Crop Residue Management

- Mechanization Solution

Country Report – India

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Indian Agriculture

Area and Holdings

- Net Sown Area : 140 million ha (42.6%)
- Average land holding : 1.1 ha

Yearly production (2022-23)

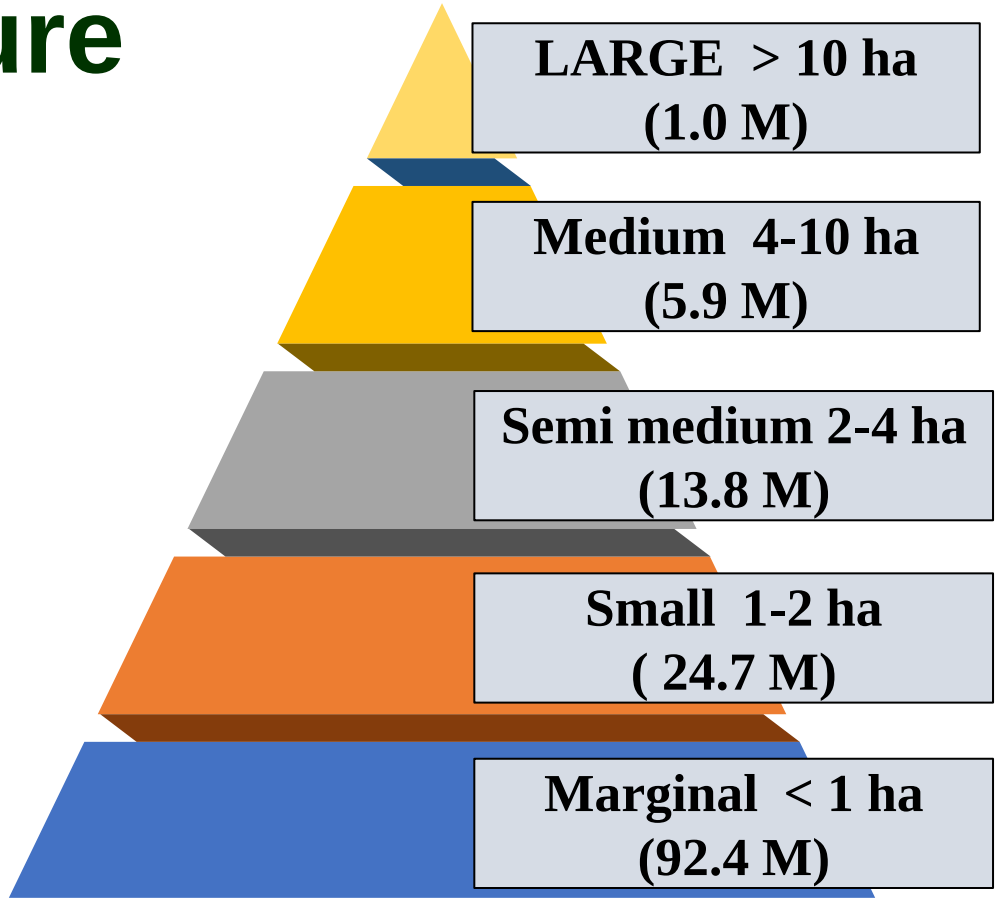
- Food grains : 330.5 million tonnes
- Fruits : 107.00 million tonnes
- Vegetables : 212.0 million tonnes

Agricultural workers

- 263 million
- Employs about 52% of the work force

Annual rate of growth : 3.5 percent (2021/22)

