Agri Tech

Opportunities for Emerging Technologies in Indian Agriculture

Dr. Syed Ismail
ismail@sifa.com

- Innovation is a method, idea or product for improving existing systems.

- *Invention is New Product, systems*

Innovation …

- Knowledge of Existing process, product, systems
- Conducive facilities, knowledge source, environment
- Significant and sustainable benefits
- Acceptability and affordability of the market
- Scalability of Innovation

Then comes… Interventions, Interruptions

"The earth, the land and the water are not an inheritance from our forefathers but on loan from our children. So, we have to handover to them at least as it was handed over to us." –

Mahatma Gandhi

- Components of Agriculture
- Current Indian Food Production Scenario
- Farm Mechanization level
- Climate resilient Agriculture
- Current Status of Electronics and ICT in Agriculture
- Emerging Technologies in Agriculture
- Challenges in Technologies
- Potential for Entrepreneurship
- Current Low-cost Embedded systems

Inputs

Seed
Soil – (Soil less in CEA)
Water
Nutrients -Fertilizers, Chemicals
Operations
Seed bed preparation
Planting
Weeding
Fertigation
Harvesting

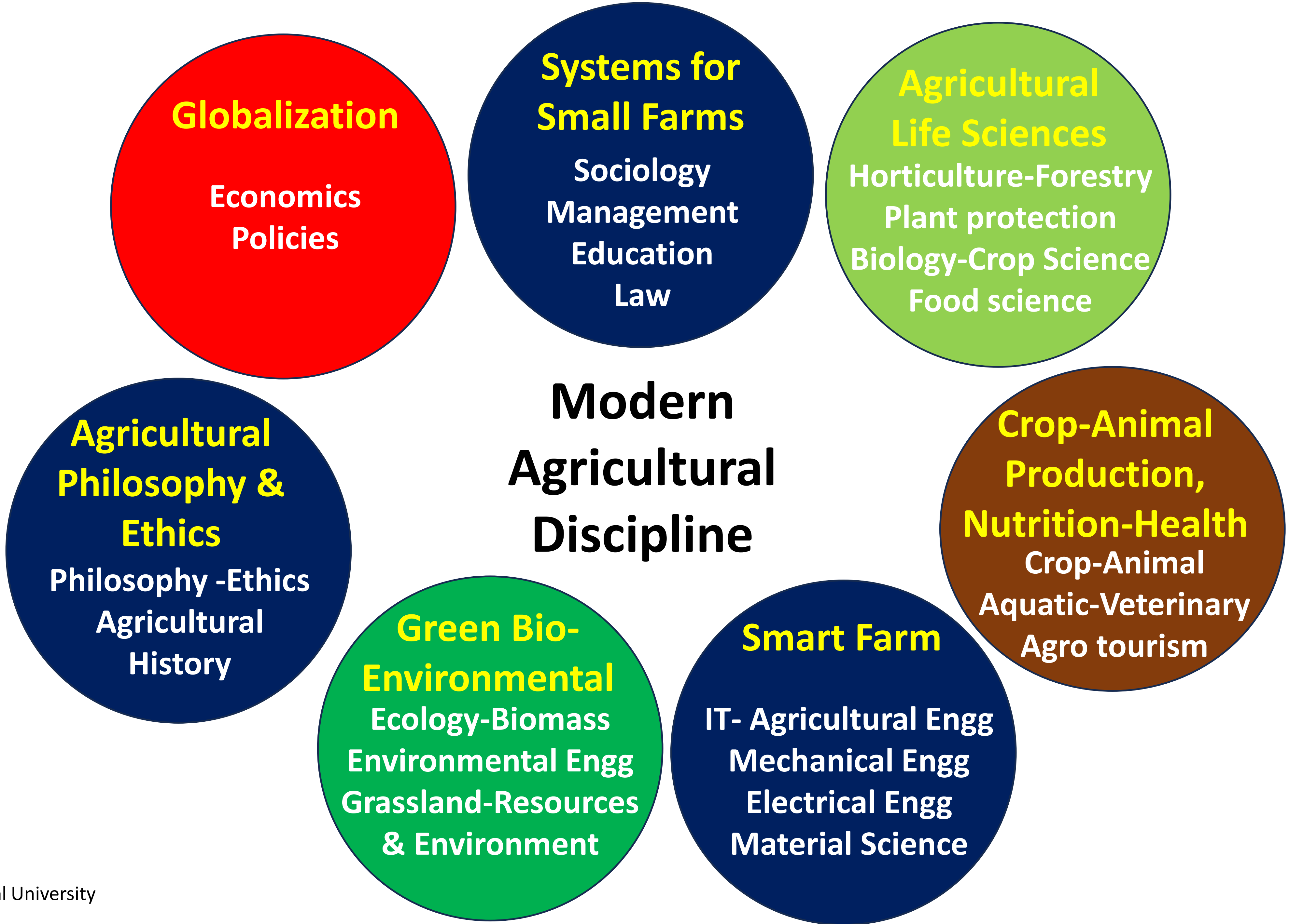
Outputs

Cereals:	Wheat, Rice
Pulses:	Millets, Gram
Fibre crops:	Cotton, Jute
Sugar:	Sugar Cane
Animal:	Milk, Meat, Poultry,
Fisheries:	Fish, Crab, Lobster
Horticulture:	Vegetables, Fruits
Forestry:	Wood, Resins, Rubber
Plantation:	Coffee, Tea

Current Agricultural Disciplines

Seed Technology
Soil Science
Agronomy
Entomology, Plant
Pathology
Agricultural Economics
Agricultural Extension

Agricultural Engineering
Food Technology
Bio Technology
Animal Sciences
Fisheries
Horticulture
Forestry



Courtesy: China Agricultural University

Change in Perception

Collaborate to be Effective

Farm Mechanization needs Collaborative work of various disciplines

We work today in Silos

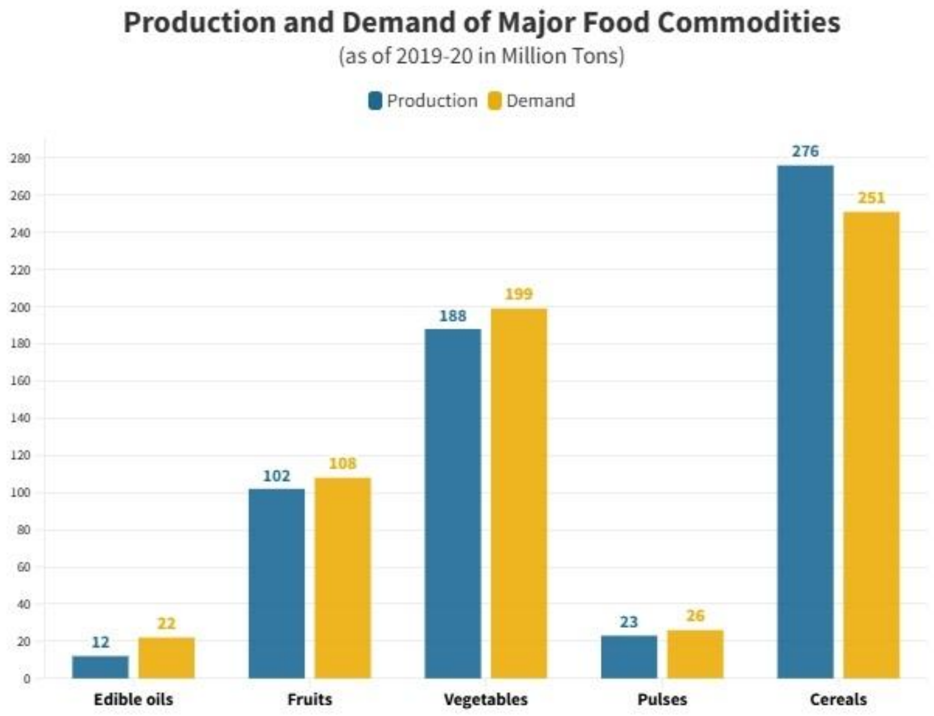
Engineers should know basics of Agronomy, Crop science, Soil Science, Entomology/ Pathology, Horticulture, Animal Science, Poultry, Agro Forestry, Fisheries to design machines. Irrigation engineer should know Soil science and Agronomy. Breeders should know spacing and strength requirements for mechanization, Horticulturists Climate Control, Conservation agriculture needs both Soil scientists & Engineers, Sprayer design needs Entomologists etc..

Economics and Extension needed for ALL!

We expect a Farmer to do all alone!

Current Scenario

Agricultural Production

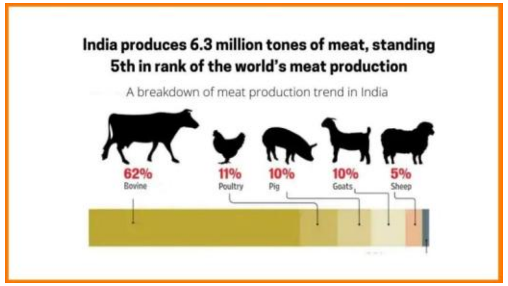


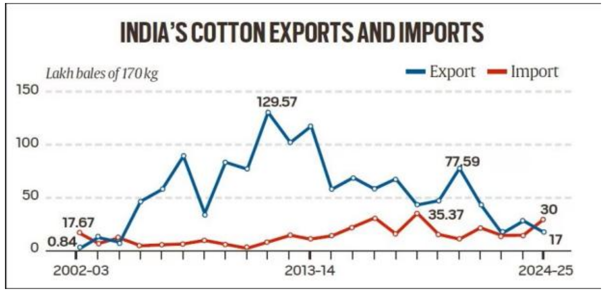
Source - NITI Aayog WGR

Demand / Production (in mt)

		Rice	Wheat	Pulses	Edible oils
2019-20	Demand	103	100	26	22
	Production	119	108	23	12
2030-31*	Demand	110	111	35	27
	Production	145	131	31	15
2047-48*	Demand	114	119	49	31
	Production	154	160	47	24

*All projections are according to business-as-usual approach when food demand grows at an annual rate of 2.44%
Source: NITI Aayog Working Group Report on Crop Husbandry, Agriculture Inputs Demand-Supply





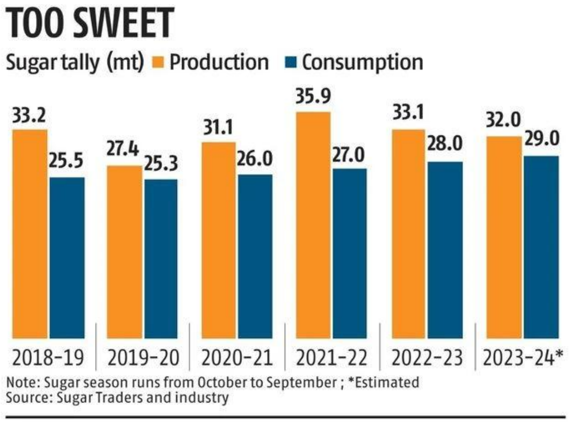
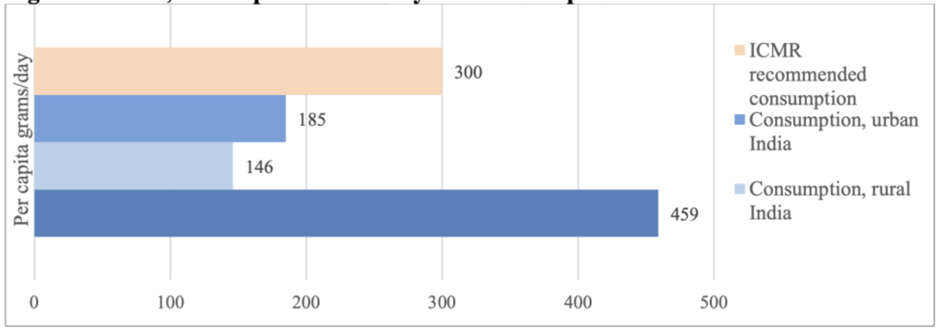


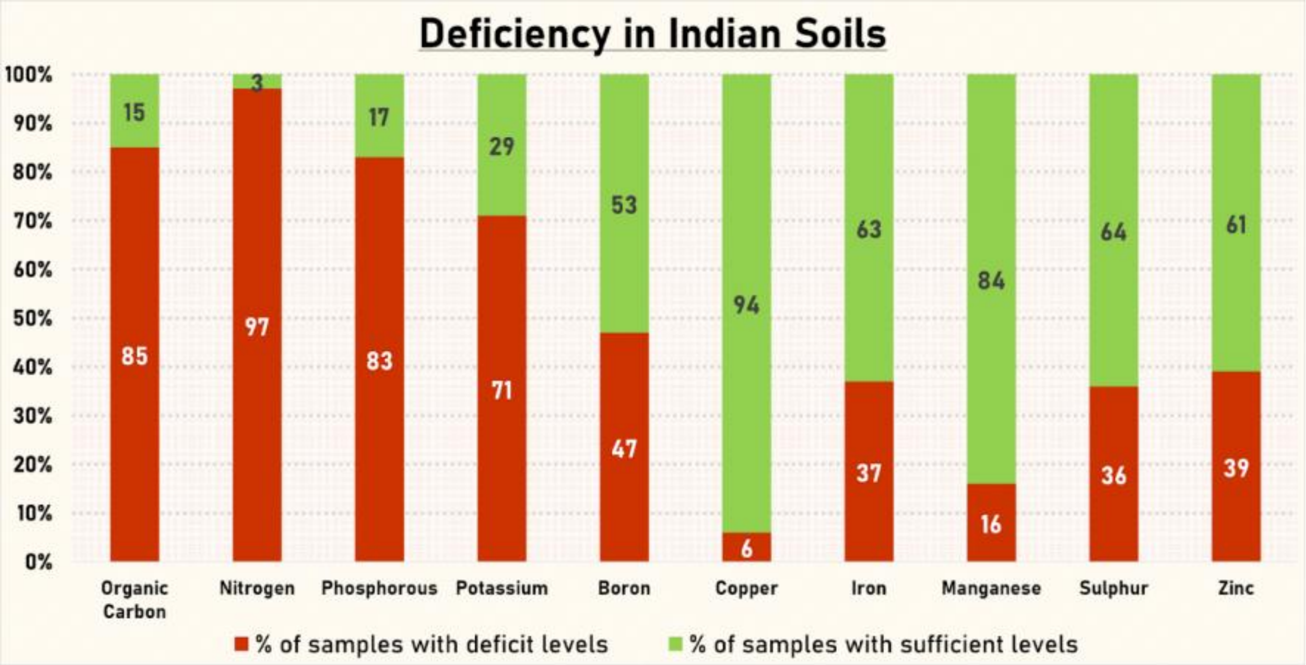
Figure 4: India, Per Capita Availability and Consumption of Milk

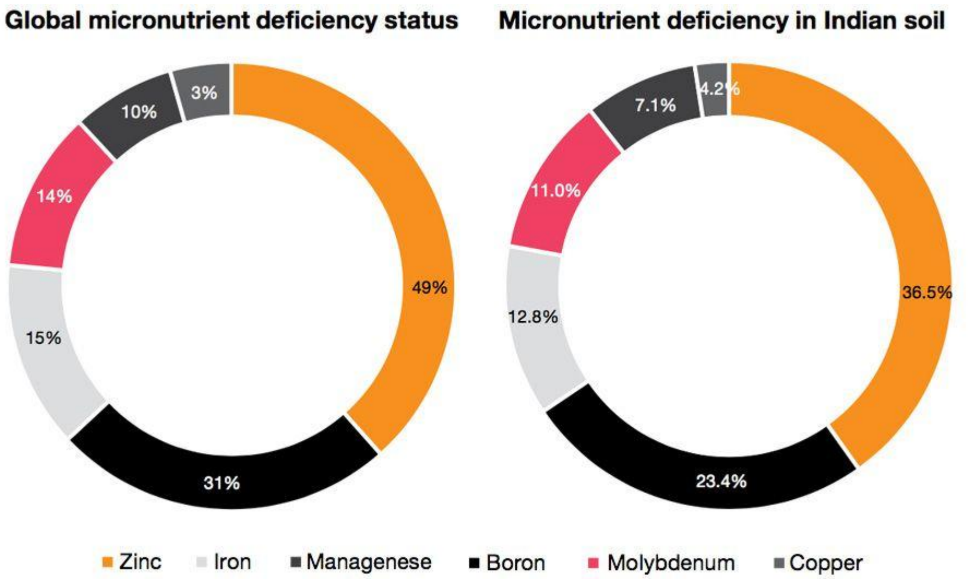


Source: FAS New Delhi Office Research, https://ccelms.ap.gov.in/adminassets/docs/24112023025348-

Edible Oils

Current Challenges

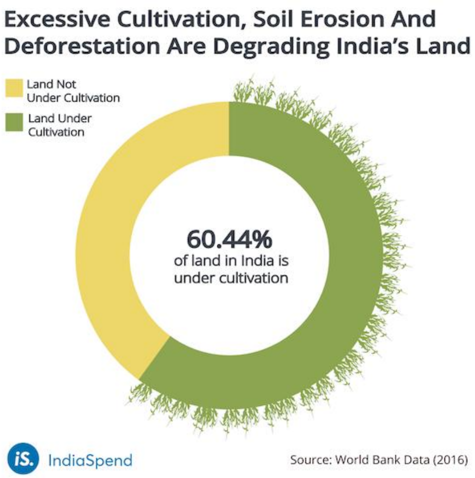


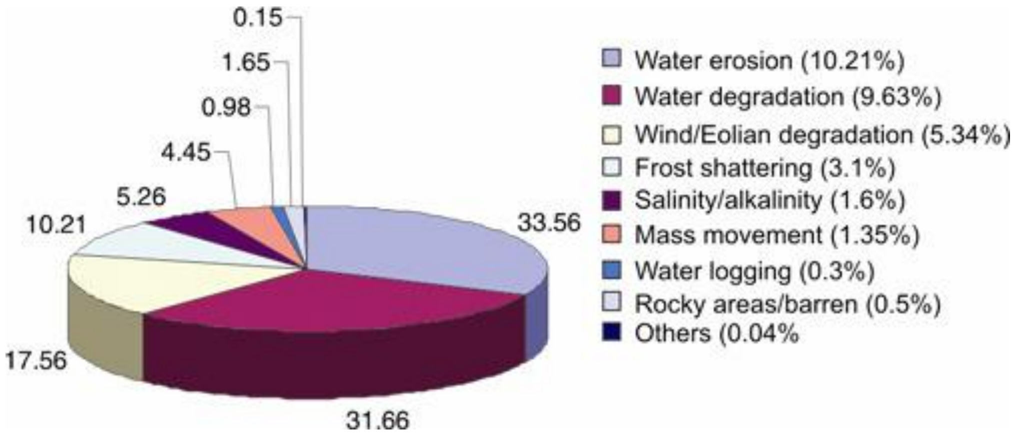


Soil Health

Land Degradation

30% (2022)





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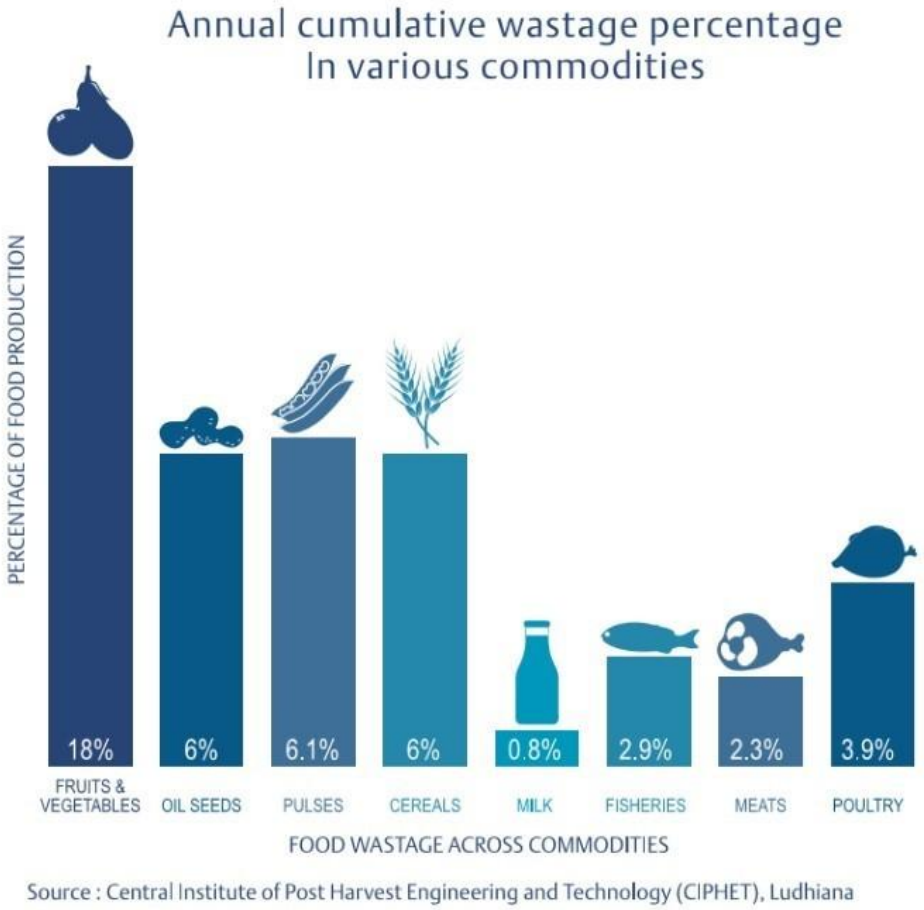
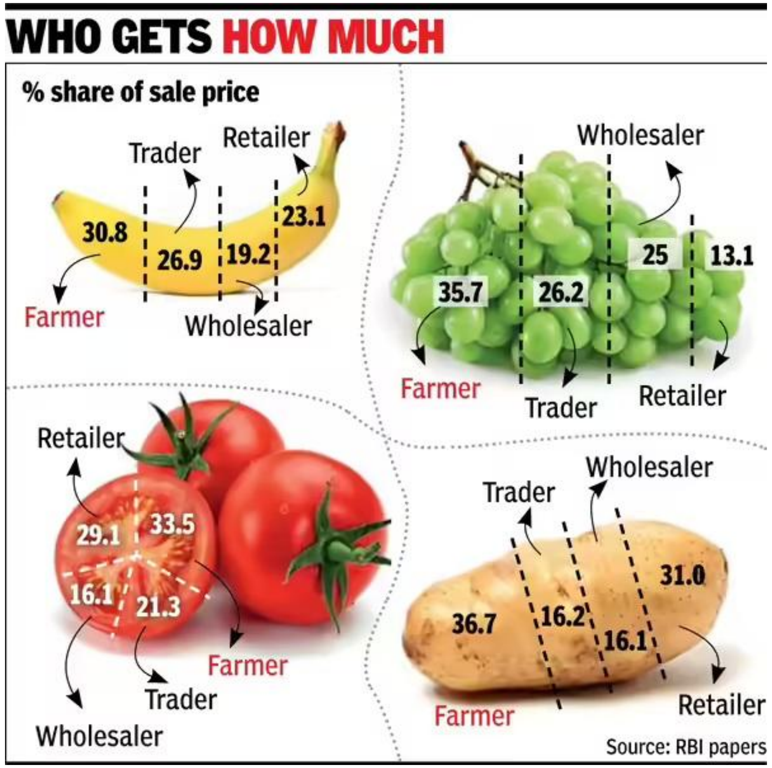


