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GS 3 : AGRICULTURE HANDWRITTEN SHORT NOTES

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* Agriculture *

- Land → Water → Production → Storage → Market → Income → Nutrition → Sustainability

8 Major Problems

1) Land - Small Land Holdings, Land Productivity, Uneven Terrain, Desertification, Leaching, Mechanisation
2) Water - Over Exploitation, Rainfed, Ground Water Pollution, Aquifer Lowering, Low Irrigation
3) Soil - Nutrient Deficiency, Errosion, Salinization, Monoculture, Excessive Inputs
4) Seeds - Terminator Seeds, Replacement Rate, HYVs, Climate Smart seeds, R & D
5) Security - Food, Income, Nutrition, Environment, Energy
6) Market - Fragmented, Accessability, Transport, Cartelization, Logistics, APMCs, Intermediaries, Pvt Sector
7) Climate - Extreme Weather Events - Droughts & Floods, Irregular Monsoons, GHGs, Climate Smart Agriculture, Subsistance Agriculture
8) Income - Loan Trap, Informal Lending, MSP, Insurance, Density, Subsidies, Disguised Employment, Allied Sectors, Extension Services, Food Processing Industry, Certification, Skills - ICT

Agriculture Value Chain

Input	Production	Post Harvest	Market	Consumer
- Land	- Fertilisers	- Transport	- APMC	- Demand
- Water	- Insecticides	- Logistics	- NAM	- Awareness
- Irrigation	- Pesticides	- Storage	- Mandi	- Preference
- Credit	- Mechanisation	- Labour	- Cartelisation	- Price & Income
- Seed	- Soil	- Processing	- MSP	- Food Health
- Tech	- Millets	- Packaging	- Fortification	- Nutrition Security
- Labour	- Organic	- Segregation	- SPS Measures	- Food Security
- Electricity	- 2BNF/IFS/ HVS	- Branding	- Export Reddiness	- PDS
		- Supply Chain		- Adulteration
		- Procurement		

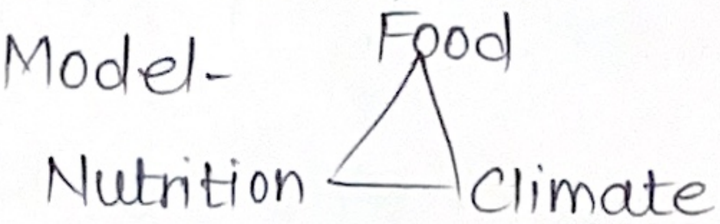
Frameworks

1) F2F (Farm to Fork)
   Production → Procurement → Storage → Transportation → Processing → Marketing → Consumption

2) Tech - (F) - Forecasting, (A) - Assessment, (R) - Resource Allocat^{n}, (M) - Monitoring
   ↳ Data → AI → Decision Making → Automation → Productivity

3) Income → Yield & Price, Cost, Risk

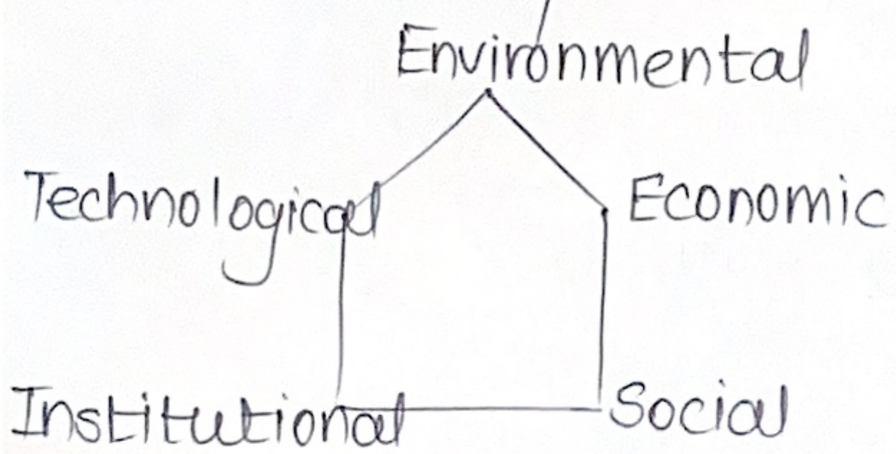
4) Triple Security Model -



5) Water Efficiency
   Flood → Canal → Drip → Sprinkler → IoT, Automation

6) Crop Diversification
   Rice/Wheat → Millets, Pulses, Oil Seeds, Horticulture, Live stocks, Fisheries

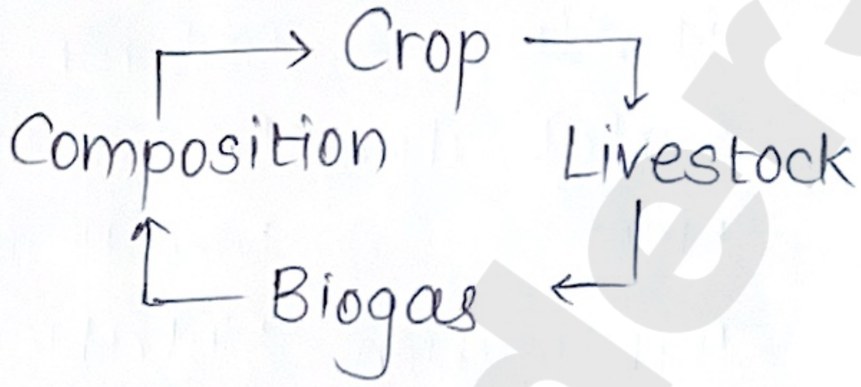
7) Sustainability



8) Capitals → Human, Social, Economic, Natural

9) Agri Transition Model
   Subsistance → Commercial → Mechanised → Digital → Pre

10)



1. Agriculture

Indian Agri: Features & Current Status

1) Subsistence Oriented [50% - NABARD]
2) Small & Fragmented Landholdings
   Avg size = 1.08 Hectors ⇒ 86% Farmers
3) Low Productivity (contributes 15% to GDP)
4) Labour Intensive (46.1% of WorkForce)
   ↳ Low Mechanisation
5) Traditional Techniques
6) Govt Support : 23 crops → MSP ← CACP
7) Land Use : 59% Land → Agri (M.o.AFW)
8) Record Foodgrain Prod^{n} - 357.73 MMT
9) Agri Exports ($34.5 Bn | FY20 → 51.1 Bn (FY25)
10) Budget Allocation = ₹ 1.30 Lakh Cr
11) Avg Annual Growth = 4.4% at constant price
12) Irrigation Status ⇒ Largest in World
    55% of gross cropped area
13) Fertiliser Consumption [150 kg/Hectare]
    2nd - Consumer 3rd - Producer
    13% States → 90% Usage
14) Agri Credit - 20 Lakh Cr target
15) Digital Agri - AI, IoT, Drones, eNAM etc

Significance of Agriculture in India

1) Contribution to GDP (15%)
2) Employment (46.1% of WorkForce - PLFS)
3) Food Security
4) Forex Earnings ($50 Bn)
5) Socio-Cultural & Envtl Sustainability

Key Initiatives

↳ 3L.Cr (M.o.FAW)

1) PM-KISAN (₹6000/yr | 11 Cr Farmers)
2) PM-FBY - Largest in the world
3) Soil Health Card Scheme (↑ Agri Tech)
4) PM-KSY - Har Khet Ko Pani
   Per Drop More Crop
5) eNAM - integrates ~1300 APMC Mandis
6) National Mission on Sustainable Agri
7) PKVY - Organic farming - certification
8) Digital Agriculture Mission
9) Mission for Atmanirbharata in Pulses
10) NeGP-A ⇒ ↑ ICT 11) MOVCDNER

"Input Based Agri ⟶ Tech Based Agri" - says ES

Key Challenges

↳ 86% (Agri census)

1) Small Land Holding (Avg = 1.08 Hectares)
   'Economy of Agrigation' - NITI Aayog
   ↳ FPOs can solve SLH problem without changing ownership)
2) Economic Hardships [₹10,218/month - NSO]
   50% Agri Household → Debt (Monsoons)
3) Soil Degradation & Water scarcity
   ISRO Desertificat^{n} Atlas ⇒ 30% Land - Desert
   PB/HR ⇒ 85% Blocks overexploited Ground water
4) Weak Agricultural Infrastructure
   ₹90,000 + Cr ⇒ Post Harvest Losses (ICAR)
5) Underinvestment in Research
   Only 0.6% of Agri GDP → Agri Research (ICAR)
6) Outdated Farming Practices
   Flood irrigation in 'Sugar Belt' (MH & UP)
7) Market Volatility & Price Fluctuations
   Late 2025 : onion prices (MH) → ₹ 2/3/kg
   Very small portion of SP → Farmers (NITI)
8) Policy Related Challenges
   Policy Paradox - Fertilisers Subsidy (x crops)
   Vs
   Govt Schemes (y crops)
9) Climate Change & Natural Disasters
   Unirrigated Region → 25% Income Loss due to climate Change (WB)
   Rainfed Rice Yield → ↓ 20% by 2050 (NICRA)

Way Forward (Ashok Dalwai Cmt; Swaminathan Cmt)

1) Blend Trad^{l} & Modern Tech eg Drones
2) Precision & Data Driven Farming
   Precision Agri ⇒ ↓ 20-30% Fertilisers & Water usage (FAO)
3) Agri R&D & Climate Resilience
   eg. ICAR - Sahbhagi Dhan Rice
4) Water Efficiency & Micro-Irrigation
   Micro-Irrig^{n} ⇒ save upto 50% of water
   ↑ 40% of productivity
5) Better Market Access & Infra eg eNAM
6) Credit & Co-operatives Support eg KCC
7) Startup Growth

Case Study - Hiware Bazar (MH) - NITI - M.o.RD

↳ Shri Popatrao Pawar
↳ Avg income ₹832 → ₹30,000/month

Millets (Shree Anna or Smart Food - ICRISAT)

India - Largest Producer - 38.4% (FAO, 2023)

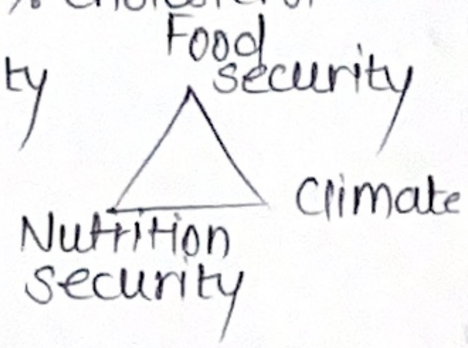
Benefits

1) Farming & Food Security
(Less Water - 75% less than Rice, pest & disease resistance, intercropping)

2) Cultural & Poverty Alleviation
(Trad' Food - Ragi Habba - KA), Low i/p cost, Preserves traditional cropping system)

3) Nutrition & Health (more cal in Ragi than Rice)
Gluten free, Low GI, ↓ 8-10% cholesterol

4) Environmental Sustainability
✓ Drought Tolerant
✓ Restores microbes
✓ ↓ Chemical fertilisers



- Odisha Millet Mission - NITI Best Practices

Government Initiatives

1) International Yr ⇒ 2023 · by UNGA
India ⇒ 40% of World prod^n - Agri Diplomacy
2) PM Modi's campaign - Shree Anna
3) Union Budget : HYBD - Centre of Excellence
4) CAPF/NDRF Diets : 80% meals - Millets
5) Millet Missions - OD, AP, CHH, KA
6) Startup & FPO Support
7) RAD Scheme ⇒ 25% Area → Millet cultivat^n