Contributes 20% to the GDP



Average land holding and no. of farmers

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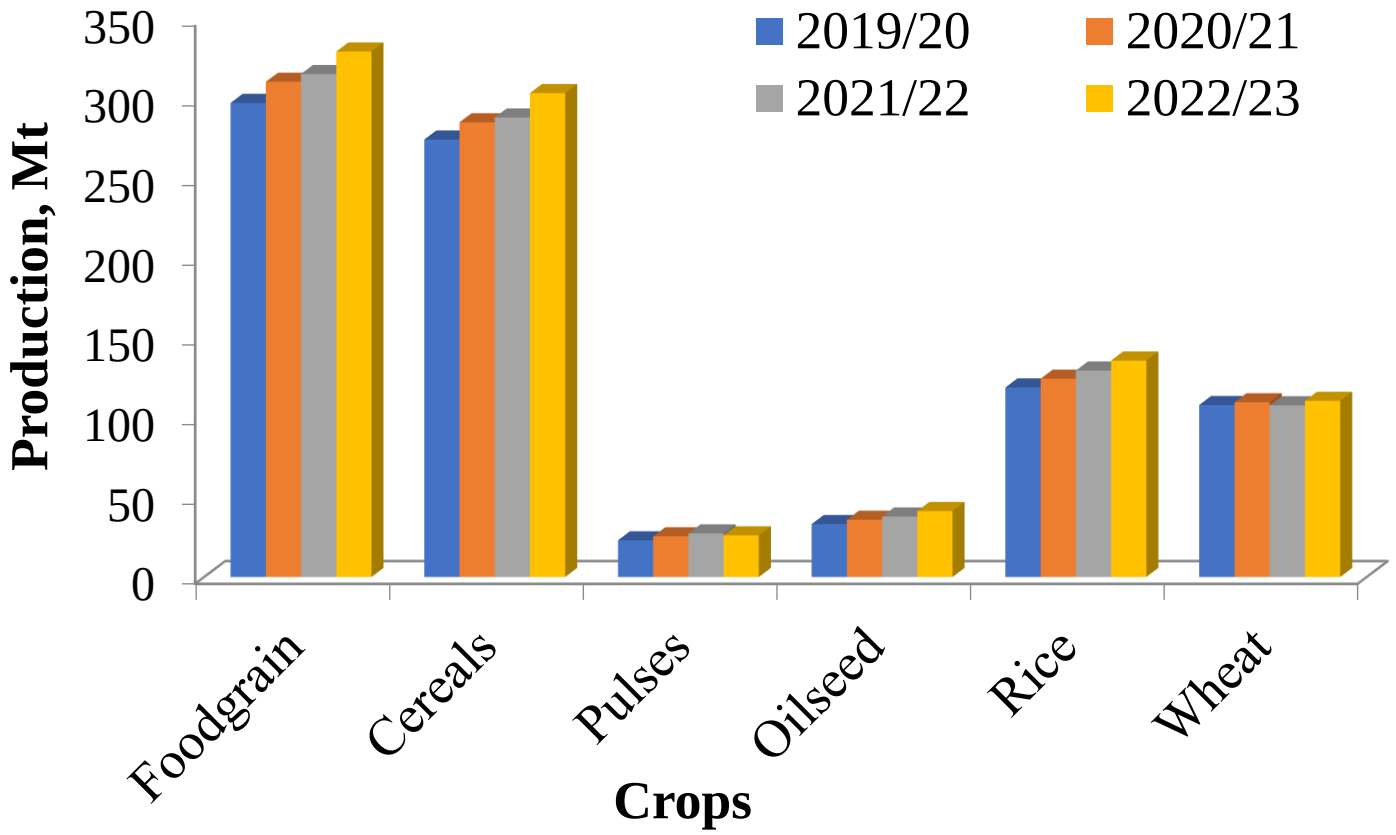
Production status of major food crops



Source: APY, Statistics, Directorate of Economics & Statistics, Department of Agriculture and Farmers Welfare, GoI

Extent of mechanization across farm operations

Operations	Mechanization (%)
Ploughing and seedbed preparation	40
Sowing and planting	29
Plant protection practices	34
Harvesting and threshing	60 to 70 (Paddy and wheat)