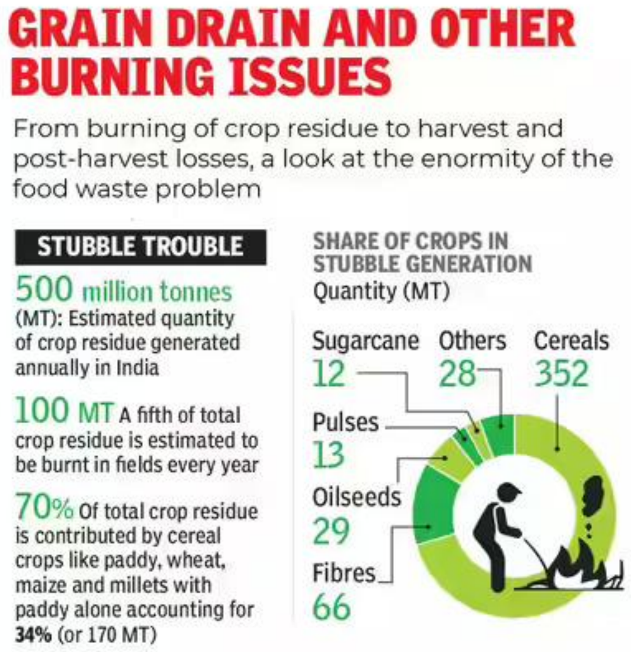


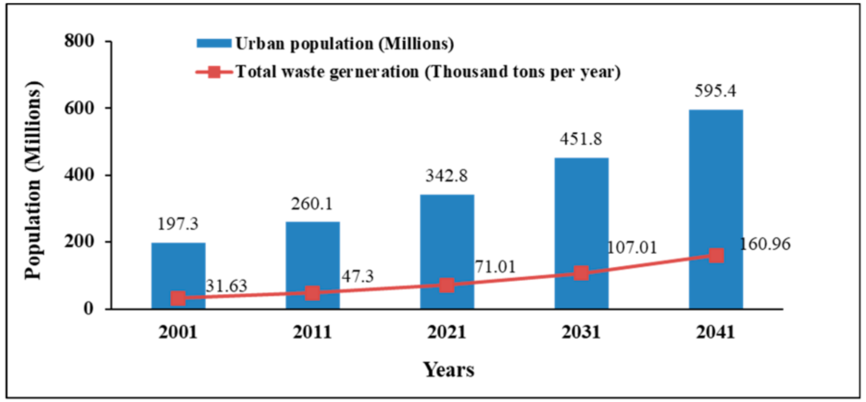
Farmer gets ~30% Sale Price

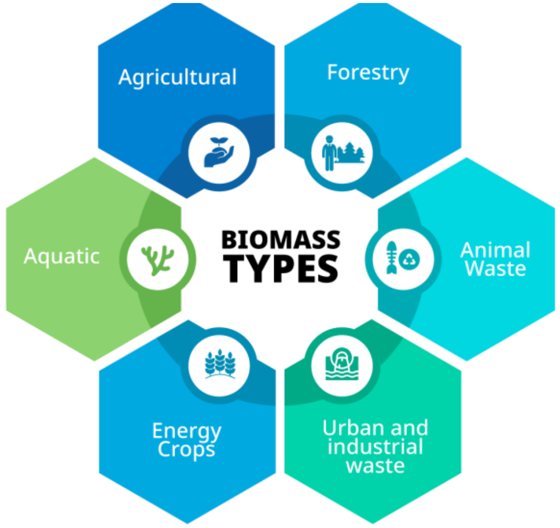
Food Waste

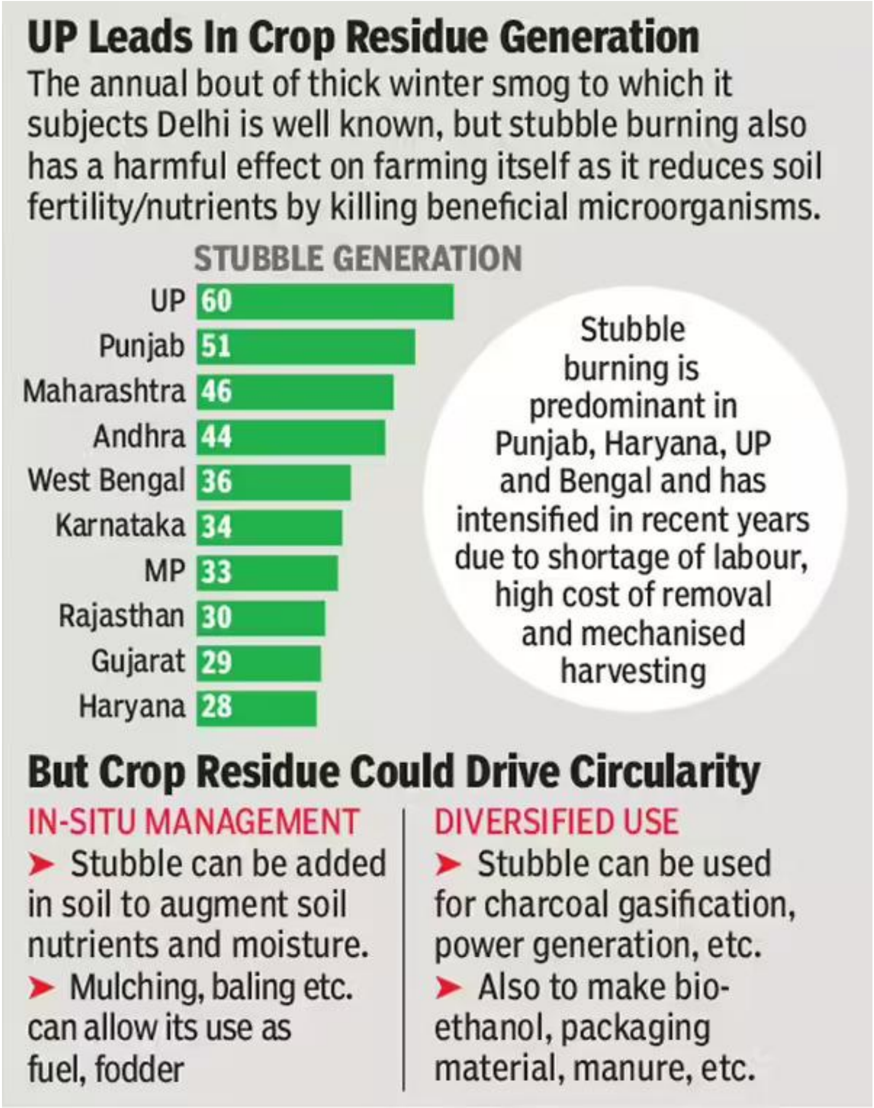
Community Storage
Local Processing
Transport / Logistics

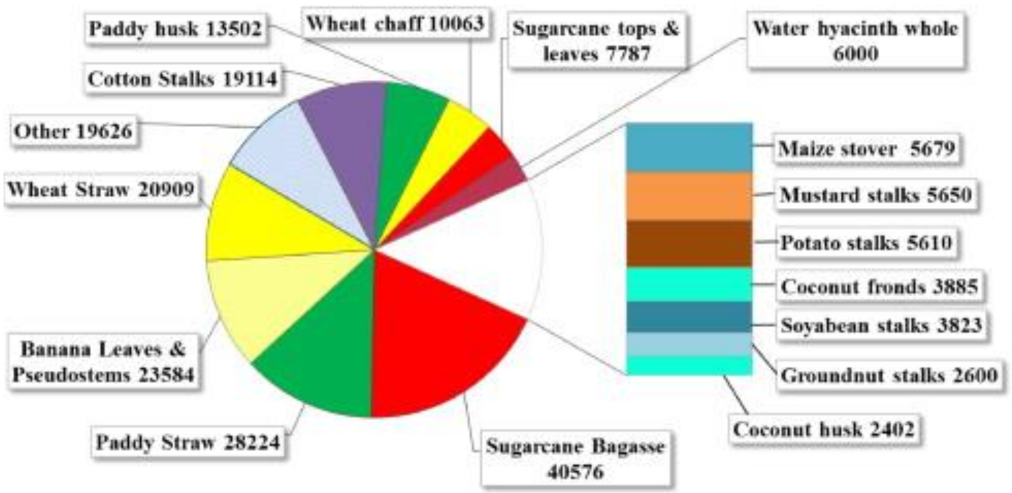
Current Challenges











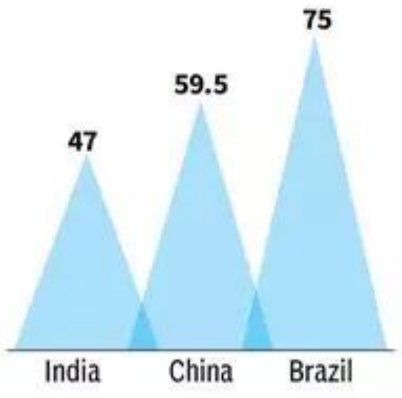
Biomass

Farm Mechanization

Farm Mechanization

India vs other developing nations

Farm mechanisation level (in %)



Advantages

- Saves 15-20% on seeds and fertilizers
- Improves seed germination by 7-25%
- Reduces time spent by 20-30%
- Cuts weed levels by 20-40%
- Lowers labour requirement by 20-30%
- Increases the number of crops grown per year by 5-20%
- Boosts crop yields by 13-23%

Source: Parliament answers; Parliamentary standing committee on agriculture

Operation-wise average mechanisation levels

(in %)

Seed-bed preparation	Sowing, planting, transplanting	Weeding, inter-culture and plant protection	Harvesting and threshing	Overall average
70	40	32	34	47

Automating agriculture

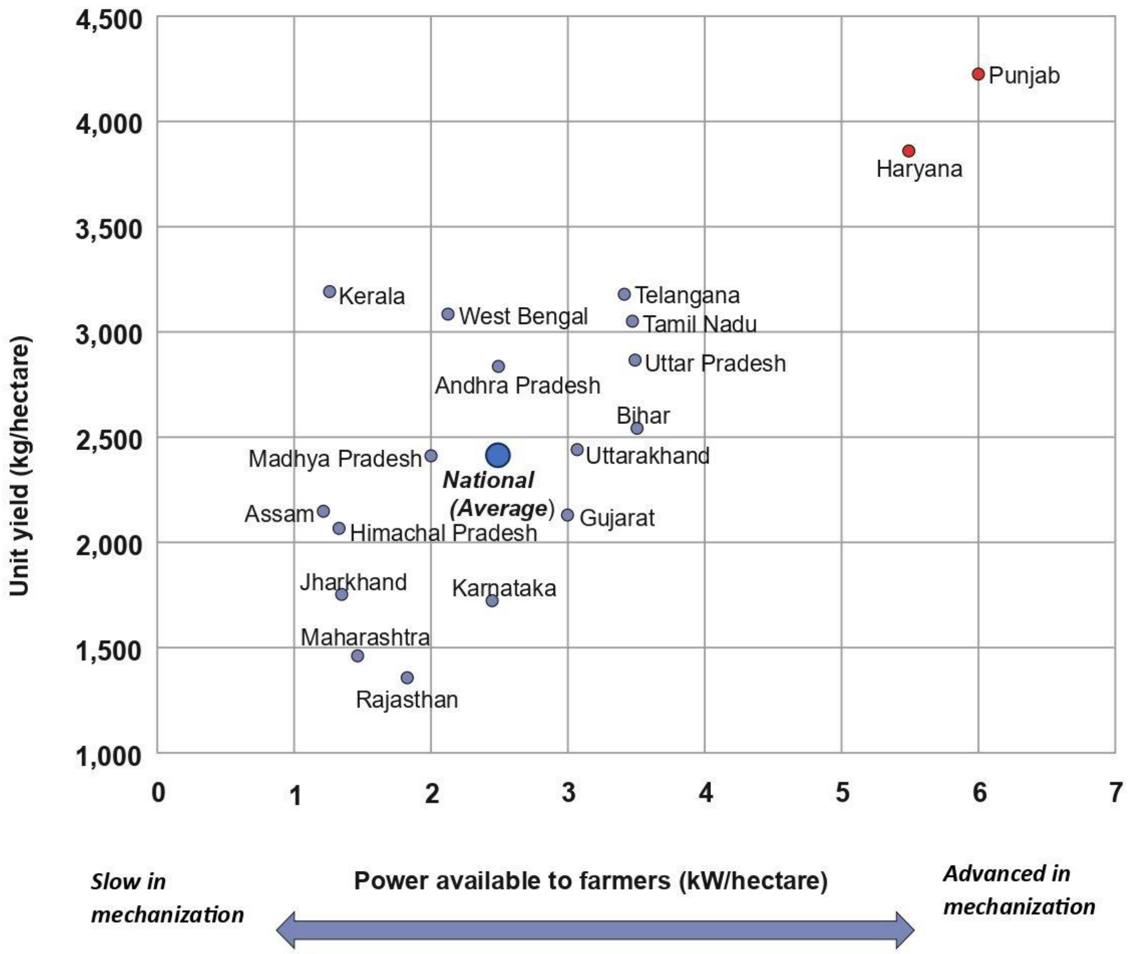
Crop-wise farm mechanisation *(in %)*

	Seed-bed preparation	Sowing, planting, transplanting	Weeding, inter-culture and plant protection	Harvesting and threshing	Crop-wise average
Rice	80	35	35	60	53
Wheat	85	65	50	75	69
Maize	70	45	40	30	46
Sorghum and millets	60	30	20	20	33
Pulses	65	40	25	35	41
Oilseed	65	40	20	30	39
Cotton	70	40	35	0	36
Sugarcane	65	25	30	20	35

- ❑ **Animal /Poultry**
- ❑ **Milk**
- ❑ **Vegetables/ Fruits**
- ❑ **Fish**

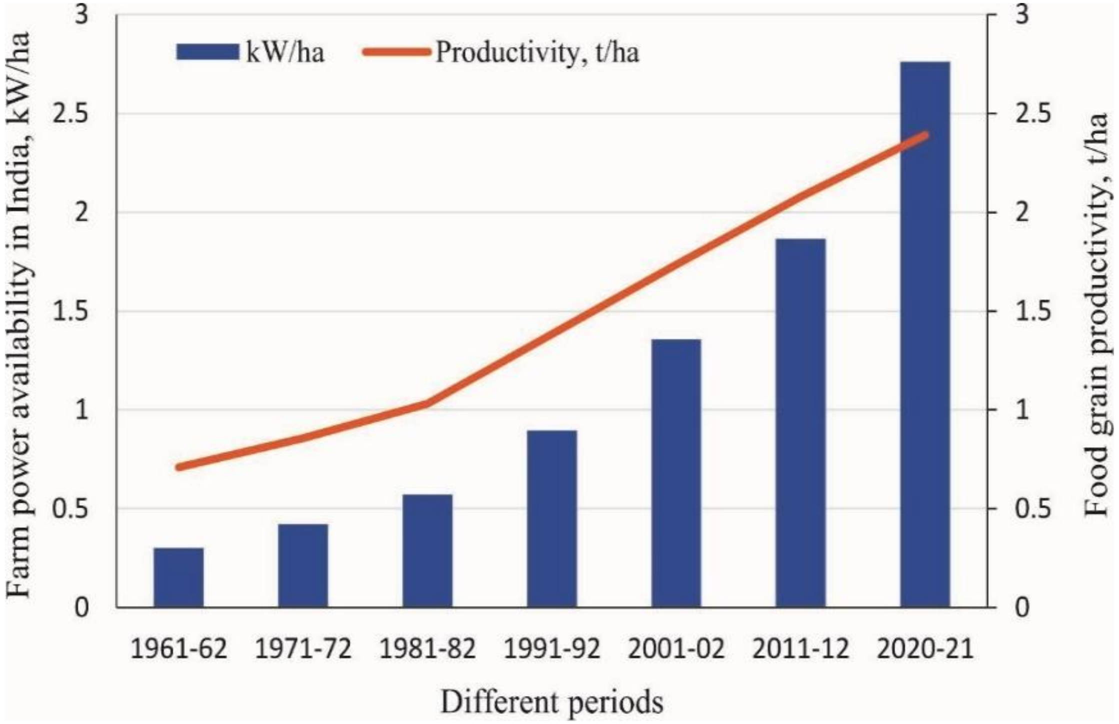
- ❑ **Storage**
- ❑ **Soil health**
- ❑ **Inputs Optimization**
- ❑ **Biomass**
- ❑ **Land degradation**
- ❑ **Energy Efficiency**

Farm Mechanization



Source: Compiled by MGSSI based on data of India's Ministry of Agriculture & Farmers Welfare
*Data for mechanization of agriculture are for FY 2018-2019; data for unit yield of food grain crops are for FY 2021-2022.

Power Availability & Yield



Data from 1961 indicates a linear increase in food grain productivity
-from **0.71 to 2.39 t ha**
corresponding to a rise in power availability
-from **0.3 kw/ha to 2.76 kw ha**

Farm Mechanization

- To enhance the profitability, dignity, and sustainability of farming
- To attract and retain youth in the agricultural sector
- To address emerging constraints posed by climate change, soil degradation, agrochemical overuse, environmental degradation, and labour shortages, particularly in labour-intensive crops and allied sectors

Farm Mechanization

Soil health restoration

Conservation agriculture equipment, including zero-tillage seeders and in-situ residue management tools for smallholder systems

Input use efficiency

Precision application technologies for fertilizers and agrochemicals, including variable-rate and targeted spraying systems (e.g., laser-guided sprayers, "See and Spray" systems).

Post-harvest management

Mechanized harvesters, decentralized storage solutions, and improved cold-chain logistics to reduce post-harvest losses.

Water productivity

Automation of irrigation and fertigation using AWD and sensor-based scheduling.

Natural resource management

Equipment for land reclamation (e.g., saline soils), agroforestry, and watershed interventions.

Allied sectors

Mechanization in animal husbandry, poultry, and fisheries to enhance productivity and reduce labour intensity.

Tractor Industry

1) In 2023 - 1.01 million tractors (10% Export) – 5% CAGR
2) 45% tractors are used primarily for land preparation and some for harvesting.
3) *The government schemes often exclude smallholders due to affordability issues*.
4) CHCs help address this gap, though many faces financial burdens from high maintenance and upgrade costs.
5) *A transition to service-based subsidy models is recommended*. *These would fund mechanization rather than ownership*

Crop varieties/ Cultivation

The effectiveness of agricultural machinery is intrinsically linked to the crops' Physical uniformity and Maturity synchronization

Examples:

- In cotton harvesting is complicated by asynchronous boll maturation, requiring multiple manual-plucking rounds. Manual harvesting operations, such as cotton picking, contribute up to 30% of total cultivation costs.
- In sugarcane, parameters such as plant spacing and stalk height are critical for mechanized harvesting.
- Soybean cultivation faces challenges due to low ground clearance, which restricts mechanized operations.