Achievements

1) Steady production growth
2) Seed production & distribution

Challenges

1) Skewed Agri-policy (Millet Policy Paradox)
2) Changing Dietary Habits 3) Percept^n issue
4) Processing & Value Chain Gaps
5) Low Yields & Profitability
6) Taste Preference Swift 7) High Market Prices
8) Limited market presence

Way Forward

1) PDS & MDM 2) MSP 3) Startups 4) R&D
5) Awareness 6) Rebranding 7) Subsidies
8) ↑ Availability 9) ↑ Exports 10) CSC

- Millets can be the next big brand From India after Yoga - NITI Aayog
- FPO Led Millet Value Chain - NABARD
- Calorie Security → Nutrition Security
  ↑ Millets can help (RBI)
- Triple win - Nutri, Agri Sustainability, Climate Resilience

Organic Farming

India → #1st - No. of organic Farmers (IFOAM 2022)
#4th - Certified Organic Area
→ Scale Certificat^n Mismatch

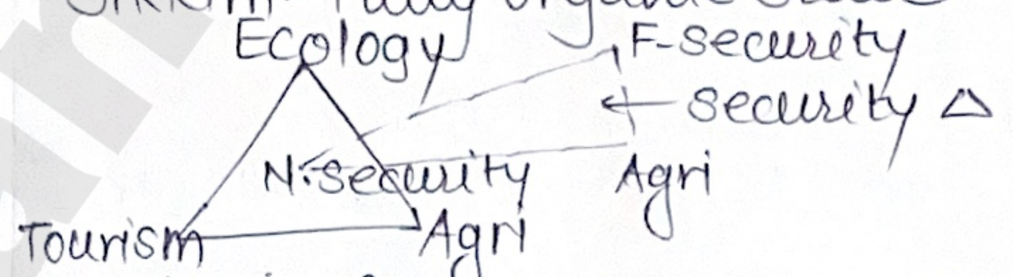
Benefits -

1) Low input cost (14-19% lower prod^n cost)
2) Soil Health (↑ Soil organic carbon - FAO)
3) Water Conservation (↓ Eutrophication)
↑ Moisture Retention
4) Healthier Food
5) Biodiversity - 30% More species richness
Mixed Farming & Agro Forestry - High BD
6) Climate Resilience (↓ GHG emission by 20% - FAO)
7) ↓ Fossile Fuel Intensive Fertilisers (FAO)
8) Compost Cycle

Govt Initiatives

1) PKVY 2) MOVCDNER 3) NPOP
4) Soil Health Mngt 5) OFEP Program

- Organic Large Cardamom Prod^n - Nagaland
  (NITI Best Practices)
- Sikkim - Fully Organic State



Sikkim Organic Convergence Model (NITI)

- Role of Tribal Communities - Tradition
Tribals Rich States → 3/4 organic prod^n area
NE - Low Chemical Intensity (NITI)
Low Fertilisers Damage

2 Different Certification Mechanism

NPOP	PGS-India
1) by APEDA (M.o.C.I)	1) NCONF (M.o.A & FW)
2) 3rd Party Cert^n	2) Peer Review
3) 1° Export Market	3) Domestic/Local Market
4) High Costs	4) Low/Nil
5) Extensive Document^n	5) Simplifies

Challenges

1) Farmers - Certif^n, Training, High i/p costs, Seeds (↑ 20% Yield ↓)
2) Infra & Market - cold storage, logistics, lmtd market access, competition, Branding
3) Export & Trade - Non tariff barriers - 'Stds'
4) Ecological & Technical - Lack of R&D, poor access

Way Forward [Sikkim (NITI) & Nagaland - PCM]

1) Policy & Cert^n ⇒ Blockchain → Digital certif^n
2) Market Development 3) Consumer Awareness
4) Support to Farmers (FPOs) 5) R&D 6) Training centres

Zero Budget Natural Farming (ZBNF)

4 Components -
1) Beejamrit
2) Jeevamrit
3) Acchadana
4) Waaphasa

⊙ Benefits
1) 50-60% Less power & water
2) Low input cost
3) ↑ Soil organic content (Microbes)
4) ↓ $[H_4$ Emission
   ↓ Residue Burning
5) ↑ Drought Resilience
6) ↓ Import Dependence for Fertilisers

⊙ Challenges
1) Labour Intensive
2) Time Consuming
3) Yield Variations & Unpredictability
4) ↑ Maintenence (cow)
5) Lmtd scientific study
6) Hidden Costs
   Overestimation - Profits
7) Transition phase cost

⊙ Govt Steps
1) BPKP under PKVY
2) Fin. Assistance
3) MOVCD-NER
4) Subsidies
5) ICAR Research
6) AP - 80 Lakh Hectares by 2027

⊙ States Practicing ZBNF
HP - Prakritik Kheti Khushhal Kisan
KA, KR, MH etc.

⊙ Way Forward
1) R&D
2) Training
3) ↑ Market Access
4) ↑ Cow Breed Conservation Program
5) Avoid Forced Adoption
6) ↑ Localised experimentation

Empowering Farmers: The Success Story of MAHAFPC

646 FPOs → 1.7 Lakh Farmers

Case Studies : ES (2025-26)

1) Innovation in Land & Resource Governance
   AP → Digital Land Titling
2) Market Reforms & Digital Market Access
   MP → Digital MSP Purchases - Souda Patrak
   AP → e-Farmarket - Rythu Bharosa Kendras
3) Climate Resilient Agri & Water Governance
   KR → KERA Project supported by WB
   OD → Pani Panchayat
4) Tribal Farming & Trad' Knowledge
   JH → Solar Irrigation Co-operatives
   └ Oraon Farmers → Year round cultivation

⊙ WRI → AP - Largest Agroecological Transition Experiment
✓ Phased Local Experiments

⊙ Israel - FAO
Agri Extension + Tech support

⊙ Cereals Based → High Value Base Agri
HVA ⇒ Horticulture + Livestocks + Fisheries
↓ (13% GR) (14% GR)
┌ Nashik Grapes Study
└ Prod^n → Processing → Exports → Eco. Growth
(Value Chain Approach)

2. Major Cropping Patterns.

⊙ What is the Cropping Pattern ?
The proportion of area under diff. crops at a given point of time in a region (MoA&FW)
Crops → Food Crops & Cash Crops

⊙ Factors affecting cropping pattern -
1) Historical Factors -
   Permenant Settlement, Ryotwari, Mahalwari
   Famines | Land Reforms | Green Revolut^n
2) Natural Factors -
   - Climate & Temp ⇒ Ⓘ = 15 Agroclimatic
   - Regions & 125+ AgroEco. Zones (ICAR)
3) Rainfall Patterns & Monsoon | Topography
3) Economic Factors
   Farm Size & Structure | Inputs Access
   Investment Capacity | Market Infra
   Eco Incentives | Irrigation
4) Govt Policies & Market Factors
   - MSP & Procurrement
   - Viksit Krishi Sankalp Abhiyan
   └ Green Manure + SHC based Fertilisers + Mixed Cropping
   - Taxation & Infra
5) Socio-cultural Factors (Plate 2 Farm)
   Food Habits | Diet | Religion | Festivals
6) Consumption Pattern
   NSS : Consumption Survey
   Rising Income ⇒ Cereals Based Consump to Protein + Fruits + Processed Food
7) Marketing Conditions -
   APMC Access | Market Integration
   Export Demand | Contract Farming
   Infrastructure

Benefits of Crop Diversification

1) ↑ Soil Health (Legumes → N-Fixation)
2) Curbing Disease Outbreak
3) Blocking Pests & Bugs
4) Taming Weeds
5) Better Use of Farm Resources
6) ↓ Total Crop Wipeout
7) ↑ Food supply & wallet security

- Floriculture ⇒ sunrise sector
  - 100% export promotion | ✓ small lands } ES
  - Income/Hectare > other crops

Challenges Associated With Current Cropping Pattern-

1) Overdependence on Rice & Wheat
   MoSPI: ↓ Area under coarse cereals
   28.48% (1970-71) → 11.7% (2020-21)
   - GRevoln → Ensured Food security but increased regional concentratn & GW stress (ES)
2) Soil Degradation & Monoculture
   NPK (PB) ⇒ 29.8 : 6.5 : 1 (ICAR)
   ISRO Desertificatn Atlas → 30% Land
3) Water Security & GW Depletion
   PB/HR → 85% Blocks - Overexploited GW
   WB → (I) Largest GW Exploiter
   Nearly 90% Fresh Water → Agri (says WB)
   Nearly 55% cultivable area → ✓ Irrigatn
4) Climate Vulnerability - Erratic Monsoon
   1°C ↑ Temp ⇒ 5 Mn Tonne Wheat prodn ↓ (WB)
5) Agro-climate misalignment
6) Inadequate Market & Storage Infra
7) Price Volatility & Debt stress (50% farmer)
   ✓ Cobweb Phenomenon

Changing Cropping Pattern in India

Wheat/Rice → Millets, Pulses, Oilseeds
Coarse cereals → Fruits & Vegetables
Sugarcane → Oilseeds & cotton
Rainfed cereals → Commercial Crops

Impacts of Changing Cropping Patern

+Ve Impacts
1) ↑ Farm income & Eco. sustainability
2) Better Water mngt & sustainability
3) ↑ Food & Nutritional security
4) ↑ Soil Health & Biodiversity

- Crop Diversification = Virtual water consevtn
  - ↳ F-security → N-security → ↓ Hidden Hunger - NITI

-ve Impacts-
1) Market Volatility & Fluctuations
2) ↓ Food grain self-sufficiency
3) Loss of trad' & Indigenous crops (NE-(I))
4) Lack of Extension support & Knowledge

Ashok Dalwai Cmt → Tech adoption depends more on extension services than tech. availability itself.

