SHAPING SUSTAINABLE FOOD SYSTEMS WITH STORAGE INFRASTRUCTURE: A PATHWAY TO VIKSIT BHARAT

Indian agriculture transformed from food deficit to surplus, now exporting globally. India has second-largest agricultural land and 200+ countries in export basket. Food production grew from 244 to 310 million tonnes in the last decade. Since 1951, Indian population surged from 35.9 crore to 140 crore, projected to reach 164 crores by 2047. Led by PM Modi, India aims to be developed by then, focusing on economic, social, environmental growth, and good governance. For that, agri-food system needs to adapt to challenges like climate change, population rise, resource depletion, and crop productivity stagnation.

- Investing in storage infrastructures offers significant benefits. Food loss and waste, totaling 14% of global food production (worth \$400 billion annually), occur at pre-shop. Additionally, 17% is wasted in retail and by consumers, constituting 38% of global food system energy usage.
- A Ministry of Food Processing Industries study, conducted by CIPHET and ICAR, revealed Rs. 92,651 crore is lost in 45 crops. Notably, cereals, pulses, oilseeds lost Rs. 32,853 crores; fruits, Rs. 16,644 crores; vegetables, Rs. 14,842 crores; spices, Rs. 9,325 crores; livestock, Rs. 18,987 crores. Major losses occur in the allied sector, notably fisheries and eggs. Horticultural crops like fruits (6-16%) and vegetables (4-12%) suffer higher losses compared to plantations and spices (1-8%).
- Government initiatives like AIF (Agricultural Infrastructure Fund), AMI (Agricultural Marketing Infrastructure), SMAM (Sub-Mission On Agricultural Mechanization), PMFME (PM Formalisation of Micro Food Processing Enterprises Scheme), PMKSY (PM Kisan Sampada Yojana), and MIDH (Mission for Integrated Development of Horticulture) aim to bolster storage and enhance food systems, supporting agricultural development across the country.

Sustainable Food Systems

- Sustainable Food System (SFS) ensures food security and nutrition without compromising future generations' resources. The Food Systems (FS) approach covers all stages from production to disposal. Storage infrastructure enhances resilience, positively impacting food security. Scientific storage methods can minimize losses to 1%-2%, which is crucial for ensuring food supply stability during crises like COVID-19.
- Various structures ensure grain storage safety, from small bins to tall elevators. These include traditional, improved, modern structures, and farm silos. Traditionally, *60-70% of grains are stored on farms*, but these methods are not suitable for long-term storage. Warehouses and silos offer scientific bulk storage, safeguarding quantity, and quality.
- Warehouses in India are managed by FCI, CWC (Central Warehousing Corporation), or SWCs (State Warehousing Corporation). Cold chain infrastructure has also been enhanced for perishables, with 8.38 lakh MT capacity created under the Integrated Cold Chain and Value Addition Infrastructure scheme.

Government Initiatives

- Since Independence, India's agricultural storage infrastructure and warehousing policies have evolved. The National Policy on Handling, Storage, and Transportation of Food Grains, 2000 marked a significant shift by promoting private sector involvement. Key agencies like DFPD (Department of Food and Public Distribution), Ministry of Agriculture, and APEDA (Agricultural & Processed Food Products Export Development Authority) implement national schemes for supply chain infrastructure development.
- FCI, established in 1964 under the Food Corporation Act, oversees food grain movements across India. It manages storage capacity and creates/hires more as needed. FCI expands capacity through schemes like PEG (Private Entrepreneurs Guarantee) Scheme, CSS, and partnerships. Currently, it operates 1923 warehouses with 371.93 LMT capacity.

