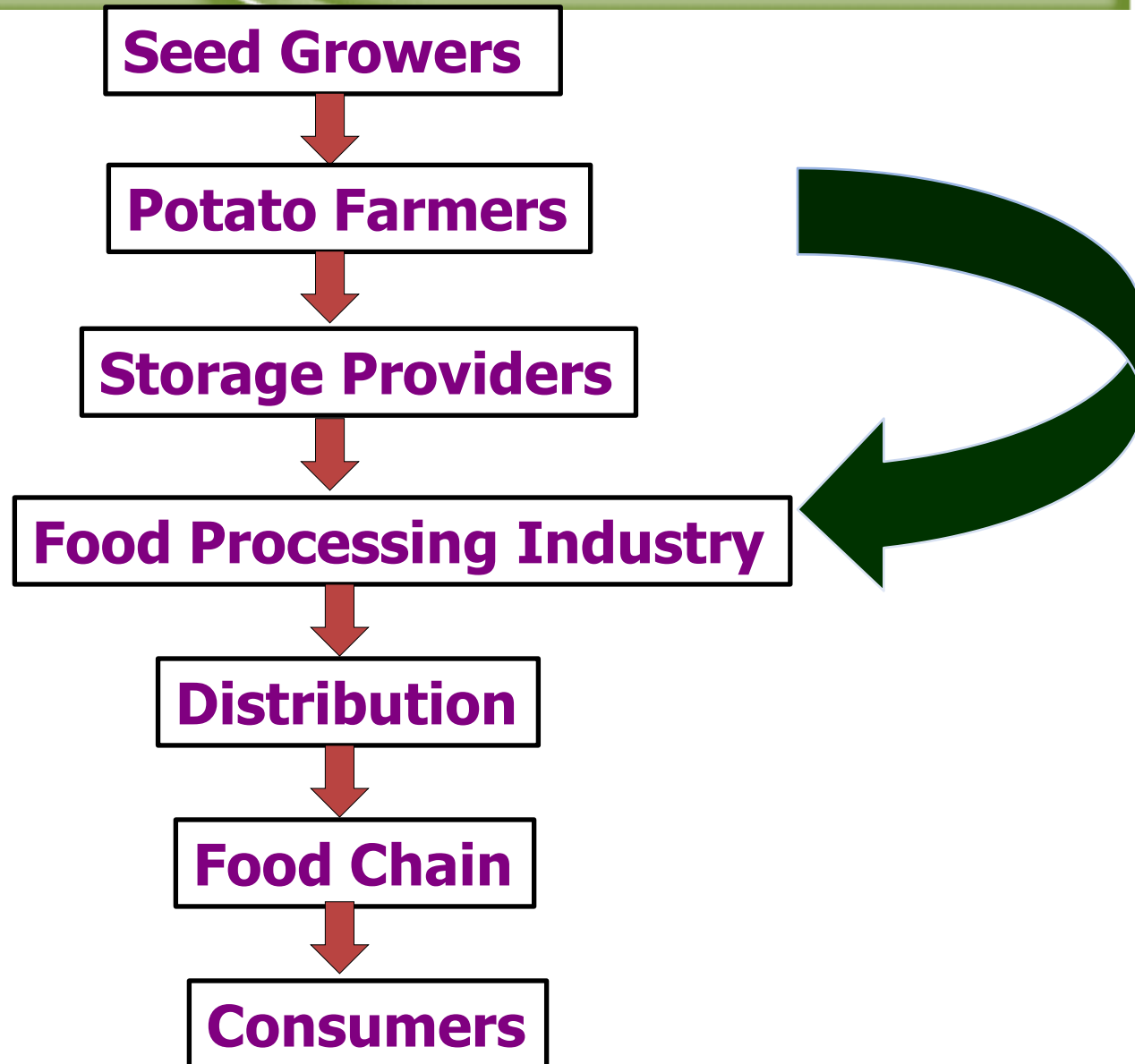
Production



Value Chain for Table Purpose Potato



Value Chain for Potato Processing



Status of Mechanization in Potato Production

Sub-soiler



It is suitable for breaking hardpan of the soil and loosening the sub-soil.

- **Effective field capacity : 0.24 ha/h**
- **Operational speed : < 1 km/h**
- **Working depth : 450-650 mm**
- **Fuel consumption : 5-6 l/h**
- **Cost of operation : Rs. 3500/ha (US\$ 52/ha)**

Rotavator/Rotary tiller



- Prepares seedbed in a single operation
 - Gives more uniform and better pulverization
-
- **Effective field capacity: 0.25-0.40 ha/h**
 - **Field efficiency : 70%**
 - **Fuel consumption : 5.0-6.5 l/h**
 - **Cost : Rs. 65000-80000 (US\$ 950-1200)**
 - **Cost of operation : Rs.1500/ha (US\$ 20-25/ha)**

Tractor Operated Laser Land Leveller



Working width	1.80 m
Function	Fine leveling of fields with desired grade
Effective field capacity	0.17-0.20 ha/h
Field efficiency	70%
Water saving	20–30%
Cost	Rs. 3.0 to 4.0 lakh (US\$ 4400-5900)

