Indian Horticulture an Overview and perspectives for Precision Horticulture

सत्यमेव जयते
Goverment Of India

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Indian Agriculture

1. Total cultivated area : 140 Mha (328 Mha)
2. Agro-climatic zones : 15
3. Temperature : -15 to +50 ^{o}C
4. Annual rainfall : 50 to 3500 mm
5. Crops grown : >250
6. Cultivated area under irrigation : 50%
7. Average land-holding size : 1.1 ha
8. Land-holding <2 ha : 86%
9. Agriculture to GDP : 18%
10. Population depend on agriculture : 50%

Resources and Responsibilities of India

1.	Land	2.3% of the world (No. 7)
2.	Fresh Water Resources	4%
3.	Population	18% (No. 1)
4.	Livestock	15% (No. 1)
5.	Rainfall	117%

Indian Agriculture: Current Scenario (2023-24)

1. **Record production of food grain (330 million t) and horticulture (355 million t).**

2. **World's largest producer of pulses, tea, spices, jute, banana, etc.**

3. **2nd largest producer of rice, wheat, fruits, vegetables, sugarcane, etc.**

4. **Export of US$ 50 billion (2021-22). Among top 5 net exporters in the world.**

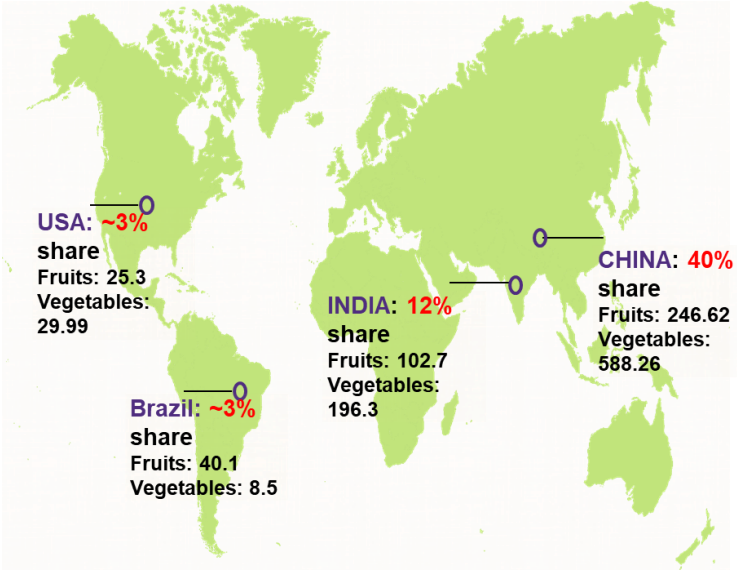
5. **The sector grew at 4.6% in the last 6 years.**

Horticulture in India- Great strides

(Base year1950-51 to 2023-24)

- **14 times Horticulture (25 to 355 million ton)**

Horticulture revolution : Nutrition & Health



Where we stand at Global Level?

Production Scenario

1st

2nd

Processing Scenario

<3%

in comparison to benchmark countries like China (**23%**) & Brazil (**70%**)

(MOFPI, 2019)

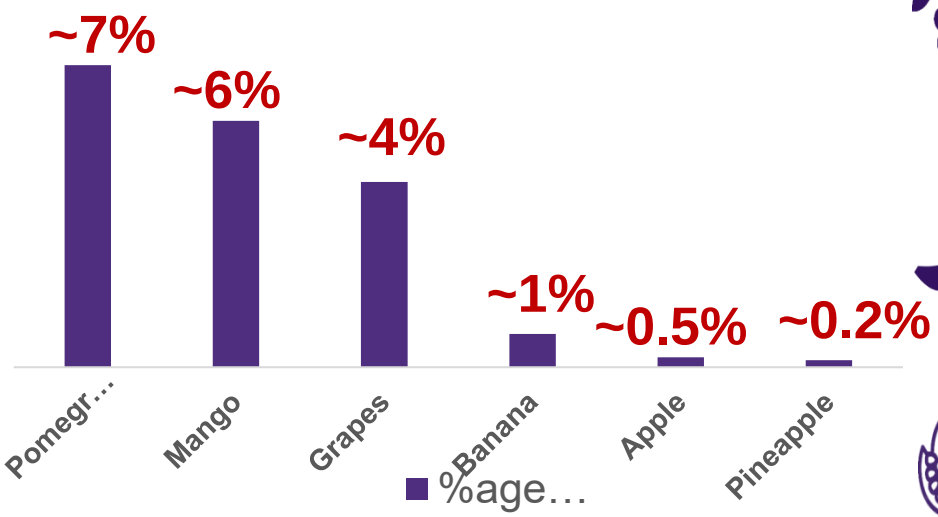
Farm Mechanization

<50%

as compared to **90%** of developed countries

(NABARD, 2018)