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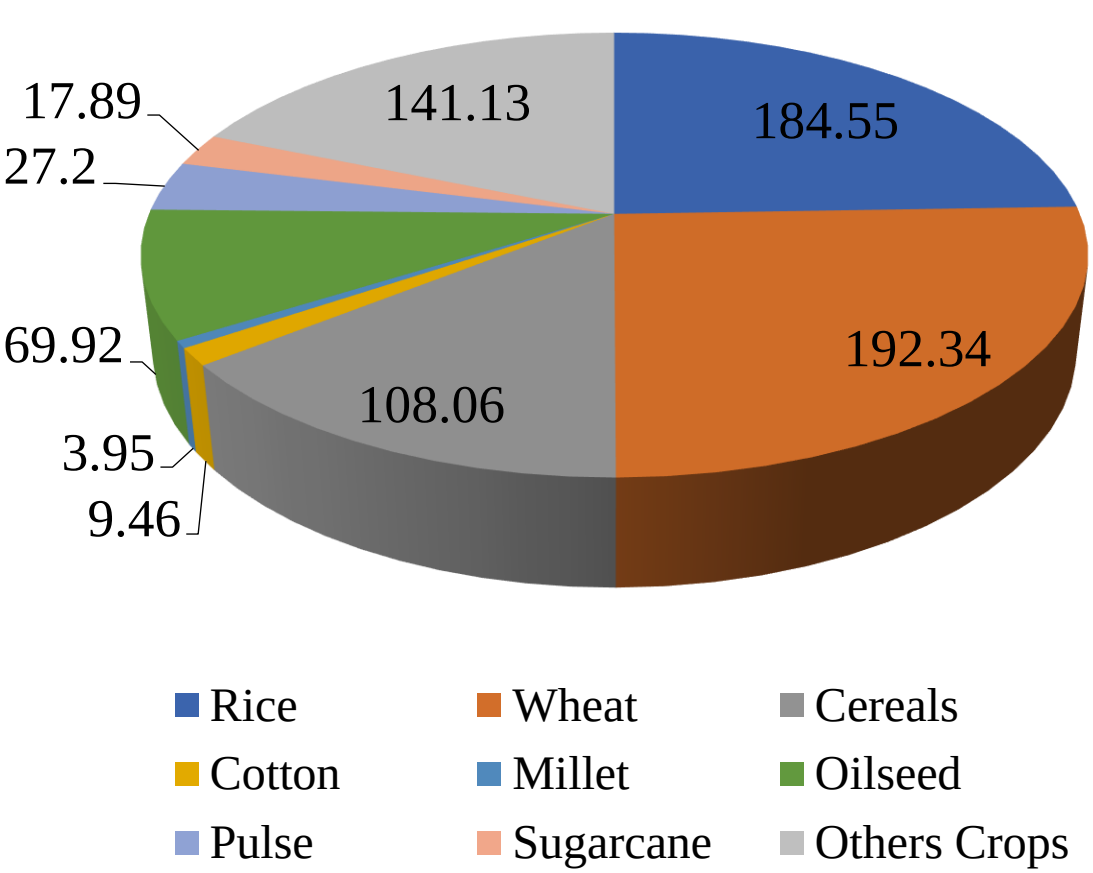
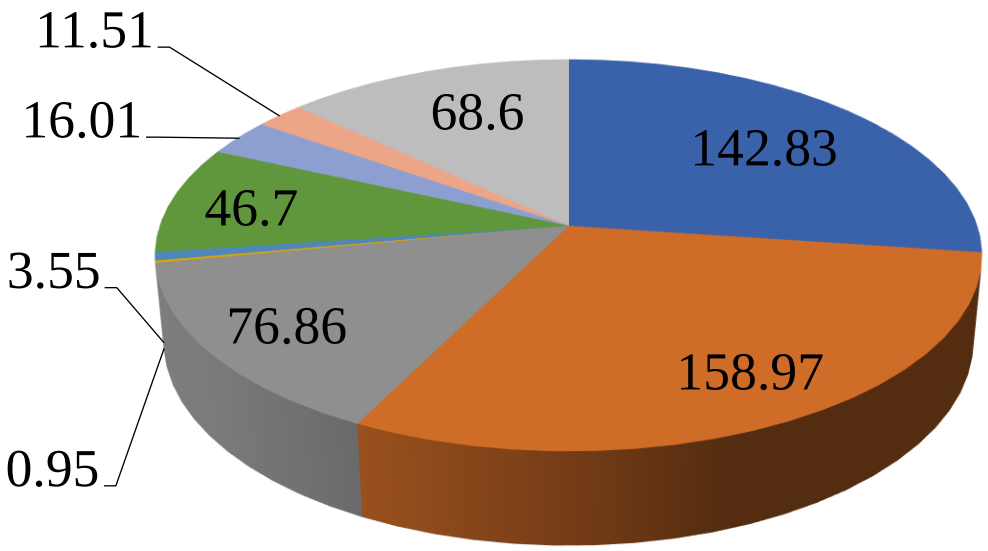
Status of crop residue Generation



