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Shaping Sustainable Food Systems with Storage Infrastructure: A Pathway to Viksit Bharat

A robust storage infrastructure is vital for ensuring sustainable agrifood systems, supporting food security and economic growth. With India aiming to become a developed nation by 2047, it's projected that the population will reach 1.64 billion, with a significant urban population. To meet growing food demands, the government is enhancing storage facilities, including the approval of the largest grain storage structure by the Union Cabinet. These upgrades will reduce post-harvest losses, maintain food quality, and boost farmers' income.

Agriculture and Food Production

- India's agriculture sector has undergone a significant transformation, evolving from food deficit to surplus and emerging as a major global exporter.
- With the world's second-largest agricultural land, India's food production has surged from 244 million tonnes in 2010-11 to 310 million tonnes in 2021-22 (Ministry of Agriculture and Farmers Welfare, 2023).
- Population growth has been substantial, rising from 35.9 crore in 1951 to around 140 crore, with projections reaching 164 crore by 2047.
- Prime Minister Narendra Modi envisions India as a developed nation, termed "Viksit Bharat," by 2047, aligning with India's centenary of Independence, aiming for economic growth, social progress, environmental sustainability, and effective governance (PMO, 2023).

Challenges in the Agri-Food System

- Climate change, rapid population growth, land degradation, and depleting natural resources pose significant challenges to India's agri-food system.
- Stagnant crop productivity, substantial food losses, and waste threaten food security and sustainability.
- Reports by the FAO and UNEP indicate that approximately 31% of the world's food is lost or wasted annually, leading to substantial economic and environmental losses (FAO, 2019; UNEP, 2021).
- A study by the Ministry of Food Processing Industries revealed quantitative losses of Rs. 92,651 crore in major crops and commodities, emphasizing the urgent need for interventions to mitigate losses and enhance supply chain efficiency (Ministry of Agriculture & Farmers Welfare, 2023a).

Importance of Storage Infrastructure

- Strengthening storage infrastructure is crucial for ensuring food security, reducing post-harvest losses, and supporting sustainable agricultural development.
- India's total food grain production reached a record high of 329.68 million tonnes in 2022-23, underscoring the need for robust storage facilities (Ministry of Agriculture & Farmers Welfare, 2023).
- Initiatives like the Pradhan Mantri Garib Kalyan Anna Yojana aim to provide free food grains to approximately 81.35 crore beneficiaries over five years, starting from January 1, 2024 (Ministry of Consumer Affairs, Food & Public Distribution, 2023).
- Government schemes such as the Agriculture Infrastructure Fund, Agricultural Marketing Infrastructure Scheme, and others play vital roles in promoting storage infrastructure and enhancing the resilience of the agri-food system (PMFME, PMKSY, MIDH).

Sustainable Food Systems (SFS)

- Sustainable Food Systems (SFS) aim to ensure food security and nutrition without compromising future economic, social, and environmental resources (FAO, 2018).
- Storage infrastructure plays a crucial role in adding resilience to the food system, positively impacting food security and availability.
- Different types of storage structures, including traditional, improved, modern, and farm silos, are utilized to store grains and other food products.
- Traditional storage structures like Kanaja and Kothi are common on farms but may not be suitable for long-term storage.
- Warehouses and silos are used for bulk storage, ensuring the protection of quantity and quality of stored products.
- Warehouses in India are owned by entities such as the Food Corporation of India (FCI), Central Warehousing Corporation (CWC), and State Warehousing Corporations (SWCs).
- India has strengthened its cold chain storage infrastructure, creating a capacity of 8.38 lakh MT under the Integrated Cold Chain and Value Addition Infrastructure scheme.

Post-harvest Food Losses

- Estimations of post-harvest food losses were conducted by the Indian Council of Agricultural Research-Central Institute of Post-Harvest Engineering (ICAR-CIPHET) in 2015 and by NABARD Consultancy Service Pvt. Ltd. (NABCONS) in 2022.
- Both studies indicated that major post-harvest losses occur in the allied sectors, particularly in fisheries and eggs.
- Among horticultural crops, fruits reported higher losses (6-16%), followed by vegetables (4-12%), while losses in plantations and spices ranged from 1-8%.
- The table provided by the Ministry of Food Processing Industries summarizes the post-harvest losses of major crops and commodities as per the two studies.
- Loss percentages varied slightly between the two studies for different crops and commodities, highlighting the need for continued efforts to reduce post-harvest losses across various sectors.

Government Initiatives

- Since Independence, India's agriculture storage infrastructure and warehousing policies have evolved.
- The introduction of the National Policy on Handling, Storage, and Transportation of Food Grains in 2000 marked a significant policy shift by promoting private sector participation in building warehouses and storage infrastructures.
- Key agencies involved in implementing national schemes to promote supply chain infrastructure include the Department of Food & Public Distribution, the Ministry of Agriculture, the Ministry of Food Processing Industries, APEDA, and the Department of Animal Husbandry, Dairying & Fisheries.
- The Food Corporation of India (FCI) is the government agency responsible for the movement of food grains across India, utilizing a network of storage infrastructure owned or hired by FCI.
- FCI augments its storage capacity through various schemes, including Private Entrepreneurs Guarantee (PEG) Scheme, Central Sector Scheme (CSS), and Construction of Silos under Public Private Partnership (PPP) mode.
- As of July 2023, FCI operates a network of 1923 warehouses with a total capacity of 371.93 LMT for storing central pool food grains.
- Despite India's total food grain production of about 311 MMT, the total storage capacity is only 145 MMT, indicating a shortage of 166 MMT.

- To address this shortage, the government approved the 'World's Largest Grain Storage Plan in Cooperative Sector' to create decentralized storage infrastructure at the Primary Agricultural Credit Societies (PACS) level.
- These pilot projects aim to converge existing schemes of various ministries, including AIF, AMI, SMAM, PMFME, PMKSY, and others.
- Pilot projects are implemented by the NCDC with support from NABARD, FCI, CWC, NABCONS, NBCC, etc., in different states and UTs.
- PACS can avail subsidies and interest subvention benefits for constructing godowns and setting up other agri infrastructure.
- NABARD provides financial support to PACS by refinancing them at subsidized rates, benefiting from interest subvention under the AIF scheme.
- Construction of godowns is underway in 13 PACS of 13 states/UTs under the Pilot Project, with storage capacities ranging from 500 MT to 2000 MT at the PACS level.
- Recent initiatives offer tax breaks to increase cold storage capacity in India, providing deductions on expenditures, exemptions on profits, and waivers on service tax and excise duty, which will improve the preservation of perishable commodities.

Enhanced food grain storage infrastructure is essential for achieving zero hunger targets and doubling agricultural productivity and incomes, aligning with Sustainable Development Goals. Advancements in storage facilities not only contribute to sustainable consumption and production but also require modernization, expanded warehousing capacity, and private sector involvement. Training programs on scientific storage practices empower farmers and stakeholders to manage agricultural commodities effectively. Implementing decentralized storage systems reduces food grain wastage and prevents distress sales by farmers. Increased investment in warehousing, logistics, cold chain, food processing, and integrated value chain development is crucial for realizing the goal of becoming a developed nation and attaining Sustainable Development Goals.