India's Share in Global Export



Source: UN COMTRADE, FAOStat (2022)

Major Fruit Export Destinations from India

Netherlands: 36% share
Total: USD 314 million

UAE: 56% share
Total: USD 36 million

UAE: 30.5% share
Total: USD 82 million

Bangladesh: 87.7% share
Total: USD 53.4 million

Netherlands: 11% share
Total: USD 114.5 million

Source: FAOStat (2022), APEDA(2021), Agri-exchange, GT analysis

Transformed horticulture

23 ICAR Horticulture Institutes, 14 All India Coordinated Research Programs, 74 Agricultural Universities, 6 Horticulture Universities

- Hybrid seeds of vegetable crops
- Plant architecture engineering
- Root stock technology & trellis system
- HiTech Nurseries - Accredited
- Micro-propagation and tissue culture in plant production
- Drip and sprinkler systems and fertigation (13 million ha)
- Greenhouses technology (Polyhouse, shadenet, low tunnel, mulching)(200 thousand ha)
- Biopesticides & biofertilizers (825 thousand tons)
- Integrated cold chain (36 million ton)

DESHACKLERS

- Back up of Technologies
- Development Initiatives
- Policy Support

Indian Agriculture Now and at 2047

Parameter	2023	2047
1. Food grain production (Mt)	330	520
2. Fruit production (Mt)	**112**	**244**
3. Vegetable production	**207**	**405**
4. Nutri-, coarse cereals (Mt)	51	74
5. Milk availability (kg/day)	0.4	1.0
6. Farm mechanization (%)	47	75
7. Post-harvest losses (%)	15	10
8. Water use efficiency (%)	40	60
9. Nitrogen use efficiency (%)	35	50
10. Agri-export (% of world)	2.5	5.0

- **India needs 7.6% GDP and 4.9% agriculture growth to become developed by 2047: RBI**
- **India's per capita income needs to surpass US$ 21,664, from current US$ 2,500: World Bank**

Challenges in Horticulture: many to Address

1. Productivity enhancement
2. Increasing efficiency and reducing cost of production
3. Increasing quality intrinsic as well as extrinsic
4. Improving marketing and export
5. Reducing post-harvest losses
6. Reducing risks, uncertainty and drudgery
7. Reducing GHG emission in agriculture
8. Adapting to changing climate
9. Income security to farmers

Roadmap to Achieve the Growth in Horticulture

Intervention	Potential contribution (%)
1. Crop improvement technologies	20-25
2. Precision production technologies	15-20
3. Protected cultivation techniques	25-30
4. Diagnostics and robust seed-based production system	10-15
6. Post-harvest technologies	25-30
7. Indigenous crops-based diversified production systems	4-5

NIAP (2023)

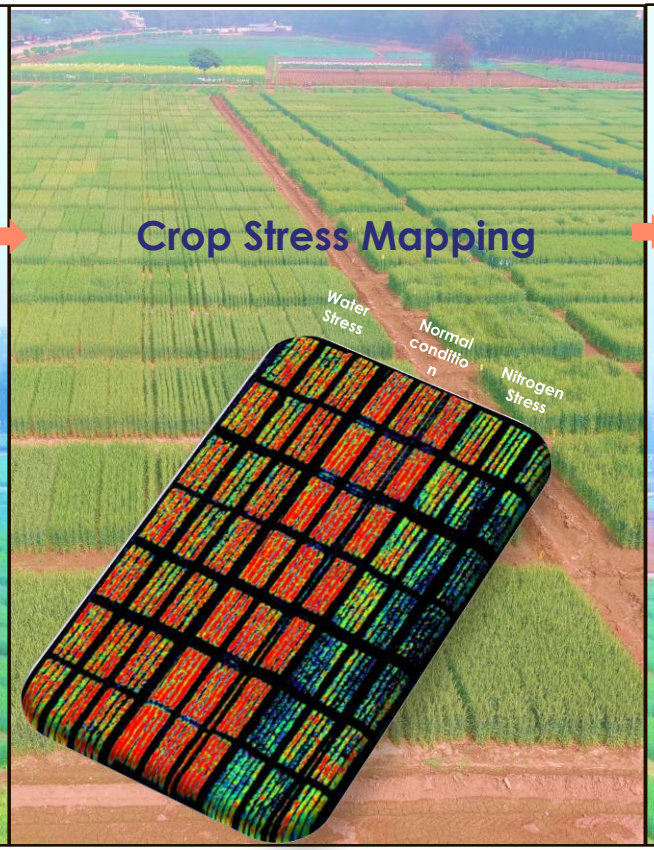
Precision Horticulture -
Can drive innovation and transformation