Residue generated from major crops



Crop residue utilization

Total biomass generation : 750 Mt

Biomass surplus : 225 Mt

Vulnerable areas: Northern, Central and Western plains

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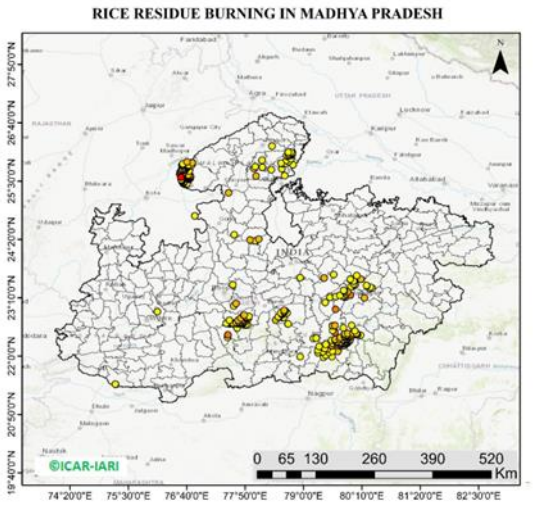
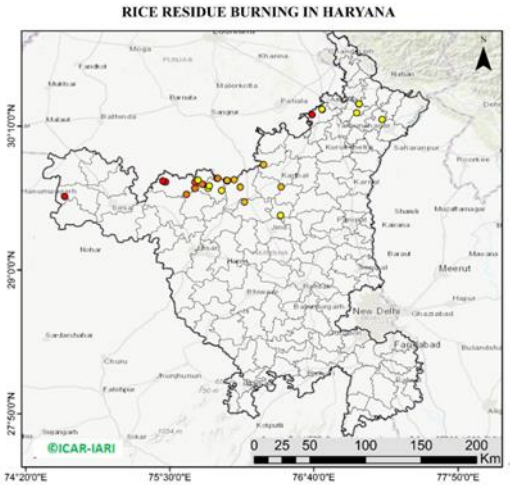
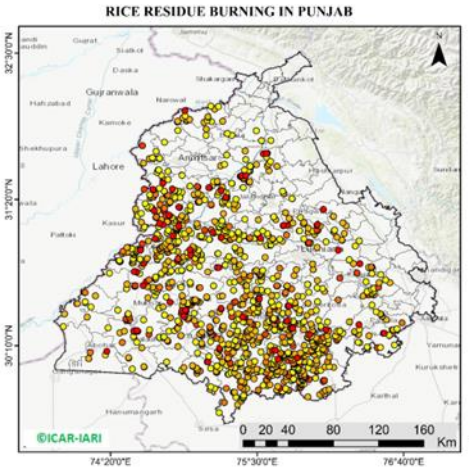
Number of Paddy Residue Burning Events Detected (Period: 15 Sep-04 Nov)

State	2020	2021	2022	2023
Punjab	48578	23610	26583	14173
Haryana	2771	3666	2440	1405
Uttar Pradesh	1686	1493	903	1119
Rajasthan	842	187	496	1003
Madhya Pradesh	6482	1765	1927	4865

Area Burnt in Punjab: 49.39% (1.51 Mha) during 2018







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Challenges and Constraints

1. **Shortage of labour**: Go down to 40 % from 52% during 2011
2. **Mechanical Harvesting**: More 60% Harvesting (Combine)
3. **Size of land holding**: Avg land holding capacity,1.10 ha.
4. **Short time interval**: 20-25 days
5. Energy intensive operation
7. **Economical**: High capital for collection, storage.
8. Supply Chain and Crop Diversification.

