Q.1) How has the Pradhan Mantri Krishi Sinchayee Yojana promoted the adoption of micro-irrigation in India? Examine its role in improving water-use efficiency in agriculture. (150 words, 10 marks)

Introduction

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), launched in **2015**, is a centrally sponsored scheme that promotes **irrigation efficiency** and coverage through convergence of resources under **"Har Khet Ko Pani"** and **"More Crop Per Drop"**.

Body

Features of PMKSY

1. **Funding Pattern:** Centre–State share of **75:25** (**90:10** for NE and hill states).
2. **Major Components:** AIBP, Har Khet Ko Pani (HKKP), and Watershed Development.
3. **Amalgamated Approach:** Consolidates AIBP, IWMP, and On-Farm Water Management.
4. **Digital Monitoring:** Mobile app launched in **2020** for geo-tagging of project components.
5. **Farmer Inclusivity:** Aims to benefit **22 lakh farmers**, including SC and ST communities.

Role in Promoting Micro-Irrigation

1. **Incentivising Adoption:** PMKSY gives financial and technical help for drip and sprinkler systems, which helped bring over **72 lakh hectares** under micro-irrigation till **2023**.
2. **Convergence of Resources:** Micro-irrigation is supported through **district-level planning** linked to watershed projects under PMKSY.
3. **Enhancing Infrastructure:** PMKSY builds ponds, repairs canals and water bodies that make it easier for farmers to adopt micro-irrigation systems.
4. **Farmer Training and Awareness:** PMKSY trains farmers in **water-saving methods** using KVKs and on-field support, especially under the **Command Area Development program**.
5. **Precision Technology Promotion:** N**ABARD's Micro Irrigation Fund** under PMKSY supports modern tools like sensors and timers for water-efficient farming.

Role in Improving Water-Use Efficiency

1. **Reduced Water Wastage:** Drip and sprinkler systems reduce runoff and water loss; in **Maharashtra**, sugarcane farms saved up to **40%** water.
2. **Enhanced Crop Yield:** Efficient watering under micro-irrigation raised crop yields by **20–25%** in states like **Karnataka**.
3. **Groundwater Recharge:** Structures like **check dams** and trenches under PMKSY help refill groundwater.
4. **Drought Resilience:** Micro-irrigation ensures crops survive dry spells, seen in drought-hit regions like **Vidarbha and Marathwada**.
5. **Urban Wastewater Reuse: Ministry of Jal Shakti** has created a framework for using treated wastewater in farming, though no PMKSY project has used it yet.

Challenges

1. **Implementation Gaps:** Delays at the **state level** in planning and using funds.
2. **Limited Awareness:** Many farmers, especially in **dry areas**, are still unaware of micro-irrigation benefits.
3. **Monitoring Shortfalls: Ministry of Jal Shakti (2023)** reported that **some states** missed targets due to **weak coordination**.

Way Forward

1. **Expand NABARD's Micro Irrigation Fund:** Make it easier for small farmers to access funds.
2. **Mandate Micro-Irrigation for Select Crops:** Promote drip and sprinkler use for water-heavy crops in dry areas.
3. **Swaminathan Commission:** Increase public spending on water projects and improve groundwater recharge.
4. **Dalwai Committee:** Focus on efficient irrigation and make micro-irrigation a core policy.

Conclusion

PMKSY has laid the foundation for **sustainable irrigation** and efficient water use, contributing significantly to the goal of **sustainable agriculture** and the achievement of **SDG-6** in India.

Q.2) Agricultural marketing in India faces structural challenges. How far has the e-NAM platform addressed these issues? Highlight its achievements and limitations. (150 words, 10 marks)

Introduction

Agricultural marketing includes **all activities that facilitate the movement of farm produce from producers to consumers**. In India, agriculture marketing faces several hurdles. The **e-NAM** platform, launched in **2016**, seeks to address these challenges digitally.