Warehousing: Changing Gears to meet Present Challenges

Warehouses, traditionally considered as mere storage facilities, have undergone a significant transformation in recent years. Factors such as the globalization of production, the rise of e-commerce, and shifting consumer demands have reshaped warehouse operations. Today, warehouses are recognized as crucial components of supply chains, facilitating the efficient movement of goods from production to consumption points. The primary objective of modern warehousing is to minimize costs while delivering quality service. This involves optimizing storage space, utilizing handling equipment, preserving product quality, ensuring timely access to goods, and maintaining security measures. Additionally, warehouse receipts play a pivotal role in securing timely finance, highlighting the multifaceted nature of warehousing beyond simple storage.

Understanding the Warehouse Receipts

- **Definition:** A warehouse receipt is a written or electronic acknowledgment issued by a warehouseman upon receiving goods for storage, serving as proof of deposit.
- **Familiar Concept:** Similar to leaving belongings in a coat check or luggage in a cloakroom at an airport, individuals receive a receipt and expect to retrieve their items in the same condition.
- **Use as Collateral:** Depositors sometimes leverage warehouse receipts to secure loans from banks or financial institutions, using the goods stored as collateral.
- **Historical Origin:** Warehouse receipts have a long history, with records dating back to Mesopotamia around 2,400 BC, and have been utilized in various ancient civilizations for trading goods.
- **Evolution:** Over time, warehouse receipt systems have evolved with specialized laws, but faced challenges such as lack of complete trust from banks, concerns about the quality and quantity of stored goods, and issues with negotiability.
- **Impediments:** Warehouse receipts historically lacked uniformity in format and faced difficulties in negotiability, hindering depositors and farmers from fully benefiting from their stored goods, especially during harvest.
- **Solution:** The introduction of Negotiable Warehouse Receipts (NWR) addresses these challenges by providing proof of deposit and serving as a regulated document of title, facilitating easier transfer of goods' ownership.

Role of Warehouse Receipt System

- Farmers encounter liquidity issues, especially during the post-harvest stage, compelling them to sell their produce immediately at lower prices in local markets.
- Price fluctuations post-harvest prevent farmers from waiting for better prices, as they need funds to repay loans, meet consumption needs, and prepare for the next sowing season.
- Despite increases in food production and credit flow into agriculture, liquidity remains low in rural areas, affecting farmers' incomes.
- Analysis reveals that a significant portion of agricultural credit is allocated for pre-harvest finance, with only a small fraction dedicated to post-harvest needs.
- Farmers often sell their produce at lower prices immediately after harvest, resulting in significant losses compared to potential market value.
- Increasing credit flow at the post-harvest stage is crucial for enhancing farmers' incomes and addressing liquidity challenges.
- Enabling tradability and negotiability of warehouse receipts can encourage banks to provide pledge finance against farmers' stocks, thereby improving liquidity.

- A well-regulated warehouse receipt system is essential to instill confidence among lending institutions, facilitating post-harvest financing for farmers.

Warehouse Receipt System (WRS)

- **Depositor**: Provides goods to the warehouse, pays associated costs, expects benefits like reduced losses and access to credit.
- **Warehouseman**: Receives, tests, grades, and weighs goods, issues detailed receipts, responsible for protecting and delivering goods.
- **Bank or Financial Institution**: Accepts receipt as loan collateral, lends a percentage of commodity value, can liquidate goods in case of non-payment.
- **Insurance Companies, Testing Agencies, etc.**: Provide insurance and testing services, ensure trustworthiness of receipts and warehouseman.
- **Regulator**: Registers warehouses, conducts inspections, resolves disputes, enforces regulations, maintains trust among stakeholders.

Legal Framework for Warehouse Receipts

- **Core Principle:** Documents of title, such as negotiable warehouse receipts and bills of lading, simplify transactions by allowing the transfer of ownership through paper documents rather than physical goods, particularly beneficial for bulky commodities like grain.
- **Legal Protections:** Parties accepting warehouse receipts require legal safeguards, which are provided in English common law countries like the UK and the US through:
  - Laws governing bailments, issuance of warehouse receipts, and licensing of warehouses.
  - Legislation concerning negotiable instruments or bills of exchange, specifying the rights of transferees.
  - Laws regulating the sale of goods, determining the status of warehouse receipts as title documents and the transfer of title to goods covered by such receipts.
  - Legislation pertaining to the pledging of goods.
- **Smooth Functioning:** These laws ensure the efficient operation of a warehouse receipt system (WRS) by defining the rights and obligations of parties involved. Details of a WRS are outlined below.
- **Additional Considerations:** Apart from legislation governing rights and obligations in the country where the warehouse is situated, written storage agreements and the language used in storage documents further define the rights and obligations of involved parties.

Warehousing in India

- **Enactment of Warehousing (Development & Regulation) Act (2007):**
  - Aimed to provide legal support for negotiable warehouse receipts (NWRs).
  - Recommended by an RBI report to establish a comprehensive warehouse receipt system.
- **Objectives:**
  - Establish a negotiable warehouse receipt system for all commodities, including agricultural ones.
  - Address concerns such as lack of negotiability and trust in receipts issued by private warehouses.
  - Make warehouse receipts a key trade tool.
  - Facilitate finance against warehouse receipts.
  - Improve the quality of lending portfolios for banks.
- **Key Provisions:**
  - Establishment of Warehousing Development and Regulatory Authority (WDRA) to oversee and regulate the warehouse receipt system.
  - Compulsory registration of warehouses intending to issue NWRs with WDRA.
  - Definition of liabilities and duties of registered warehousemen to protect depositors' interests.

- Standardization of warehouse receipts with defined mandatory particulars.
- Clarification on negotiability and non-negotiability of warehouse receipts, along with associated warranties.
- Identification of offenses by warehousemen/depositors and imposition of penalties.
- Recognition of warehouseman's lien on goods for recovery of lawful charges.
- Granting special powers to deal with perishable and hazardous goods.
- Establishment of an Appellate Authority to hear appeals against WDRA's orders.
- Formation of a Warehousing Advisory Committee to advise on regulation-making and effective implementation.
- Provision for the Act to have overriding effect on inconsistent laws or instruments.