Need of the Hour

1) ↑ Crop Diversificatn & support system
2) ↑ Infra & Post-Harvest systems
   Post Harvest Losses ⇒ 40% Fruits & vegetables
3) ↑ Water-Efficient & microirrigation
4) ↑ Market Access & Institution Building
5) Broaden Risk Mitigation & Insurance
   Income Risk ← Productn Challenges & Price Volatility (ES)
6) ↑ Knowledge, Extension, Tech Adoption
   Agri 4.0 (FAO) | Annadata → Agripreneurs
7) Agroforestry & Natural Farming

Some Success Stories -

1) Dharawad - Haveri (KA) → Millet Magic Project
   CROPS4HD
   ↳ i/p intensive → Climate smart farming
2) Enabavi Village (TS) ⇒ 1st Organic Village
   ↳ Ecology + Livelihood + Health ⇐ FAO
3) Barahnaja System (UK) - Trad' Multi-cropping

Integrated Farming System
(Whole farm management approach)

Prodn Maximizn → System Optimizn (ICAR)
Waste of One → i/p of another (ICAR)

Benefits

1) ↑ Farm Income
2) ↑ Livelihood security
3) ↑ Recycling
4) ↑ Soil Health
5) Environmental Protection

Challenges

1) Knowledge & Technical Skills gap
2) High initial investment & credit constraints
3) Small & Fragmented Landholdings
4) Lack of infra
5) Cultural Resistence & social constraints
6) Risk & longer transitn

Way Forward (Swaminathan Commission)

1) FPOs
2) Single Window credit
3) Micro Processing Units

Crop Diversification (Portfolio Strategy)

CD → Virtual Water Conservat^{n} (NITI)

Produce More → Produce Smart (NITI)

eg.- Alappuzha (KR) = Pokkalia + Prawns
Rice Farming

Barahaja (Uk) → Multicropping

Benefits-

1) ↓ Risk
2) ↑ Climate Resilience
3) ↑ Income
   ↑ Employment
4) ↑ Soil Fertility
5) ↓ Input Cost
6) Food & Nutritional Security

Challenges

1) Policy Bias towards Monoculture
2) Lack of market access & infra
3) Water scarcity & Climate eg. Marathwada
4) Limited awareness & extension services
5) Cultural & Traditional Preferences

Emerging Technologies → ↑ 20% crop intensity (ICAR)

1) Precision Agri & Remote Sensing
   - Crop suitability mapping (ISRO)
   (Intuition → Data Based Agriculture)
2) AI & Mobile Based Advisory Platforms
   Apps- Kisan Suvida, AgNext, CropIn
   John Deere's See & Spray
3) Biotechnology & Improved Varieties
   ✓ 2nd cropping window
   ✓ Nutrients Mining
4) Hydroponics, Verticle Farming & Protected Cultivation
5) E-Marketplace & Supply Chain Tech
   eg. DeHaat's ⇒ UP

Wheat-Rice Dilemma in India

Concerns-

1) Crop Residue Burning : Air pollut^{n} - Delhi
2) Soil Health ⇓ : Ludhiyan (N) decreased by 22%
3) Groundwate Depletion
   PB & HR → 85% Blocks overexploited GW
   Exporting Rice → Exporting GW (NITI)
4) WTO Disputes
5) Genetic Diversification, Skewed MSP, Methane Emission, Fossil Fuel Based Fertilisers etc.

Way Forward

1) ↑ Crop Diversification 2) Water use Efficiency
3) Soil & Nutrient Mngt 4) AI & IoT
5) In-situ crop residue mngt (Happy Seeder)
6) Integrated policy
7) Procurrement Based Risk Reduct^{n} (NITI)
8) HR - Mera Paani, Meri Virasat

3As:
- Assured Procurrement (NITI)
- Agroclimate Suitability (ES)
- Alternate Income Support (ES)

Determinants of High Value CD.

1) Eco. incentives & price signals
2) Agro-climatic suitability
3) Market Access & Infrastructure
4) Risk percept^{n} & Risk Mitigat^{n} capacity
5) Access - Credit, Tech, Extension
6) Govt policy & Institutional support
7) Land holding Structure & tenure security

3. Irrigation & Irrigation System

Irrigation - Artificial supply of water
A tool to improve soil health & product^{n} mngt.

Data-

1) Irrigat^{n} cover ⇒ 55% Gross Cropped Area
2) Irrigat^{n} Intensity ⇒ 155% (over irrigat^{n})
3) PB & HR ⇒ 98% & 94% GW Extraction
4) Micro-irrigat^{n} ⇒ India: 8% | USA - 68%
5) Total Irrigated Area = 68 Mn Hectares
6) Share of Irrigated Area = 48% net sown area
7) Groundwater ⇒ Nearly 68% of irrigat^{n}
8) Canal Irrigat^{n} ⇒ 24% of irrigat^{n}
9) Crop-wise ⇒ 90% → Wheat & rice
10) Tube wells ⇒ 50 Lakh
11) Tank Irrigat^{n} ⇒ Peninsular States

Necessity of Irrigation

1) Uncertainty of Monsoonal Rainfall (Flood, Drought)
2) Highly seasonal rainfall
3) Winter Rainfall (North India) ↓ GW
   South West Monsoon (South India)
4) Cultivation of High Yielding Crops
   1 kg Rice ⇒ 1500 - 2000 Ltrs of Water
5) Difference in Water holding capacity
6) (I) → Land of Rabi Crops
7) Topography

Type:
- Surface
- Localised
- Sprinkler
- Lift
- Manual

Microirrigation Systems

Field/Ground Irrig^n → Root Zone Irrig^n
Gravity Based → Controlled Pressurised Syster

Features:
- Presurised Piping system
- Drop by Drop water
- Moisture is always maintained
- support all terrain
- Water applied at a low rate
- constant & uniform growth
- Frequent Intervals

Types:
- Sprinkler Irrig^n
- Drip/Trickle Irrig^n

Advantages of Micro-irrigation

1) Saves water (45-60%)
   Micro-irrig^n can save upto 50% of water & ↑ 40% productivity
2) Uniform water application → moisture is maintained
3) Saves electricity
4) Better Chemical Application
5) Reduces weeds & diseases
6) Tolerates soil salinity
7) Suited to varied topography & soil
8) Allows automation (IoT/Moisture Activ^n)
9) ↓ Labour cost
10) ↑ Crop quality & yield
11) Fertigation

Challenges

1) High Initial cost
2) Emitter clogging
3) Low Technical know-how
4) Power supply issue
5) Poor maintainance
6) Animal damage risk
7) Unsutaible for tall crops

Gout Steps-

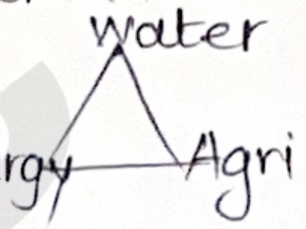
1) CSS → Per Drop More Crop
2) Micro Irrig^n Fund - NABARD - ₹5000 Cr
3) Sahi Fasal Campaign
4) State Gout Subsidies

Problems : Irrigation

1) Waterlogging & Salinity
2) Difficulty in infra creation
3) Sustainability & Falling yields (HR-GR)
4) Conflict over water eg. Cauvery
5) Neglect enut^l Flows eg. Yamuna
6) Siltation - eg Bhakra & Hirakund reservoirs
7) Health Implicts

Major schemes : Irrig^n Sector

1) PM-KSY → Har Khet Ko Pani
   → Per drop more crope
   Irrig^n Expansion → Irrig^n Efficiency
2) Atal Bhujal Yojana ⇒ 8000 Gram Panchayat
   ↳ Community led GW governance
3) PM-KUSUM ⇒ Solar pumps & grid connected RE.



4) Polavaram Irrig^n Project, Sharyu National Project etc

Water availability → Water mngt problem (NITI)
Irrig^n ⇒ Agri : Single to multi season

Measures to improve water storage & Irrigation System

1) ↑ Micro-irrigation
2) Modernise canals & watercourses
3) Water Harvesting
4) ↑ Conjunctive use of surface & groundwater
5) ↑ Rainwater Harvesting in fields
6) Use Treated wastewater
   Waste water Reuse = New Water Source (WB)
7) crop divessification
8) ↑ on-farm water management
9) Maintain minimum ecological flows
10) Precision Irrigation
11) IoI & AI → Fixed Scheduling

Some Innovative Solutions

1) Smart IoT & AI Irrigat^n systems
2) Floating Solar power pumps
3) Modern Subsurface storage (Tanka 2.0)
4) Digital Water Credits & Trading
5) Rooftop & Road Runoff Harvesting
6) Biochar & Hydrogel Soil Amendments
7) Automated Canal Gates & smart Distributaries.

Jal Shakti Abhiyan

1) Water Conservation & rainwater Harvesting
2) Rennovation of trad^l & other water bodies
3) Reuse & Recharge of Borewells
4) Watershed Development
5) Intenssive Afforestation

4. Storage, Transport & Marketing of Agricultural Produce

Storage of Agricultural Produce

Need

1) Preventing Post-Harvest Losses
Prod^{n} Deficit → Post Harvest Mngt Deficit
Forced Sale → Timed Market Agri Eco.
74 Mn Tonne Food Loss - ICAR
NABARD ⇒ 4-8% cereals, 5-15% fruits
2) Food Security
3) Stabilizing Prices
4) Supporting Farmers' Income
5) Enabling upstream & downstream SCM
6) ↑ Agri Exports
7) Complementing govt schemes

(WB): Warehouses → Storage Logistics Ecosystem

Current Mechanism

1) Traditional Methods
2) Modern Storage System
   (C)/St. Warehousing Corporation (eNWHR)
   Farm Silos | Covered storage | cover & plinth
3) Recent Technologies
   - AI-Driven Solar Powered Cold Storage
   - Smart IoT Based Silos & Cold Chains
   - Nano-packaging eg. Dantewada
4) Recent Schemes
   1) NHB Cold Storage Subsidy (35%)
   2) PM Kisan Sampada Yojana (PMKSY)
      └ Integrated Cold Chain Scheme
   3) National Centre For Cold-Chain Develop^{t}
   4) Gramin Bhandaran Yojana

- Cold Storage in India
  - 8815 units ⇒ 40.21 MnMT | 70% utilizn
  - PM-KSY
  - ICCVAI Scheme → MIDH, Operation Greens, NHB scheme, AIF
  - Pvt Entrepreneurs Gaurantee Scheme

Issues: Storage System

1) Inadequate Storage Infra
   FAO → 30-40% food produced is wasted
2) Regional Disparity (4 sts ⇒ 50%)
3) On Farm Storage Issues
4) FCI - Procurement & Storage
   Open-ended procurement | X FIFO
   X scientific methods
5) Lack of Proactive Liquidat^{n} Policy
   - Shanta Kumar Cmt
6) Quality Deficity (FAO)
7) Land Acquisition

Way Forward

1) Shanta Kumar Cmt
   - FCI → Outsorcing → FIFO Policy
     → Proactive Liquidation
     → Limit on mouths (3 Months)
     → Mechanisation in all silos
2) Safe & Scientific Storage
3) Internation Collaboration
   eg Karnal & Japan
4) Passive Storage → Active Preservation
5) Learn from local innovations eg COOLBOT

- FCI is increasingly transiting from procurement manager to inventory manager
- FCI: Grain Handling Agency
  ↳ Strategic Food Mngt Agency

Govt Initiatives

1) National Policy on Handling & Storage of Food Grains, 2000
2) Gramin Bhandaran Yojana
3) Negotiable Warehouse Receipt System
4) Decentralised Procurement scheme
5) PEG Scheme
6) Eco. Survey → Hospan mobile storage units
   ↳ Smart Warehouse Initiative (WFP + IGMRI)
   ↳ Future agri strength doesn't depend on how much is produced but how efficiently India is preserving, moving & marketing (PMM) food

Transport of Agricultural Produce

(I) ⇒ 2nd Largest fruits & vegetables production but 40% wastage
↳ Logistic cost - 13 to 14% | Developed - 8-9%

Importance of Transportation

1) ↑ Backward & Forward Linkage (F2F)
2) ↑ Agri Exports
   (I) ⇒ 2.5% of world agri trade with Rank 10
   WTO - World Trade Report
   Reasons - i) Fragmented Logistics
   ii) SPS compliances
   iii) Weak Cold Storage Chain

3) ↓ Post Harvest Losses
4) ↑ Price competitiveness for farmers
5) Develop rural economy
6) Food Security
NITI ⇒ 'Good On The Move'
↳ 40% post harvest loss of perishable goods
7) Acts as a support system for providing inputs