Body

Structural Challenges in Agricultural Marketing

1. **Fragmented Market Access:** Farmers sell mostly in local mandis, limiting price discovery; the **Dalwai Committee** noted this restricts competitive pricing.
2. **APMC Restrictions:** Interstate trade and private markets are limited due to state laws; the **2013 Agri Marketing Reforms Committee** flagged this as a major barrier.
3. **Middlemen Dominance:** Agents decide prices and extract commissions; **the Shanta Kumar Committee** highlighted their negative impact on farmer profits.
4. **Poor Infrastructure:** Many mandis lack storage, weighing and grading; **NITI Aayog** stressed modern infrastructure for better marketing.
5. **Low Digital Literacy:** Many farmers don't know how to use digital platforms; the CMs' Sub-Group (2015) pushed for digital training.
6. **Inadequate Market Information:** Real-time data on prices and buyers is missing; the DFI Committee (2017) recommended better ICT tools.

Key Features of e-NAM

1. **Online Trading Platform:** Connects APMC mandis for transparent online bidding and trading.
2. **Unified Licensing System:** Enables one license to trade in multiple mandis.
3. **Quality Assaying and Logistics Support:** Offers digital weighing, grading, and payment facilities.

How e-NAM Addresses Structural Issues

1. **Expands Market Reach:** Lets farmers sell across mandis and states, as supported by the **Dalwai Committee** for price discovery.
2. **Reduces Role of Middlemen:** Direct farmer-trader links improve prices, in line with **Shanta Kumar panel's** recommendations.
3. **Improves Transparency:** Real-time price updates and online payments reduce manipulation.
4. **Boosts Infrastructure Use:** Promotes grading, assaying, and better logistics through digital tools.

Achievements of e-NAM

1. **Wider Integration:** Over **1,300** mandis and **1.75 crore** farmers onboarded by **2023**.
2. **Digital Payment Push:** Nearly **65%** of trades settled through online payments.
3. **Increased Price Realisation:** Farmers report **15–20%** higher returns in e-NAM mandis.

Limitations of e-NAM

1. **Partial State Participation:** Some states haven't reformed APMC laws fully for e-NAM rollout.
2. **Inadequate Infrastructure:** Many mandis still lack labs, internet, and trained staff.
3. **Low Farmer Usage:** Many farmers prefer old methods due to habit and lack of trust.

Way Forward

1. **Full APMC Reform:** States must amend laws to allow open trade, as advised by the **Model APMC Act** and **Dalwai Committee**.
2. **Farmer Training and Incentives:** Improve awareness and reward digital platform use.
3. **PPP in Mandi Infrastructure:** Private investment should improve logistics and quality checks, as **NITI Aayog** suggests.

Conclusion

While **e-NAM** has improved **transparency and market access**, structural reforms like the now-repealed **farm laws are essential** to make agricultural marketing truly farmer-centric and future-ready.

Q.3) How can digitisation and e-technology transform Indian agriculture? Discuss their role in enhancing farmers' income along with key challenges and recent initiatives. (150 words, 10 marks)

Introduction

Digital agriculture, as per **FAO**, uses digital technologies to **enhance productivity** and **sustainability**. The **WEF** highlights its potential to double farmer incomes. In India, it can transform agriculture through efficiency, better access, and resilience.

Body

Role in Enhancing Farmers' Income through Digitisation and E-Technology

1. **Input Optimisation:** Technologies like **AI and IoT** help farmers use fertilizers, water, and seeds efficiently, reducing costs and increasing returns.
   Example: AI-based sowing advisory systems by **Microsoft and ICRISAT**.
2. **Precision Farming:** Satellite imagery, GIS, and drone monitoring allow for timely interventions and improved crop health.
   Example: **YES-TECH system** for yield estimation at Gram Panchayat level.
3. **Better Access to Credit and Insurance:** Digital platforms integrate farmer databases with banks and insurance providers for faster services.
   Example: **Kisan Rin Portal** ensures streamlined loan and subsidy tracking.
4. **Improved Market Linkages:** Platforms like **e-NAM** help farmers get better prices through wider reach and transparency.
5. **Climate Resilience:** Real-time weather data and early warnings help farmers adapt quickly to weather shocks.
   Example: **WINDS system** provides actionable weather insights.
6. **Empowered Governance:** Frameworks like **IDEA** help create integrated databases for targeted delivery of welfare schemes.