Multidisciplinary Activities:

- Conservation Agriculture (Conservation, Traditional, Regenerative, Natural, Organic - CA,TA,RA,NF,OA)
  - Residue/ Biowaste
  - Minimal Tillage, NRM interventions
- Control Environment Agriculture
- IPM/ Crop rotation/ Plant protection
- Intercropping/ Weeding/ Mulching
- Planting/ Irrigation/ Fertigation/ Harvesting
- Drainage/ Soil Erosion/ Runoff
- Agro forestry
- …

Advancing Agricultural technology and Input efficiency

- ❑Indian Farming accounts for 80–90% of freshwater use
- ❑Inefficiencies in fertilizer and agrochemical applications < 10% effective uptake.
- ❑Irrigation pumps currently operate at 30–50% efficiencies

- o Improve skills and research in Emerging technologies for precision farming and increasing input use efficiency
- o Promoting small and medium enterprises engaged in agricultural electronics and automation.
- o Currently, many subsidized polyhouses remain underutilized due to the absence of affordable climate control technologies

Agricultural Machinery

Tillers/Cultivators/Weeders- Seeders/Planters -Sprayers/Spreaders

Tillers, cultivators, and weeders

- cultivators with low soil compaction footprint
- laser-based non-tillage weed control

- Soil Compaction
- Reduce tillage – no till
- Damage to hardpan

Single pass Cultivation, Seeding and Fertigation

Seeders/Planters

- Multi grain for small farms
- Vegetables / Fruits
- Sugarcane – bud chip reduce weeds

Sprayers/ Spreaders

- Laser assisted/ “See and Spray”
- Improved research in efficient delivery
- Organic spreaders for small farms

- <10% chemicals reach target

Agricultural Machinery

Sugarcane - Fibre crop

Sugarcane

- cane node cutting
- bud chip planting
- root-zone irrigation
- ratoon crop management
- harvesting

Cotton

- weeding
- Harvesting
- Compact ginning machines

Jute

- Modernization
- Retting
- Spinning
- Weaving loom

Agricultural Machinery

Horticulture – Livestock, Poultry - Fisheries

Horticulture- vegetables, flowers, fruits

- harvesters for fruit trees
- pruning tools
- Cleaning, grading
- packaging
- Storage
- Floriculture needs mechanization

Fisheries

- Live fish transportation
- Fish cutting, meat-bone separation
- Driers
- Refrigeration

Livestock & Poultry

- Small farms in milk production need animal feeding, cleaning, and monitoring.
- Waste generated in this sector, often utilized for biogas or vermicomposting, holds potential for conversion into other industrially valuable products
- Poultry equipment for feeding, watering, and disease detection in poultry farming

Agricultural Machinery

Irrigation / Fertigation

Challenges

- Reduce water use from 80-90%
- Improve Nutrient application efficiency
- Reduce ground water usage
- Improve surface water storage
- Reduce flood water impact
- Improve drainage

Control Environment Agriculture

- Climate Control
- Automated Irrigation/ fertigation

Micro Irrigation Systems are well adopted

Research/ Extension

- Irrigation Scheduling (Demand/ Supply)
- Automated Irrigation control
- Root Zone Irrigation
- Sub surface Irrigation
- Alternate wetting and drying
- Efficient irrigation equipment—including pumps, valves, dispensers, and monitoring
- Precision on-demand Nutrient application

Agricultural Machinery

Conservation Agriculture

- Zero-till drills
- Residue-in-situ machines
- Cover crop seeders
- Mulching equipment
- Compost spreaders
- Agroforestry tools
- Conservation drainage systems
- Multi crop machinery (seeders/weeders)

Biomass
Example: 60% Banana biomass is waste

Traditional Farming
Natural Farming
Organic Farming
Regenerative Agriculture
Conservation Agriculture

Seeds
Nutrients
Weeding

Can India become Food bowl of the World

Strength

- Largest Arable land
- Largest Research Team
- Varied Climate/Soil
- Demographic advantage
- Educational Institutes
- Huge Agricultural base

Weakness

- No collaborative work
- Educating Farmers
- Mono cropping
- Excess Chemicals & water
- Poor Infrastructure
- Supporting Policies
- Lack of Mechanization

Opportunities

- Wide variety of crops
- Supply round the year
- Export potential
- Healthy life

Threats

- Irreversible damage to soil
- Deteriorating health
- Import burden
- Increased unemployment

Innovation & Strategy

Strategies

	PUSH	PULL
CHARACTERISTICS	- It is a Proactive effort to convince customers to purchase a Product. - It tends to Focus on the Product's Fetures.	- It is a Passive Strategy that consists on attracting Customers with Values or Desires. - It tends to Focus on Aspirational Values.
WHEN TO USE IT	- Technical Products. - Products Valued by their Features. - For New Products. - For Improved Products. - For Old Products in New Markets.	- For Common Products. - For Simple Products. - In Well-Known Products. - In Strong Brands. - For Mediocre products in Saturated Markets.

Buzz words of Emerging Technologies

Drones, Robots
Artificial Intelligence
Machine learning
Big data
Block chain
Internet of things (IOT)
Internet and Computer Technologies (ICT)
Virtual reality / Augmented reality
Nanotechnology in Agriculture

- Applicability/ Limitations of Technologies – Time/Effect/Cost
- Current Agricultural challenges

Block Chain

Distributed Database
Security
Redundancy

Applications:

Inventory, Product Distribution

Machine Learning

Set of rules, optimization based on Error function

Applications:

Field application of Nutrients, Chemicals

Big Data

Storing and retrieval of large data

Applications:

Soil, Plant environment information
Health prediction, Genetics

IOT

Connected sensors and actuators

Applications:

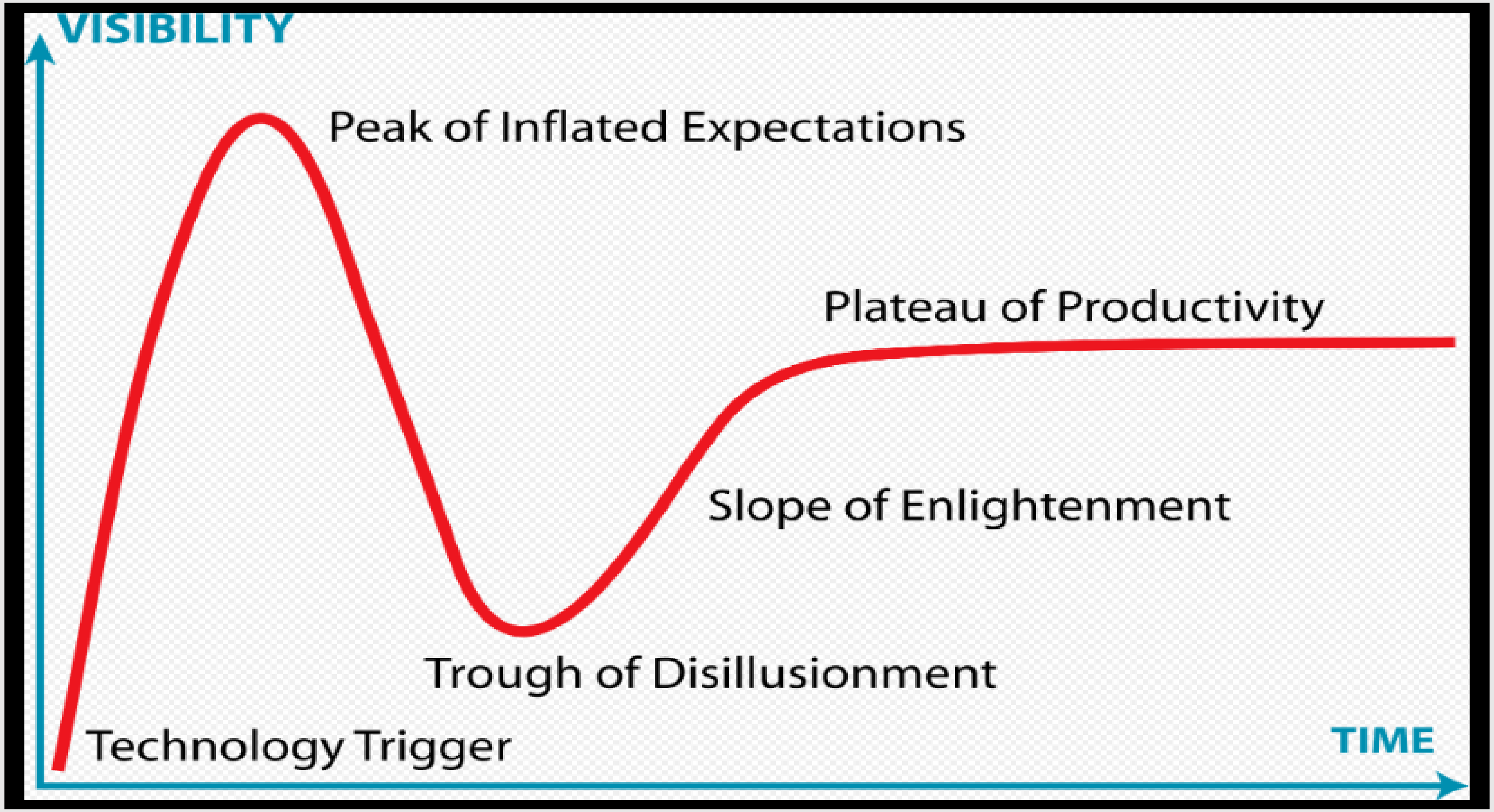
Automated Irrigation, location and guidance systems (robots),Crop status

ICT
Information Collection,
Distribution tools
Applications:
Data collection, Forecasting, Sales, Logistics

AI
Neural Networks, Decision making algorithms on reduction principle.
Applications:
Yield prediction, Advisory analysis, image and data interpretation.

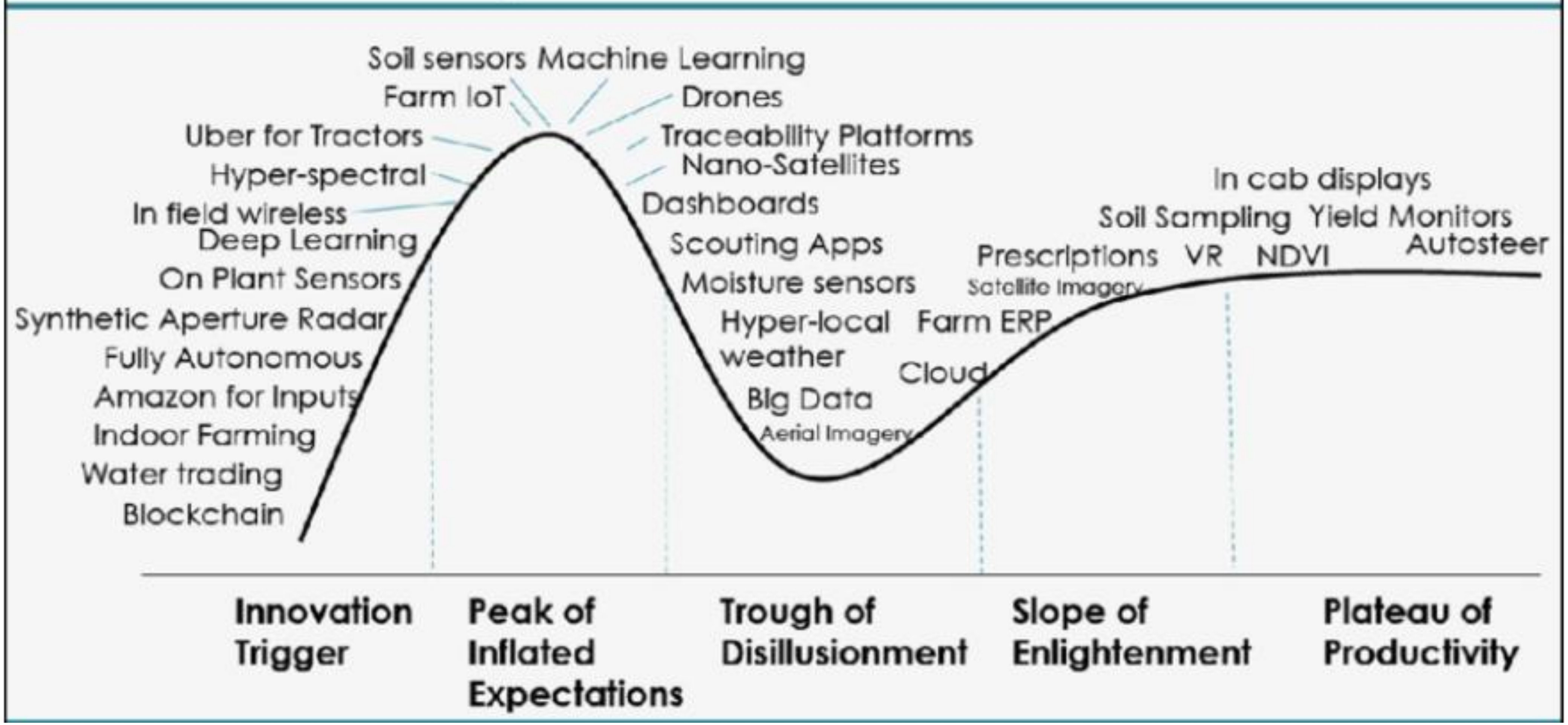
Drones
Autonomous aerial data capturing and product delivery
Applications:
Logistics, Inputs application.

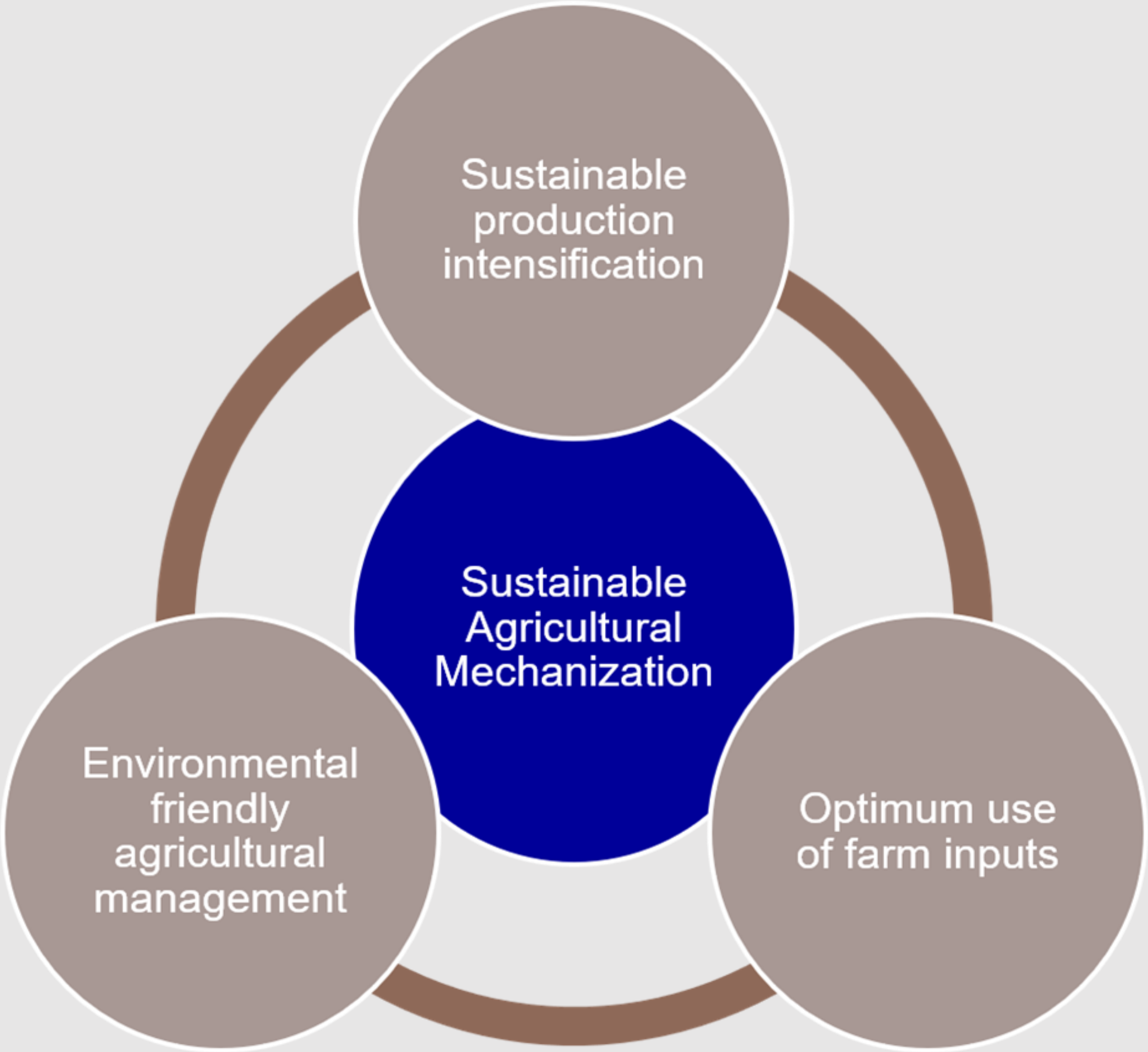
Hype and Reality



Precision Ag Innovation Hype Curve

Is this accurate? What is missing? What needs to be removed?





Courtesy: Gajendra Singh, GPC 2022, FAO, Rome

Pull needs to Redefine

The world realized that "Tillage"

- Is not related to productivity
- Disturbs soil health & organisms
- Soil Compaction
- Damages hardpan

We are yet to work on

- Crops other than Wheat & Rice
- Horticultural Crops
- Fibre crops (Cotton)
- Oil Seeds, Millets, Pulses
- Animal, Poultry & Fisheries
- Sugarcane

Work on Productivity & Efficiency

- Water (80-90% of fresh water),
- Fertilizers ~30%/ Chemicals (~8-9%)
- Processing/ Storage/ Logistics
- Energy inputs

Challenges

- Soil Health
- Climate Change/ Disasters
- Labour availability
- Rural growth
- Agriculture as Business

Current Challenges

- Less Farm Income
- High Chemical Application (<10% on plants)
- High Water Application (90%)– Ground water depletion
- Environmental pollution (17%)
- Mono-Cropping
- Soil health deficiency, Salinity 7-12%
- Too much wastage (vegetable/fruits >40%)
- High cost of farm labor
- Higher population dependent on Agriculture (50%)
- Insufficient advisory, resulting in over/under production
- Insufficient storage/ logistics

Pull needs of Mechanization in Maharashtra

Current Scenario & Challenges

More Output/Less Waste ***Income*** ***Labour***

Mechanization of Wheat/Paddy Land Preparation, Sowing, Harvesting	Sugarcane, Cotton, Sorghum, Millets, groundnut, Soyabean, Maize -Requires multi crop compatibility. (Soil health/Crop Rotation)*****
Fertilizer application Manual	Precision farming, Low cost application equipment (Soil health/ Environment) *****
Weeding Mostly manual	Robots and tech assisted weeding to avoid herbicides (Soil health/ Environment) *****
Water application Pumps, Drip, Sprinkler	Automated/ Scheduled Water application. Current usage 80-90%- Save Water, Reduce Ground water depletion. (Soil, Water/Environment) *****
Spraying Pesticides Manual	See and Spray with Laser/Camera and Tech. Only <10% chemicals sprayed reach target. (Soil/Water health/Environment)*****
Storage & Logistics Conventional for Cereals	Modern storage for cereals, Climate Control – short term and long term for fruits and vegetables. Reduce 24% Food waste (Farm revenue/ Nutrition Reach)*****
Meat, Poultry, Fisheries Basic	Reduce Wastage, Increase Farm Income, Increase Exports (Sustainability)*****
Horticultural Crops Manual	Reduce wastage, Timely harvest (Farm revenue/ Nutrition Reach)*****

Mechanization

Sugarcane

Precise Irrigation & Mechanized harvesting in ADT/VSI case studies show increased productivity/ cost reduction

- Bud-Chip preparation/ planting machinery
- Inter cultivation/ ratooning
- Residue management equipment
- Harvesting equipment
  Latur 93%, Bhima Sugar 70% , Overall ~40% (MPKV, VSI)
- Sustainable Sugarcane Initiative (SSI) Irrigation/ fertigation
- Spraying – Canopy dependent
- Intercropping- vegetables, pulses, and cereals

Coton

High Density Planting System (HDPS) Yield Increase of 25-40%

- Pneumatic planters, boom sprayers, fertilizer spreaders, and mechanical cotton pickers
- Pickers cost ₹15,000- ₹27 Lakhs
- ~5% of cotton is harvested by machines in MH
- Indian bolls mature and open 3-4 times
- Maha Agri-AI Policy 2025–2029- ₹500 Crores
- Robot pickers – Bangalore, Pune
- Small cotton quality tools- moisture/ lint
- Small ginning machines
- Adhering to GM revisions and standards while planting- Herbicide-Tolerant (HTBt) cotton
- Pink boll worm infestation- advance warning systems
- Intercropping- green gram, black gram, pigeon pea

Economical/ Timely Labour availability

Mechanization

Soybean/ Pulses/ Millets

Challenges: Cost of machines, Service & upgradation, CHC's viability

- Majority of Soybean harvesting- Manual
- Other operations Mechanization is 20-25%
- Reapers cost 50K-1.5 Lakhs
- Combines (cutting, threshing, and cleaning ~ 5 lakhs)
- Subsidies for reapers 50-80%
- Labor cost is <20%
- 2022- Study 95% farmers – labour availability
- Wild animal intrusion
- High ground clearance crop (VNMKV)
- Multi grain harvesters – new (Cost factor)
- Intercropping- soybean + pigeon pea

Tillers, cultivators, and weeders

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Mechanization

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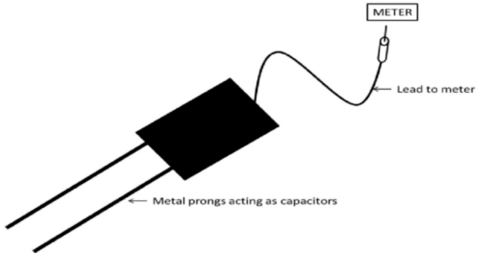
Sensors & Actuators & IOT