Difference between Paper Based Warehouse Receipts and Electronic Negotiable Warehouse Receipt (eNWR)

Aspect	Paper Based Warehouse Receipts	Electronic Negotiable Warehouse Receipt (eNWR)
Sharing with Prospective Buyers	Limited to one-to-one mode	Access to nationwide buyers, enhancing bargaining power
Splitting Capability	Cannot be split	Can be split with obligation to transfer part of commodity
Security Risks	Prone to loss, tampering, mutilation	No risk of loss or tampering
Clearing and Trading Efficiency	Inefficient, lacks transparency	Promotes efficient, transparent trading and settlement
Information Sharing	Difficult to share with multiple stakeholders	Easily shareable with multiple stakeholders via online portal
Assaying Requirement	Not mandatory	Mandatory reporting of goods quality
Finance and Selling Process	Cumbersome process	Eases access to finance, enables multiple transfers
Duplicate NWR Issuance	Possible	Not possible
Fraudulent Overstatement	Possible	Benchmark prices retrieved for accuracy
Monitoring and Surveillance	Costly	Regularly monitored by WDRA at reduced costs
Valid Transferability	Problems in transfer/endorsements	Easy multiple transfers, backed by W(D&R) Act 2007
Multiple Finance Risks	Cases of multiple finance against same WR	Impossible due to electronic lien marking

Warehousing Development and Regulatory Authority

- **Achievements of WDRA:**
  - Over 5,000 valid warehouse registrations as of December 31, 2023.
  - Annual loaning against eNWR increased to Rs. 2,582 crore by the end of December 2023.
  - State Bank of India introduced a special product for extending pledge finance to farmers against eNWRs, with other banks likely to follow suit.
- **Impact of WDRA's Journey:**
  - WDRA's regulatory framework has demonstrated that warehouse receipts can be widely accepted instruments for transactions of commodities, even between geographically distant parties.
  - It expands the range of goods usable as collateral for loans, benefiting farmers beyond traditional land-based collateral.
  - WDRA's regulations also foster other financial services such as insurance, encouraging depositors to store produce in registered warehouses and obtain loans against them.

- Introduction of warehouse receipt legislation can professionalize the warehouse industry, leading to reduced post-harvest losses, lower price volatility, and improved production and yield assessment.
- WDRA's regulatory ecosystem improves warehousing standards and efficiency through standardized practices and inter-operability between warehouses.

- **Significance of Legal Framework:**
  - An effective legal framework for warehousing is crucial for a healthy agricultural sector and business environment.
  - SEBI mandates settlement of trades on commodities exchanges using eNWRs issued by WDRA-registered warehouses, indicating trust in regulated warehouses.
  - Food Corporation of India requires stocks to be stored in WDRA-registered warehouses, emphasizing trust in regulated facilities.

In summary, WDRA's regulation has successfully established an effective WRS based on NWRs in India, addressing challenges in the warehousing sector such as infrastructure improvement, adoption of scientific storage practices, and enhanced pledge finance. Although not all warehouses are currently under WDRA's ambit, registered facilities serve as models of quality and professionalism within the sector.

Institutionalised Management of Food Security: FCI's Role in Safe Storage, Distribution and Transportation of Food Grains

The world's largest food security management system, spearheaded by India, not only caters to the needs of a vast population but also operates on a massive scale, encompassing extensive supply chains. Central to this system is the safe storage of food, alongside the crucial aspects of transportation from surplus to deficit regions and the subsequent distribution among numerous beneficiaries and institutions. At the helm of this monumental task is the Food Corporation of India (FCI), a governmental entity. This article delves into the current state of the food storage infrastructure essential for ensuring food security management, along with the intricacies of the associated supply chain involving transportation and distribution of food grains.

Evolution of India's Food Security Management

- **Government Initiatives and Scope of Distribution:**
  - India's population accounts for 17.5% of the global population, with around 1.40 billion people.
  - Pradhan Mantri Garib Kalyan Ann Yojana (PMGKAY) distributes free food grains to approximately 81.35 crore people as per the National Food Security Act (NFSA), 2013.
  - Antodaya Anna Yojana (AAY) covers 8.93 crore people, while the remaining 72.42 crore people receive food grains through Priority Household (PHH) allocation.
- **Historical Context and Food Deficit Period:**
  - India, once a food-deficit nation, relied on imports, particularly from the USA under PL-480 agreements.
  - Short-term approvals of shipments under the 'Short Tether Policy' by President Lyndon B Johnson led to a precarious 'Ship-to-Mouth' situation.
- **Initiation of Green Revolution and FCI's Role:**
  - The 'Green Revolution' was launched to boost food production through high-yielding seeds and agricultural technology.
  - FCI played a crucial role in supporting farmers with Minimum Support Price (MSP) purchases, ensuring viable returns and encouraging increased production.
- **Shift to Self-Sufficiency and Food Surplus:**
  - India achieved self-sufficiency and even surplus in food production, reducing dependence on imports.
  - FCI's institutionalized operations, including storage, transportation, and distribution, facilitated this transition.
- **FCI Mandates and Operational Enhancements:**
  - FCI was mandated to provide remunerative prices to farmers, ensure food grain availability to vulnerable sections, maintain buffer stock reserves, and stabilize market prices.
  - To fulfill these mandates, FCI continuously improved its operations, particularly in storage, transportation, and distribution of food grains.

Importance of Proper Storage in Food Security

- Adequate storage is essential for preserving the quality of agricultural produce, including food grains, ensuring their usability and consumption.
- Proper storage is crucial not only for regular consumption but also for maintaining buffer reserves to address emergencies.
- Non-perishable food grains like wheat and rice, characterized by low moisture and pH levels, can be stored for 1 to 4 years.

- Wheat is stored in godowns or silos in both bagged and bulk forms, while paddy is milled into rice before being stored in bagged form in godowns.

Storage Structures

- **Conventional Godowns**
  - Functional requirements include quality conventional storage structures with management practices to prevent damage during storage.
  - Features of FCI's storage structures include robustness to withstand environmental stresses, prevention of entry by rodents and other animals, damp-proof walls, floors, and roofs, provision for aeration, and proper location connected to roads.
  - Typical dimensions of a conventional godown depend on capacity, with small godowns ranging from 1120 to 10500 tonnes and large godowns up to 57020 tonnes.
  - Major engineering requirements include suitable foundation, plinth height, platform width, wall thickness, ventilator placement, and roof structure.
- **CAP (Covered and Plinth) Storage**
  - CAP storage, a low-cost method for short-term storage of wheat and paddy, involved stacking bags on a wooden frame placed on a raised platform and covering them with polyethylene sheets.
  - CAP storage sites should be at a higher elevation, away from drainage, canals, and flood-prone areas to prevent flooding.
  - Disadvantages include ineffective fumigation and vulnerability to damage from wind, rain, bird, and monkey attacks, leading to the phased-out of CAP storage by FCI since 2022.
- **Bulk Storage - Silos**
  - Silos are modern storage techniques consisting of vertical containers for storing food grains in loose and bulk form.
  - Silos are made of masonry, reinforced concrete, or metals, with facilities for bulk handling, aeration, and fumigation.
  - Modern silos include temperature recording and monitoring systems, but temperature gradients may be higher in metal silos due to thermal conductivity.
  - Spout lines in bulk storage can lead to heat development and pest propagation, affecting grain shelf life.