5 Sectors

1. **Precision Horticulture:** Application of sensors, Variable rate technology, Drones, Robotics, AI, Protected cultivation, Vertical farming, Hydroponics,
2. **Climate smart horticulture:** Weather monitoring, crop management, data management, Farm Management
3. **Supply Chain Management:** Quality management, Improving transparency, traceability and efficiency
4. **Financial inclusion:** Promoting financial inclusion, Unified Payment Interface (UPI), Mobile banking, Microfinance
5. **Human Resource Development**

(Increase productivity, reduce waste, increase export, improve food, nutrition and income security)

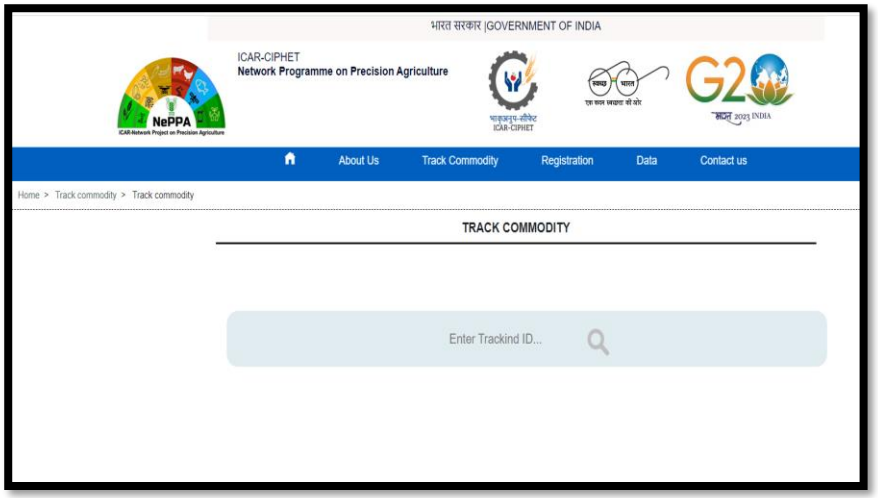
Precision Agriculture: Future Proof Smart Farming



Sensor based system for banana tracking

Sensor based System tracks

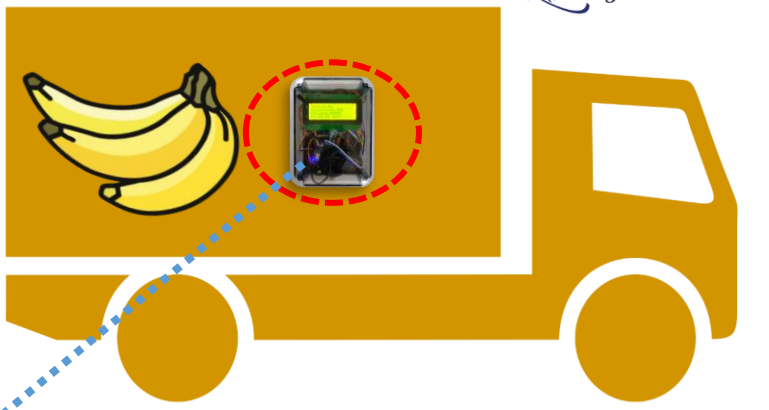
- ✓**Temperature**
- ✓**Relative humidity**
- ✓**Ethylene (ripening gas)**
- ✓**Time and location**