⊙ Current Mechanism for Agri Transports
1) Road → 97% perishables
2) Rail → Bulk grains (Kisan Rail)
3) Air → High Value Perishables (Kisan Udan)
4) Water → Bulky Non Perishables
5) Cold Chain → Reefer Trucks
6) Digital Aggregators eg.- Dehaat, Waycool
Ninjacart → Farm to Retail startup

⊙ Constraints
1) Inadequate Infra & Connectivity
↳ Poor rural roads / Poor metalled roads
Weak inter-modal connectivity
2) Dominance of Roadways → costly
3) Lmtd Cold Chain & Storage
4) High Post Harvest Losses
5) Lack of R&D
6) Policy & Regulatory Issues
7) Poor Trafic Mngt

⊙ Initiatives Taken
- Kisan Rail
- Krishi Udan
- PM-GSY
- Dedicated Freight Corridors
- Kisan Rath App
- eNAM

⊙ Budget 2025
- ↑ Reefer Coaches
- New Rail Lines (Vidarbha & MP)
- Maritime Dev^t Fund
- Integrated Agri Export Facility
↳ Nhava Sheva
- Dedicated Agri Export → JNPT

⊙ Way Forward
1) Road → Rail 2) PPP Model
3) Ashok Dalwai → ↑ investment on logistics
4) Dedicated Corridors 5) Road Concretis^n
6) Easing Interstate Regulatory Provision
7) Tech Driven Solut^n 8) Decentralised Model

⊙ Case Study - Alibaba's Cainiao
↳ Rural Producers to National Markets
i) Smart Supply Chain
ii) Cold chain Network
iii) Rural Logistics Network

⊙ Marketing of Agri Produce

⊙ Need
1) ↑ Farm Level Income
✓ Market Access → commercialization
eg. Sahyadri (MH)
✓ Price Stabiliz^n ✓ Direct Marketing
2) ↓ Post Harvest Losses ← Timely Delivery
3) ↑ Agri Exports
4) Boosting Rural Economy
eg Araku Coffee (AP), Kandhamal Haldi (Od
5) ↑ Agribusiness and Value Addition
6) Food Security

⊙ Current Mechanism
1) APMC Mandis
Shanta Kumar Cmt - Excessive Mandi Dependence
2) Direct Market Places
eg - Apani Mandi, Rythu Bazar
3) FPOs
4) Contract Farming
5) Digital Marketing (e-NAM, ONDC)
6) Pledge Financing (e-NWR)
7) Private Mandis & Aggregators (Ninjacart)

⊙ Challenges -
1) Inadequate Infra
Amenities / Grading Units / Market Density
2) APMC Mandis Issue - Monopolistic Setup
Cartelisation; Intermediaries, Licensing
3) Deficient Market Linkage & Information
4) Constrained value add^n & Processing
ES ⇒ (I) processing of Agri ⇒ Only 10%
Developed countries ⇒ 60-80%
x Modern Facilities / x credit access
5) Storage Facilities
6) Absence of National Integrated Market

⊙ Initiatives For Promoting Agri Marketing
1) Digital Mandi Expanssion & e-NAM
2) AIF - Infrastructure
3) AAF - Accelerator
4) e-govt portal eg - AGMARKNET
5) KCC scheme
6) FPOs under One Dist., One Product
7) Makhana Board - BR

⊙ Case Study - Shimlipal FPC - OD
FPO registered on eNAM through Udala main Market Yard

⊙ Way Forward

1) Harshavardhan Patil Cmt
   ↳ Put Investment in Marketing
   ↳ Market Fees ≤ 2% value of Produce
2) Inter Ministerial Task Force
   ✓ Direct Marketing ✓ Contract Farming
3) Swaminathan Cmt
   ✓ Allow put/co-op^re markets
   ✓ Farmer Centric
4) Ashok Dalwai Cmt
   ✓ min 30,000 Farm Produce Markets
5) Tech Solutions -
   Blockchain & IoT → Traceability & Quality Assurance
6) FPO → Collective Marketing

· Bandaid Sol^n's → Must Do Reforms

· ES ⇒ Agri reforms don't require isolated interventions but requires integration of Marketing, Logistics, Storage, Processing & Digital Access (MLSPD).

Agricultural Supply Chain Management (Agri-SCM)

⊙ Structure : 5 Stages -

1) Production (Fragmented Cultivation)
2) Aggregation (Intermediary Dependence)
3) Storage (Distress Sale Pressure)
4) Transport (Logistics Friction)
5) Retail (Low Farmer Share)

⊙ Significance

1) Reduces post harvest losses (Protecting Food Wealth)
2) Improves Farmer Price Realisation (Breaking Monopsony)
3) ↑ Food Security & Nutrition
4) ↑ Export Competitiveness
5) Stabilises Prices
6) Rural Employment
7) Financial Inclusion

⊙ Key Challenges -

1) Post Harvest Losses
2) Cold Chain Deficit
3) Intermediary Exploitation
4) Transport & Last-Mile Gaps
5) Information Asymmetry (Price Discovery Failure)
6) Fragmented Landholding (Aggregation Failure)

⊙ Solutions

1) Tech-Driven
   - Blockchain Traceability
   - AI Predictive SCM (Demand Forecasting)
   - IoT Cold Chain Monitoring
   - Drone Logistics & Monitoring (Last-Mile Efficiency)
2) Market Architecture Innovations
   - ONDC
   - Dynamic Pricing Algorithm
   - Agri-Stack
3) Infrastructure Innovations
   - Solar Powered Micro Cold Storage
   - Zero Energy Cool Chambers
   - Mobile Pre-Cooling Units
4) Financial & Institutional Innovations
   - Commodity-Backed Financing
   - Smart Contracts
   - Agri-Fintech & Embedded Finance
5) Systemic & Governance Innovations
   - Commodity Futures & Hedging
   - Urban Vertical Farming
   - Agri-Logistics Parks

✓ Khet Se Kismat
✓ Beej Se Bazaar Tak Samriddhi

5. E-Technology in Aids of Farmer

ES → Digital infrastructure is very crucial in improving productivity per drop, per crop and per farmer.

Use of Technology In Aid of Farmers

1) Pre-Sowing Phase
- Weather Forecasting : Meghdoot (IMD)
  eg. Gramin Krishi Mausam App (IMD)
- Soil Health Assesment : SHC Scheme
  eg. PB → Kheti Badi App
- Seed Selection : Biotech - GM seeds
- Input Planning : Agrostar, BigHaat
- Satellite Imagery : ISRO's - Bhuvan Portal

2) Sowing Phase
- AI Based Decision - FASAL App
- RemoteSensing & GIS Support - Krish-e
  ↳ Topographical Analysis, Moisture content
- Digital tools for crop select^{n} - Kisan Suvidha

3) Crop-Production Phase
- AI - Pest/Disease Mngt → Plantix App
- Drones → Kisan Drone Yojana
- IoT → Irrigat^{n} - TN Precision Farming Project Calendar → Demand Based Irrig^{n}
- Digital Extension Services - Digital Green
  Intuition Based → Data Based
- e-Krishi Samvad & mKisan

4) Post-Harvest (Storage & Processing)
- Warehouse Digitisation (e-NWR)
- IoT → Storage & Cold Storage / Tango
- Tech Integration

5) Marketing & Price Realisation
- Digital Mandis & e-NAM
- FPO-Based Marketing Platform
- Blockchain → Traceability / AgriChain / AgNext
- Direct-to-Consumer Platforms
  ↳ DeHaat, Ninja Cart, BigHaat

6) Transportation & Logistics
- Digital Logistics Matching Platforms
  ↳ Kisan Rath App (MoAFW)
- AI-Optimised Supply Chain - Ninjacart

7) Digital Export Facilitation
  APEDA's Agri Export Portal

Challenges

1) Digital Divide & Connectivity Gaps
2) Smartphone Penetration & Usage
3) Digital Literacy & local language Barriers
   47.8 Mn Rural Citizens → PMGDISHA
4) Affordibility of Smart Devices & Tech
   Avg Land Holding ≤ 2 Hectares (1.08)
   Avg Monthly Income = 10,180 ₹
5) Infrastructure & Power Constraints
6) Trust, Data Privacy & Farmer Hesitation
7) Access to High-End Tech
   ↳ Mostly large Farmers / FPOs
   ↳ Kisan Drone Yojana → PB/AP max
8) Weak last-Mile Extension & support
   713 KVKs For over 140 Mn Farmers
   Only 1 Extension worker per 1000 farmers

Some Key Initiatives

1) NeGP-A ⇒ KCC / KVK / CCS
2) Kisan Sabha App → Logistic Support
3) Seednet

. Pvt -
1) ITC MAARS (ITC) ⇒ Phygital Ecosystem
2) Reliance Jio Krishi
3) Fasal - IoT Based Precision Agriculture

Way Forward : Building a Digitally Inclusive Agrarian Economy

1) Rural Digital Development
   ✓ Smart Village Blueprints
   ✓ Community Tech Stewardships
     ↳ Digital Krishi Sakhis
2) Culturally Relevant & Accessible Content
3) Behavioural Change & Digital Literacy
4) Rewiring Agri Markets through ICT
5) ↳ Geo Fenced Mandis ; Farmer IDs
5) Policy, Governance & Institutional Reforms
   ✓ Farmercentric Data Govce.
   ✓ Multi-Stakeholder Agri-Digital Councils
6) Skilling & Capacity Building
   ✓ Re-skilling Extension workers
   ✓ Open Access Research Repositories

. ✓ SDG-2 & SDG-9
. Digital India will bring Digital Empowerement - PM Modi.

6. Issues Related to Farm Subsidies & MSP

Agricultural Subsidies

Types → Direct | Indirect

Direct: PM-KISAN, PAHAL, PM-Surya Ghar etc

Indirect: Fertilisers, Power, MSP etc

Rational/Need

1) Stabilizing the prod^n income - PM PRANAM
2) Direct Monetary Support - PM KISAN
3) ↓ Middle Income Trap
4) Eradication of Poverty - MSP, PM-AASHA
5) ↑ Tech Promotion - PM KUSUM, Happy Seeder
6) Establishing Equity
7) Economic Develop^t - eg R.O.TEP
8) Voice of Global South & Peace Clause
9) Achieving Govt Commitments
   eg PM Surya Ghar → Just Transit^n (NITI)
10) Crop Diversification 11) Insurance

Issues -

1) Fiscal Burden : ₹ 1.71 Trillion → Fertilisers
2) Envtl Degradat^n : NPK (4:2:1 → 8:3:1)
3) Distorting Cropping Pattern & Ecological Damage → Monoculture
   ↓GW ⇒ PB/HR → 85% Blocks overexploited
4) Nutritional Insecurity (36% Children-Stunted)
5) Leakage & Corruption - Middle Men Syndrome
   Shanta Kumar Cmt → 46.7% Leakage - PDS
   → JAM Trinity
6) Inflationary Tendencies
7) Pop Political Populism eg Loan Waiver
8) Out of 23 crops ⇒ 1/3 procurement - Wheat & Rice (Skewed MSP)
8) Crowding out of public investment → ↓ Cap Ex
9) Discourage Self Reliance

Upheavels at WTO

1) Inconsistent with Art 7.2(b) of A.Agri
   └ Violation of De Minimis Limit = 10%
   Brazil, Australia, Guatemala → overshoot FRP
2) Breach of SCM Agreement
3) Distortions of Market Economy

India → Poverty Alleviation; Spl. & Differential Treatments; CBDR
Food Security; Polluters Pay
↓ Domestic Industry