Key Challenges in Digital Agriculture

1. **Digital Illiteracy and Fraud:** Many farmers lack digital literacy and fear online fraud, leading to hesitancy in adoption.
2. **High Initial Cost:** Advanced tools require capital investments, making them inaccessible to small and marginal farmers.
3. **Fragmented Landholdings:** Smaller farm sizes make implementation and scalability of technologies difficult.
   Note: As per **Agriculture Census**, average holding shrank from **2.28 ha (1970–71)** to **1.08 ha (2015–16)**.
4. **Nascent Agri-Tech Ecosystem:** India has **less than 1%** Agri-Tech start up penetration, limiting innovation and outreach.
5. **Infrastructural Deficits:** Rural areas often lack reliable electricity, internet, and service support systems.
6. **Poor Content Design:** Lack of local language options, simple UI, and granular farmer-level datasets reduce effectiveness.

Recent Government Initiatives

1. **Advanced Data Platforms:** Unified Portal for Agricultural Statistics **(UPAg)** enables crop and land data management.
2. **Credit and Subsidy Integration: Kisan Rin Portal (KRP)** links banks, farmers, and government for seamless service delivery.
3. **Weather Intelligence: WINDS system** provides weather-based farming advisories for better preparedness.
4. **Digital Public Infrastructure:** In the **Union Budget 2023–24**, the government announced creation of an open-source digital public infrastructure to support crop planning, credit, insurance, and market intelligence.
5. **Digital Extension Services:** National e-Governance Plan in Agriculture (**NeGP-A)** promotes ICT-based agricultural service delivery.

Way Forward

1. **Affordable and Inclusive Innovation:** Encourage plug-and-play tools and shared models for cost-effective access to technology.
2. **Capacity Building:** Train farmers in using e-tools and protect them from digital frauds through awareness campaigns.
3. **Agri-Tech Ecosystem Support:** Facilitate incubators, funding, and **PPPs** to promote scalable Agri-Tech Start-ups and regional solutions.

Conclusion

Digitisation, as reaffirmed in the **G20 Delhi Declaration**, is key to inclusive farm growth. Along with enabling policies and reforms like the repealed farm laws, digital tech can redefine Indian agriculture for the better.

Q.4) Indian agriculture faces a dual challenge of boosting productivity while ensuring sustainability. In this context, discuss the need for crop diversification and the policy support required to promote it. (250 words, 15 marks)

Introduction

India's agriculture must increase productivity while conserving natural resources. The **FAO** notes that **unsustainable practices** threaten long-term output. In this context, crop diversification offers a path toward balanced, **climate-resilient growth**.

Body

Dual Challenge of Productivity and Sustainability

1. **Stagnant Yields in Staples:** Yield gains in rice and wheat are plateauing despite input intensification. **Economic Survey (2020–21)** notes declining marginal returns in Green Revolution areas.

2. **Soil and Water Degradation:** Excessive fertilizer and water use degrades soil health and depletes groundwater.
   Example: **Punjab** reports **85%** blocks as over-exploited by **Central Ground Water Board.**
3. **Climate-Induced Losses:** Extreme weather events affect crop output and income stability.
   Case: Unseasonal rains in **Maharashtra (2023)** caused widespread crop losses in sugarcane and **soybean**.
4. **Nutritional Deficits and Dietary Imbalance:** Overproduction of cereals leads to poor dietary diversity. **NITI Aayog** advocates shift towards nutrient-dense crops to tackle hidden hunger.

Role of Crop Diversification

1. **Enhances Climate Resilience:** Millets and pulses are better suited for variable rainfall and rising temperatures.
   Case: **Odisha's millet mission** led to both income and climate benefits.
2. **Improves Soil Health and Water Use:** Legumes fix nitrogen; diversified patterns reduce groundwater dependence.
   Example: Crop rotation with **pulses in MP** restored soil fertility.
3. **Boosts Farmer Income:** Horticulture, spices, and floriculture offer better returns and export opportunities.
   Case: **Sikkim's shift to organic horticulture** increased farmer profitability.
4. **Promotes Dietary Diversity:** Diversified food baskets lead to better community nutrition. **NFHS-5** highlights improved dietary indicators in states promoting coarse grains and vegetables.