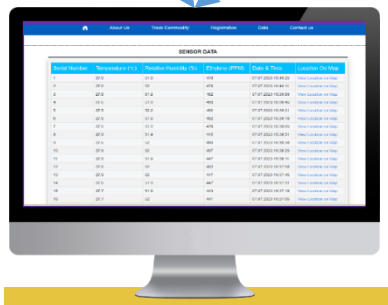
Track commodity using website

Application in supply chain

Cold storage Monitoring

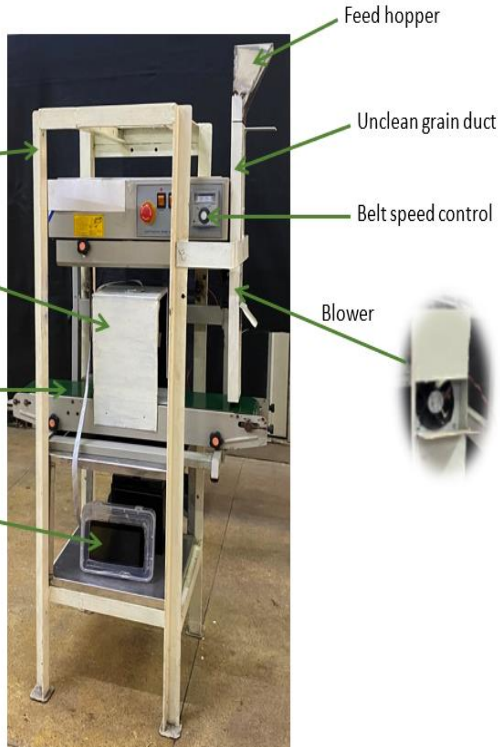


Transportation Monitoring



Traceability

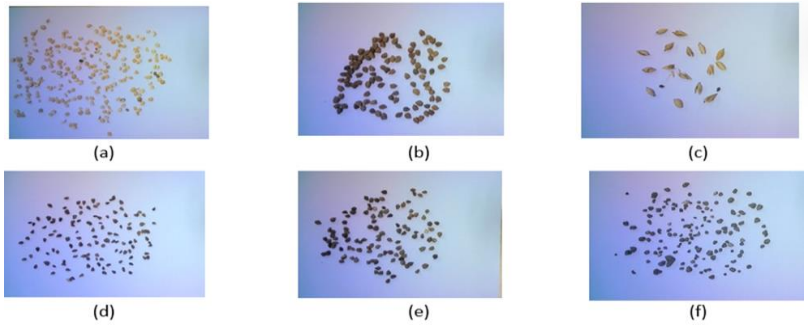
Sensor-based Multi-Pass Cleaner for Seeds



Multi-Pass Cleaner

Raw threshed grains on the belt

Material Annotation



(a) Broken grains (b) Good grains (c) Husk (d) Immature grains (e) Infected grains (f) Stones