Measures -

1) Kelkar Cmt → Rationalis^n
2) Shanta Kumar
   └ Bal. Food & Nutritional security
3) B. Swaminathan → Transparency in DBT
4) Contract Farming
5) Co-operative Farming

MSP

↳ Protection of Farmer's produce & national Food security in India

- CACP Recommends → 22 Crops (MSP) + 1 Sugarcane (FRP)
- CCEA → Final Decision | FCI - Nodal Agency

FCI - 'MSP is the backbone of PDS, which ensures nationwide Food security'

Determinants:
- Demand & Supply
- Market Price Trends
- Cost of Production (A2+FL)
- Inter Crop Price Parity
- ToT Bet^n Agri & Non Agri Sector

Benefits

1) Income Security for Farmers (46% Workforce)
2) Rural Demand Multiplier | ↑ Farmer Income by 24%
2) Reduces Exploit^n
3) Encourage Agricultural Prod^n
4) Stabilizes Market Prices - eg NAFED ← PSS
5) Boost Rural Economy
6) Food Security & Public Distribution
   Annual Requirement of Wheat = 20 MnT
   Buffer Stock = 45-50 MnT
7) Crop Planning & Investment
8) Inflation Mngt → OMSS

Challenges

1) Distortions in Cropping Pattern
2) Arbitrary fixat^n of cane price
3) ↓ Agri Ecosystem 4) MSP Pay^t Bottleneck
5) Hurdles @ Procurement - APMC Issues
   ↳ Regional Disparity ⇒ 4 sts → 85% wheat procurement (PRS)
6) Challenges @ Implementat^n
   Shanta Kumar Cmt → Only 6% farmers
7) Envt Damage 8) Against Free Market
9) Harms Local Crops 10) Virtual Water Export

Demand For Legalisation ⇒ 6 → 20% Farmers

- **Issues** - 1) ↑ Fiscal Burden → 17 @ Lakh Cr
  2) MSP Access Disparity 3) Intermediaries
  4) Farmers may focus on MSP backed crops
- **Middle Path** - 1) Min Auction Rate
  2) Legally obligate pvt parties 4) Consensus Building
  3) Direct Compensation
  5) ₹s 5 L Cr Fund → MSP @ Swaminathan

Required Reforms

1) NITI → Improved & Transparent Mechanism
   → Better Infra → Effective implement^n
   → Price Deficiency Pay^t → Bhavantar Bhugtan (MP) + Bharpayi (HR)
   → Discourage Cartelisat^n
2) PM-AASHA; PSS; PDPS

7. Public Distribution System (PDS)

"Famines do not occur in functioning democracies with a free press & active PDS. The system is crucial in preventing large scale hunger" - Amartya Sen

Entitlement Theory ⇒ PDS → ↑ Accessibility to Food

- PDS → MoCAF&PD | Fair Price Shops
- TPDS → 35 kg food grains → BPL & AAY
  - Dual Pricing Structure → Central Issue Prices
    BPL (50%) ; APL (100%)
    3₹/2₹/1₹ ⇒ Rice / Wheat / Coarse Grain
  - Eligibility & Identificat^{n}
    - (C) govt → overall size
    - (St) govt → Identification of Beneficiaries
  - Split Governance

Objectives

1) Food Security
   NFSA ⇒ 67% popul^{n} → Legal Entitlement to Food
   ↳ 80 Cr Beneficiaries
2) Alleviate Poverty and Hunger — 75% → Rural, 50% → Urban popul^{n}
3) Stabilize Food Prices
4) Maintains Buffer Stock
5) Domestic Procurement
6) Supports Nutritional Needs (Fortified Rice)
7) ↓ Regional Imbalance

Development & Evolution

1950-60s → Import Dependent Phase
1970s → Universal PDS
1992 → Revamped PDS
1997 → Targeted PDS
2000 → AAY
2013 → NFSA

How Does It Works?

(C) govt → FCI ↔ Supply Food Grains
↓
(St) govt → Ration cards ! Beneficiaries Identificat^{n} ! Monitoring FPS
↓
Distribution - Ration Shops / FPS
↳ PDS Supplies ⇒ Pulses + Edible Oils + Salt & Spices
↳ Wheat / Rice / Sugar / Kerosene

Govt Schemes & Programmes

1) NFSA, 2013 ⇒ Subsidized Food Grains ⇒ 75% Rural + 50% Urban
   81 Cr People
2) ↓ Leakages
   ↑ Performance
3) ✓ 5kg / person / month @ ₹ 3/2/1 (R/W/CG)
   ✓ AAY : 35 kg / month ✓ ₹6000 maternity benefit
   ✓ Free Meals for Children (0-14 yrs)
2) PM-GKAY - Garib Kalyan Anna Yojana
3) PM-POSHAN Scheme
4) AAY - Antyodaya Anna Yojana
5) ONORC - 1 Nation 1 Ration Card
6) Social Audits

- Anna Chakra - designed by World Food Program
  ↳ smart algorithm to find the best transport routes
- SCAN System → Helps state claim Food subsidies easily under NFSA, 2013

+Ve Results of PDS

1) Food Security
2) Support the Vulnerables
3) Stabilizes Food Prices
4) Encourages Domestic Procurement
5) Supports Nutritional Needs
6) ↓ Regional Imbalances
7) Tech Reforms → Digitisation
   99.8% Ration Cards | 98.7% Individuals
8) ONORC

Challenges

1) Leakages & Diversion of Food grains
   HCES ⇒ 28% allocated → diverted
2) Ghost Benficiaries & Identity Fraud - 40 L
3) Storage Losses & Quality Degradation
   74 MnT of food | 22% Foodgrain o/p
4) Inclusion Error - PM-GKAY → 57% popul^{n}
5) Fiscal Burden & Budgetary Constraints
6) Nutritional Gaps -
   22 Cr Indians - Undernourished (FAO)
   80% Adolescents - Hidden Hunge (FAO)

Shanta Kumar Cmt Recommendations

1) Targeted Procurement
2) Decentralised Procurement
3) Pvt Sector Involvement
4) ~~Decentrali~~ Diversified Procurement Basket
5) Digital Mapping of FPS
6) GPS Tracking

Recent Reforms

1) Digitaliz^{n} & Real Time Monitoring
   eg. CHH - Annasathi
   ↳ 50% → 10% Leakage after reforms
2) Portable Benefits for Migrants
3) Modern Storage Infra
4) ONORC

Way Forward : Shanta Kumar Cmt / Wadhwa Cmt

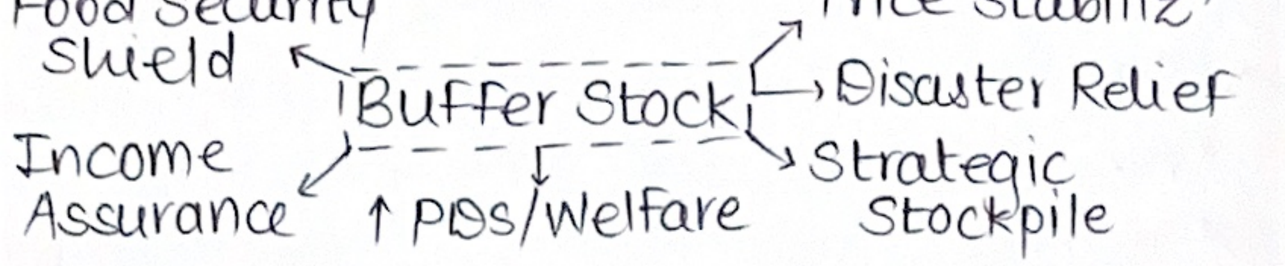
1) Smart FPS eg-TN - Biometric System
2) Capacity Building of FPS Dealers
3) Community Participation & social audit
4) Green & Sustainable FPS - RJ - Solar FPS
5) Grievance Redressal & Transparency
   eg. JH - Mera Ration App
6) Nutrition Focussed PDS
7) Improved Crisis Response
8) Collaborative Federalism

Case Study - CHH - Doorstep Delivery, Aadhar-based ePoS, Decentralised Procurem^{t}.

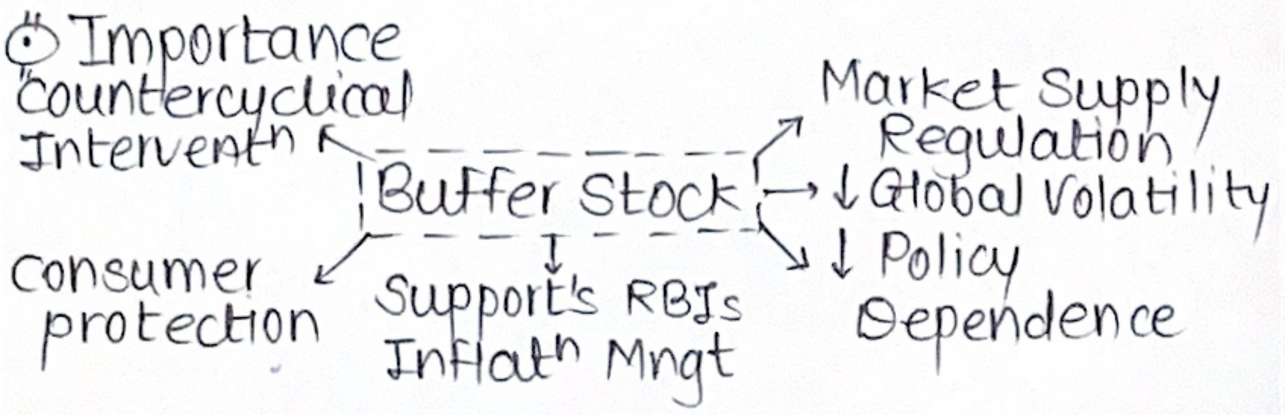
8. Issues Of Buffer Stock & Food Security

. Buffe Stock

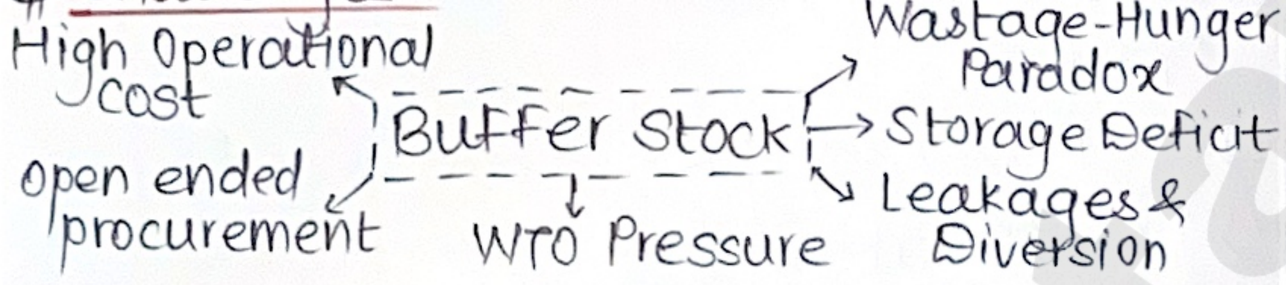
Need - Food Shock Absorber



Importance



Challenges



Goverment Steps & Buffer Norms

1) Buffer Norms (by GoI)
   - Operational Stock - TPDS/OWS
   - Food Security Reserve
2) OMSS → E-auction to Flour millers
   ↳ Bharat Atta & Bharat Dal
3) Storage Infrastructure Mission