Soil Moisture Sensors



Capacitive

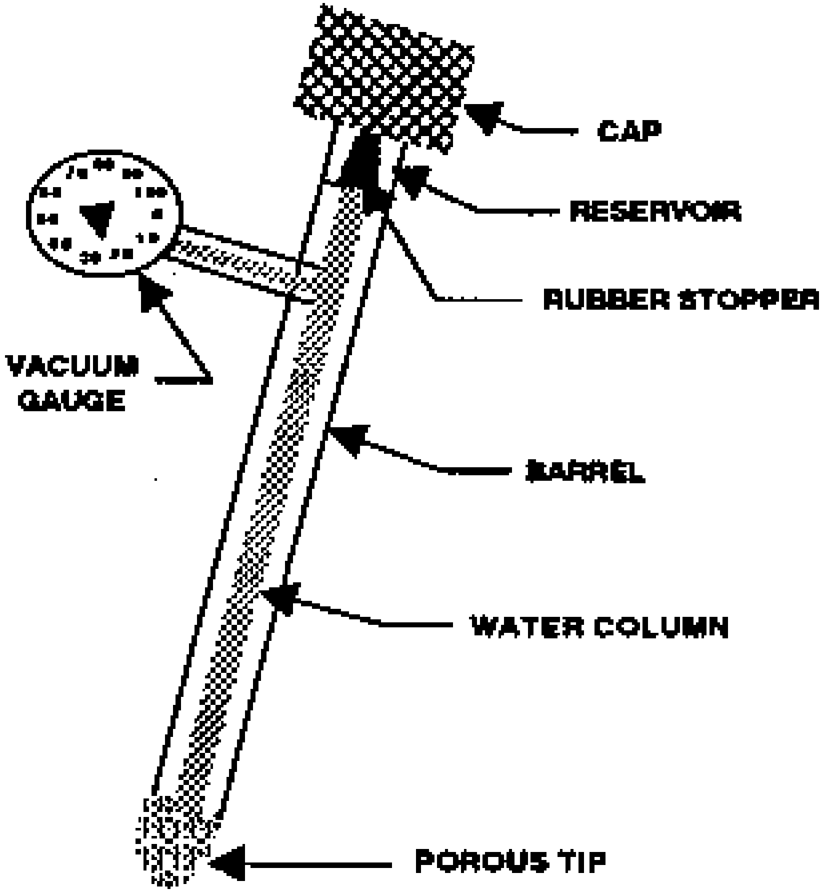
PCB

TDR Time Domain Reflection

Dielectric – Matric Potential

Soil Moisture Sensor

TDR, Matrix Potential,
Capacitance

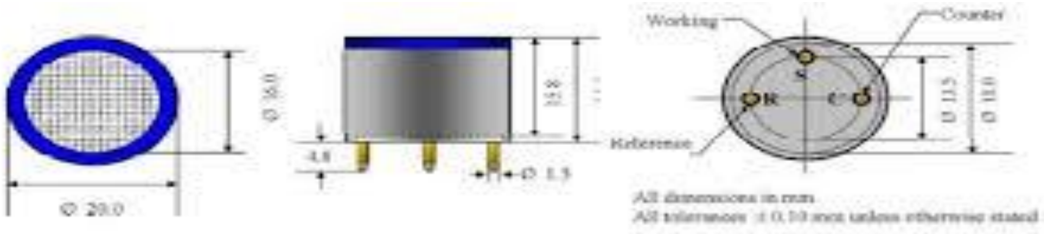


Tensiometer

PH & Oxidation Reduction Potential Sensor(ORP)

Typical Temperature Sensor Characteristics				
Typical Charac-teristics	Thermistors General Purpose	Resistance Temperature Devices (RTDs)	Thermocouples (TCs)	Semiconductor Temperature Sensors
Temperature Range	- 55°C to + 125°C	- 200°C to + 850°C	-600°C to +2000°C	-50°C to +150°C
Linearity	Exponential	Fairly linear	Fairly Linear	Best
Sensitivity	High	Low	Medium	Highest
Response Time	Fast	Slow	Fast to Slow (depends on construction)	Slow
Excitation or power	Needed	Needed	Not Needed	Needed
Long-Term Stability	Low	High	High	Medium
Self-heating	Yes	Yes	No	Yes
Cost	Low	Low (film) High (wire wound)	Moderate to High: (depends on construction)	Low to Moderate

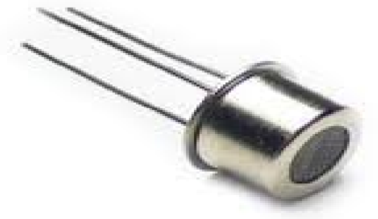
Sensors – Gas



LPG
Methane
Ammonia
Oxygen
Co
CO2
….

Heat – Gauss
Electro- Chemical
Semiconductor

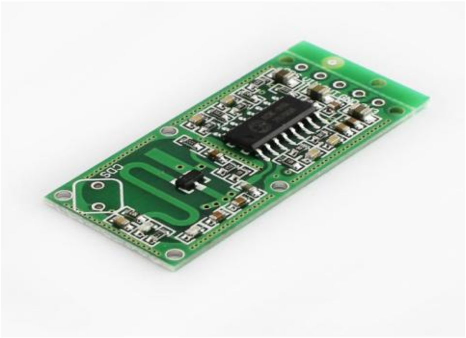
Sensors – Air Quality



PM2. 5 refers to atmospheric particulate matter (PM) that have a diameter of less than 2.5 micrometers, which is about 3% the diameter of a human hair.

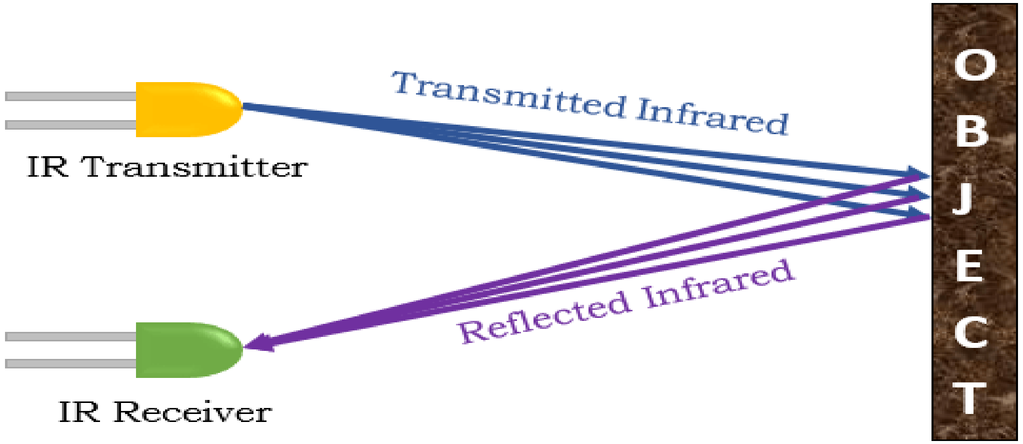
Sensor Range:
Mass concentration: PM1.0, PM2.5, PM4 and PM10
Number concentration: PM0.5, PM1.0, PM2.5, PM4 and PM10

Sensors – Motion



PIR

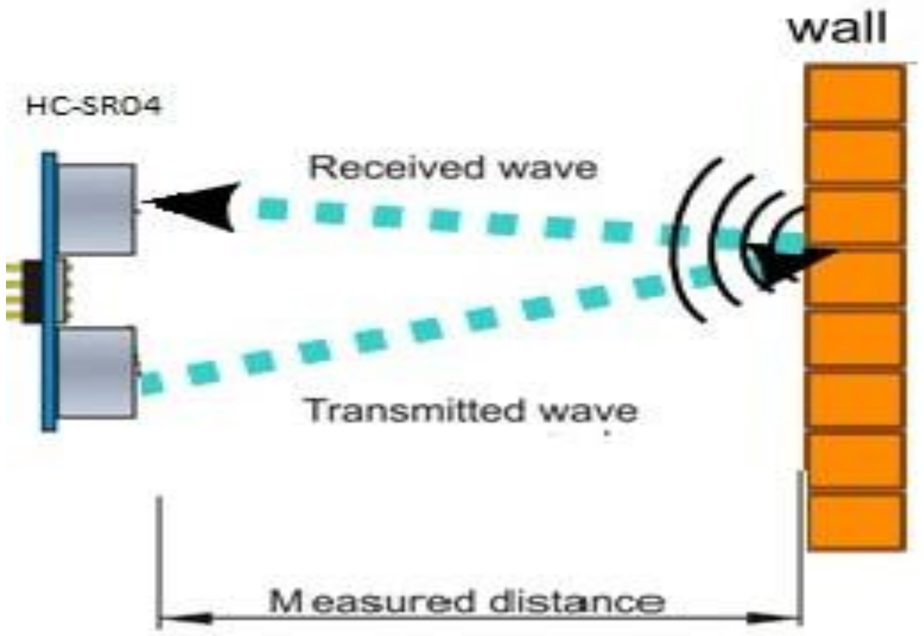
Radar



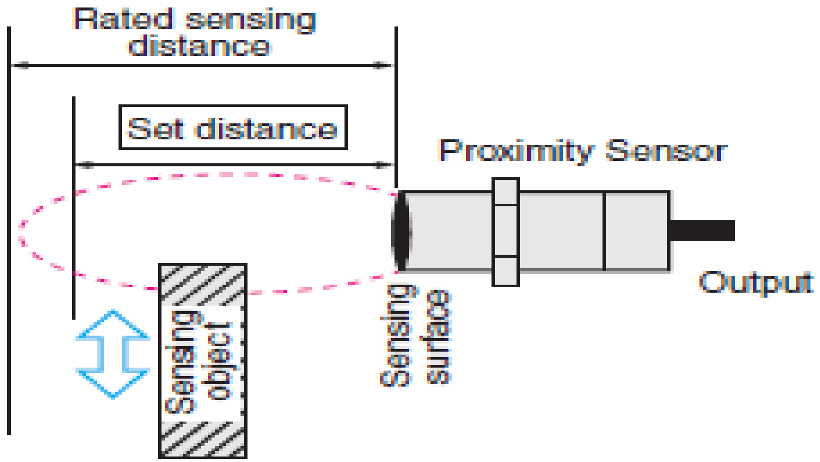
Opto Interruptor

Sensors – Distance, Motion

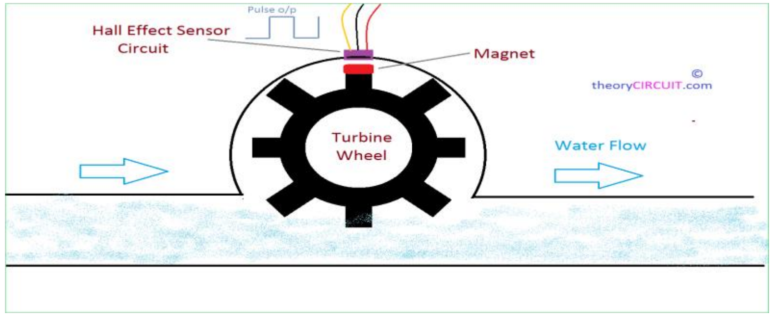
Ultra sonic



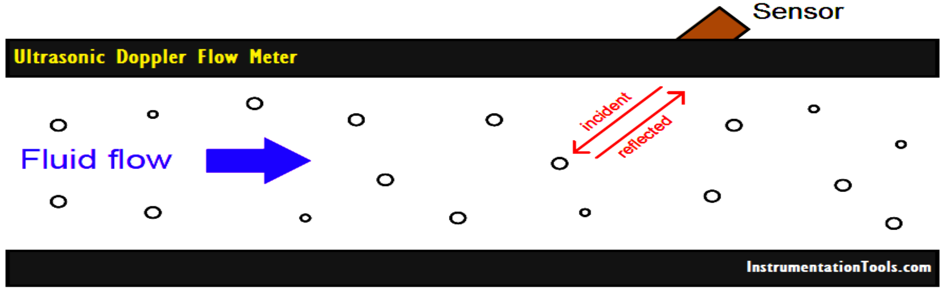
Proximity

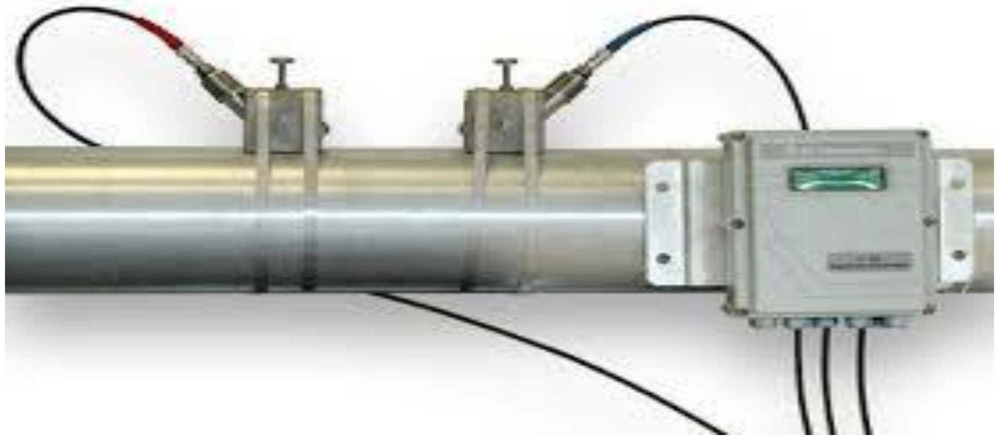


Sensors – Flow



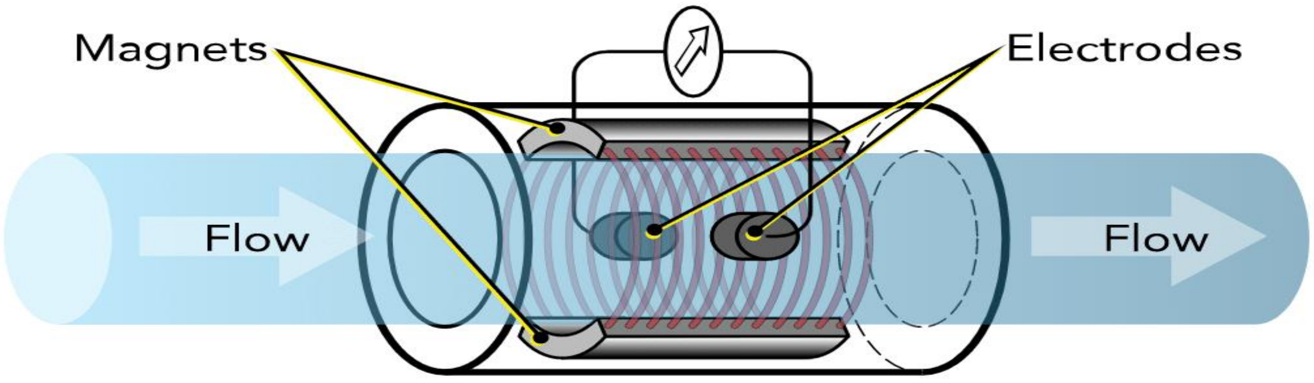
Turbine





Ultrasonic

Sensors – Flow



Electro magnetic

Sensors – Pressure

Air Flow
Abosulte/Differential

Water pipes- Pressure
Depth of water (Wells)

Technology
Micro Electro-Mechanical System
Piezo Ceramic
Strain

Sensors – Speed

Doppler Effect

Radra Sensors
Affordable

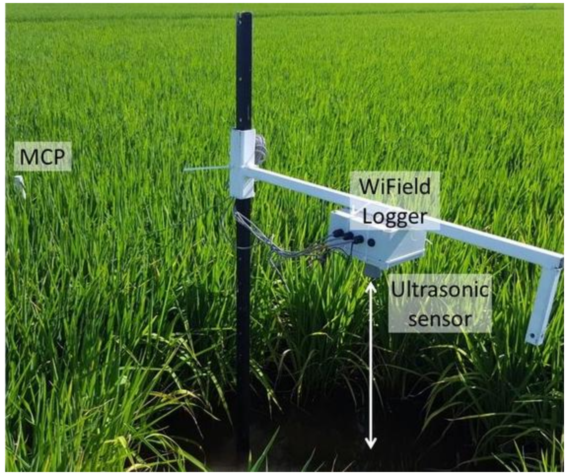
Actuators

Pump Starter

Solenoid Valves

Blowers

Water Level Measurement



Field

Bore Well

Canal

Tank

Solenoid valves

Hydraulic

Latched

IOT in Agriculture

Agricultural sensors development, Soil moisture measurement, Nutrient Analysis

Land Preparation equipments, Seeding, Weeding, harvesting by machines/robots

Artificial Intelligence, Machine learning, Edge computing, Big Data, Block chain

Agricultural actuators development – Solenoid valves, pumps

Crop Protection, Advanced Sprayers, Spraying by Drones

Depth measurements of Wells, Canals, Automatic Irrigation/ Fertigation

Hydroponics, Aeroponics, Vertical farming, Poly house and Green house

Drones for Planning and Insurance

Ware house management, Refrigeration , Logistics, Climate Control

Food Processing
Other Agricultural Produce Processing -cotton

Live Stock Identification / Tracking, Live stock facility Management

Electric fencing and protection systems

Solar Pump, other Solar applications

Weather Stations

Internet of Things (IOT)

Sensing ***Control***

Water / Fertigation

Latched Solenoid Valves/ Motorized valves
Irrigation Schedule
(with Drip ~ 75K/acre) – no need for soil moisture sensors.
(Soil, Water/Environment) *****
Automated Irrigation

Water level measurements
Logging of climate and soil status

Animal, Poultry, Fisheries

Animal (climate, feed, water, movement, health)

Control Environment

Automated climate control
Irrigation/ Fertigation

Storage/ Logistics

Automated climate control
Cleaning, Sorting. Grading, Packing

Internet & Communication Technology (ICT)

Advisories – Weather, Sowing, Harvesting, Pests& Diseases
Market Link – Procurement & Sales

Precision Agriculture

Precision Agriculture

Optimum amount of Inputs
at the correct Place
at the correct Time

Precision Agriculture

What	Water, Fertilizers, Nutrients/ Chemicals
Where	At the root zone
When	Schedule of Timing, Duration
Who	Sprinkler, Drip, (Flood) / ***Manual, Automatic***
How much	Dosing systems

Influencing Events:

- ❑ Climate (Rain, Wind)
- ❑ Soil Moisture
- ❑ Soil Nutrient Level
- ❑ Plant Nutrient Level

Irrigation Automation

Irrigation Scheduling Parameters

- How much water gets into the soil
- How much water the soil can hold Soil type, density
- How much water is being used by the plant
- Plant evapotranspiration
- Projected rainfall
- Amount of time in which water available

Advantages of Irrigation Scheduling

- Enables minimise crop water stress and maximize yields.
- Reduce costs of water and labour
- Lower fertiliser costs by holding surface runoff and deep percolation
- Increase net returns by increasing crop yields and crop quality.
- Minimise water-logging problems by reducing the drainage requirements.