Storage Capacity in Central Pool

- By the end of 2023, FCI had a total storage space of 761.29 lakh MT across approximately 2000 locations, even after phasing out CAP storage.
- This storage capacity marks a significant increase from the 6.18 lakh MT capacity at FCI's inception in 1965-66, representing a growth of approximately 125 times.
- Of the total storage space, FCI possesses 363.69 lakh MT, while state government agencies hold approximately 397.60 lakh MT.
- FCI has augmented its storage capacity by adding 146.5 lakh MT of scientific covered storage through 414 conventional godowns under the Private Entrepreneurship Guarantee (PEG) scheme with Public-Private Partnership (PPP).
- To modernize its storage infrastructure, FCI is creating 111 lakh MT state-of-the-art modern silo storage in a hub-and-spoke model, with approximately 15 lakh MT already completed.
- Plans include constructing 25 lakh MT silos for hubs at 36 locations and 86 lakh MT silos for spokes at 249 locations, along with 0.77 lakh MT storage in difficult terrains.
- Additionally, about 0.83 lakh MT of storage is under construction to accommodate food grains in challenging areas.

- FCI has also improved existing godown infrastructure by introducing LED illumination for energy efficiency, reducing carbon footprint, and installing high-quality CCTV systems to enhance security.

Transportation and Distribution

- Food grains are distributed to 81 crore people across India, necessitating transportation from surplus to deficit states.
- FCI employs a multimodal transportation approach, utilizing railways, roadways, and waterways to connect surplus grain-producing regions with deficit areas.
- Wheat is typically transported from Punjab, Haryana, and Madhya Pradesh to all other states, while rice is transported from several states including Punjab, Haryana, Uttar Pradesh, Uttarakhand, Chhattisgarh, Odisha, Andhra Pradesh, Telangana, and Madhya Pradesh.
- Over the last 5 years, an average of 600 lakh MT of food grains has been transported, marking a significant increase from the 15 lakh MT transported during 1965-66.
- This supply chain involves transporting approximately 82% of wheat procured in 3 surplus states and about 66% of rice procured in 9 surplus states, with the average food grain bag traveling approximately 1200 km within the country.
- Food grains transported to deficit regions are stored in local godowns and distributed to 5.45 lakh Fair Price Shops (FPSs) across the country through state government agencies.
- Implementation of biometric authentication and the One Nation One Ration Card (ONORC) has enhanced transparency, efficiency, and security in the distribution process, particularly benefiting migrant workers.
- FCI distributed approximately 700 lakh MT of food grains during 2023, representing a significant increase from the amount distributed during 1965-66.

Technology Integration and reduction in losses

- FCI has embraced technological advancements to enhance its operations, including the implementation of digital systems for inventory management such as the Depot-on-Line System (DoS) and GPS-enabled Vehicle Tracking System (VLTS).
- Integration of rice mills with individual depots/warehouses for rice delivery and the allocation of space at warehouses through the WINGS system ensure transparency in the procurement process.
- Utilization of e-procurement platforms and the establishment of a dedicated call centre for addressing stakeholder grievances have contributed to improved accuracy, efficiency, transparency, and accountability throughout the supply chain.
- Scientific studies by ICAR to develop norms for losses, coupled with online documentation and improved operations have reduced overall storage losses from 0.17% in 2013-14 to a gain of -0.12% in 2022-23.
- Measures such as exhaustive joint verification (JV) and high-security seals have significantly decreased transit losses from 0.46% to 0.22% during the same period.
- FCI's food supply chain not only ensures food security for all citizens across the country but also positions it as the world's largest food system.
- Ongoing efforts to modernize operations and engage stakeholders aim to continually enhance efficiency and effectiveness in fulfilling FCI's mission.

Mega Food Storage Plan: Challenges and Way ahead

The Ministry of Cooperation has approved a large-scale network of grain storage facilities to be set up through Primary Agricultural Credit Societies (PACS) nationwide. This initiative, known as the Mega Food Storage Plan, aims to address the significant gap between India's food production and its storage capacity. Despite being the world's second-largest food producer, India's current storage infrastructure can only accommodate about 47% of its total produce, highlighting the need for expanded storage capabilities.

Background and Challenges

- A study by the National Academy of Agricultural Sciences highlights storage as a major cause of post-harvest losses in India, leading to significant losses in cereal crops and perishables.
- Storage capacity varies regionally, with some southern states having higher capacities compared to northern states like Uttar Pradesh and Bihar.
- Multiple government agencies manage grain management, but the results have been suboptimal, leading to open-air storage and substantial damages to food grains.

Government's Initiative

- The Government of India aims to reduce post-harvest losses through a new storage infrastructure plan.
- The plan focuses on providing safe and secure storage facilities, especially in market yards, to protect grain stocks from natural calamities.
- The Ministry of Cooperation has approved a network of integrated grain storage facilities through Primary Agricultural Credit Societies (PACS) across the country, aiming to create the world's largest grain storage plan in the cooperative sector.

Integrated Grain Storage Facilities

- The integrated facilities will include procurement centers, primary processing units, storage sheds, container storage, and silos.
- Spread over 1 acre of land, each facility will be built at a cost of Rs. 2.25 crore, with subsidies and loans provided for construction.
- The plan seeks to enhance food grain storage capacity by 70 MMT in the cooperative sector, utilizing a hub-and-spoke model with PACS functioning as storage hubs.

Implementation and Funding

- The plan utilizes the approved outlays of various government ministries and schemes for infrastructure creation and modernization at the PACS level.
- An Inter-Ministerial Committee (IMC) and National Level Coordination Committee (NLCC) have been constituted to oversee implementation.
- State-level committees have also been established to monitor progress and ensure flawless integration of the plan with existing programs.

Mega Storage Plan

- **Need for Mega Plan:**
  - India, with 18% of the global population, possesses only 11% of cultivable land, necessitating efficient food storage to support its massive population.
  - The National Food Security Act, 2013, covers approximately 81 crore people, emphasizing the need for a robust network of food grain storage facilities.

- **Implementing Agencies:**
  - The National Cooperative Development Corporation, with support from NABARD, NABARD Consultancy Services, Central Warehousing Corporation, and Food Corporation of India, is executing the pilot project across 24 PACS in different states.
  - Construction has commenced at five PACS in Tripura, Haryana, Tamil Nadu, Uttar Pradesh, and Madhya Pradesh, while detailed project reports are being prepared for the remaining PACS.
- **Benefits of Implementation:**
  - Increasing storage capacity will reduce transportation costs for farmers, allowing them to maximize profits and avoid distress sales.
  - Modern silos with computerized monitoring systems will enhance efficiency and strengthen food security by ensuring a stable supply of food grains across the country.
  - Expansion of storage facilities will generate employment opportunities in rural areas and contribute to overall rural development.
  - Empowering PACS through agri-infrastructure will enhance their economic viability and foster growth in the agricultural sector.
- **Challenges Ahead:**
  - Conflict with Farmer Producer Organisations (FPOs) may arise due to overlapping roles in post-harvest handling.
  - Challenges in managing and maintaining infrastructure, given India's history of inadequate capital maintenance expenditure.
  - Quality management of stored food grains remains a concern, particularly in primitive storage facilities like FCI godowns.
  - Multiplicity of institutions with overlapping objectives could reduce effectiveness, while policies may favour medium and large farmers over small and marginal ones.
- **Possible Solutions:**
  - Implementing the scheme through Public-Private Partnership or Farmer Producer Organisations may enhance efficiency.
  - Prioritizing modernization of existing storage infrastructure for both food grains and perishable goods.
  - Providing adequate storage facilities for high-value horticultural crops to support the target of doubling farmers' income.