Policy Support Required

1. **Price and Procurement Reforms:** Expand MSP and assured procurement beyond rice and wheat. **Shanta Kumar Committee** suggested restructuring MSP and diversifying procurement.
2. **Agro-Climatic Zoning:** Promote location-specific crops based on land and water suitability. **CACP** urged agro-ecological zoning for better crop planning.
3. **Infrastructure and Market Linkage:** Invest in cold chains, storage, and processing for perishable high-value crops. **Agriculture Infrastructure Fund (AIF)** supports such investments.
4. **Research, Training, and Extension:** Strengthen **ICAR and KVKs** for capacity-building and farmer advisories.
   Example: **ICAR's All India Coordinated Research Projects** promote diversified cropping.
5. **Credit and Insurance Access:** Improve credit for non-traditional crops and expand PMFBY coverage.
   Case: **Odisha** included millets in **state-level insurance pilot schemes**.
6. **Awareness and Behavioural Change:** Launch mass campaigns on ecological and economic benefits of diversification. **National Mission on Sustainable Agriculture (NMSA)** promotes awareness and adoption.

Conclusion

Swaminathan envisaged an **"evergreen revolution"**—productive agriculture without ecological harm. Crop diversification, backed by strategic policies, remains essential for sustainable, resilient, and inclusive farming.

Q.5) Evaluate the key constraints in the storage and transportation of agricultural produce in India. How do these affect farmers' income, and what measures have been taken to address them? (250 words, 15 marks)

Introduction

As per **ICAR**, post-harvest losses due to **inefficient storage and transport systems** account for nearly **6-7% of total** agricultural output. These inefficiencies directly impact farmers' incomes and the nation's food security.

Body

Key Constraints in Storage and Transportation

1. **Unscientific storage:** Around **80%** of handling and warehousing facilities are not mechanized, leading to frequent spoilage and quality degradation.
2. **Limited storage capacity:** With food grain production at **311 MMT** and available storage capacity at **145 MMT**, India faces a storage deficit of **166 MMT**.
3. **Surplus buffer stock: FCI** has been maintaining food stocks well beyond the buffer norms, congesting storage infrastructure and reducing space for fresh procurement.
4. **Post-harvest losses:** Traditional storage methods fail to prevent losses due to pests, moisture, or theft, affecting both quantity and marketable quality of produce.
5. **Lack of private investment in warehousing:** Scarcity of land and regulatory hurdles deter private sector participation in modern storage infrastructure.
6. **Inadequate cold-chain and transport linkage:** Lack of reefer vans and multi-modal transport affects perishables, with **ICRISAT** estimating **20-25% loss** in horticultural produce annually.

Impact on Farmers' Income

1. **Distress sales:** Without access to reliable storage, farmers are forced to sell immediately after harvest, often at lower prices.
2. **Increased logistics cost:** Poor infrastructure increases transport costs, reducing net earnings, especially for small and marginal farmers.
3. **Quality-based price reduction:** Without cold storage or packaging, produce quality deteriorates, fetching lower prices at mandis or export hubs.
4. **Missed market opportunities:** Time-sensitive produce misses optimal market windows, affecting profitability and bargaining power.

Measures Taken

1. **Grain Storage Plan in Cooperative Sector:** The Prime Minister recently inaugurated a pilot of the **World's Largest Grain Storage Plan** for **11 PACS** across **11 states** to strengthen decentralized warehousing.
2. **Operation Greens:** Focuses on reducing price volatility of **tomato, onion, and potato** by improving cold-chain logistics and value addition.
3. **e-NAM integration with logistics:** Promotes inter-market connectivity and quality-based online trade, with better access to transport and storage service providers.

4. **PM Gati Shakti Scheme:** Develops **multi-modal infrastructure**, including agriculture-specific warehousing zones, under a digitally integrated platform.
5. **Rural Infrastructure Development Fund (RIDF):** Supports construction of storage godowns and rural roads in underdeveloped regions.
6. **Warehousing (Development and Regulation) Act, 2007:** Promotes scientific warehousing practices and negotiable warehouse receipts for formal credit access.

Committee Recommendations

1. **Shanta Kumar Committee:** Suggested **reducing buffer stock norms** and promoting **decentralized procurement** to free up storage.
2. **Dalwai Committee:** Recommended integrated cold chain development through **PPP** and **viability gap funding**.
3. **NITI Aayog Task Force:** Advocated strengthening rural logistics through digital platforms and aggregation models.

Conclusion

Adopting a **"farm-to-fork" approach**, as advocated by the **National Commission on Agriculture**, ensures sustainable agri-logistics, reduces post-harvest losses, and enhances farmer income by integrating production with efficient market access.