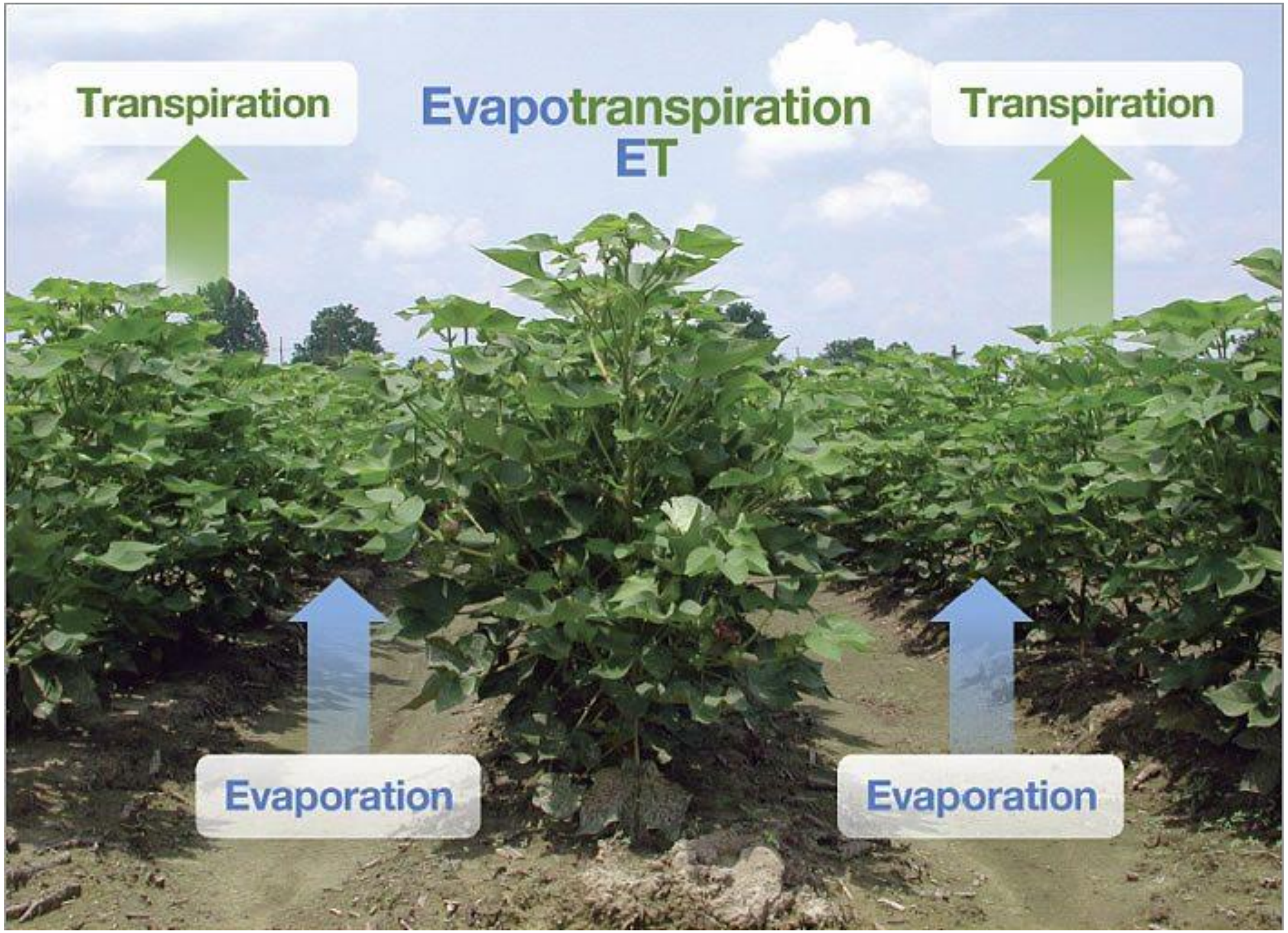
Criteria For Scheduling Irrigation

Soil moisture depletion
Plant basis or plant indices
Climatological approach
Critical growth approach
Plant water status

Irrigation Scheduling Based on

- Application rate of the irrigation equipment
- Distribution uniformity
- Soil infiltration rate
- Slope (topography) of the land
- Soil available water capacity
- Effective rooting depth of the plants to the plants.
- Current watering requirements of the plant evapotranspiration
- Amount of time in which water available for irrigation.
- Amount of allowable moisture stress
- Projected rainfall

Water requirement Modeling



Rainfall
RunOff
Evapotranspiration
Irrigation Losses
Groundwater recharge

Humidity
Temperature
Soil, Crop Color,radiation
Plant Water Content

Water Evaporation / Irrigation Schedule

Stages	**Days of irrigation interval**	
	Sandy soil	Clay soil
Tillering phase (36 to 100 days)	8	10
Grand growth phase (101 - 270 days)	8	10
Maturity phase (271 - harvest)	10	14

Germination phase (0 - 35 days):

- Provide shallow wetting with 2 to 3 cm depth of water at shorter intervals especially for sandy soil for enhancing the germination.
- Sprinkler irrigation is the suitable method to satisfy the requirement, during initial stages.
- Later, irrigation can be provided at 0.75, 0.75 and 0.50 IW/CPE ratio during tillering, grand growth and maturity phases respectively.

Irrigation Pattern

K. Madhava Chandran and E. J. Joseph

Table 02. Quantity of irrigation water applied by coconut and arecanut farmers.

Coconut		Arecanut	
Quantity of water/day/plant (%)*	Farmers (%)	Quantity of water/day/plant (%)*	Farmers (%)
0-9	33.3	0-9	15.8
10-19	14.3	10-19	nil
20-29	9.5	20-29	12.5
30-39	2.4	30-39	15.8
40-49	4.8	40-49	3.1
50-59	9.5	50-59	6.2
60-69	nil	60-69	3.1
70-79	4.8	70-79	6.2
80-89	2.4	80-89	3.1
90-100	nil	90-100	nil
More than 100	19.0	More than 100	34.2
Total	100	Total	100
Innovativeness of coconut farmers	Farmers (%)	Innovativeness of arecanut farmers	Farmers (%)
Very innovative	2.4	Very innovative	3.1
Innovative	14.3	Innovative	15.5
Non-innovative	83.3	Non-innovative	81.4
Total	100	Total	100

* expressed as percentage of per day quantity computed from the POP recommendation for the crop

<u>Coconut Farmers</u>

CWRDM 175 litres/day/plant.
64.3% of farmers apply <50%
14.3 % of farmers 50-to 79 %

Package of Practices (POP) Recommendation

CWRDM
Centre for Water Resources Development and Management

CalETa

DATA ACQUISITION FROM LANDSAT TO DESKTOP

STATEWIDE IMAGE ANALYSIS FRAMEWORK

Image Processing

Automated Imagery Download (Landsat & MODIS)

Automated Cloud Screen

Conversion to Surface Reflectance

Derive Physical & Biophysical Variables

Climate / Weather

Conditions at Satellite Overpass

Spatial CIMIS: Daily Reference ET

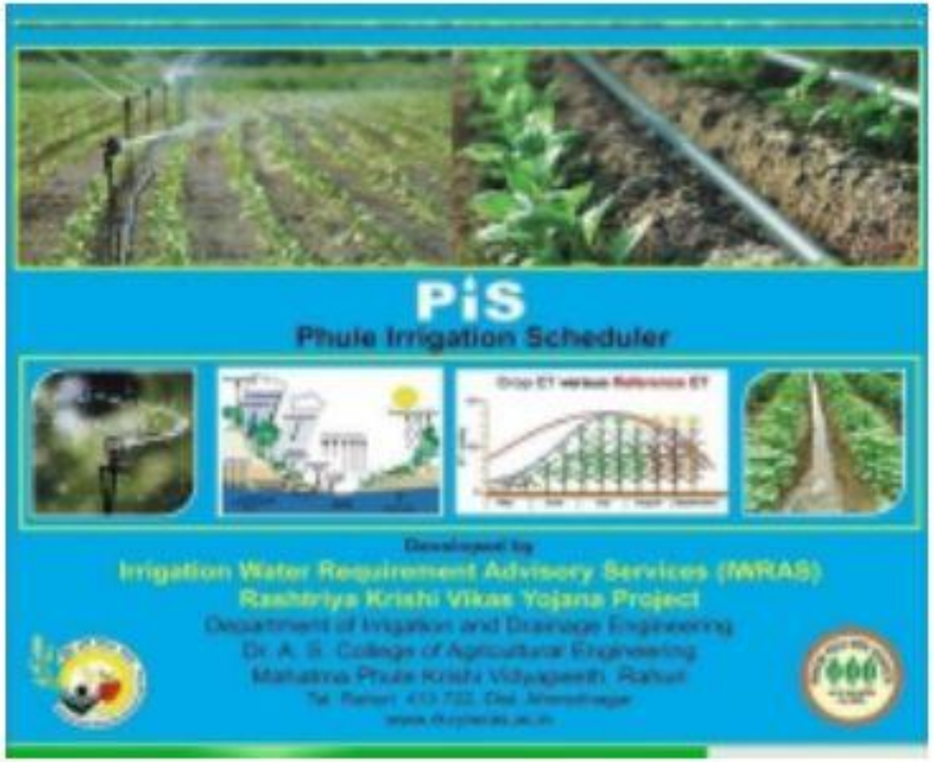
- Solar Radiation
- Air Temperature
- Relative Humidity
- Wind Speed
- Reference ET

Surface Energy Balance Equation

CalETa

Daily ETa (Statewide, 30 meter resolution)

Irrigation Scheduler Programs

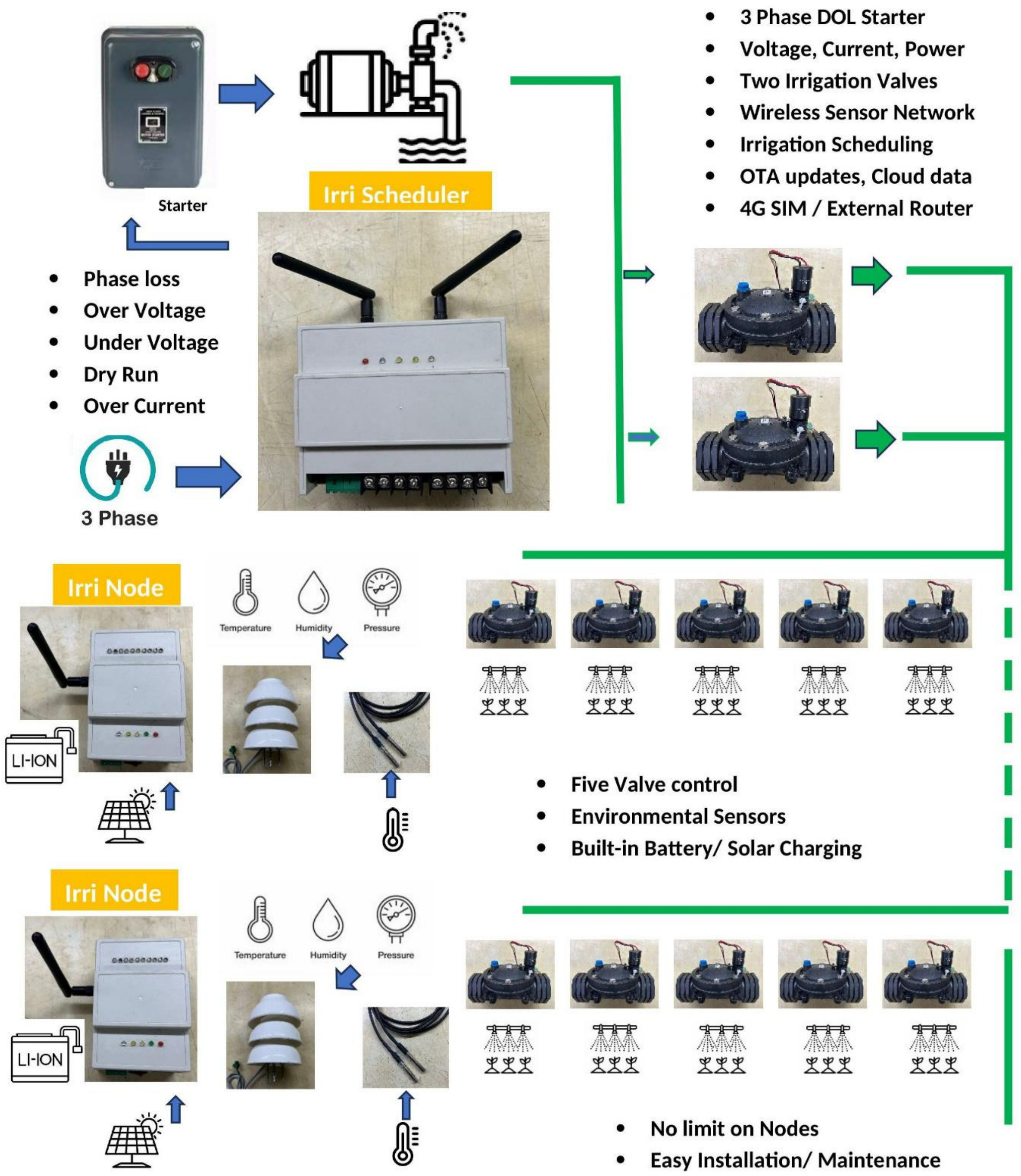


Home screen of "Phule Irrigation Scheduler" web based application

Many attempts by Industries as well as Research Institutions.

Do you see Farmers using them? What percentage.

If farmer adoption issues, then why do we have to attempt? Or is it not feasible by Indian farmers?



Starter
Irri Scheduler
3 Phase DOL Starter
Voltage, Current, Power
Two Irrigation Valves
Wireless Sensor Network
Irrigation Scheduling
OTA updates, Cloud data
4G SIM / External Router
Phase loss
Over Voltage
Under Voltage
Dry Run
Over Current
3 Phase
Irri Node
Temperature
Humidity
Pressure
LI-ION
Five Valve control
Environmental Sensors
Built-in Battery/ Solar Charging
Irri Node
Temperature
Humidity
Pressure
LI-ION
No limit on Nodes
Easy Installation/ Maintenance

‘Alternate wetting and drying irrigation’ (AWDI)

By adopting AWDI technique, farmers can save up to 30 % of water without compromising on rice productivity

Allow water to recede 15 cm below surface to re irrigate

40% global water for Rice
2500 Litres/ kg

Water depth measurement in perforated pipe.
Activation of an Event for manual or automatic irrigation

Fertilizer/ Chemical Equipment

- Higher loss
  40-90% Fertilizer (N&P >K)
  >90% pesticides
- Lack of research in delivery mechanism
  Nozzles (varying directional/ varying rate)
  Variable pressure pumps
- Precision location devices
- Precision placement – root zone
- Research on technologies
  Laser guided, Electro static, Air assisted,
  See & Spray
- Calibration and Testing systems
- Climatic correction systems

- Environmental Effects
- Fixation level on soils
- Data set / Models
- Dynamic Spray patten analysis
- Ergonomical Design of sprayers
- Safety considerations
- Robotic sprayers
- UAV sprayers
- Affordable variable rate
- Spraying efficiency comparison
- Boom design ….

Automation in Sugarcane Cultivation

- Mechanization
- Weed management
- Water and Fertilizers
- Sustainable Sugarcane Initiative
- Automated Irrigation/Fertigation
- Crop Monitoring and protection
- Sugarcane Prospects

Mechanization

Availability YES	Land Preparation, Cultivators, Node cutters, transplanters, cutters/harvesters, trash management
Challenges	Farm size Traditional Method of cultivation – Spacing Labour availability / cost Machinery cost Non-cooperative farming Extension – Research/Farmer/Industry Collaborations

Weed Management

Impact of Weed	30 to 45 days for complete germination & another 60-75 for canopy Abundant water and nutrient supply Ratoon crop very little preparatory tillage Yield Losses 12 to 72%. Twining weeds like Ipomoea sp. 25% loss remove 4 times N & P and 2.5 times K
Reduce Weed	Manual, blind or two hoeing, Inter-Culture, Earthing up Inter Cropping – Green gram, black gram, cluster bean, Onion, Okra Paired row cropping, Intercropping, mulching or Trash Mulching Chemical

Water and Fertilizers

90% Water used in Agriculture in India 35% USA and 50% China

High Fertilizer usage – polluting soil and water

Salinity 7-12% of Cultivated Land – Projected 20% in 2 decades

Surface Drip

Sub
Surface Drip

Water Technology Centre, TNAU, Coimbatore

Sustainable Sugarcane Initiative

- Raising nursery - single budded chips
- Transplanting (25-35 days old)
- Maintaining wider spacing (5-6x2 feet)
- drip fertigation (sub or sub surface)
- Encouraging organic method of nutrient and plant protection measures
- Practicing intercropping

Sustainable Sugarcane Initiative

Particulars	Conventional	SSI
Seed/Setts/acre	30,000 two budded sett 4000 kg/acre	5000 single budded chips(500 kg/acre)
Nursery preparation	No	Yes
uniformity among plants	No grading	Grading at nursery
Spacing (Row to Row)	2.0 -3.0 ft.	5.0 ft. minimum
Planting	Direct planting	Transplanting 25-35 days
Water requirement	More water(Flood irrigation)	Less(Drip fertigation)
Mortality rate	High	Low
No of tillers/plant	6 - 8	15 - 20
Air and sunlight	Low	High
Scope for intercrop	NIL	Possible

Water Technology Centre, TNAU, Coimbatore

Drones & Robots

Drones in agriculture

Foliar application of agrochemicals, including nano-urea

Potential

- Crop monitoring
- Yield estimation
- Disease prediction
- Terrain logistics
- Precision input application

Challenges

- Inadequate nozzle design and directional control limit efficacy
- Application losses are especially pronounced in crops with sparse canopies
- Techno Commercial

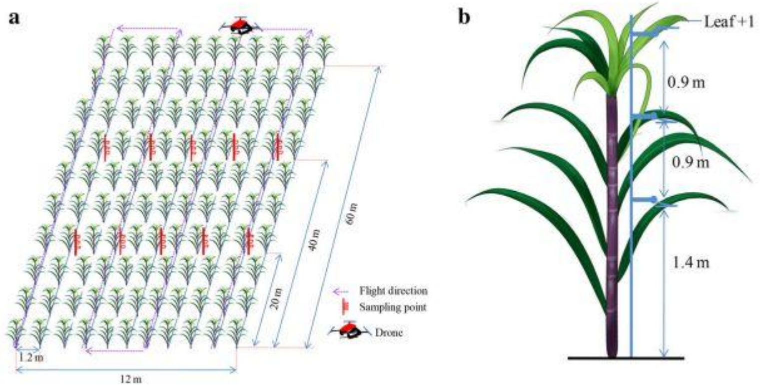
Drone Spraying- Sugarcane

Spray volume: 9-15 L/ha

Flight height: 2-4 m

Flight velocity:4-6 m/sec

droplet size:50–300 microns

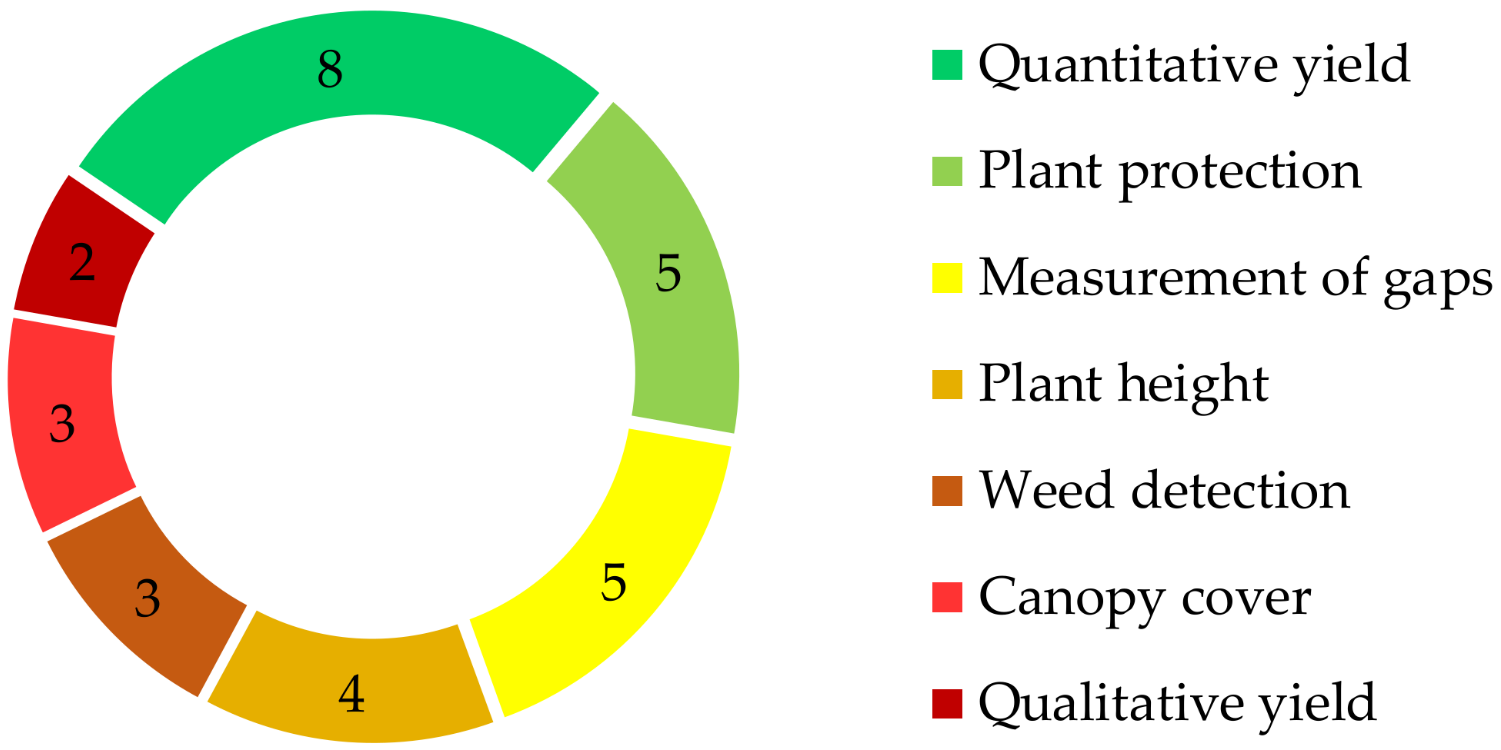


Efficiency: 60 times higher than manual spray

Pesticide application rate: 20–30% lower

Sugarcane Research Center, Chinese Academy of Agricultural Sciences; Sugarcane Research Institute, Guangxi Academy of Agricultural Sciences, Nanning 530007, Guangxi, China (2019)