Shanta Kumar Cmt → Shift in Food Procurement by FCI

1) Dicentralized Procurement
2) Revisiting MSP Incentives
3) Trade-MSP Alignment
4) ↑ Put Sector 5) Direct Cash Transfer

Way Forward -

1) Ashok Dalwai Cmt
   ✓ Integrated Agri-Logistics
   ✓ WDRA compliant godowns
   ✓ e-NWR Platforms
2) Policy & Tech
   ✓ Dynamic Buffer Norms
   ✓ Tech Integrat^{n}
   ✓ Cost mngt
   ✓ Expand Commodities
   eg ↳ TOP / SMP

. Food Security

Food & Nutritional Security - Current Statu

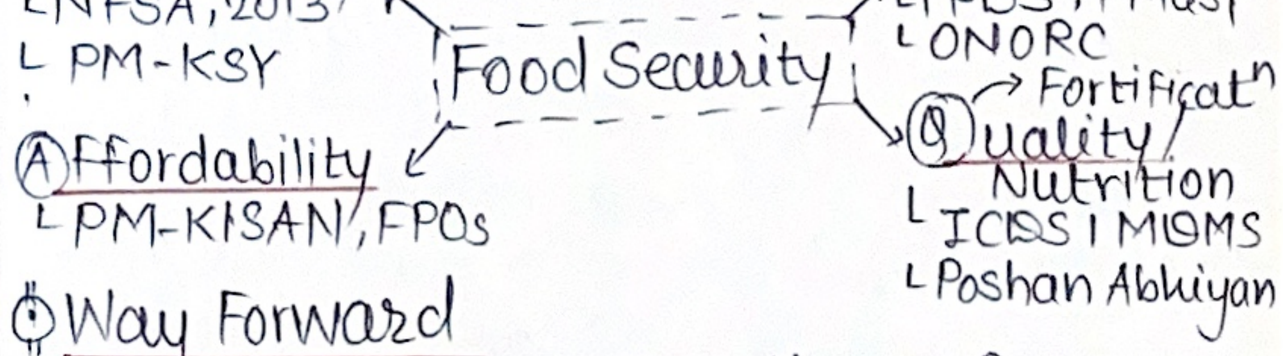
1) Global Hunger States / GHI = 102/123 = 25.8 serious
2) Burden of Undernourishment
   - 22 Cr - undernourished people
   - 25 % - World's undernourished popul^{n} } UN (2024)
3) Child Malnutrition
   NFHS-5 ⇒ 35.5 % Children ⩽ 5yr → Stunted
   19.3 % → Wasted 32.1 % → Underweight
4) Nutritional Deficiencies :
   20 % gap → Quality Protein Intake
5) HR Perspective : HR Measurement Initiative
   Only - 56.8 % of eco. capacity → Food Security

Need

1) Large Burden of Hunger & Malnutrition
   NFHS-5 ⇒ Triple Burden
2) Eco. vulnerabilities & Poverty
   NFHS-5 ⇒ 14.96 % popul^{n} → Multidimentionally poor
3) Nutritional Security for National Growth
4) ~~Struc~~ Agri Dependence & Rural Livelihoods
5) Strategic Importance & National Stability
6) Constitutional & Global Commitments
   [21], [SDG-2], UDHR, ICESCR
7) Climate Change & Resource Constraints

. Food Surplus & Hunger Paradox

4 Key Aspects of Food Security & Agovernment initiatives ⇒ AAAQ



Way Forward

1) ↑ Agri Resilience
2) Fortified Food
3) ↑ Efficiency - PDS
4) AI, Blockchain, Remote Sensing
5) Urban Agri
6) Zero Hunger Program
7) Dietary Diversity
8) Food waste Reduct^{n}
9) Best Practices
   ↳ Nutri Garden - OD

9. Technology Mission & Various Agriculture Revolutions

Some Technology Missions

1) TMOPM - Oilseeds, Pulses, Maize
- ✓ Cluster Demonstrations & Minikit Distribution
- ✓ Oilseed Hub Model → Decentralised Procuremat
- ✓ Integrated Pest Management
- ✓ Case Study - NMEO-OP ⇒ TS ⇒ 3x oil palm cultiv^{n}

2) NMSA - Sustainable Agriculture
- ✓ Micro Irrig^{n} - RAD → Dryland zone
- ✓ Agroforestry ✓ Climate Smart Villages

3) NMAET - Agri Extension & Technology
- ✓ Modern Farm Tech ✓ Training Support
- Case study: Bharat - VISTAAR - multilingual AI

4) TMC - Cotton
- ✓ HDPS - High Density Planting System
- ✓ BT-cotton ✓ Mechanised Harvesting
- CS → HDPS success in Nagpur (MH)
  - ↳ CICR → 40% yield increase

5) HMNEH - Horticulture Mission for North Eastern & Himalayan States
- ✓ Cold Chain Infra ✓ Potected Cultivat^{n}
- ✓ Tissue Culture ↳ Polyhouses/Nethouse
- ✓ Case Study - Kiwi Export Chain - AR

6) MIDH -
- ✓ ↑ Prod^{n} & Quality ✓ cold storage, supply chain
- ✓ Case Study - Jalgaon Banana Cluster

Updates - ES
1) DAM - Digital Agriculture Mission - DPI
2) SMAM - Sub-Mission on Agri Mechanisation
3) National Mission on HY Seeds
4) SMAE - Sub-Mission on Agri Extension
5) NMEO - OS & NMEO - OP

Green Revolution
HYV Seeds | Irrigation | Credit Access | Mechanis^{n} | Chemical Fertilisers & Pesticides

+ve Impacts
1) Food Grains Prod^{n} 72 MT → 357.7 MT
2) ✗ Famines
3) ↑ Rural Income
4) ↑ Agro-Industrial Growth
5) Scientific Agri
6) ↑ Agri o/p
7) ↑ Irrig^{n} & Mechanisat^{n}

-ve Consequences
1) Eco. Inequality
2) Social Exclusion
3) Institutional Failure
4) Regional Disparities
5) Land Use Disparities
6) Rice Wheat Monoculture
7) Enut Degradation
8) ↓ Ground Water
9) Stuble Burning

Green Revolution 2.0 (Evergreen Revol^{n})

Need -
1) Climate Volatility
2) Environmental Unsustainability
3) Low Productivity
4) Market & Price Instability
5) Nutritional & ecological concerns
6) Crop Diversification
7) Post Harvest Mngt
8) Tech Integration

Key Aspects
1) Climate Resilience → CR Dhan 804
2) Nutritional Security → Madhuprabha (Wheat)
3) Precision Farming → Namo Drone Didi
4) Diversification → Mera Pani Meri Virasat
5) Integrated Farming (IFS) → Rice-Fish-Poultry Model
6) Eco-Friendly i/ps → BPKP
7) Eastern India Focus → BGREI

Way Forward
1) Adopt One Health & Climate-Smart Practices
2) R & D 3) Educate & Empower Farmers
4) ↑ Co-operatives & Supply chains
5) Data-Driven Governance

Various Revolutions -
1) Golden → Horticulture, Honey, Fruits
   'Sweet Revolution' | MIDH & NBHM
2) Blue → Fisheries & Aquaculture | Rank ②
   PMMSY (20K Cr) & FIDF
3) Pink → Meat, Poultry & Prawns
   AHIDF | NLM - National Livestock Mission
4) Silver → Eggs & Poultry | Rank ③
   NLM | PVCF - Poultry VCF
5) Grey → Fertilisers & Wool
   PM-PRANAM, Nano-Urea/DAP, SHC
6) Yellow → Oilseeds → NMEO-OP & NMEO-OS
   ① → Largest Edible Oil Importer (60%)
   → Largest Edible Oil Consumer
7) Round → Potato : TOP to TOTAL
   PM-FME (Micro Food Processing Enterprises)
8) Red → Meat & Tomato → Op Greens
   Specialised Export Clusters under APEDA

⊙ Jute- The Golden Fibre

✓ 15 Tonne CO_2 Sequestrat^n/Hectare

1) Mandatory Usage via JPM Act, 1987
90% - Food Grains 20% - Sugar

2) MSP & JCI Procurement : 4 Mn Farmers

3) Jute - ICARE Program

- Challenges - Synthetic Fibre | Labour Intensive | Outdated Tech | Bangladesh Climate Change eg - Cyclon → 25% Harm Limited Usage

⊙ Grey Revolution → Fertilisers

Ship to Mouth Surplus | NPK → 4:2:1 (8:3:1)
PB → 23:6:1

⊙ Present Steps

1) Boosting Domestic Production
✓ Record Prod^n → 525 Lakh Tonnes (2025)
✓ Urea Self Sufficiency
✓ Strategic Diversification - 5yr LTA

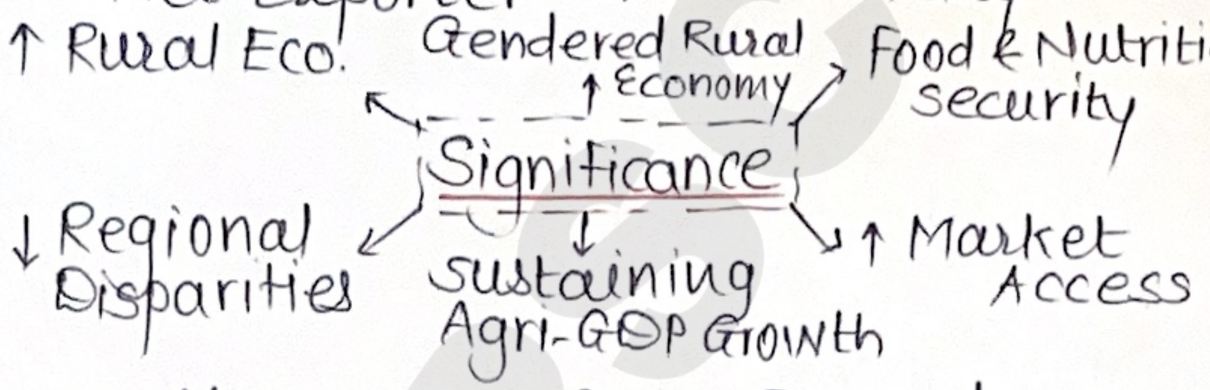
2) Efficiency through Nano-Fertilizers
Nano Urea | Nano Urea + | NANO-DAP
Urea Gold - Sulphar Coating

3) Sustainability & Policy (PM-PRANAM)
✓ Financial Incentives
✓ NBS - Nutrition Based Subsidy

⊙ White Revolution 2.0 (2024) by MoCo-op^n

✓ 1007 Lakh kg/day milk procurement (2028-29)
✓ Cover underserved states

India - Rank 1 ⇒ Global Milk Prod^n (25%)
↳ Dairy - Largest Agri Product
↳ 5% to National Economy | 8Cr Farmers
↳ Net Exporter ↳ 250 MT/day



⊙ Challenges

1) ↓ Milk GR
6.47% → 3.78%
2) Poor Animal Productivity
3) Low Credit
4) Diseases
5) Feed & Fodder Deficiency

⊙ Way Forward

1) ↑ Organised Milk Procurement
2) Breed Dev^t & AI Coverage
3) Feed Security
4) Value Add^n & Branding
5) Policy & Fiscal Support