Entrepreneurial Opportunities in Feed Storage Infrastructure

India's food industry plays a pivotal role in the nation's manufacturing, exports, and economic growth. With factors like population rise, urbanization, and evolving consumer preferences, the sector has witnessed significant expansion. By 2025, it is projected to reach a size of US$ 535 billion, offering vast opportunities for entrepreneurs and farmers.

The increasing demand for processed food presents a lucrative opportunity for farmers to enhance their income. This trend fuels demand for raw materials, encouraging farmers to diversify into horticulture and cultivate high-value varieties. Such shifts can particularly benefit small and marginal farmers.

Challenges in the Sector

- Challenges such as inadequate cold chain infrastructure, modern logistics, and storage facilities contribute to high levels of post-harvest wastage in the country.
- In developing nations, approximately 40% of food loss occurs post-harvest due to factors like inadequate refrigeration and unreliable energy supply, resulting in significant financial and environmental costs.

Storage Facilities and Concerns

- Entities like the Food Corporation of India (FCI), the Central Warehousing Corporation (CWC), and the Central Railside Warehouse Company (CRWC) provide storage facilities nationwide.
- However, issues related to capacity, quality, rising storage costs, losses, and the lack of storage facilities at the farm gate level persist.
- The Shanta Kumar Committee (2015) has recommended the modernization of storage infrastructure to ensure improved food grain quality, reduced losses, efficient land utilization (with silos requiring one-third less land than conventional warehouses), enhanced operational efficiency, and increased private investment in the sector.

Entrepreneurial Possibilities in Food Storage Infrastructure

- **Components of Agri-food Supply Chains:**
  - **Production:** Includes inputs like seed, feed, and harvesting equipment.
  - **Processing:** Involves activities such as washing, drying, and freezing food.
  - **Aggregation and Distribution:** Encompasses marketing cooperatives, storage facilities, brokerage services, logistics management, and delivery trucks.
  - **Retailing:** Includes all entities selling or serving food to consumers, ranging from restaurants and grocery stores to schools and fast-food outlets.
  - **Marketing:** Involves promotional efforts like advertising, campaigns, packaging materials, and branding.
  - **Capital:** Comprises finance, natural capital (e.g., land, water), human capital, and social capital.
- **Entrepreneurship Opportunities:**
  - The food industry presents numerous entrepreneurial opportunities, particularly in addressing challenges like food supply, food security, and food waste.
  - Enterprises focusing on food storage infrastructure can lead to job creation, especially benefiting rural youths, women, and Self-Help Groups (SHGs).
  - Additionally, these ventures can contribute to the income enhancement of small and marginal farmers.

- However, sustainable enterprise development requires the establishment of a robust ecosystem providing comprehensive support services.
- Persistent challenges such as funding limitations, marketing issues, lack of IT knowledge, compliance with legal formalities, and inadequate training and extension services need to be addressed.
- Various entrepreneurial avenues exist within food storage infrastructure, necessitating the conceptualization of food value chains to map out the entrepreneurial opportunity space effectively.

Schemes and Programs for Food Storage Infrastructure Development

- **Mega Food Parks:**
  - Aims to link agricultural production to markets through cluster development.
  - Provides capital grants of 50-75% (up to $7.15 million per project).
  - 42 parks were under various stages of implementation by March 2019.
- **Cold Chain, Value Addition, and Preservation Infrastructure:**
  - Focuses on integrated cold chain and preservation facilities.
  - Grants-in-aid provided for storage and transport infrastructure, as well as value addition and processing.
  - 299 approved projects were under implementation by March 2019.
- **Creation of Food Processing and Preservation Capacities:**
  - Aims to modernize processing and preservation capacities to reduce wastage.
  - Provides a capital grant of 35-50% (up to $0.71 million per project).
  - 134 projects approved until December 2018.
- **Creation of Backward and Forward Linkages:**
  - Seeks to establish effective backward and forward integration in the processed food industry.
  - Offers financial assistance for primary processing centers, collection centers, and modern retail outlets.
  - 70 projects approved until December 2018.
- **Food Safety and Quality Assurance Infrastructure:**
  - Aims to enhance India's food sector competitiveness through safety and quality infrastructure.
  - Offers financial assistance for laboratory equipment and civil work.
  - 76 Food Testing labs instituted until November 2018.
- **Agro Processing Cluster:**
  - Encourages the development of modern infrastructure and common facilities for food processing units.
  - Grants-in-aid provided for eligible project costs (up to $1.43 million per project).
  - 33 projects approved until December 2018.
- **PM Formalisation of Micro Food Processing Enterprises (PMFME) Scheme:**
  - Aimed at upgrading existing micro food processing enterprises.
  - Provides financial, technical, and business support along with skill training.
  - Supports capital investment, common infrastructure, branding, and marketing.
- **Mission for Integrated Development of Horticulture (MIDH):**
  - Provides financial assistance for cold storage, pre-cooling units, pack houses, reefer transport, etc.
  - Subsidy available at the rate of 35-50% of project cost through State Horticulture Missions.
- **Other Government Schemes and Programs:**
  - Various schemes under the Ministry of Agriculture and Farmers Welfare, Ministry of Fisheries, Animal Husbandry and Dairying, etc.

- Regulatory bodies like the National Horticulture Board (NHB) and Agriculture and Processed Food Products Export Development Authority (APEDA) also support entrepreneurship in these areas.

Way forward

- **Need for Adequate Food Storage Facilities:**
  - Essential to reduce food wastage and prevent distress sales by small and marginal farmers.
  - Lack of access to credit and training programs hinders MSMEs' adoption of food processing and storage technologies.
- **Examples of Innovative Storage Solutions:**
  - Clusters of SMEs offering potato cold storages in Bihar have empowered small farmers to store produce and wait for better prices.
  - Innovative solutions like the MittiCool refrigerator and Subjee-Cooler offer cost-effective and environmentally friendly storage options.
- **Utilization of Decentralized Renewable Energy:**
  - In areas without reliable electricity grids, decentralized renewable solutions like solar and hydro-powered mini-grids can be implemented.
  - Solar energy-based technologies such as solar dryers and solar storage can preserve food quality and mitigate waste while reducing greenhouse gas emissions.
- **Need for Private Investment and ICTs:**
  - Private investment is crucial for developing food processing, refrigeration, storage, and retail markets.
  - Investments in Information and Communication Technologies (ICTs) are needed to provide farmers with tailored information about weather, water consumption, diseases, and market prices.
- **Establishment of Cold Storage Facilities:**
  - Efforts should be made to establish one cold storage facility in every Gram Panchayat.
  - Detailed mapping of crops, fruits, and vegetables grown in each area can optimize transport and storage requirements, ensuring the availability of safe and nutritious foods.