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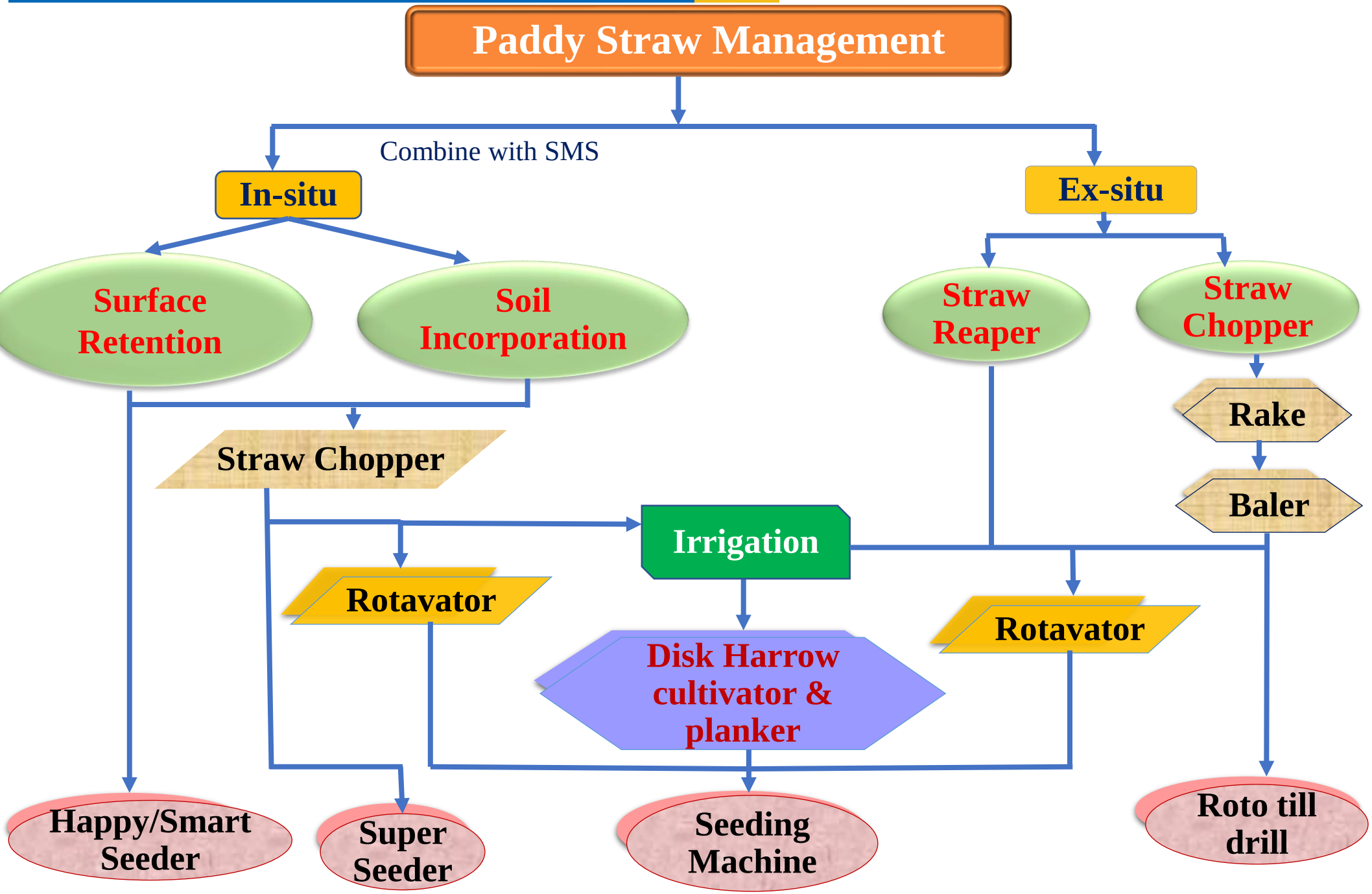