10. Economics of Animal Rearing

⊙ Current Status of Livestock Sector

Livestock Demographics -
Bovine : 304 Mn | Goat : 149 Mn
Sheep : 75 Mn | Pigs - 9.06 Mn | Poultry - 851

- Livestock Sector Growth (Es)
CAGR : 12.99% @ Constant Prices
Share in Agri GVA - 30.23%
Livestocks - Rural Moveable Assets
- Shock Absorber for Rural Income

⊙ Significance of Animal Husbandry

1) Income Security : Living Bank for Farmers
77% Rural Households - (NSSO, 77th Round)
2) Employment : Highest Women & Labour Intensive ⇒ Feminisation
3) Nutritional Support ⇒ ↓ Hidden Hunger
4) Drought : Power & Transport
5) Waste Utilisation & Energy Production
6) Socio-cultural Functions -
Symbolic role in religious functions

⊙ Key Challenges

1) Persistently Low Milk Yield (Nearly 50%)
2) Credit Bottlenecks & Fin. Disincentives
Only 3.5% total agri credit
3) Lack of Organised Market Access
4) Fodder Shortage
5) Disease Surveillance Gaps & Veterinary Shortfall
↳ 1 : 6000 Livestock against 1 : 1000 (FAO)
6) Poor Quality Testing & Inadequate Processing Infra
7) AMR → Impact on Milk

⊙ Key Govt Initiatives

1) NADCP - National Animal Disease Control Program - FMD & Brucellosis by 2030
2) NLM - National Livestock Mission
3) RGM - Rashtriya Gokul Mission
4) NAIP - National Artificial Insemination Program (20k Bovines/dist)
5) AHIDF - Infra Development Fund

⊙ Way Forward
1) Breed Conservation + ↑ Productivity
AI (Artificial Inseminat^{n}) + IVF
2) ↑ Veterinary Infra & Disease Surveillance
3) ↑ Agri-Markets via Digital Platforms
eg.- FPOs, eNAM integrat^{n}, ONDC

Fisheries Sector : Sunrise Sector

⊙ Economic Value
- Contributes 1.09% to India's Total GVA & 6.7% to Agri GVA

⊙ Significance & Strategic Importance
1) Food Security
2) Nutritional security → Animal Proteins & micronutrients, Omega 3
3) Livelihood generation → 30 Mn People
4) Blue Economy, Mariculture, Seaweed farming, eco-tourism
5) (I) → World's Top shrimp exporter
Seafood Exports > ₹60,000 Cr
6) PM-MSY → +55 Lakhs by 2025

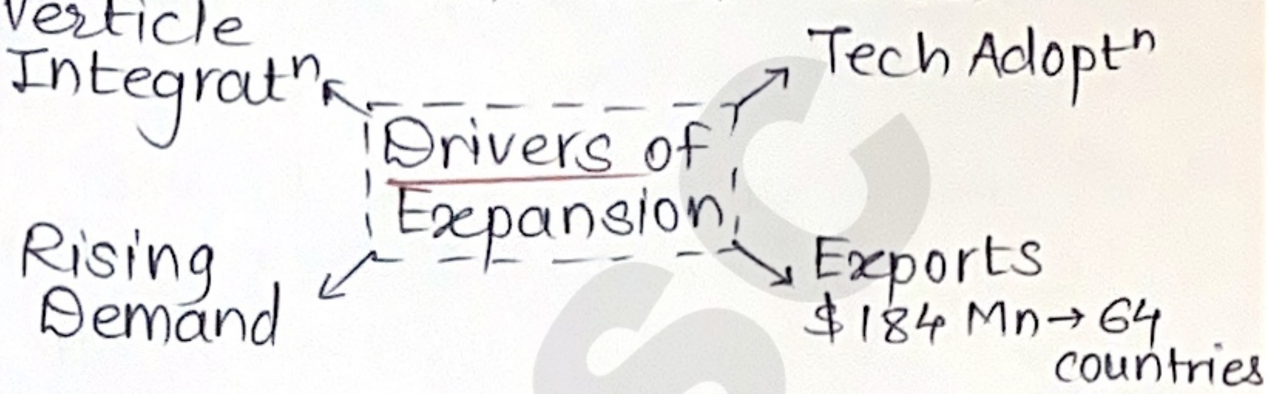
⊙ Challenges
1) Marine Capture Fisheries - Overexploitat^{n}
└ Outdated fishing practices
2) Inland → Seasonal, degraded natural stock, tenure insecurity, outdated tech
3) Aquaculture → Credit Barriers
Only 4.76 Lakh KCC, Inadequate Infra
X Trained workers/Extension Workers
4) Cross Sectoral : IUU Fishing ⇒ 16-35%
5) Cold Storage & Logistic Gaps

⊙ Govt Schemes & Interventions
1) PM-MSY → 220 Lakh MT by 2025
2) Blue Revolution - Neel Kranti
3) Aquaculture Infrastructure Devt Fund
4) National Marine Fisheries Policy (2017)
5) KCC for Fishers

⊙ Way Forward
1) Legal/Insti. reforms
2) Species-specific Fishing Vehicles
3) R&D, Disease Resistance Breeds
4) Cold-chains, processing hubs, Traceability
5) ↑ International Competitiveness
6) Meena Kumari Committee
- Climate Resilient Rice-Fish Farming in Assam (NITI Best Practices)

Poultry Industry in India

⊙ Industry Scale & Significance
✓ Global Positioning ⇒ #3-Eggs; #5-Chicken
✓ Market Size : ₹2100 Bn in 2023
CAGR OF 8.9% (2024 → 2032)



⊙ Challenges
1) Fluctuations in Feed Cost
2) Animal Welfare
3) Waste & Biosecurity Issue
4) Disease Threats - avian influenza

⊙ Govt Schemes
1) Mega Food Parks & Cold Chain Scheme
2) 100% FDI & Tax Breaks - 100% - 5 yrs
3) Biosecurity & Export Support
WOAH notifications, AI Surveillance, AI-Free compartments

⊙ Way Forward
1) E.O.D.B
2) Envtl & Welfare Compliance - Orage norms
3) Food Security → Legalised GM Feed imports
4) Consumer Awareness - One Health Messaging

Impact Of Climate Change on Livestock

1) Heat Stress ⇒ ↓ Feed intake, ↓ Milk Yield ↓ Fertility (may 0%)
2) Pasture Availability
10-40% decline by 2050 (ICAR)
3) Disease Patterns ⇒ 52-84% variations in FMD (ICAR)
4) Aquaculture Impact

⊙ Impact of Livestock on Climate (↑GHGs)
Livestock → CH_4 | Waste & Feed → N_2O
Meat Prod^{n} → 18-25% global GHG (UNEP)

⊙ Best Practices & Innovations
1) Climate Resilient Shelters
2) Precision Livestock Farming
3) Genetic Selection
4) Manure Biorectors
5) Drought Adopted Fodder Crops
└ Stylosanthes, Napier Hybrid

11. Food Processing Sector in India

"Sunrise Sector"

2 Categories -
i. Primary Food Products
ii. Secondary Food Products

Data & Numbers - ES
1) Total Valuation ⇒ $400 Bn
2) Contributes → 18% to Agri GVA
3) Share of Processed food exports in agri food exports → 20.4%
4) Largest employment providers in the organised manufacturing sector (12.83%)
5) Total agri-food exports → $50 Bn (2025)
6) (I) processes only 10% of agri o/p
7) 25-Lakh - unorganised & unregistered micro foods processing enterprise
8) Govt Target ⇒ 1.1 Trillion $ by 2025
9) Annual Growth Rate ⇒ 7.5 %

Scope of Food Processing in India
1) Agro-climatic diversity → yr round varities
2) Large Agri Base → Input availability
3) Expanding Market
Ready to Eat (RTE) ⇒ 12% annual GR
4) Export Potential : Share of processed food in agri-export ⇒ 23.4% (2023-24)
5) Technological Advancement
6) Policy Support - PM-KSY | PM-FME
PLI Scheme | Op-Greens | 100%-FDI
Mega Food Park Scheme

Significance of Food Processing
1) ↓ Post Harvest Losses ($13 Billian)
2) Employment Generation
3) Doubling Farmers' Income
4) Boost to Exports
5) ↑ Food Security - Mega Food Parks
6) ↑ Nutritional Security
7) Linking Agri with Industry
eg. Sanchi Mega Dairy Plant (MP)
8) Favourable Geography
Largest area of arable land after USA
9) Changing Lifestyles (RTE - 58% ↑ in 2024)
10) Retail & E-commerce Boom
11) Govt Support

Govt Initiatives -
1) Infrastructure & Value Chain Develop^{t}
✓PM-KSY ✓MFP Scheme ✓Op-Greens
2) Support for Micro Enterprises
✓PM-FME ✓ODOP
3) Boost to Domestic Manufacturing & Branding → ✓PLIS-FPI
4) Investment Promotion & Ease of Business
✓100% FDI - Automatic Route
✓Lowest GST Rates @ 0% or 5% (M.FPI)
✓Revised ~~PL~~ PSL Norms
✓Spl. Food Processing Fund - 2000 Cr ₹ NABARD
5) Policy & Market Access
✓National Food Processing Policy
✓FSSAI → Global Food Regulators Summit

Case Study
1) Kerala's KERA Project for Agri-Food MSME
2) GAURA SHG - Food Processing - UK
└ NITI Best Practices

Upstream & Downstream SCM
Upstream ← Pre-processing | Downstream → Post-processing

Suppliers → i/ps → Procure → Produce → Distribute → Customers
↑ Feedback / Info Flow

Upstream Supply Chain - Farm to Factory Requirements -
1) Accessibility to Raw Materials
2) Modern Extraction Techniques
eg - Supercritical CO_2 extraction
3) Good Linkage with Farmers
eg PepsiCo's collaborative farming model
4) Storage facilities for Raw Materials
eg. Silo complexes for Wheat - MP & IGF
5) Quality Testing Facilities - Milk Collection
6) Transport Facilities eg Reefer Trucks
7) Workforce eg Trained Technicians

Downstream Supply chain - Factory to consumer
1) Processing & Packaging
2) Distribution Challenges
3) Quality Testing Facilities eg NFLs
4) Marketing & Retailing
5) Consumer Interface eg D-Mart

Opportunities in Food Processing Sector

1) Integrated Cold Chain → Ice-Block Cooling
2) Quick-Commerce Logistics → Dark Stores
3) Digital Traceability → Farm to Fork
4) Plug & Play Clusters
5) Supply Chain - RTC pre cut veggies

Challenges -

A) Upstream -

1) Fragmented Land Holdings
2) Inadequate Cold Chain Infra
3) Poor Primary Processing Facilities
4) Insufficient Aggregation Mechanisms
5) Post Harvest Losses
6) Other Agri-Issues. eg-Irrigation etc