Adequate food storage facilities are imperative to combat food wastage and alleviate distress sales among small and marginal farmers. However, the adoption of food processing and storage technologies by Micro, Small, and Medium Enterprises (MSMEs) is hindered by limited access to credit and training programs. Nonetheless, promising examples of innovative storage solutions have emerged, such as clusters of SMEs offering potato cold storages in Bihar. These initiatives empower small farmers by allowing them to store their produce and wait for better prices in the off-season. Moreover, innovations like the MittiCool refrigerator and Subjee-Cooler provide cost-effective and environmentally friendly storage options, offering significant benefits to farmers and consumers alike.

In regions where the electricity grid is unreliable or nonexistent, decentralized renewable energy solutions, such as solar and hydro-powered mini-grids, can provide reliable energy for food storage. Additionally, solar energy-based technologies like solar dryers and solar storage can preserve food quality and reduce waste while contributing to greenhouse gas emission reductions. Private investment is essential for developing food processing, refrigeration, storage, and retail markets, while investments in ICTs can empower farmers with vital information about weather, water consumption, diseases, and market prices.

Efforts should be made to establish one cold storage facility in every Gram Panchayat, supported by detailed mapping exercises of locally grown crops. This approach can optimize transport and storage requirements, ensuring the availability of safe and nutritious foods while creating an enabling environment for both farmers and consumers. Ultimately, the development of robust forward and backward linkages is crucial to stabilize food market prices, ensure remunerative prices for farmers, and provide affordable prices for

Making India the Food Basket of the World

India has the potential to become the largest food supplier in the world, given its abundant cultivable land and favourable climatic conditions for growing a wide variety of fruits and vegetables. By leveraging state-of-the-art techniques and building an efficient supply chain, India can not only address hunger domestically but also contribute to global food security while ensuring fair prices for farmers.

- **Global Food Shortage Concerns:**
  - Despite progress, global hunger remains a pressing issue, with millions of people lacking adequate access to food.
  - The UN predicts that the goal of Zero Hunger by 2030 may not be achieved, with an estimated 670 million people still facing hunger by the end of the decade.
- **India's Role in Addressing Food Security:**
  - Prime Minister Narendra Modi has expressed India's readiness to supply food stocks to the world, highlighting the country's surplus food production capacity.
  - India has already begun exporting significant quantities of food grains, with traders signing contracts for exporting millions of tonnes of grains.
  - Favorable government policies and investments have propelled India's food processing capacity to new heights, enhancing its potential as a global food supplier.
- **Investor-Friendly Policies and Infrastructure Development:**
  - India has implemented investor-friendly policies and initiatives, including the creation of an agri-export policy and the development of nationwide logistics and infrastructure.
  - The establishment of district-level hubs and the expansion of mega food parks have further boosted India's food processing capacity.
  - Prime Minister Modi highlighted various agricultural products being exported for the first time, showcasing India's diverse agricultural potential.

Why can India do it?

- **Wheat and Rice Production:**
  - India ranks second globally in wheat and rice production.
  - Current stockpile exceeds 850 lakh tonnes, with significant reserves allocated for strategic purposes and the Public Distribution System (PDS).
  - During the Covid-19 pandemic, the PDS provided food to approximately 800 million people, showcasing its reliability.
- **Export Potential:**
  - India's surplus allows for potential foodgrain exports, contributing to stabilizing global commodity prices.
  - It exports wheat to about 70 countries and rice to approximately 150 countries, leveraging its reputation for supplying affordable grains.
- **Millets:**
  - India emerges as a crucial player in mitigating the global food crisis through its millet production.
  - Key millet-producing states include Rajasthan, Karnataka, Maharashtra, Uttar Pradesh, Haryana, and Gujarat.
  - Millets, termed India's 'Super Food Bucket,' offer resilience to climate change and rich nutrition, supporting small-scale farmers.
- **International Recognition:**
  - India spearheaded the UN General Assembly resolution designating 2023 as the International Year of Millets, garnering support from 72 countries.
  - Millets are recognized for their nutritional benefits, suitability for various climates, and

- **Government Initiatives:**
  - The Indian government prioritizes millet promotion through initiatives like the National Food Security Mission and state-level Millet Missions.
  - High-yielding and bio-fortified millet varieties are introduced to boost production, supported by schemes like the POSHAN Mission and PLI.

How can India do it?

- **Food Processing Industry:**
  - Food processing industry crucial for creating a global food basket.
  - Linking farmers to consumers domestically and internationally.
  - Potential to address agricultural surpluses, waste, and rural employment.
  - Government targets to double sector's GDP contribution by 2030.
  - Sector estimated to grow from US $322 billion to US $543 billion by 2025.
- **Food Supply Chain:**
  - Strengthening food supply chain vital for India's global food supplier status.
  - India's diverse population offers opportunities for various food hubs.
  - Complex supply chain with perishable goods and small stakeholders.
  - Need for infrastructure improvement and stakeholder collaboration.
  - Integration of technology for demand forecasting and efficient logistics.
- **Food Packaging:**
  - Packaging crucial for distributing food products worldwide.
  - Modern technology adoption in processing and packaging.
  - Significant foreign direct investment (Rs. 50,000 crore since 2014).
- **Standards:**
  - Standardization essential for improving supply chain efficiency and food safety.
  - Food standards focus on content, manufacturing, and packaging.
  - Logistics and IT standardization for seamless transfer of goods and information.
  - Increased importance of food safety measures for global market penetration.
  - Compliance with stringent food safety standards crucial for trade.

India has the potential to emerge as the world's largest food supplier, given its abundant cultivable land, diverse seasons for fruit and vegetable production, and functional agribusiness system, albeit with room for improvement. The primary area needing attention lies in supply chain management. By establishing a robust supply chain incorporating cutting-edge techniques, India can address hunger while ensuring fair prices for farmers. The surplus of cereals, fruits, vegetables, milk, fish, meat, and poultry can be processed into value-added products and aggressively marketed both domestically and internationally. Essential steps include investments in cold chain infrastructure, research in post-harvest technologies, establishment of food processing plants, and growth of the food retailing sector.

ODOP: Providing Framework for Value Chain Development

The ODOP initiative integrates small businesses and rural farmers into e-commerce platforms, enhancing their visibility. For instance, the Tribal Cooperative Marketing Development Federation of India promotes tribal products in urban markets, fostering exports and grassroots livelihoods. With 137 unique products endorsed across 713 districts, ODOP boosts local economies and aligns with India's self-reliance and global engagement goals under the Aatmanirbhar Bharat initiative.