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Straw mulching and Sowing

- **Attachment of Super Straw Management System in Existing Combines**
- **Direct wheat sowing with Harvesting**
- **Mulch helps to reduce irrigation requirements by about 15-20 %**

Happy Seeder

- Developed for sowing wheat directly into the combine harvested paddy fields without any other operation
- Operated by a 45 hp or above tractor

Strip till seeder (Smart seeder)

- Incorporates only a small part of the straw into the soil and retains the majority of straw as surface mulch

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Straw Incorporation

- Super straw management system (SMS)
- Straw chopper-cum-spreader
- Reversible Mould Board Plough
- Super seeder
- Roto till drill

For Rice-Potato/vegetable cropping

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Ex situ management

Power generation from biomass

- Installed capacity: 5,940 MW
- 4,946 MW grid-connected
- Punjab : Installed capacity 97.50 MW with 8 Lac Metric ton per annum
- Encourage biomass pellet (5–10%) in thermal power plants

Bio-CNG/Compressed biogas (CBG)

- A new initiative was taken by Govt of India
- SATAT' scheme on Compressed Bio Gas (CBG) to set up CBG plants, & supply to Oil Marketing Companies
- Commissioned Plants : 68
- CBG : 22097 Tonnes 92022-23

Bio-ethanol

- Govt of India allow 20% Blending
- Financial assistance to lignocellulose based ethanol plants







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Paddy Straw based Biogas Plant made up of M. S. sheet

- Paddy straw to cow dung ratio : 4:1
- Biogas generation : 3 – 4 m^3/day for 3 months
- The life of the plant is around 15 years.

Other R & Developments

- Mycelium Based Packaging Materials Utilizing Crop Residue
- Biochar
- Briquette
- Compost making
- Fodder for animals
- Packaging material
- Mushroom cultivation

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Schemes of Govt of India

The National Policy for Management of Crop Residue (NPMCR) in 2014 to prevent agricultural residue burning

- **Expenditure : INR 24.17 billion during last four year**
- **Total machineries provided: 213,536 Nos**

- Awareness, Training programmes at Village Panchayat/ Block/ District Level
- Mobilization of schools and colleges through essay completion, painting, debate etc.
- Hoarding, Poster, Wall writing and Webinars

Machineries under financial support

i) **Super Straw Management System (Super SMS) attached with Combine Harvester;**

ii) **Happy Seeder;**

iii) **Paddy Straw chopper/Shredder/Mulcher;**

iv) **Shrub Master/Cutter cum Spreader;**

v) **Hydraulic Reversible M.B. Plough;**

vi) **Rotary Slasher**

vii) **Zero Till Seed cum Fertilizer Drill;**

viii) **Super seeder,**

ix) **Rotavator.**

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Future Actions and Suggestions

Mechanization for crop residue management (CRM)

- Financial incentives and custom hiring system, Establishing self-help groups
- Refinements in existing CRM machinery

Research & Developments

- Multi-functional farm machinery
- Alternative uses of Crop residue at farm as well as industry level
- Shorter duration crop variety

Social Awareness Campaign

- On-farm adaptation of CRM machinery in both large and small fields
- Capacity building, large scale demonstrations and trainings
- Incentivising to industry using crop residue

Future Actions

Biomass Supply chain

Laws and legislation

- Crop and region-specific residues management policy
- Crop diversification
- Appropriate legislation on prevention and monitoring of on-farm crop residue burnings through incentives and deterrence
- Introducing Carbon-credit schemes to benefit the farmers

- Joint working group for research and development
- Policy support at industrial level utilization of crop residue
- Corporate Social Responsibility (CSR) of private sector.

The ex-situ straw management options are more capital intensive and require significant subsidy amounts for farmers and user industry to be sustainable.

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