Drone Research



Drone – Yield Prediction

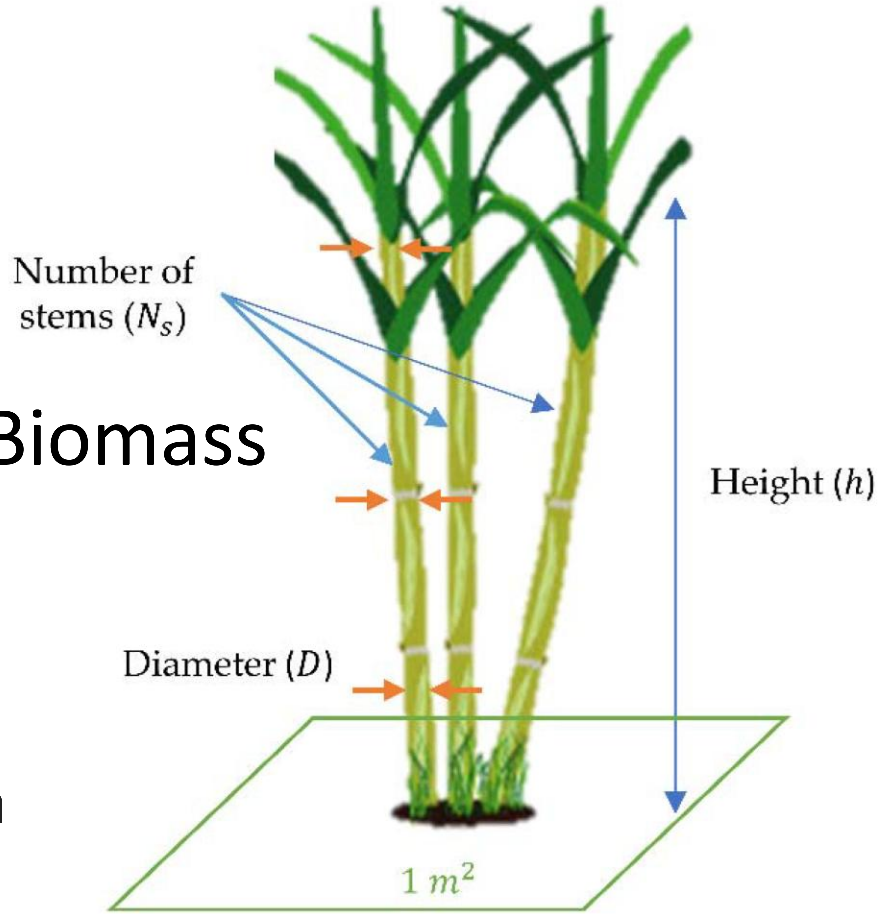
Synthetic Apertura Radar (SAR)
– Above ground biomass (AGB)

Harvesting date: 8 Days
Productivity: 10.7%

Radar{ L, P, and C bands used

Fully polarized bands with more surveys, ML and AI can bring prediction average error to less than 2%,

Biomass



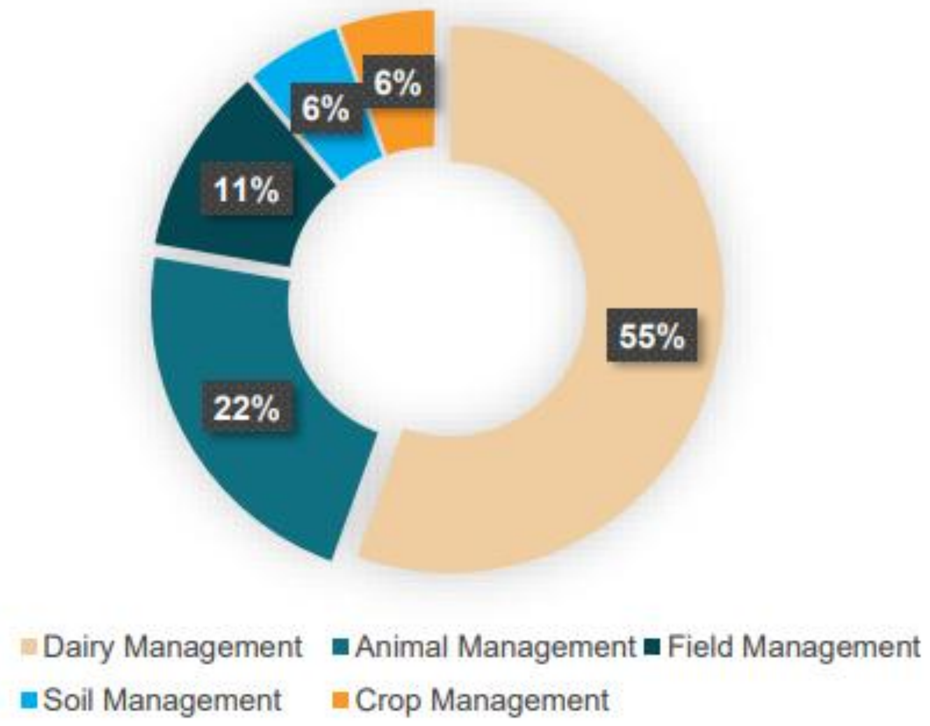
University of Campinas—UNICAMP, Campinas 13083-852, Brazil

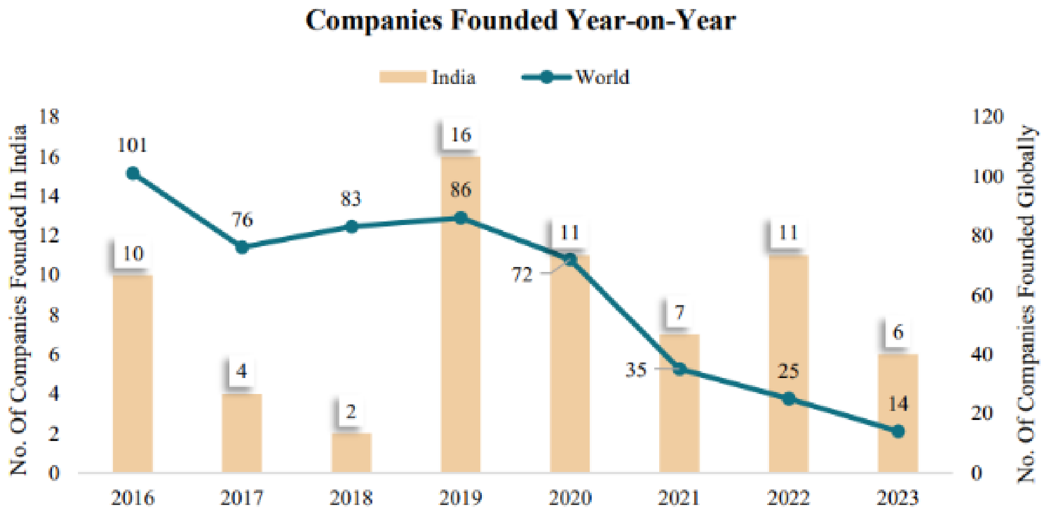
Nutrition Deficiency

Pest & Diseases

No quantitative data

Robots in agriculture





Robots in agriculture

Applications of Robotics in Indian Agriculture

***Precision Application*:**
Robotics allows for targeted application of pesticides, fertilizers, and water, reducing waste and minimizing environmental impact.

Weed Control:
AI-powered robots can identify weeds and apply agrochemicals / laser only where needed, improving efficiency over traditional broadcast spraying.

***Robotic Harvesting*:** Specialized robots are being developed to delicately pick fruits and vegetables, minimizing damage and ensuring high-quality produce.

***Automated* Operations:**
Autonomous tractors, seed planting robots, and weeding robots automate various farm tasks, increasing efficiency and productivity.

***Crop Monitoring & Analysis*:**
Drones and ground-based robots equipped with advanced sensors and cameras collect real-time data on crop health, soil conditions, and pest activity, enabling data-driven decisions.

Emerging Technologies

AI/ML

Regression/ Machine Learning

Predictions of outputs from Statistical/ Mathematical Models.

Identification, Classification of crops, weeds, pests Estimation of yield, application levels

Artificial Intelligence

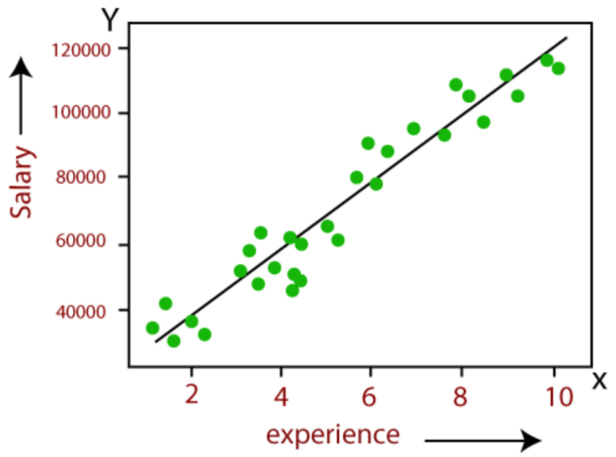
Generative Transformer models for prediction based on past scenarios, and desired variations.

Trend predictions and probable solutions

‘The creativity of the output is limited to accuracy of data provided for training the model’

Regression Analysis / Machine Learning

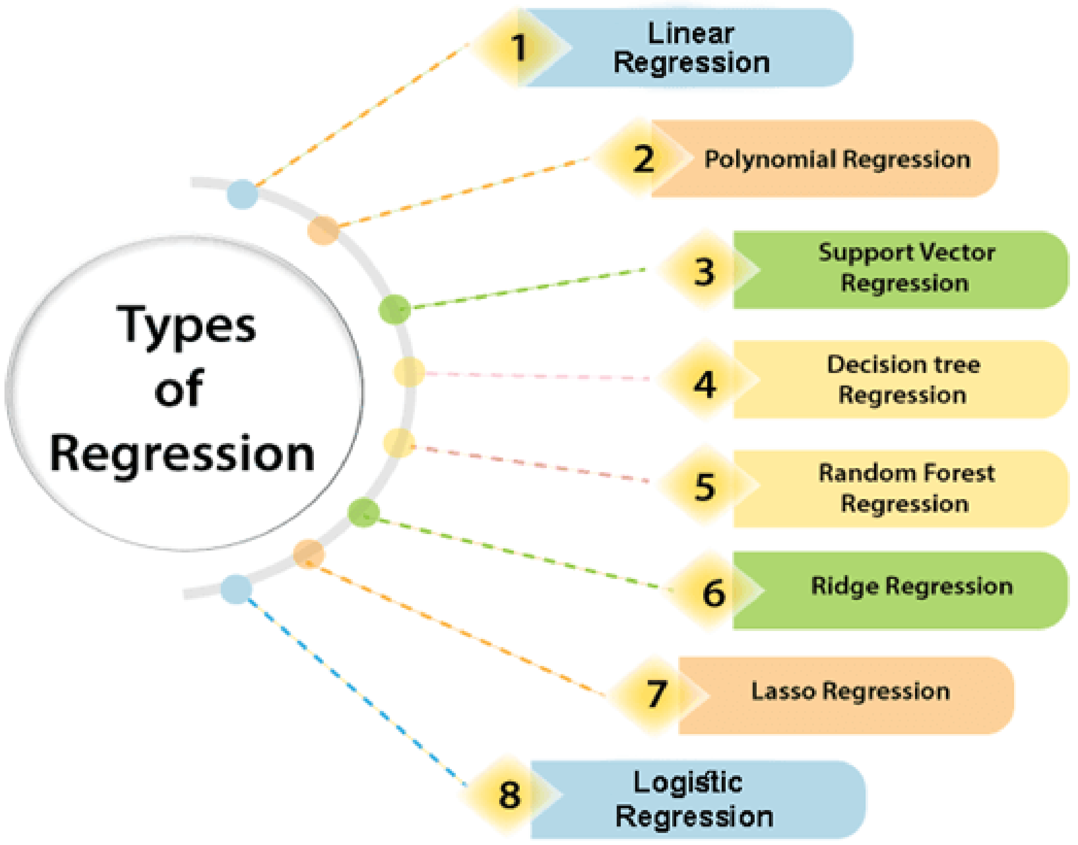
Regression analysis plots a best-fit line or curve between data points to establish a relationship between variables.



Y= aX+b

Y = dependent variables (target variables),
X= Independent variables (predictor variables),
a and b are the linear coefficients

Regression analysis assumes data follows a certain distribution, while machine learning can handle any type of data. Regression analysis also relies on predefined models, while machine learning can use various types of models and create new ones. **Regression algorithms are commonly used for predicting crop yields because they are simple to understand and easy to implement. These algorithms use a set of inputs (such as weather data, soil data, and management practices) to predict the output (crop yield).**



Machine Learning Models

How can machine learning be used in farming

Crop monitoring and management

Predictive analytics for yield optimization

Precision agriculture

Livestock monitoring and management:

Supply chain optimization

Crop disease detection and management

Market forecasting price prediction….

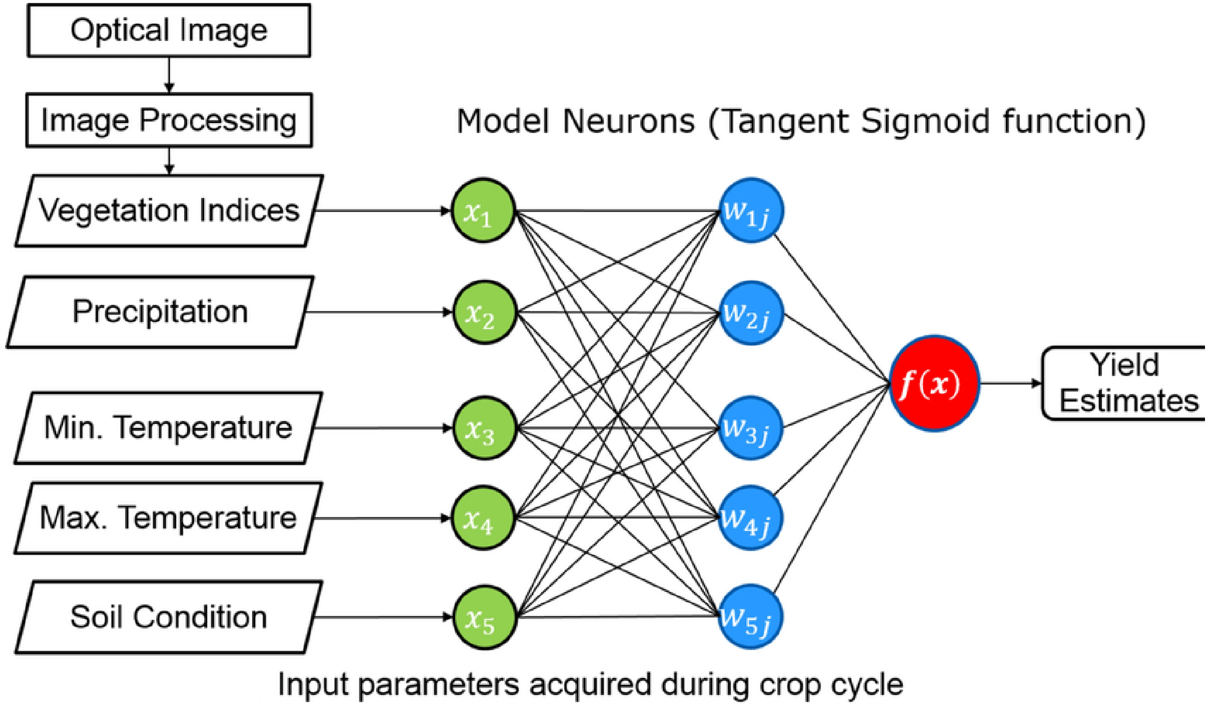
Deep Learning uses Neural Networks
Machine Learning is subset of Artificial Intelligence

Deep learning algorithms for agriculture

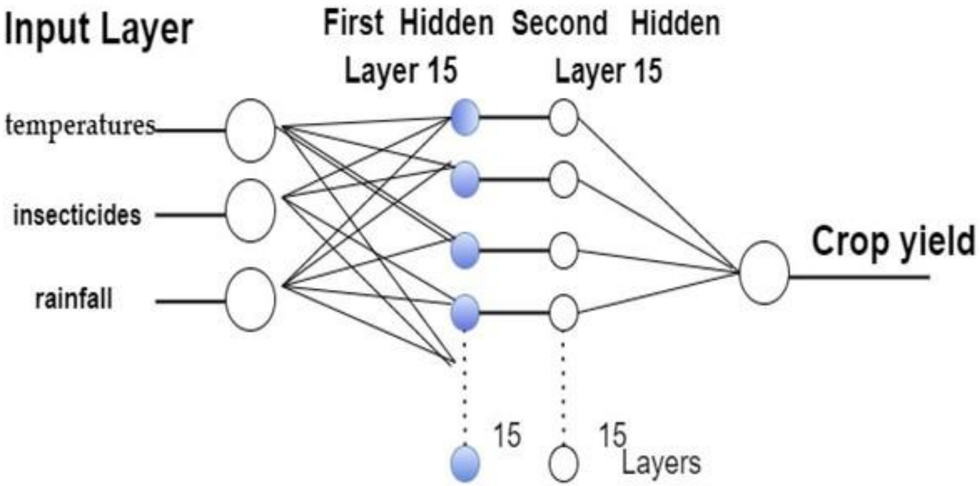
Example: Weed Detection and Management

Deep learning algorithms can distinguish between weeds and crops in photos, which will assist farmers in using targeted weed management techniques. This enhances weed control effectiveness while reducing the need for pesticides, supporting ecologically friendly agricultural methods

Neural Network

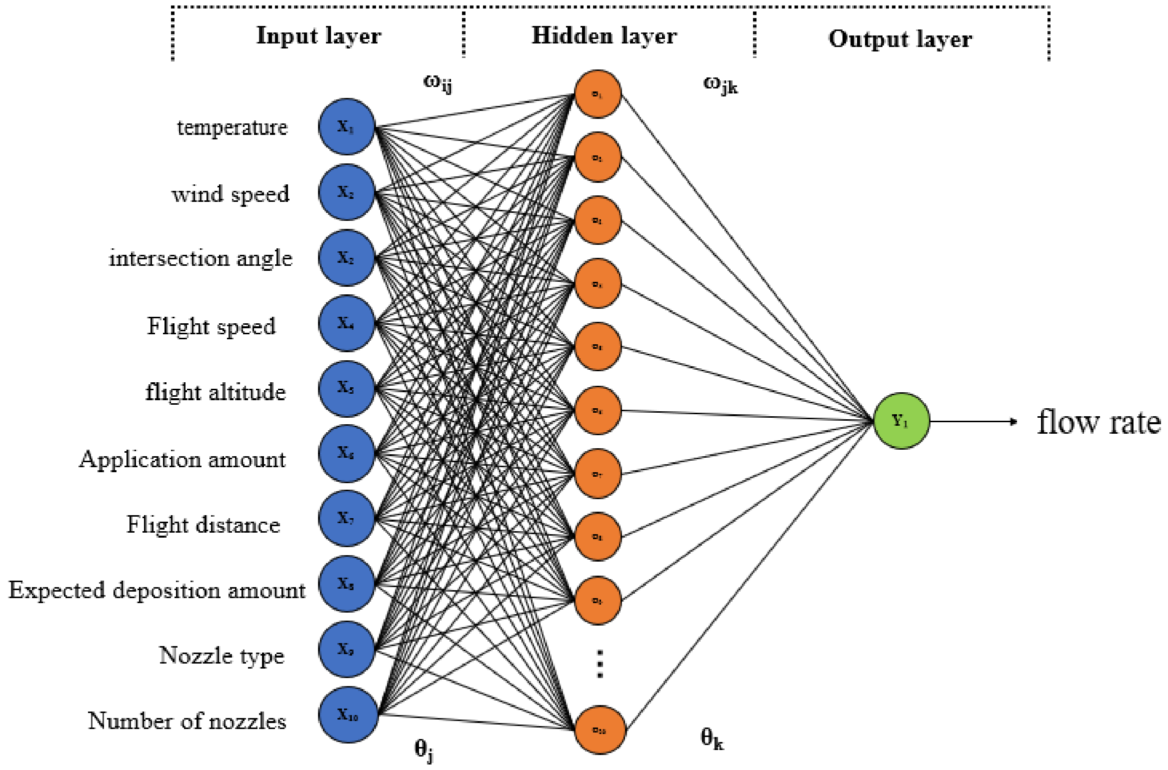


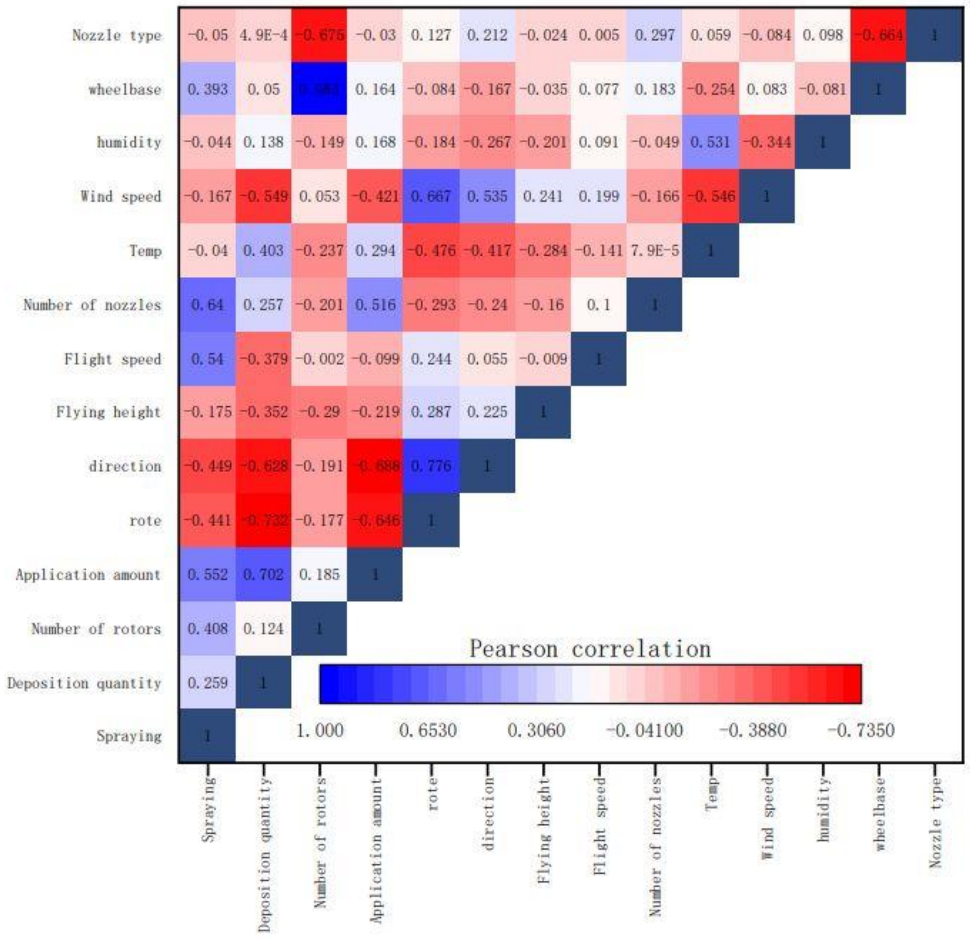
Impact of climate change on wheat yield in Morocco based on stacked ensemble learning