Pradhan Mantri Formalisation of Micro food processing Enterprises (PMFME)

- The food processing sector facilitates economic development by bridging agriculture and industry.
- Rising demand for processed food due to lifestyle changes creates opportunities for the sector.
- It promotes diversification and commercialization of farming, resource efficiency, job creation, and entrepreneurship.
- The Ministry of Food Processing Industries launched the 'PM Formalisation of Micro Food Processing Enterprises Scheme' under the Aatmanirbhar Bharat Abhiyan.
- The scheme, with a Rs. 10,000 crore funding over five years, aims to support over 2 lakh micro-food processing enterprises, including FPOs, SHGs, and cooperatives.
- It enhances the agri-based ecosystem by upgrading existing micro food processing firms.
- The 'One District One Product' concept under the scheme facilitates scale benefits in common services, input procurement, and marketing.

Progress of ODOP Scheme

- The PMFME scheme, with its flagship 'One District One Product (ODOP)' intervention, facilitates scale benefits in input management, common services, and local product marketing in the food processing sector.
- Key objectives of the PMFME scheme via ODOP include: (a) providing financial assistance for technological upgrades to micro food processing entrepreneurs, (b) capacity building through skill training and technical support, (c) aiding Farmer Producer Organizations (FPOs), Self-Help Groups (SHGs), and Cooperatives, and (d) formalizing informal entities into registered agri-based businesses.
- Under the ODOP scheme, the Government of India approved 137 unique products in 713 districts across 35 States and Union Territories, laying the groundwork for value chain development and support infrastructure alignment.
- Through branding and marketing support, FPOs, SHGs, and Cooperatives serving as 'Special Purpose Vehicles' for ODOP-based micro food processing enterprises receive assistance for market research, product standardization, packaging, quality control, warehousing, and retail sales.
- The scheme supports clusters and groups throughout their value chain, encompassing sorting, grading, storage, processing, packaging, and marketing of various agricultural products.

No.	State/UT	No. of Districts	ODOP Products (Major Products from the District)
1	Andaman & Nicobar Island	3	Marine, Fish and Coconut Products
2	Andhra Pradesh	13	Spices, Groundnut, Mango, Tomato, Onion, Cashewnut
3	Arunachal Pradesh	26	Orange, Kiwi, Large Cardamom, Oilseed, Pickle, Ginger and Turmeric
4	Assam	33	Mustard Products, Banana based Products, Ginger based Products, Rice, Potato and Pickles

5	Bihar	38	Pulses, Makhana, Rice, Banana, Pineapple, Litchi, Betel and Bakery
6	Chandigarh	1	Bakery Products
7	Chhattisgarh	28	Rice, Papaya, Tomato, Mahua, Sugarcane and Turmeric
8	Dadar and Nagar Haveli & Daman Diu	3	Fish and Allied Products & Mushroom
9	Delhi	11	Bakery and Ready to Eat products- Namkeens
10	Gujarat	33	Banana, Finger Millet (Ragi), Cumin, Groundnut, Sapota
11	Goa	2	Coconut and Jackfruit based Products
12	Haryana	22	Milk, Bakery, Ginger, Mushroom, Amla
13	Himachal Pradesh	12	Apple, Fruit Wine, Peas, Ginger, and Turmeric
14	Jammu and Kashmir	20	Fish, Poultry/ Mutton, Milk, Apple, Mushroom, Honey, Olive and Bakery products
15	Jharkhand	24	Peda, Mango, Papaya, Honey, Potato, Chironjee
16	Karnataka	30	Fruits, Spices, Vegetable and Marine Products
17	Kerala	14	Rice, Coconut, Banana, Jackfruit
18	Ladakh	2	Apricot and Sea Buckthrone Products
19	Lakshadweep	1	Coconut Based products
20	Madhya Pradesh	52	Tomato, Potato, Orange, Guava, Sugarcane, Mustard and Turmeric
21	Maharashtra	36	Rice, Milk products, Spices, Millets, Marine Products, Mango, Pulses and Marine Products
22	Manipur	16	Fish, Pineapple, Kiwi, Turmeric and Coconut
23	Meghalaya	11	Sohiong, Pineapple, Jackfruit, Banana, Ginger
24	Mizoram	11	Mizo Chilli, Pineapple, Turmeric and Ginger
25	Nagaland	11	Pineapple, Kholar (Rajma), Kiwi, Soyabean, Fish
26	Odisha	30	Millets, Milk, Fish, Rice, Maize, Mushroom, Honey
27	Puducherry	2	Fish and Milk Based Products
28	Punjab	23	Meat/ Chicken/ Poultry, Pickle, Chillies, Milk, Litchi, Potato, Mango Guava and Mushroom
29	Rajasthan	33	Onion, Groundnut, Fruits, Mango, Potato, Mustard, Amla. Jamun, Custard Apple
30	Sikkim	6	Meat, Bakery Snacks, Red-cherry Pepper and Large Cardamom
31	Tamil Nadu	37	Fishery, Milk, Poultry, Coconut Products, Millet Products, Edible Oils, Banana based products
32	Telangana	33	Soybean, Milk, Rice, Millets, Mango, Chillies, Turmeric and Ready to Eat (Snacks and Savouries)

			Products and Bakery products
34	Uttar Pradesh	75	Petha, Groundnut, Mango, Guava, Onion, Potato, Milk Products, Aonla-based Products, Oil Seed, Honey and Jaggery
35	Uttarakhand	13	Apricot based products, Kiwi based products, Turmeric based product, Apple and Bakery Products

- India boasts a diverse range of products including rice, maize, spices, turmeric, coconut, mushroom, mango, banana, honey, milk, apple, bakery products, and Mizo chilli, reflecting regional diversity and usage.
- The ODOP intervention facilitates the onboarding of sellers onto e-commerce platforms, enhancing visibility for small businesses and rural farmers, with TRIFED promoting tribal products in various markets and supporting exports.
- Districts and states play a crucial role in making India an export powerhouse, aligning with the vision of 'Vocal for Local' and 'Atmanirbhar Bharat', fostering awareness and commitment at the district level to establish new markets.
- As of January 14, 2024, around 70,286 loans have been sanctioned under the PMFME Scheme, with top-performing states being Maharashtra, Bihar, Tamil Nadu, Uttar Pradesh, and Telangana.
- The scheme provides capital subsidy and credit linkage for individual micro-enterprises, as well as credit-linked grants for clusters and groups like FPOs, SHGs, and cooperatives.
- Seed capital is provided to SHGs processing food products for working capital and to purchase capital goods, while credit-linked grants aid in building common infrastructure.
- Additionally, 50% of branding and marketing expenditure is funded through the scheme.
- ODOP facilitates balanced regional development, improving backward and forward linkages of identified products and contributing to socio-economic development nationwide.
- The initiative is widely adopted across states/UTs to unlock the true potential of each district in terms of export contribution and national income, establishing brand identity and positioning for local products.