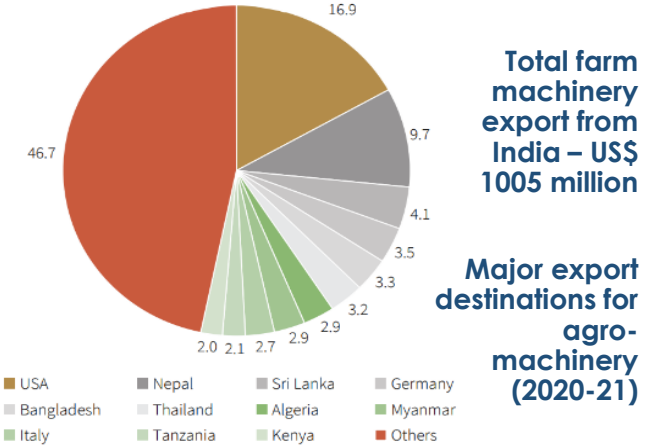
Segregation into different classes

Agricultural Mechanization

Intelligent Modernization for efficiency and prosperity

Gender Neutral Machines

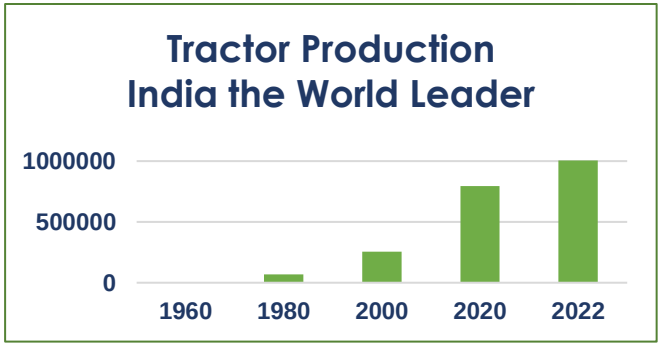
Robotic apple picking

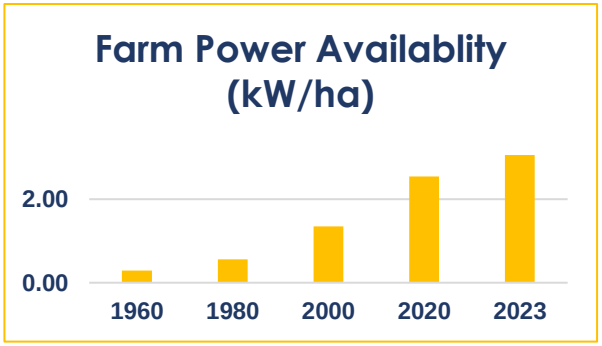


Total farm machinery export from India – US$ 1005 million

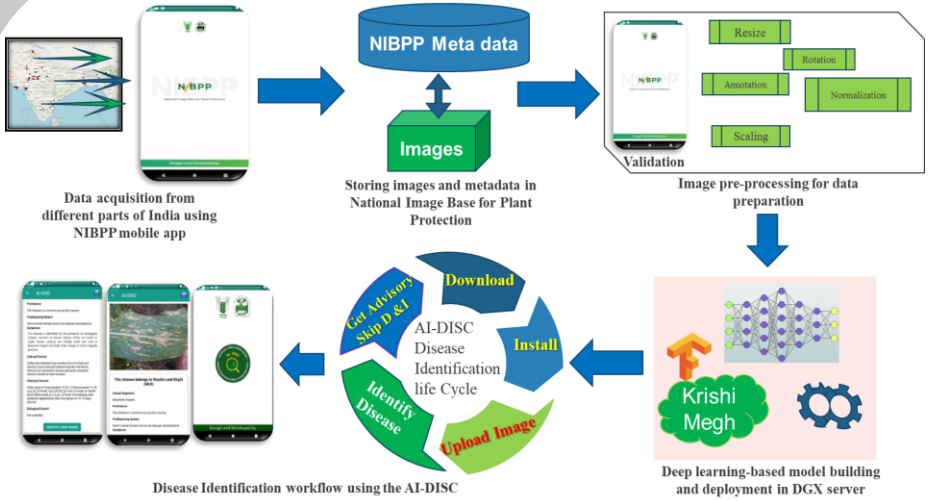
Major export destinations for agro-machinery (2020-21)

Robotic Weeding





Artificial Intelligence Based Disease Identification for Crops (AI-DISC) App



Simple Steps to Identify Crop Diseases

- Download AI-DISC android mobile app (https://play.google.com/store/apps/details?id=com.ai.ai_disc)
- Upload image with visible symptoms
- Get the disease and advisory automatically

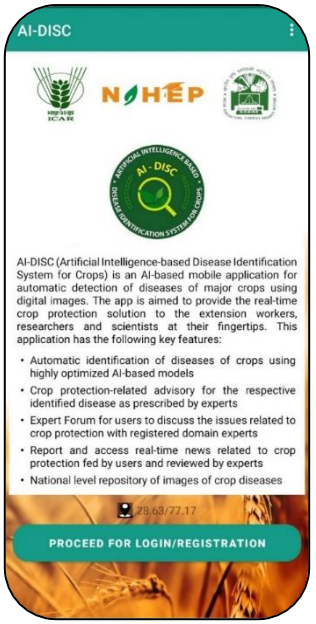
Models

- Artificial Intelligence (Deep Learning) models for more than 20 crops (Rice, Wheat, Maize, Tomato, Mustard, Cotton, Brinjal, Apple, Peach, Kinnow, Mandarin, Assam Lemon, Chickpea, Green gram, Cluster bean, Moth bean, Chilli, Coriander etc.)
- Trained over 1.5 lakh images
- Developed and deployed in NVDIA GPU server at KrishiMegh

Features

- AI-enabled disease identification within fraction of seconds with over 95% accuracy
- Expert consultations facility via text/video chat
- Real time reporting system for disease infestation across India

AI-DISC App



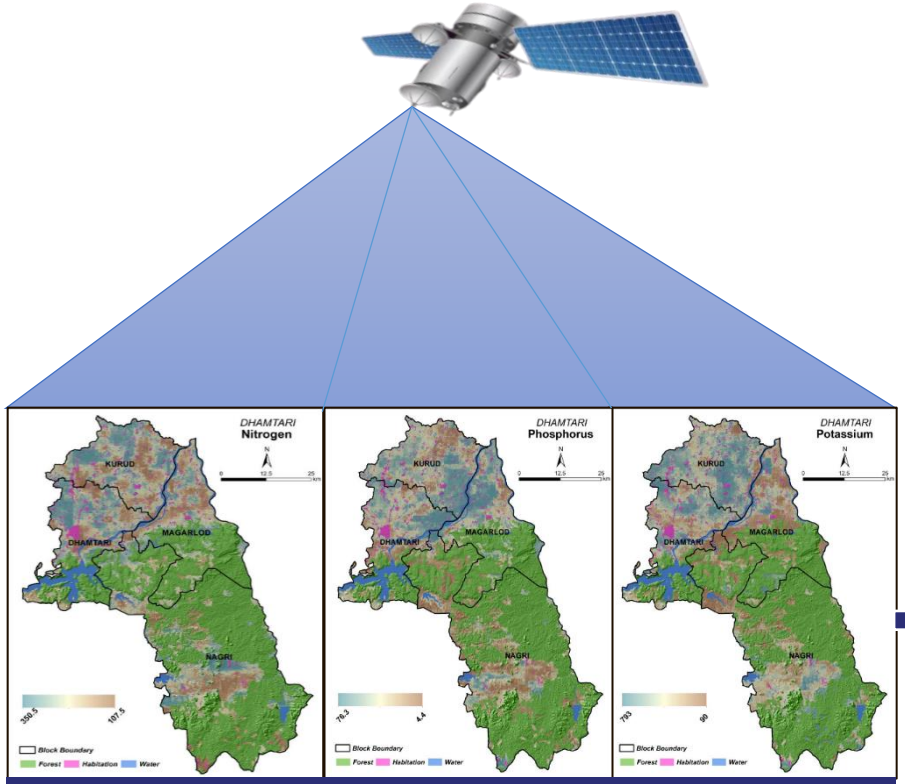
Designed & Developed by:

Division of Computer Applications
ICAR-Indian Agricultural Statistics Research Institute
New Delhi, India

Under NAHEP Component 2 Project 'Investment in ICAR Leadership for Agriculture Higher Education'

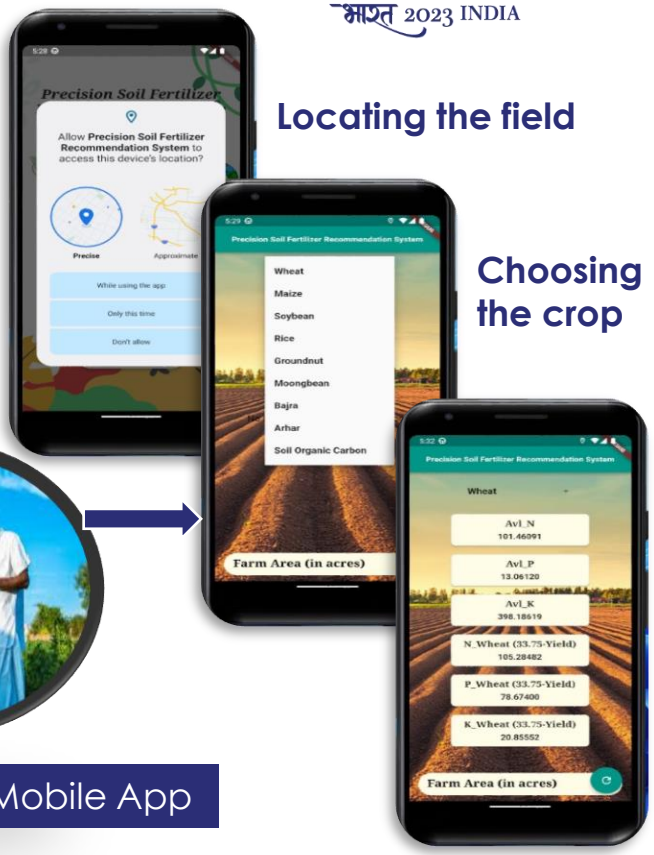
IoT-based Intelligent Irrigation System

Rapid Soil Fertility Mapping for Fertilizer Recommendation



Remote Sensing based Digital Soil Fertility Map

Use friendly Mobile App



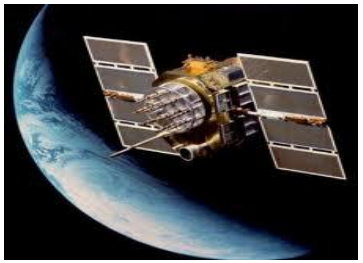
Locating the field

Choosing the crop

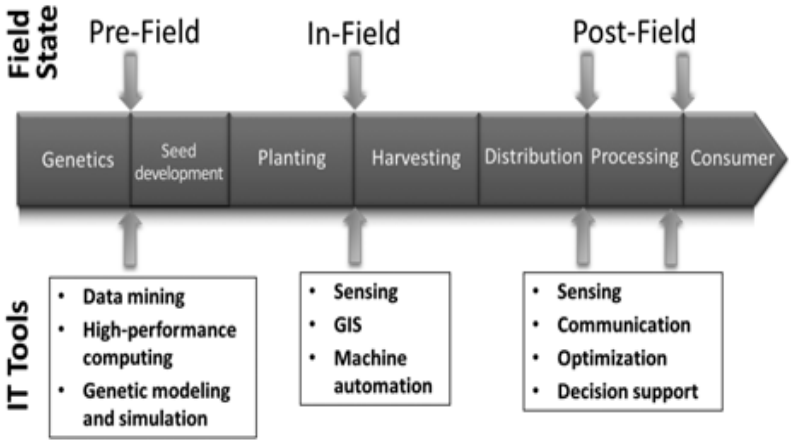
Advisory for Fertilizer

Space Applications in Agriculture

- Crop and Land use Planning, Soil and Water Conservation and Mapping for crops
- Satellite sensors provide valuable database for suitable decisions in maintaining productive capabilities of agro-ecosystems
- Surveillance of pests and diseases in crops