Regression between rainfall, temperatures, insecticides, and different crop yields

Neural Network

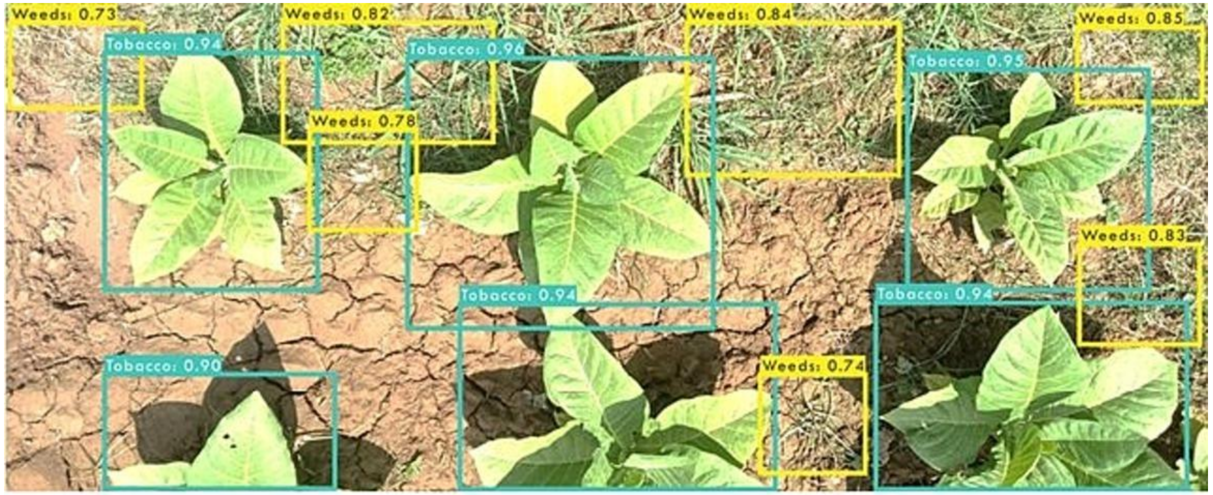




Research on flow decision-making model of plant protection UAV based on feature selection (October 2023) Meng Wang, Zhihao Bian, Yu Yan, Mujahid Hussain, Guobin Wang, Cancan Song, Yubin Lan

Convolutional Neural Network Model

Weed detection predictions in tobacco crop using YOLOv5



Soybean insect pests examples used to train the pest detection algorithm

YOLO Weeds: A novel benchmark of YOLO object detectors for multi-class weed detection in cotton production systems

A 12-class image dataset consisting of **9370 bounding boxes** was created for common weeds in cotton.

Dataset Collection

To train and validate the insect pest detection system, we used the internet as a source for collecting images.
Insect pests as the research object was mainly to identify and detect the twenty-three categories.
In the data collection, first, we searched the images from different databases and search engines, such as Kaggle, Google, Baidu, Iostock, Dream, Flickr, and Bing.
We collected 7046 images and divided them into 23 different classes, as illustrated in Table 1. We resized the images into the same dimension as 640 × 640 representing the corresponding width and height.

Farmers and Students can be a great source for dataset creation – using smart phones
We need a national Data base of data sets.

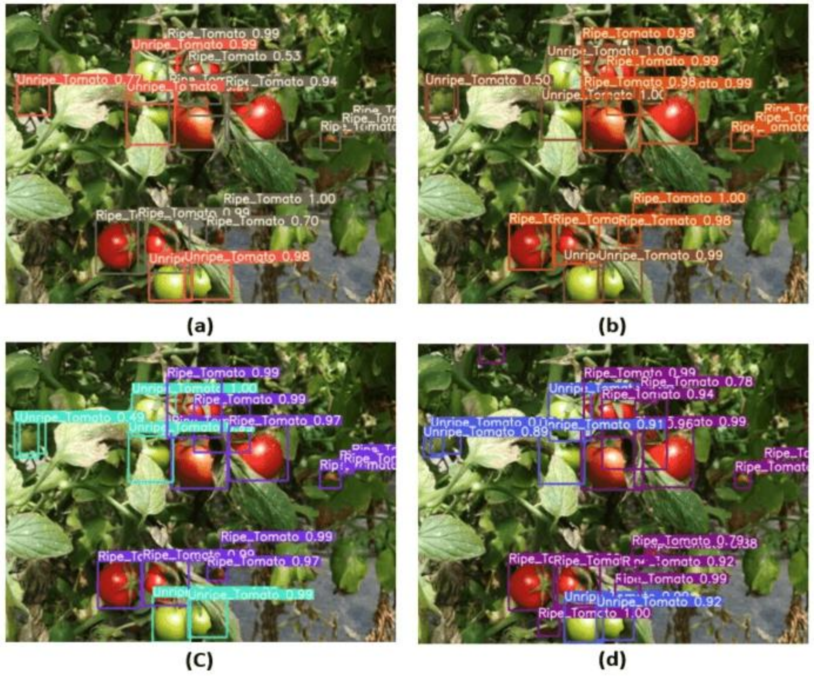
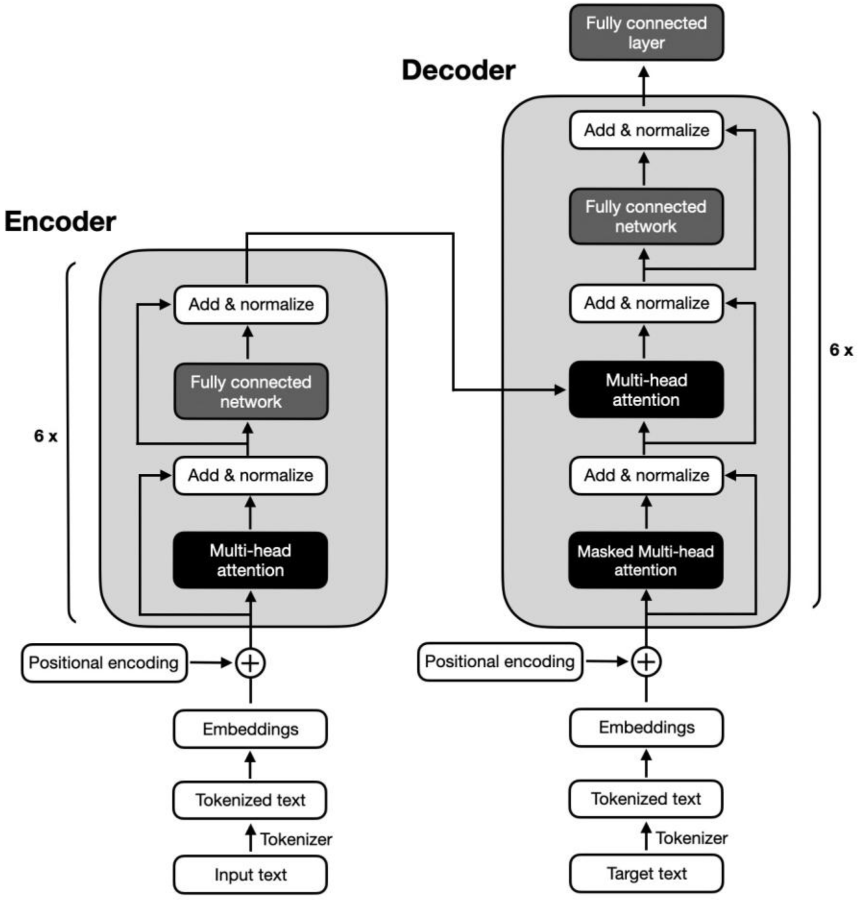


Image from Tomato detection based on modified YOLOv3 framework

Artificial Intelligence / Transformers



The GPT (**G**enerative **P**re-trained **T**ransformer) series are decoder-only models pretrained on large-scale unsupervised text data and finetuned for specific tasks such as text classification, sentiment analysis, question-answering, and summarization.

The GPT models, including GPT-2, (*GPT-3 Language Models are Few-Shot Learners, 2020*), and the more recent GPT-4, have shown remarkable performance in various benchmarks and are currently the most popular architecture **for natural language processing.**

Large Language Models

Training Model

Dataset Training Inference

yolov5_setu.ipynb

File Edit View Insert Runtime Tools Help

+ Code + Text

```
import os
import glob as glob
import matplotlib.pyplot as plt
import cv2
import requests
import random
import numpy as np
```

This code imports libraries for handling files, visualization, image processing, networking, randomness, and mathematical operations.

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
!cp /content/drive/MyDrive/yolo_dataset.zip /content/
```

```
!unzip /content/yolo_dataset.zip -d /content/yolo_dataset/
```

```
Streaming output truncated to the last 5000 lines.
  inflating: /content/yolo_dataset/data/train/images/Ripe_Mango.011b7a5d-ebe1-11ed-b993-346f24e2fa38.jpg
  inflating: /content/yolo_dataset/data/train/images/Ripe_Mango.01301427-ebee-11ed-b773-346f24e2fa38.jpg
  inflating: /content/yolo_dataset/data/train/images/Ripe_Mango.0172f6e0-ebd2-11ed-8c61-346f24e2fa38.jpg
  inflating: /content/yolo_dataset/data/train/images/Ripe_Mango.024f42aa-ebe1-11ed-863d-346f24e2fa38.jpg
```

Training Model

Dataset Training Inference

yolov5_setu.ipynb

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\+ Code + Text

```python
data_dir = '/content/yolo_dataset/data'
```

```python
dirs = ['train','test']
```

```python
for dir_name in dirs:
    images_dir = os.path.join(data_dir,dir_name,'images')
    labels_dir = os.path.join(data_dir,dir_name,'labels')
    all_image_names = sorted(os.listdir(images_dir))
    for j, image_name in enumerate(all_image_names):
        if (j % 2) == 0:
            file_name = os.path.splitext(image_name)[0]  # Get file name without extension
            # Remove image file
            os.remove(os.path.join(images_dir, image_name))
            # Remove corresponding label file if it exists
            label_file = os.path.join(labels_dir, f"{file_name}.txt")
            if os.path.exists(label_file):
                os.remove(label_file)
```

```python
#validate dataset

images_dir = os.path.join(data_dir, 'train', 'images')  # Change to 'valid' or 'test' if needed
labels_dir = os.path.join(data_dir, 'train', 'labels')

# Select 9 random images to fit a 3-row layout
all_image_names = sorted(os.listdir(images_dir))
random_images = random.sample(all_image_names, 9)

# Define a color mapping for labels
label_colors = {}

# Function to load bounding boxes from a YOLO-format label file
def load_bounding_boxes(label_path, img_width, img_height):
    boxes = []
    with open(label_path, 'r') as f:
        for line in f:
            label, x_center, y_center, box_width, box_height = line.strip().split()
```

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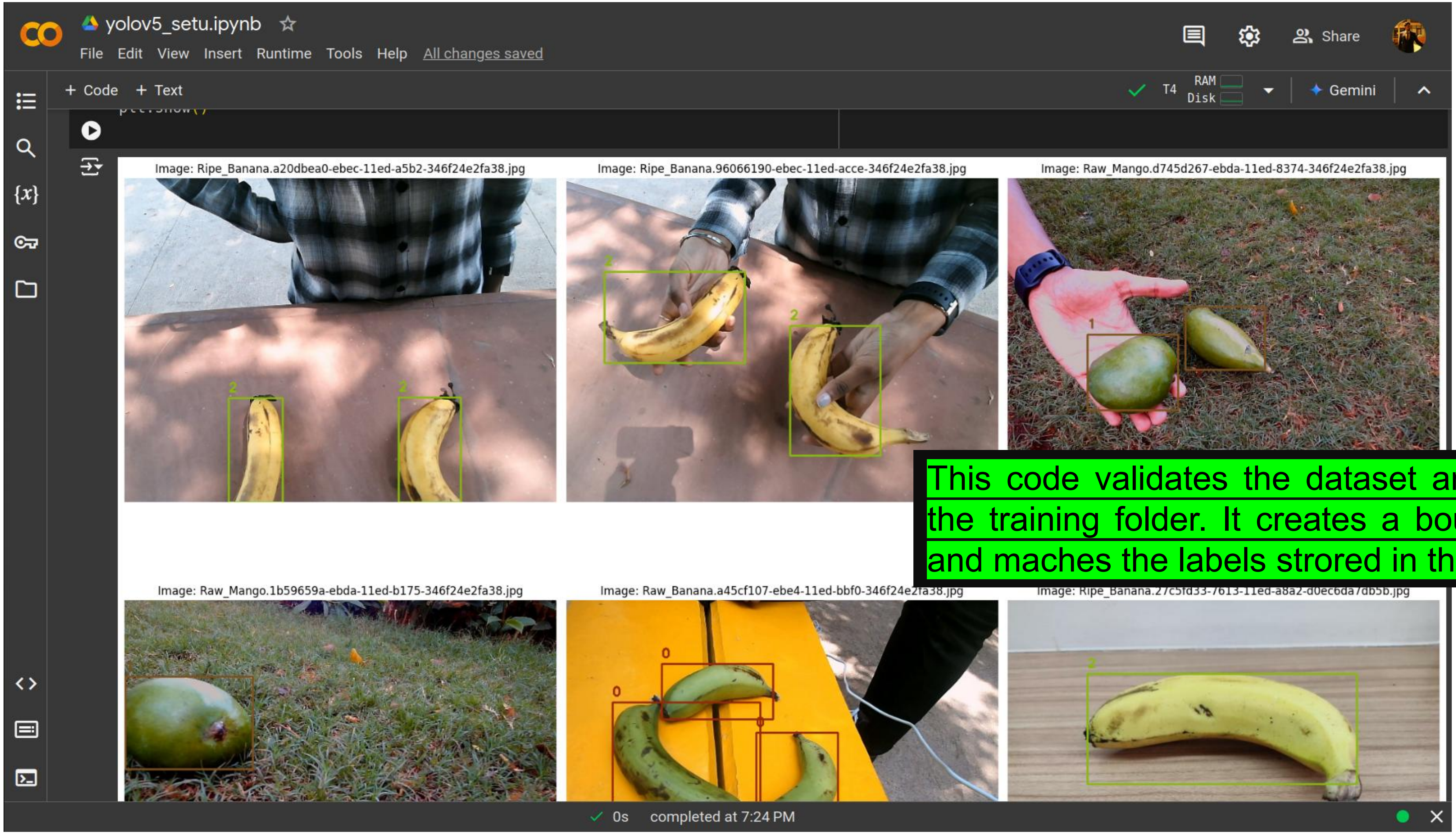
This code creates directories for the dataset and creates folder structure for training and testing of images

Training Model

Dataset Training Inference



This code validates the dataset annotated in the training folder. It creates a bounding box and maches the labels strored in the directory

Training Model

Dataset Training Inference

yolov5_setu_v1(2).ipynb

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```
labels = set()
# Iterate over each label file in the directory
for label_file in os.listdir(labels_dir):
    with open(os.path.join(labels_dir, label_file), 'r') as f:
        for line in f:
            label_id = line.split()[0]  # Get the label ID (class ID)
            labels.add(label_id) # Add it to the set

print(labels)
```

```
{'Ripe_Banana', '0', '2', '1', 'Ripe_Mango', 'Raw_Mango', '3', 'Raw_Banana'}
```

```
class_names = ['Raw_Banana','Raw_Mango','Ripe_Banana','Ripe_Mango']
colors = np.random.uniform(0,255, size = (len(class_names),4))
```

```
# Function to convert bounding boxes in YOLO format to xmin, ymin, xmax, ymax.
def yolo2bbox(bboxes):
    xmin, ymin = bboxes[0]-bboxes[2]/2, bboxes[1]-bboxes[3]/2
    xmax, ymax = bboxes[0]+bboxes[2]/2, bboxes[1]+bboxes[3]/2
    return xmin, ymin, xmax, ymax
```

```
def plot_box(image, bboxes, labels):
    # Need the image height and width to denormalize
    # the bounding box coordinates
    h, w, _ = image.shape
    for box_num, box in enumerate(bboxes):
        x1, y1, x2, y2 = yolo2bbox(box)
        # denormalize the coordinates
        xmin = int(x1*w)
        ymin = int(y1*h)
```

Prepares necessary 'helper functions' to aid in the dataset training

Training Model

Dataset Training Inference

yolov5_setu_v1(2).ipynb

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+ Code + Text

```python
def set_res_dir():
    # Directory to store results
    res_dir_count = len(glob.glob('dataset/data/train/run/*'))
    print(f"Current number of result directories: {res_dir_count}")
    if TRAIN:
        RES_DIR = f"results_{res_dir_count+1}"
        print(RES_DIR)
    else:
        RES_DIR = f"results_{res_dir_count}"
    return RES_DIR
```

```python
def monitor_tensorboard():
    %load_ext tensorboard
    %tensorboard --logdir runs/train
```

```python
TRAIN = True
EPOCHS = 25
```

```python
if not os.path.exists('yolov5'):
    !git clone https://github.com/ultralytics/yolov5.git
```

```
Cloning into 'yolov5'...
remote: Enumerating objects: 17022, done.
remote: Total 17022 (delta 0), reused 0 (delta 0), pack-reused 17022 (from 1)
Receiving objects: 100% (17022/17022), 15.61 MiB | 20.76 MiB/s, done.
Resolving deltas: 100% (11690/11690), done.
```

```python
%cd yolov5/
!pwd
```

```
/content/yolov5
```

The code Imports the YOLO framework, the model uses pre trained weights provided by the framework.