Seedbed Preparation under Residue Condition



Straw chopper-cum-spreader and reversible hydraulic mould board plough in operation for mixing paddy residue

Potato Planting Machines



A. Semi-automatic

- Belt Cup Type
- Revolving Magazine Type

B. Automatic

- Picker Wheel Type
- Belt Cup Type

T. D. Semi-automatic Belt Type Potato Planter Ridger



- Working width : 1200 mm
- Travelling speed : 1.30-2.15 km/h
- Effective field capacity : 0.1-0.2 ha/h
- Row to row distance : 600 mm
- Depth of planting : 150-210 mm
- Labour saving : 75%

Tractor Operated Potato Planter



- **Effective field capacity :** 0.4 ha/h
- **Operating speed :** 2.5-3.0 km/h
- **Field efficiency :** 75-80%
- **Saving in labour :** 60-70%
- **Cost (Semi-automatic) :** Rs. 45000 (US\$ 700)
(Automatic) : Rs. 60000 (US\$ 925)

Four Row Automatic Potato Planter



Manufacturer: M/s. Droli Mechanical Works, Moga, Punjab, India

Vertical Belt Paired Row Automatic Potato Planter (PAU)



- **Power source** : 34 kW tractor
- **Seed metering mechanism** : Vertical belt cup type
- **Effective field capacity** : 0.24 ha/h
- **Forward speed** : 2.5 km/h
- **Cost** : Rs. 85000 (US\$ 1270)
- **Cost of operation** : Rs. 2700/ha (US\$ 40/ha)

Self-propelled Power Weeder



Used for weeding row crops such as potato, cotton, sugarcane, maize, pigeon pea and vegetable and orchard crops

- Field capacity : 0.10-0.13 ha/h
- Saves 90% operating time, and 30% in cost of weeding



Spring Tyne Cultivator



- **Single operation**
- **Field capacity : 0.8-1.2 ha/h**
- **3 & 5 row configuration**

Tractor Operated Fertilizer Broadcaster



Power source	Tractor (45 hp)
Effective swath width, m	6.75
Fertilizer application rate, kg/min	25.00
Saving in cost as compared to manual broadcasting, %	2.50
Saving in labour as compared to manual broadcasting, %	81.80

Tractor Operated Boom Sprayer

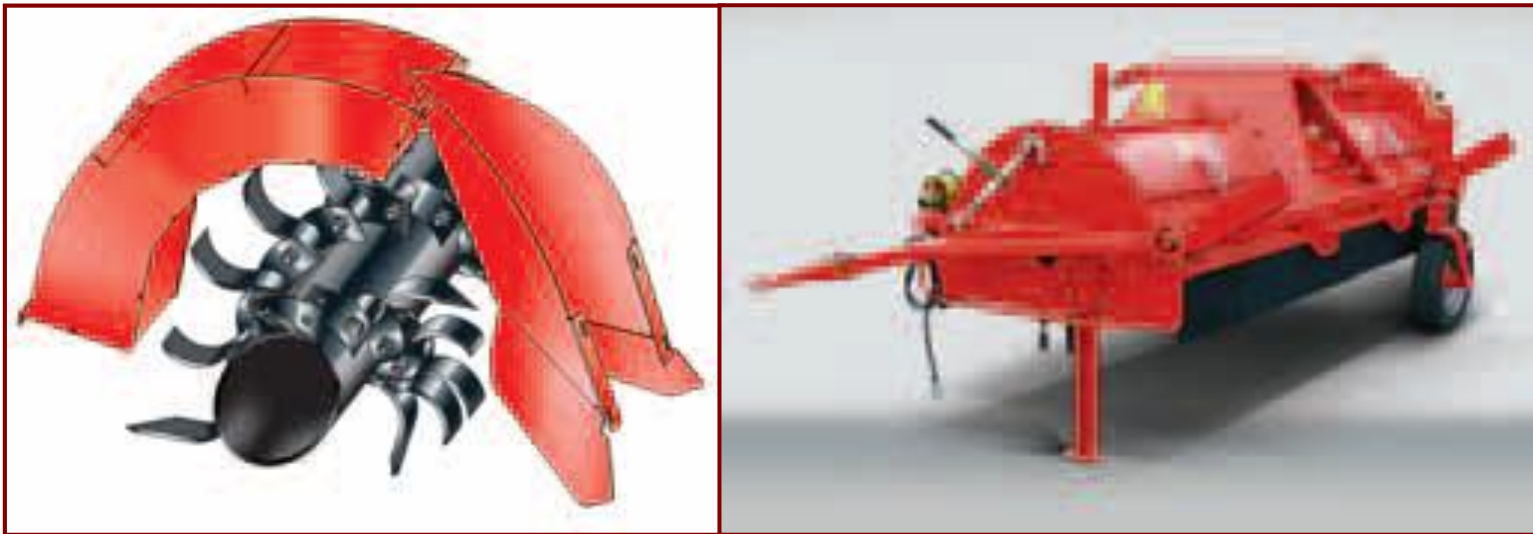


- **Field capacity** : 1.12-1.25 ha/h
- **Field efficiency** : 75%
- **Fuel consumption** : 5.5 l/ha
- **Cost of operation** : Rs. 800/ha (US\$ 12/ha)