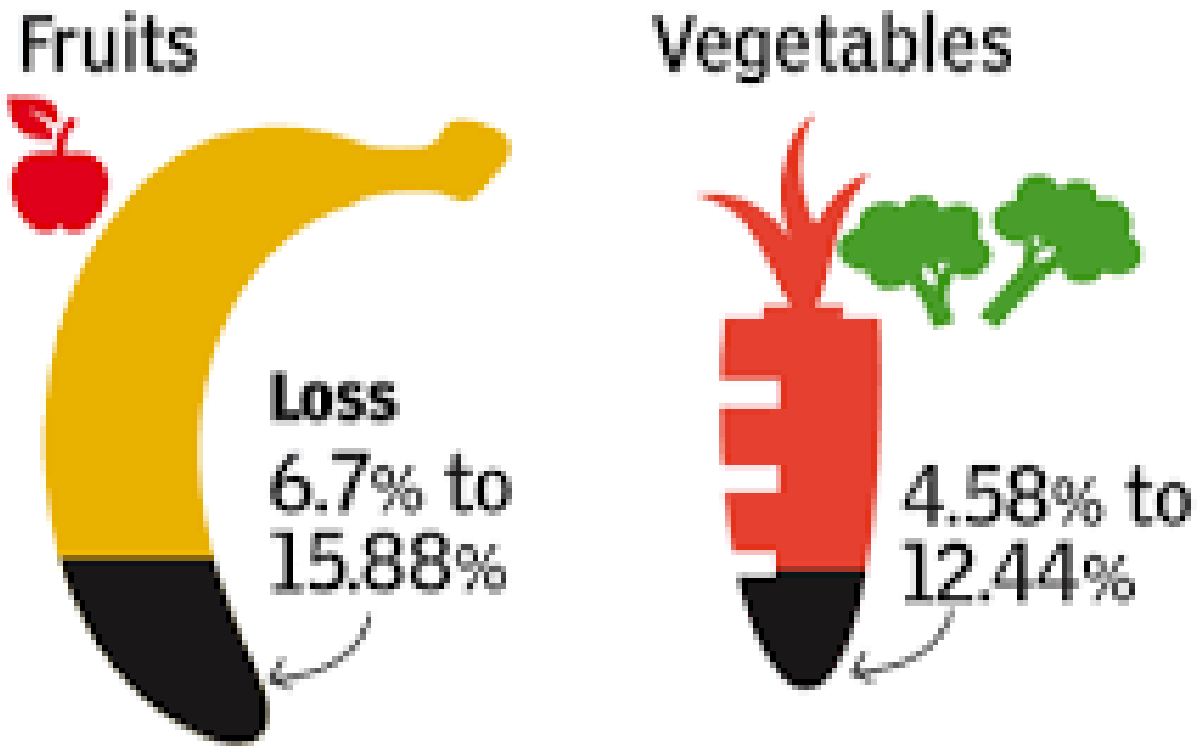
Applications in Agriculture



CHAMAN – FASAL : Mahalanobis National Crop Forecast Centre

Geospatial Information for Survey, Monitoring and Projections

Estimated post harvest losses in horticultural produce



Lack of cold chain
(8150 cold storages – 36 million ton capacity, 15000 refrigerated vehicles)

Integrated Cold chain system

Low temperature and high R.H. is maintained from the point of production to the point of end consumption for keeping the horticultural commodities fresh.

Lack of cold chain
(8150 cold storages – 36 million ton capacity, 15000 refrigerated vehicles)

Scheme for Integrated Cold Chain, Value Addition and Preservation Infrastructure

Eligible Project Components:

- **Minimal Processing Centre at the farm level with facilities such as weighing, sorting, grading waxing, packing, pre-cooling, Controlled Atmosphere (CA) / Modified Atmosphere (MA) cold storage, normal storage and IQF.**
- **Mobile pre-cooling vans and reefer trucks.**
- **Distribution hubs with multi product and multi CA /MA chambers, cold storage /Variable Humidity Chambers, Packing facility, CIP Fog treatment, IQF, Ripening chamber and blast freezing.**
- **Irradiation facility.**

Horticultural Universities in India (Horticulture for food, nutrition, health and income security)