Training Model

Dataset   Training   Inference

yolov5_setu_v1(2).ipynb

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+ Code + Text

```
Successfully installed thop-0.1.1.post2209072238 ultralytics-8.3.23 ultralytics-thop-2.0.9
```

```
[ ] # prompt: create a file data.yaml with following content : train: /home/setu/yolo5/dataset/data/train
    # val: /home/setu/yolo5/dataset/data/test,
    # replace the filepath for train and val form the google drive
    # nc: 4  # Number of classes
    # names: ['Raw_Banana', 'Raw_Mango', 'Ripe_Banana','Ripe_Mango']  # List of class names

    import yaml

    # Define the content of the YAML file
    data = {
        'train': '/content/yolo_dataset/data/train/images',
        'val': '/content/yolo_dataset/data/test/images',
        'nc': 4,
        'names': ['Raw_Banana', 'Raw_Mango', 'Ripe_Banana', 'Ripe_Mango']
    }

    # Write the YAML content to the file
    with open('data.yaml', 'w') as outfile:
        yaml.dump(data, outfile, default_flow_style=False)
```

```
RES_DIR = set_res_dir()
if TRAIN:
    !python train.py --data data.yaml --weights yolov5s.pt \
    --img 640 --epochs {EPOCHS} --batch-size 16 --name {RES_DIR}
```

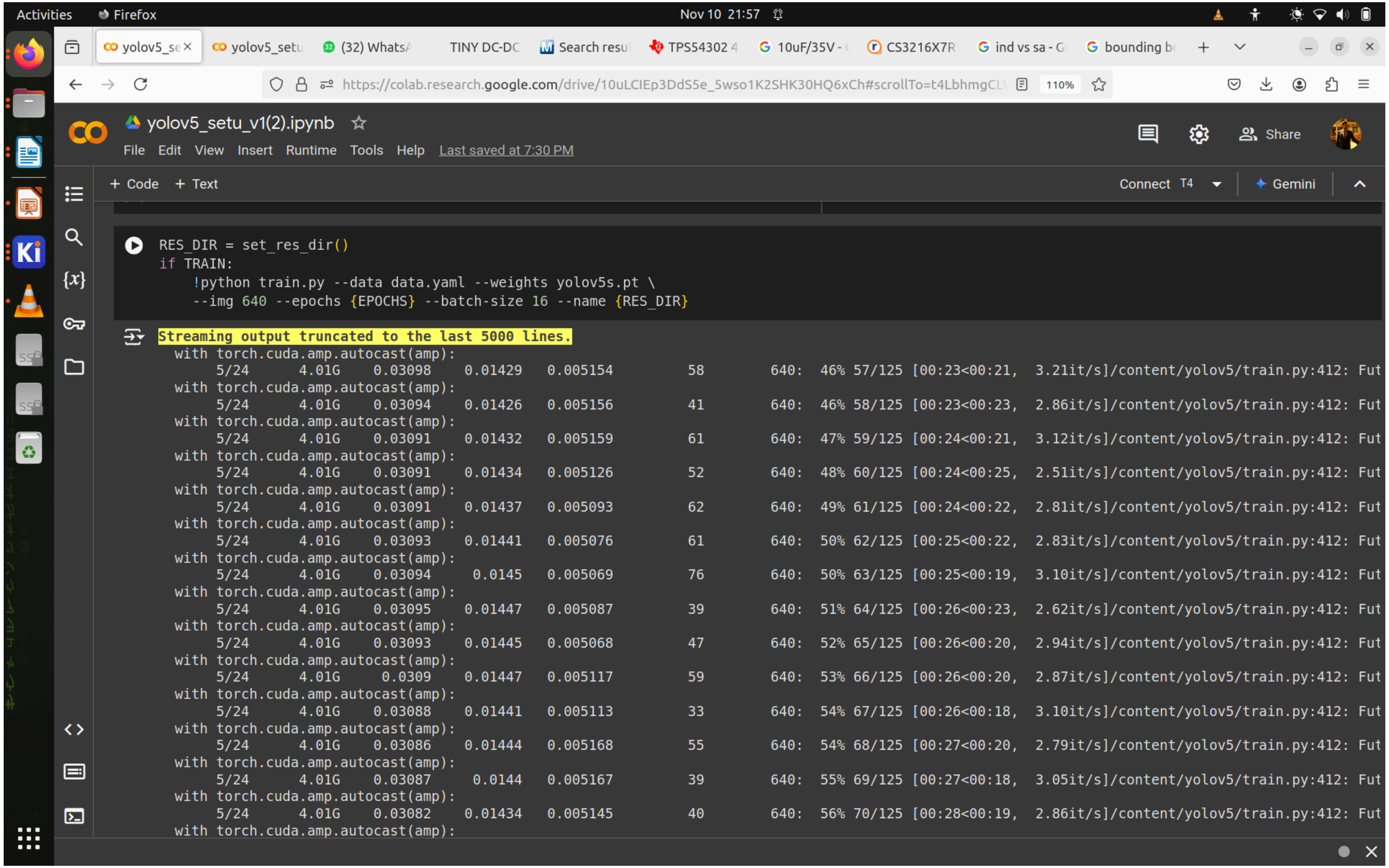
```
Streaming output truncated to the last 5000 lines.
  with torch.cuda.amp.autocast(amp):
     5/24      4.01G    0.03098    0.01429    0.005154        58        640:  46% 57/125 [00:23<00:21,
  with torch.cuda.amp.autocast(amp):
     5/24      4.01G    0.03094    0.01426    0.005156        41        640:  46% 58/125 [00:23<00:23,
  with torch.cuda.amp.autocast(amp):
```

Creates directories pointing to the file location and dataset class for classification – the information is stored in YAML file

Training Model

Dataset Training

Inference



Performes the training of model based on number of EPOCHS, Batch size, GPU/CPU

Training Model

Dataset Training

Inference

yolov5_setu_v1(2).ipynb

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```
[ ] # Helper function for inference on images.
    def inference(RES_DIR, data_path):
        # Directory to store inference results.
        infer_dir_count = len(glob.glob('runs/detect/*'))
        print(f"Current number of inference detection directories: {infer_dir_count}")
        INFER_DIR = f"inference_{infer_dir_count+1}"
        print(INFER_DIR)
        # Inference on images.
        !python detect.py --weights runs/train/{RES_DIR}/weights/best.pt \
        --source {data_path} --name {INFER_DIR}
        return INFER_DIR
```

```
def visualize(INFER_DIR):
# Visualize inference images.
    INFER_PATH = f"runs/detect/{INFER_DIR}"
    infer_images = glob.glob(f"{INFER_PATH}/*.jpg")
    print(infer_images)
    for pred_image in infer_images:
        image = cv2.imread(pred_image)
        plt.figure(figsize=(19, 16))
        plt.imshow(image[:, :, ::-1])
        plt.axis('off')
        plt.show()
```

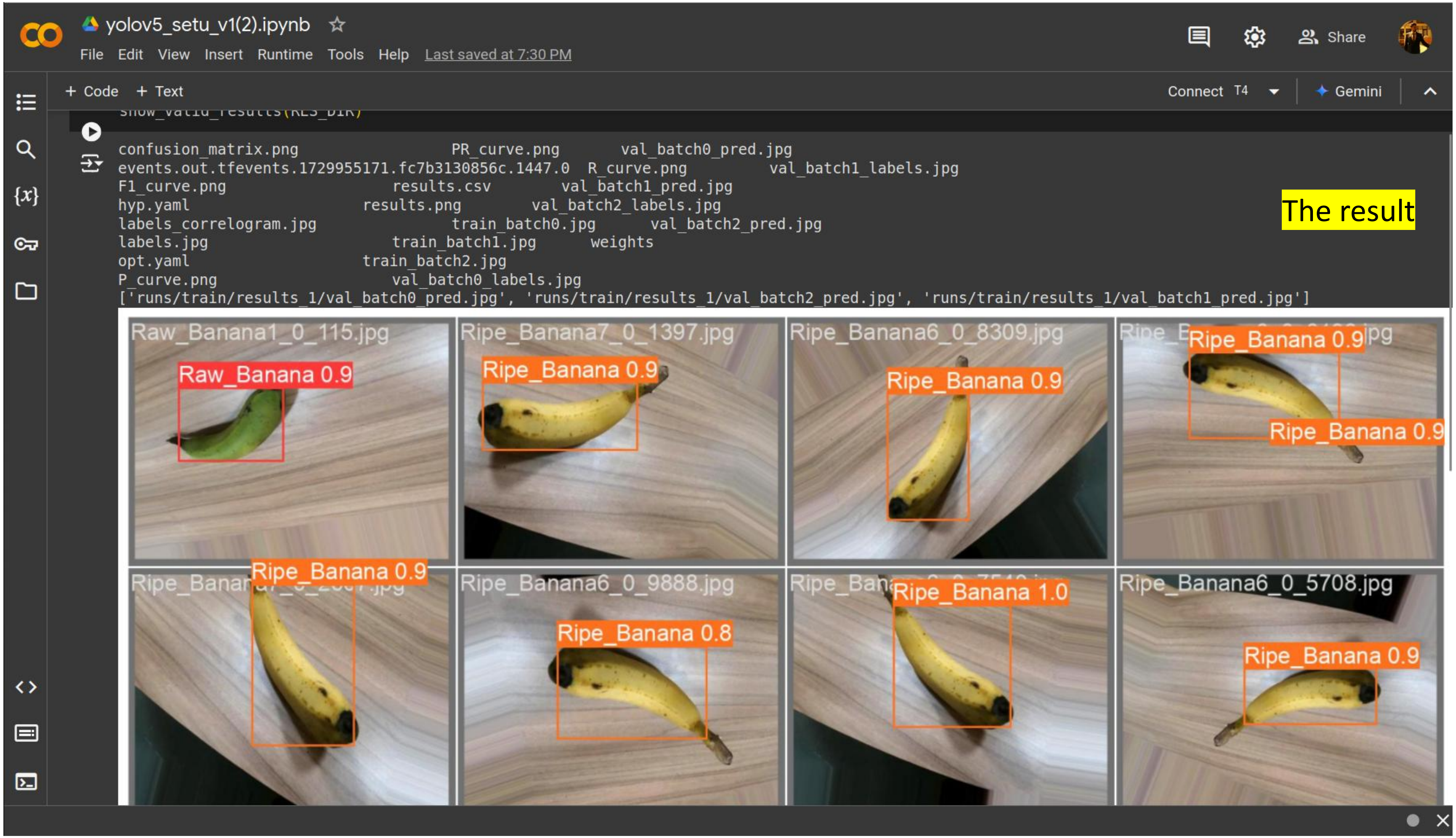
```
[ ] show_valid_results(RES_DIR)
```

```
confusion_matrix.png                          PR_curve.png        val_batch0_pred.jpg
events.out.tfevents.1729955171.fc7b3130856c.1447.0  R_curve.png        val_batch1_labels.jpg
F1_curve.png                        results.csv        val_batch1_pred.jpg
hyp.yaml                         results.png        val_batch2_labels.jpg
labels_correlogram.jpg                        train_batch0.jpg       val_batch2_pred.jpg
labels.jpg                          train_batch1.jpg       weights
opt.yaml                         train_batch2.jpg
```

Helper code to validate the inference results and visualisation

Training Model

Dataset Training Inference



Few Policies for Consideration

Impact Policy Changes

Researchers/ Academia

- More recognition for Equipment/ Technology adoption level by farmers than number of patents/ publication
- Applied research/ Basic research ratio 6:4
- Freedom to collaborate with Industry by individual professor
- More recognition for Industrial sponsorship
- Encourage cooperation between institutes
- Encourage multi- discipline collaboration

Subsidies

Instead of subsidy to buy Equipment, Support 'Services rendered'.

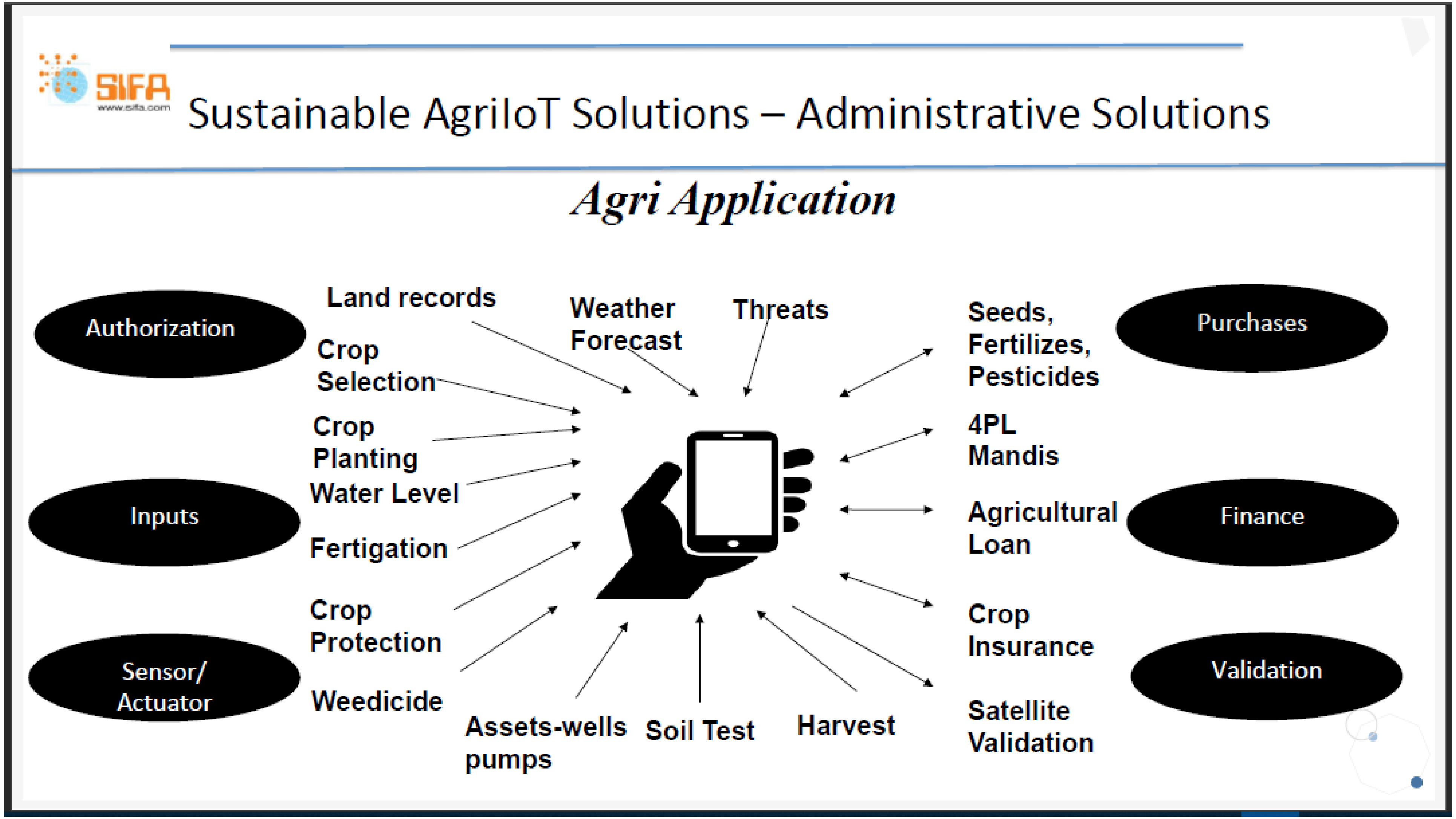
Advantages:

- Small farmers can adopt Mechanization.
- Promotes entrepreneurship
- Equipment can be upgraded by CHC's
- Better Maintenance by CHC's
- Freedom of Equipment selection
- Assured rendering of service to farmers
- Lend-to-Rent model with 30% more utilization

Agri Aadhar 7/12

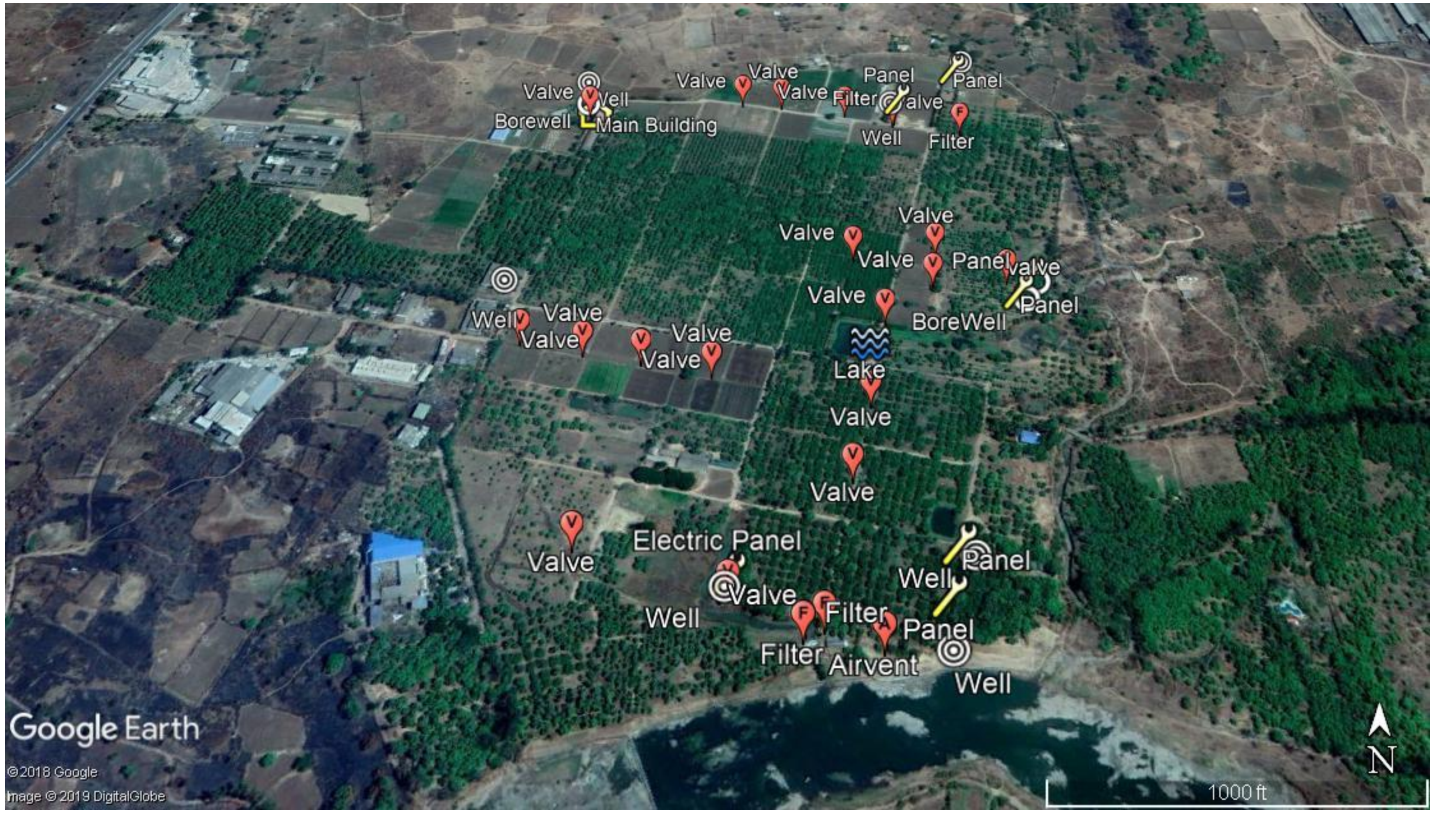
The Agri Aadhaar is an attempt towards having a single, unique identification document or number that would capture all the details, including geographic, geological information including soil characteristics, water resources, power availability, cropping pattern, fertigation, pest details of every Agricultural land in India.

ICT Solutions



Sustainable IoT Solutions – Automation Solutions

Field Challenges



- ***Rugged and Simple***
- ***Harsh Environment***
- ***Rodents, Animals***
- ***Theft***
- ***Power Outage***
- ***Lightening***
- ***Networking***
- ***Poor Access for Service***
- ***Return on Investment***

Important for IT Engineers

BTech Agricultural Engineering

Language-English
Chemistry
Physics
Mathematics
Mechanics
Thermodynamics
Fluid mechanics Material science

Basic Electronics
Electrical Engineering
Computing, Programming
Electrical Machines
Instrumentation & Control

Kinematics and Dynamics
Machine Design
IC Engines
Tractors and Power Units
Farm Machinery

Soil Mechanics
Surveying and Levelling
Soil & Water conservation
Ground Water & Well Engineering
Irrigation Engineering
Hydrology
Pumps & Hydraulic Control
Drainage Engineering

Post Harvest Engineering
Refrigeration & Air-conditioning
Dairy and Food Processing
Food Products & Process Technology

Structures & Rural Engineering Building Materials and Structure

Environment & Ecology
Agriculture & Environment

Soil Science
Crop Production

B Tech (Agricultural Information Technology)

Introduction to agriculture
Field crops (Kharif and Rabi)
Commercial Horticulture
Environmental Science, Ecology And
Forestry System
Soil, Plant Nutrient And Wat
Management
Principles Of Agricultural Economics
Agricultural Statistics
Fundamental Of Agricultural Extension
Introduction To Biotechnolo
Agricultural Meteorology:
GIS And Remote Sensing Techniques

Introduction to web scripting
Programming in C
Fundamentals in computers
Data structure through C
Introduction to Multimedia
Computer Organization And Architecture
System Analysis And Design
OOP Using C++
Website Development Using PHP
Relational Database Management
Information Security
Software Engineering
Introduction To .Net Framework

And ASP.NET
Java Technology
Computer Networks
Advance Asp.Net
Application Development In Mobile Technology
Data Analysis With Matlab
Operating System With Unix/ Linux
E-Content Development Using Multimedia

Addition from 2024 graduate will learn technologies relevant to

Increased use of AI-based digital tools in this era

Big Data Analytics in Agriculture with a focus on sustainability

Larger utilization of precision agriculture, primarily to reduce costs.

Remote Sensing, UAV, GIS and Image processing

B Tech - Artificial Intelligence and Data Science

I Year
Mathematics
•Physics
•Programming C language
•Communication WKSP 1.1
•Basics Electronic Engineering
•Data Structure with C language
•Communication WKSP 1.2

II Year
•Computer System Architecture
•Design and Analysis of Algorithms
•Web Technologies
•Programming in Python
•Communication WKSP 2.0
•Securing Digital Assets
•Operating Systems
•Data Management Systems
•Introduction to Java

III Year
•Mobile Application Development
•Software Engineering
•Machine Learning
•Communication WKSP 3.0

IV Year
•Web Technologies
•Universal Human Values and Ethics
•Robotics and Intelligent Systems

Core Subjects
•Artificial Intelligence
•Neural Networks
•Pattern Recognition
•Algorithms
•Machine Learning
•Language processing

Elective Subjects
•Robotics
•Automata
•Deep learning
•Sensors
•Programming language [Python or C or other languages]
•Database management and Big data

B Tech AI in Agriculture SKUAST-K

First two years at SKUAST-K
Mathematics
Computer fundamentals
Chemistry
Physics
Basic agricultural sciences
Introductory AI and ML principles

IIT Mandi in the third year
Machine learning
IoT systems
Cloud computing
Robotics
Deep learning
Blockchain in agriculture

In the fourth year
Projects and internships at SKUAST-K, IIT Mandi, or with industry partners

Electrical/ Electronics/ Software Skills

Inter disciplinary subjects

Precision Farming
Crop Forecasting
AI tools in Cultivation, Harvesting
Automatic Watering, Fertigation
AWD and Root zone applications
Control Environment Agriculture
Urban Agriculture
Landscaping
Sugarcane Mechanization
Cotton, Jute Mechanization
Horticultural Crop Mechanization
Agricultural Spraying
Wild Animal Protection

Conservation Agriculture
NRM Activities
Saline Reclamation
Animal Management
Poultry Industry Fisheries
Integrated Farming
Agro forestry
Storage and Logistics
Pre-processing, Packaging
Food Processing
Agricultural Machinery Manufacturing
Banking and Rural Development

Potential avenues for Entrepreneurship

- Automated Water/ Fertigation Systems
- Automation Control Environment Agriculture
- Climate control storage system
- Logistic systems – packing, storing and transport of fruits/vegetables
- Weeding/ harvesting tools for crops like soybean, cotton – assisted or autonomous
- Machinery for horticultural crops/ Trees.
- Plant advisory- Long term

Thank you