Value Chain Development, Infrastructure and Marketing Support

- **Common Infrastructure:** ODOP scheme provides access to common infrastructure facilities in rural areas for FPOs, SHGs, and cooperatives, while private enterprises can utilize these facilities on a hiring basis. This includes sorting, grading, warehousing, and cold storage for ODOP products. Credit-linkage grants of 35% are available to promote the development of common infrastructure, recognizing its value in the value chain.
- **Development of Clusters:** Clusters for ODOP products can span across one or multiple districts, facilitating value chain development and alignment of support infrastructure. These products encompass perishable items, agri-based products, cereals, and value-added products. The scheme strengthens both forward and backward linkages, offering common facilities, skill training, incubation centers, research, development, marketing, and branding.
- **Value Addition:** The cluster-based approach adopted by states/UTs prevents wastage, facilitates processing, and enhances the marketing ecosystem for ODOP products, adding value and ensuring effective access to customers.
- **Branding and Marketing:** Strong branding and marketing support are crucial for making ODOP products accessible to consumers. The scheme emphasizes common branding, packaging, and standards, tailored to district, regional, or state levels, determined by State Nodal Agencies. Support for branding and marketing is provided within permitted expenditures.
- **Institutional Architecture:** ODOP project establishes committees at district, state, and national levels, ensuring proper planning, execution, and monitoring through a robust institutional

Nodal Agencies, State Level Approval Committee, District Level Committee, and Project Executive Committee, fostering viable, valuable, and sustainable development processes.

ODOP Opportunities and Benefits

- ODOP scheme benefits local communities by fostering employment, empowering rural demographics, and improving livelihoods.
- It preserves local practices, fostering self-reliant ecosystems, and provides training for localized entrepreneurship.
- By promoting exports and supporting 'Aatmanirbhar Bharat', it contributes to inclusive development.
- Digital ODOP GIS maps aid in identifying resources for growth.
- Challenges include underutilization of cold chain infrastructure and uneven distribution of resources across districts.

The success of 'Democracy and Swaraj' relies on effective planning and reaching every corner of society, achieved through initiatives like ODOP under PMFME. ODOP enhances value chains for various products and has earned praise for its bottom-up approach, contributing significantly to India's integrated development.

Recognized for its role in unlocking district potential, fostering local employment, and driving economic growth, ODOP is a flagship initiative of inclusive development. India's journey towards a stronger economy involves robust public policy support, improved infrastructure, and effective implementation of ODOP to achieve the goal of 'Atmanirbhar Bharat'.

Traditional Storage Infrastructure and Practices in India

India's ambition to become a primary global food grain exporter hinges on its exploration of indigenous food storage practices, which offer cost-effective and sustainable solutions. Despite this, the country has achieved a notable milestone in food grain production, reaching 3296.87 lakh tonnes in 2022-23, surpassing previous years' averages. This achievement not only ensures self-sufficiency but also elevates India to a leading exporter status. However, maintaining this position necessitates robust food grain storage infrastructure, crucial for national food security. Traditional storage methods, rooted in ancient civilizations like the Vedic age and evidenced in sites such as Harappa and Mohen-jo-daro, utilized materials such as wood, cane, cow dung, and clay. Despite modern advancements, the sustainability and eco-friendliness of traditional practices remain debated. Nonetheless, they continue to support small farmers who lack access to modern storage facilities, with studies suggesting that 60-70% of the country's food grains are stored using these indigenous methods at the household level.

Traditional Storage Structures in India

- **Traditional Storage Pits in Andhra Pradesh:**
  - Farmers in Andhra Pradesh use traditional pits, 6 feet deep, filled with hay and clay to store grains.
  - Protected by sealing with mud, these pits safeguard against rain, theft, and fire.
  - Decorated by women, these pits hold cultural significance.
- **Bukhari:**
  - Square-shaped structure, plastered with mud and straw, raised on platforms to store paddy, maize, and jawar.
  - Features an outlet at ground level and a capacity of 3.5 to 18 tonnes.
- **Kothar:**
  - Wooden box-type structure with tilted roofs, elevated on pillars to store various grains.
  - Roofed with planks or corrugated metal sheets, equipped with rat-proofing cones.
- **Cylindrical Grain Bins**: Concrete-based bins with column support, capable of storing 10 to 40 tonnes of various grains.
- **Rectangular Grain Bin**: Multiple storage bins under one shed, with walls made thick for durability.
- **Bharola**: Portable, egg-shaped earthen bin, holding 40-80 kgs of grains.
- **Kupp**: Inexpensive storage method for chaff and wheat straw, secured with rope or metal wire.
- **Crib**: Bamboo and wood structure with thatched roof, elevated for airflow, preventing grain damage by rats.
- **Kanaja**: Underground bamboo container, plastered with mud and cow dung to prevent spillage.
- **Sanduka**: Used for smaller grain quantities, with partition walls and raised above ground to avoid moisture

Traditional Storage Practices in India

- **Sun-Drying and Sieving for Wheat Storage**: Farmers in the northern region dry and sift wheat before storage, reducing the risk of pest attacks.
- **Salt Mixing for Red Gram Storage**: Red gram is mixed with table salt, packed in jute bags to prevent insect movement, effective for 6-8 months.
- **Ash Application for Sorghum Seeds**: Farmers in Rajasthan and Punjab mix moth bean and moong with ash to repel beetles, reducing crop damage by 80%.
- **Neem and Thumbai Leaves for Ragi Storage**: In Tamil Nadu, neem and thumbai leaves are

- **Camphor Usage for Pulse and Grain Storage**: Farmers use camphor to repel pests during pulse and grain storage, providing protection for up to 3 months.
- **Gingelly Seeds and Jaggery for Oil Preservation**: Gingelly seeds are mixed with paddy to prevent larvae infestation in oil seeds, while palm jaggery pieces preserve oil for up to 18 months.
- **Tamarind Storage with Salt**: Tamarind is stored in earthen pots with salt to loosen flesh and prevent pests and moths.
- **Sweet Flag Technique for Grain Storage**: Farmers have used powdered sweet flag to mix with grains and pulses, preventing infestation due to its strong odour.

These traditional methods, while eco-friendly and regionally suited, may not suffice for national food security. Integration with modern technology is necessary to create sustainable and large-scale storage structures.

What can be done?

- **Timing of Harvesting**: Harvesting should occur at the right time to ensure optimal moisture levels and maturity, avoiding both premature and post-mature grains. Delayed harvesting can lead to increased susceptibility to pests and fungi, as observed in a study conducted in Karnataka.
- **Transition to Mechanized Harvesting**: While traditional methods like sickles and knives are accessible to small farmers, they result in significant grain loss through shattering and scattering. Transitioning to mechanized harvesting can mitigate these losses and improve efficiency.
- **Efficient Cleaning Methods**: Manual cleaning and winnowing methods often result in substantial grain loss. However, hand-driven mechanical winnowers, particularly those developed in India; offer a simpler, eco-friendly, and more efficient solution, reducing grain loss by up to 90%.
- **Utilization of Solar Dryers**: Solar dryers provide an environmentally friendly and cost-effective means of removing moisture from grains before storage, minimizing grain wastage compared to conventional drying methods.
- **Improved Transportation Methods**: Traditional grain transportation methods are prone to spillage, damage, and contamination. Encouraging innovative solutions like solar-powered electric vehicles and better transportation bags at the farm level can reduce losses during transit. Additionally, the government should invest in fuel-efficient vehicles and rural transportation infrastructure to enhance economic standards in rural areas.