Haulm Cutting

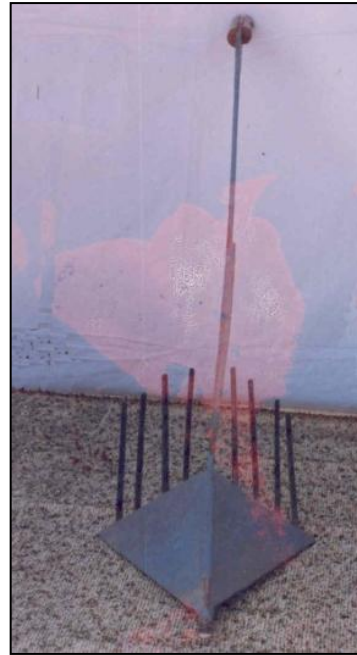


- **Minimizes skinning and bruising damage during harvesting by destroying haulm 10 to 12 days before the harvesting**
- **Control transmission of virus through leaves and stems under favorable condition**
- **Improved soil-potato separation during harvesting.**



- **Driven by 35 hp tractor or above**
- **Field capacity : 0.5 ha/h**

Animal Drawn Potato Digger



- **Cutting width : 300-450 mm**
- **Working depth : 200 mm**
- **Operating speed : 2.0-2.5 km/h**
- **Field capacity : 0.05-0.12 ha/h**
- **Field efficiency : 60%**
- **Cost : Rs. 7200 (US\$ 110)**

Potato Digger Elevator



- **Field capacity** : **0.2-0.3 ha/h**
- **Field efficiency** : **60-70%**
- **Exposed bulbs** : **100%**
- **Cost of machine** : **Rs. 40000 (US\$ 615)**
- **Cost of operation** : **Rs. 1000/ha (US\$ 15/ha)**

Potato Digger Elevator



Potato Harvester



Features

- Direct offloading to trailer
- Less damage to potatoes
- Control system includes adjustment of inclination of belt and depth

**M/s. Ganesh Agro Equipments,
Mehsana, Gujarat, India**

- Power source** : 34 kW tractor
- Weight** : 1550 kg
- Working width** : 1310 mm
- Conveyor belt length** : 2120 mm

Tractor Operated Potato Combine



- Offset-trailed type tractor operated (> 40 kW)
- Single row
- 2 t hopper capacity



Tractor Operated Potato Combine



Grading/Sizing

Potato grading is generally done manually



Output capacity : 2.6 t/h
Sizing efficiency : 85-90%



Potato Handling



Manual handling



Two trays (50 kg) trolley



Eight trays (200 kg) trolley



**Fork lift assisted handling
(50 trays/1250 kg)**

Storage



- **85% of potato is produced during winter season and stored during long hot summer.**
- **Potatoes are stored at 10-12° C for processing and table purpose.**
- **Seed purpose potatoes are stored at 2-4° C.**
- **Traditional low-cost and non-refrigerated storage structures (evaporative or passive evaporative cooling based) are in use in India**
- **In non-refrigerated storages, sprout suppressants are used to prevent excessive weight loss and shrinkage due to sprouting.**

Processing



- **7% of the total annual production of potato is processed in India as compared to 60% in USA and 47% in the Netherlands**
- **Increase in demand for processed potato products in India and international market**
- **Need to expand potato processing industries in India to produce flour, cubes, granules, flakes and starch.**

Potato Chip Making Machines



Potato Peeler
Capacity : 188 kg/h



Potato Slicer
Capacity : 150 kg/h

Challenges and Constraints for Whole-process Mechanization of Potato



- **Mechanization of loading and unloading of potato seeds in a tank for seed treatment.**
- **Need of low cost planters for planting of cut seeds of potato for growing crop for table purpose.**
- **Need of low cost potato digger cum elevator or potato combine for harvesting.**
- **Need to keep tubers well covered with soil or mulch from planting to harvesting to protect from disease and pest attacks.**
- **Need to develop light weight farm tools and equipment to mechanize potato cultivation in hilly region.**
- **Enhance potato processing industries in India to produce flour, cubes, granules, flakes and starch.**

Suggestions for Regional Cooperation



- The member countries can help India in providing technical knowhow and low cost technologies particularly for mechanization of potato harvesting and processing.
- Provide technical knowhow and improved farm equipment and machinery for potato production and processing to member countries.
- Help in formulation of standards and testing of potato cultivation machinery to promote regional trade.

Conclusions



- **Future potato mechanization through mechanical sources of power**
- **Machines suitable for custom hiring – Automatic potato planter and potato digger elevator**
- **Need to enhance processing of potato for value addition**
- **Low cost and small size potato combine suiting to Indian condition are needed.**
- **India can provide technical knowhow on potato production machinery to member countries in the region.**



Thank You

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