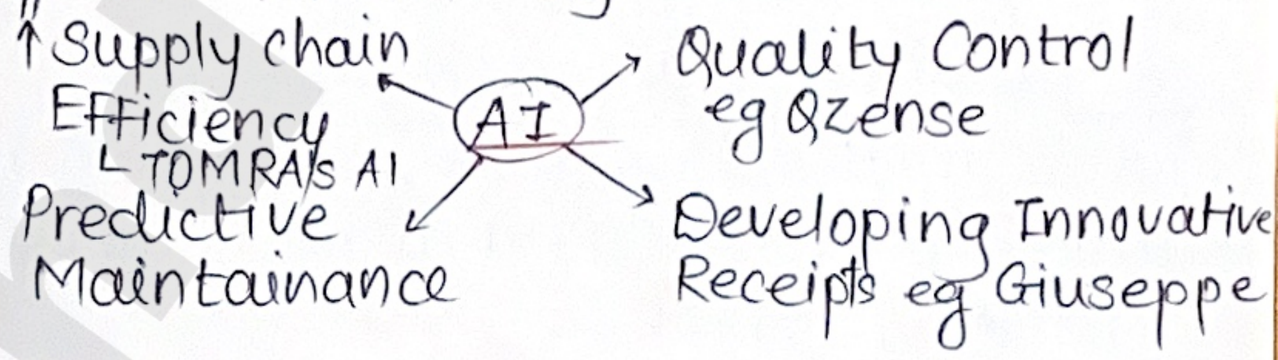
B) Downstream

1) Weak Market Linkage
2) Limited Access to Modern Retail & Export Markets
3) Complex Regulatory Environment
4) Low Access to Finance
5) Technology Gaps : R&D (0.64% of GDP)
6) Unorganised Sector Dominance - Nearly 60%
7) Changing Consumer Prefrences
8) Thin Margins & Price Sensitivity
9) Food Safety & Quality Issues
10) Waste Management Issues

Way Forward

1) Augment Infra (F2F) ⇒ AIF
2) Formalisation & Promotion of Micro Enterprises ⇒ PM-FME
3) Skilling & Capacity Building eg. NIFTEM & IIFPT
4) ↑ Research & Innovation Ecosystem eg GoodDot & Blue Tribe Foods
5) ↑ Export Competitiveness eg. Nashik Grape Clusters
6) Digitalizath of Supply Chains eg. eNAM
7) EoDB & Regulatory Simplification eg FSSAI's Eat Right India
8) ↑ Agro Processing Clusters & Decentralised Models eg CHH

Role AI Can Play



Case Study - AMUL - Model of Inclusive Food Processing.

12. Land Reforms

Objectives -

1) Enhance Agri-Productivity
   - ✓ Tenants Lacked Ownership x
   - ✓ ↓ Insecurity & High Rent
   - ✓ Replace Archaic Structures
   - ✓ Gunnar Myrdal & K. Raj
     - ↳ Insti. Reforms are more crucial
2) Social Justice
   - ✓ Zamindari Abolition ✓ Ceiling on Land
   - ✓ Tenancy Reforms ✓ Protect land Rights
3) Catalyst for Economic Development
   - ✓ Removal of Intermediaries
   - ✓ Integrated Development ← FYP
4) Improve Rural Living Standards
   - ✓ Redistribute income & land resources
   - ✓ Integrated rural upliftment

Post Independence Steps Towards Land Reform

A. For Refugee Farmers
- ✓ Resetted E. PB on vacated lands
- ✓ Initial Land Allotment (4 Hectares)
- ✓ Support through credit

B. Congress's Eco. Program Committee (1947)
- ✓ Eliminate Intermediaries
- ✓ Impose Land ceilings
- ✓ Pilot co-operative farming models
- ✓ Consolidate Fragmented land holding

Zamindari Abolition

Salient Features of Abolition Acts
1) Ownership Transfer
2) Common Resources
3) Direct Taxation
4) Self-Cultivation Clause
5) Tenant Rights

Achievements
1) 1.7 Cr Hectars → 2 Cr tenants
2) ↓ Begari & Bonded Labour
3) Modernisation
4) ✓ DPSPs - Art 38, 39, 48
5) PC → 20 Mn Tenants → Direct relations with govt

Shortcomings
1) Poor Documentatation
2) Delayed Implementation
3) 'Personal Cultivation' Loophole
4) Neo-Zamindari
5) No-Benefits to Ryotwari Areas
6) Benami Transfers

Ceiling on Land Holdings - Max Limit
1) Obj → Identify & redistribut 'Surplus Land'
2) Surplus Lands
   ↳ Landless, marginal farmers & tenants
   ↳ Village Panchayat or co-op. farming groups
   ↳ Equitable Access

Justification
✓ Prevent Monopolisat^{n} ✓ Empower Tenant
✓ Protect Small Cultivators
✓ Prevent - Neo-Zamindars

Equity

Benefits
Achievements

Productivity
Employment
Pol. Evolution
Social Harmony

Constitutional Reinforcement
(34th Amendment, 1974)
↳ Ninth Schedule via Art 31-B

Challenges
1) Implementation Gaps
2) UP Case (Fertile lands retained by elite)
3) Limited Redistribution
4) Administrative Apathy
5) Lack of political will

Long Term Impacts -
1) Rural Land Market Stagnation
2) Land Fragmentation
3) Low Productivity
4) Unfinished Transition

Tenancy Reforms in India

5 Major Elements -
1) Right to Lease
2) Right to Resume Cultivation
3) Protection from Eviction
4) Rent Regulation
5) Right to Voluntary Surrender
6) Right to Ownership

Challenges & Limitations
1) Delayed Legislation
2) Oral Tenancies
3) Elite Capture
4) Bureaucratic Apathy
5) Judicial Delays
6) Political Apathy

Socio-Political Impacts
1) Rise of New Rural Politics
2) Social Justice Gains
3) Economic Transformation

Consolidation of Land Holdings

Need
1) Dispersed Ownership
   ↳ Small & scattered land holdings
   Avg ⇒ 2.28 (Ha) (1970-71) ⟶ 1.08 (Ha) (2021-22)
2) Operational Difficulties
3) Barrier to Mechanisation
4) Emerging Sectors

Advantages
1) Sci. & modern farming methods eg. -sprinkle
2) ↓ Operational inefficiencies & transport^{n} costs
3) ↓ Boundry Land Wastage & Disputes
4) Surplus Land → Rural infra
5) ↑ Long-term Land Improvements

Challenges - 1) Cultural Attachments
2) Elite Resistance 3) Informality
4) Quality Variation 5) Administrative Bottlenecks
6) Misuse of Real Estate Gains

Contract Farming & Land Leasing

⊙ Advantages-
1) Assured procurement
2) ↓ Credit Market failure
3) Tech Transfer
4) Integrates Farmers into global value chain through quality standardisatⁿ & traceability

⊙ ~~Advantages~~ Concerns-
1) Monopsony like conditions
2) Hold-up risks - Rejection Episodes
3) ↑ crop shift toward water intensive cash crops
4) Weak legal safeguards & dispute-resolutⁿ

⊙ Land Leasing
· Advantages -
1) ↑ Economies of Scale
2) ↓ Land Market Failure
3) Supports reverse tenancy
4) Enables FPO-led Collective Cultivation
5) Legal Recognition & institutional credit access to tenant farmers

· Concerns
1) Adverse possesions → tenant insecurity
2) Consolidated mechanised farms
   ↳ Agricultural labour displacement
   ↳ ↑ Disguised unemployment
3) Speculative corporate control & diversion of farmland towards non-agri purposes

Bhoodan Movement
(Voluntary Land Donation)
1951- @ Pochampalli, AP → Zamindars gifted land to Vinobha Bhave
✓ Gandhian ethics of trusteeship

⊙ Mechanism
1) Organisation Hierarcy - Sarvoday Samaj
2) Padayatras
3) Land Titling
4) Beneficiary Selection
5) No Cost to Beneficiaries

Gramdan : Collectivised Rural Living
Gandhi → Communal Cultivation & Egalitarian Rural Society

⊙ Structure
✓ Land ownership → Gram Sabha
✓ Committee Decisions

⊙ Success & Challenges
1) Thrived in tribal & egalitarian villages
2) Less effective in socially stratified or commercially-oriented rural settings

Regional Variations in Success & Failure of Land Reforms in India

⊙ Successful Stories-
1) Kerala - Near total abolition of landlordism
2) WB → Operation Barga

⊙ Mixed Success
1) PB / HR - Large Landowners → Benami
2) Western UP - Middle Peasantry but landless remained landless

⊙ Failure -
1) BR → Land Wars
2) MP → High instances of Benami Transfers

Land Reforms 2.0
Physical Redistribution → 21st century digital empowert & legal certainty

⊙ Need
1) ↑ Landlessness & Inequality
   Top 10% own over 50% agri land
   Bottom 50% own less than 5%
   - Indian Land & Development Conf. (2023)
2) Poor Land Records & Titling Issues
   DILRMP ⇒ only 66% land records → updated & digital
3) Fragmentatⁿ of Land Holding (1.08 Ha)
4) Low productivity & Land Use Efficiency
   25 Mn Cultivable land → Fallow (MoAFW)
5) Women's Land Rights ⇒ < 13% land holdings

⊙ Key Components
1) ULPIN (Bhu-Aadhar)
2) SVAMITVA Scheme (Use of Drones)
3) NLRMP → DILRMP (sector)
4) NGDRS → National Generic Documentⁿ System → 1 Nation 1 Registⁿ Software
5) Conclusive Titling
6) Revenue Court Management (RCCMS)

⊙ Targets-
1) Digitalisation & Conclusive Titling
2) Liberalising Tenancy laws
3) Land Ceiling Review & Redistribution
4) Land Consolidation & Pooling
5) Gender-Sensitive Land Ownership
eg.-OD- Patta in her name policy

⊙ Computerisation of Land Records
• Need-
1) Equity in Land Reforms
2) Reduced Legal Conflicts
3) Boost to Investment
4) Transparency & Accountability
5) Administrative Efficiency

• Challenges-
1) Linguistic diversity limits rural usability
2) Low digital literacy & awareness
eg. NASSCOM: Indian digital literacy rate = 37%
3) Outdated Cadastral records
4) Fragmented governance
5) Weak digital infra

• Some States Successes
1) KA - Bhoomi 2.0 & Parihara
2) MH - Mahabhulekh & E-Chavadi
3) TS - Dharani Portal
4) UP - UP Bhulekh & Varashat
5) TN - Land Stack Pilot (2026)
6) MP - MP Bhulekh

• Way Forward-
1) Integrated Digital Platforms
2) Community Participation
3) Regular updates & tech use
4) Dispute Resolutn Portals
5) Strengthen Legal Backing
6) Support for Customary Rights

⊙ Land Pooling
⊙ Core Feature- Ownership remains with titleholders
⊙ Delhi: A Model in Land Pooling
↳ Delhi Development Act, 1957
✓ Participants → A share of serviced developed land

⊙ Key Advantages
1) Owners receive a share of developed land
↳↑ Asset value & utility
2) Bypass acquisition process
3) Unlocks larger, contiguous tracts
4) ↑ PPP
5) ↑ Planned Urbanisation

⊙ Challenges-
1) Owner Resistance
2) Implementation Lag → Unplanned Growth
3) Urban Constraints
4) Time Lag Returns
5) Co-ordination Issues

⊙ Conclusion & Policy Outlook
1) A forward looking alternative
2) A win-win solution
3) Centre, under the concurrent list powers (Entry 42), should encourage progressive phase out of traditional acquisition.

⊙ Tech & Land Reforms 2.0
1) Blockchain
✓ Immutable Title History
✓ Prevention of Benami Transactions
2) AI
✓ Automated Boundry Detection
↑ High Resolution Drone Imagery (SVAMITVA scheme)
✓ Dispute Analysis eg- Bharat Vistar
3) Drones
✓ Cadastral Maps & Land Surveys.