- **Maharana Pratap Horticultural University, Karnal, Haryana**
- **YSP University of Horticulture & Forestry, Himachal**
- **VCGS University of Horticulture & Forestry, Uttarakhand**
- **University of Horticulture Sciences, Karnataka**
- **Dr YSR Horticulture, University, Andhra Pradesh**
- **SKLT Horticultural University, Telangana**

Mandate of the MHU

Mandate: **Centre of excellence in teaching, research and extension education in the field of horticulture and allied sectors for food and ecological security, improved livelihood opportunities and economic prosperity of farming communities.**

Aim: **To develop diversified sustainable farming systems for improving productivity and profitability in horticulture and also to train the farmers and extension functionaries for the effective dissemination of advanced horticultural technologies in Haryana and its neighboring states.**

Initiatives at MHU

The Maharana Pratap Horticultural University:

- **Function in three tier system viz. education, research and extension.**
- **Imparting degree in graduation in Bachelor in horticulture. Masters and Ph.D. in Fruit Science, Vegetable Science, Floriculture and Landscape gardening.**
- **Has six Regional Horticulture Research Centers**
- **Center for Smart Horticulture and Centre for Bi-solutions in Horticulture.**
- **Extension: Technology assessment and refinement. Transfer of technology through front line demonstrations in clusters, trainings**
- **In addition to fruits, vegetables, mushroom, flowers, bee-keeping, protected cultivation, Post harvest management the university has started work on spices, medicinal and aromatic plants**
- **MOUs: Brunel University, UK; Wagnenian University, Netherland, Kochi University, Kochi (Japan)**

Centre for Smart Horticulture (CSH)

- **Precision irrigation:** Evolving micro-irrigation/ fertigation techniques based on sensors and monitoring systems.
- **Protected cultivation:** Development of crops modules for different types of protected structures.
- **Timely detection of diseases and pests:** Automated system, equipped with sensors to detect diseases and pests early.
- **Fertilizers and pesticide management:** Development of site specific and crop specific nutrient modules
- **Prediction of yield and optimization of harvest:** Standardize precision farming tools to analyze data on crop health, weather patterns and soil conditions, evapotranspiration, photosynthesis.
- **Creation of Smart farming infrastructures:** Data sensors, Global positioning system, automated machinery, drones for aerial insights and data driven decision support systems.
- **Optimization of drone parameters:** The drone parameters will be optimized for speed, height, discharge of inputs.
- **Postharvest management:** Integrated cold chain, energy efficient cold storages

Collaboration with Brunel University, London

- UKRI-GCRF funded project " Solar Powered Horticultural Cold Chain (Sol-Tech) under the Center for Sustainable Energy Use in Food Chain (CSEF).

- Commodity based storage protocol for storage of the fruits and vegetables under solar based dual fuel cold storage system.

Digitalization and G20 Perspective

2018: Argentina

- **Digital Infrastructure**: Broadband connectivity and data centers
- **Data Governance:** Develop framework, data privacy, data security
- **Standards & Interoperability:** Promote development of open platforms
- **Capacity building in digital agriculture**
- **Financing:** Increase investments

2023: India

- **Digital agriculture and sustainable agri value chain and PPP**
- **Digital agriculture and traceability**
- **Digital tech solutions for reducing post harvest losses and waste**
- **Agri tech start up ecosystem**
- **Pluralistic agriculture extension & advisory services**

Areas of collaboration

- **Research:**
  - Studies on energy efficient Vertical farming structures for horticulture based food production
  - Sensor based technologies for fertigation management
  - Solar powered food driers for rigid commodities such as ginger and turmeric
  - Super critical CO2 grinders for retaining spices and herbs aroma
- **Development:**
  - Available solutions, technology assessment & refinement
- **Education**
  - Student exchange program 1-3 months Internship (UG)
  - Dual degree in Masters & PhD

Conclusions

- **Proliferation of startups and R&D: Smart farm infrastructure creation**
- **Sustainable and efficient utilization of resources including land and water**
- **Smart advisory- improved forecasting**
- **Enhanced production- seeds/inputs, smart farming, digital platform-based value chains**
- **Increased smart manufacturing in Agri and Allied Sectors**
- **Product-specific management and traceability**
- **Technology based risk mitigation**
- **Improved (Green) value chain and market linkages especially for perishables**
- **Extensive use of e-commerce**
- **Best quality of skilled human resource**

Horticulture Vision for 2047

- **Horticulture in more potential areas**
- **Potential crop in potential area**
- **Input use in potential areas**

Forward looking holistic approach to address challenges and capitalize on opportunities

THANK YOU

INTERNATIONAL YEAR OF MILLETS 2023

- **India took lead for successful implementation of International Year of Millets-2023**
- **Now the next year 2025 will be for International Year for Women in Agriculture**