- The total food grain production in India is about 311 MMT and total Storage Capacity in India is only 145 MMT, i.e., there is a **shortage of 166 MMT of Storage**. To address the shortage of food grain storage capacity in the country, the Government last year approved the 'World's Largest Grain Storage Plan in Cooperative Sector', which have been rolled out as a Pilot Project in different states/UTs of the country.
 - The plan aims to establish agri infrastructure at PACS (Primary Agricultural Credit Societies) level, including godowns, processing units, and Fair Price Shops. It integrates schemes from Ministries like Agriculture, Food Processing, and Consumer Affairs, including AIF, AMI, SMAM, MIDH, PMFME, PMKSY, and others.
 - These Pilot projects are implemented by the National Cooperative Development Corporation (NCDC) with the support of NABARD, FCI, CWC, NABARD Consultancy Services (NABCONS), National Buildings Construction Corporation (NBCC), etc. in different States/UTs.
 - Through various schemes, PACS can access subsidies and interest subvention for constructing storage facilities and other agri infrastructure. With over 1,00,000 PACS and 13 crore farmers, NABARD provides financial support at subsidized rates. Additionally, 1,711 PACS are identified for storage capacity creation, with ongoing construction in 13 PACS across states/UTs.
- Recent efforts to boost India's cold storage capacity include tax incentives. The Income Tax Act permits a deduction of up to 150% for cold storage setup expenses. It offers exemptions on profits for 5 years and partial exemptions for the next 5 years. Service tax and excise duty exemptions also apply.

Conclusion

The nation maintains substantial food stocks to aid the needy, supported by **PMGKAY** (PM Garib Kalyan Anna Yojana), providing free grains to 81.35 crore beneficiaries for five years starting January 1, 2024. Improved storage infrastructure ensures food availability and accessibility nationwide. Food grain storage will directly support in achieving the targets made under the **Sustainable Development Goal of zero hunger**, which aims to end all forms of hunger and malnutrition and double the agricultural productivity and incomes of small-scale food producers. Also, indicators under target 12 i.e. sustainable consumption and production can be achieved through advancement in storage infrastructures in India.

Upgrading storage infrastructure, expanding warehousing, engaging private sector, and training in scientific storage empower farmers. Decentralized storage reduces grain wastage, bolsters food security, and curbs distress sales. Increased investment in modernization aids development goals and Sustainable Development Goals attainment.

WAREHOUSING: CHANGING GEARS TO MEET PRESENT CHALLENGES

A warehouse serves as accommodation for goods in the supply chain journey. Formerly seen as cost centers, warehouses now play a crucial role due to global production shifts and e-commerce growth. Warehouses are crucial links in supply chains, facilitating the flow of goods between supply and demand points while minimizing costs, maintaining service quality, and guaranteeing access to goods as and when needed. The warehouse receipt also plays a key role in warehousing operations for obtaining timely finance. Therefore, warehousing is not just about storage; it encompasses a host of other activities, which are equally important.

Warehouse Receipts and Warehouse Receipt Systems

• Post-harvest, farmers struggle with liquidity issues, often selling at low prices to meet immediate financial needs such as repaying loans and funding future sowing seasons. Despite increases in food production and credit flow, farmers still face issues with storage facilities, distress sales, and income. Pre-harvest finance dominates, with post-harvest finance comprising only 2% of total agricultural credit.

- To enhance farmers' incomes, credit flow must increase post-harvest. Enabling *tradability and negotiability of warehouse receipts* can attract banks to offer pledge finance against them. Thus, a well-regulated warehouse receipt system is vital for lender confidence.
- A warehouse receipt, issued upon receiving goods for storage, functions similarly to coat checks or luggage claim tickets, ensuring safekeeping and eventual return of items in their original condition. Goods deposited using a warehouse receipt can serve as collateral for loans from banks or financial institutions. Legal frameworks connect the receipt to stored goods, enabling this collateralization opportunity.
- A Negotiable Warehouse Receipt (NWR) addresses the issue of negotiability, providing proof of deposited goods and serving as a regulated document of title, facilitating access to pledge finance for depositors and farmers. NWRs have several benefits over ordinary receipts as shown in the comparison between an ordinary warehouse receipt and NWR in the table below:

Comparison of an Ordinary	Warehouse Receipt and NWR
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Ordinary Warehouse Receipt/ Stock Receipt	NWR
Not regulated	Regulated by a statutory authority
No uniformity of information in the receipt	Receipts contain information in a standard format, as
	prescribed under the regulatory act and rules
Problems in valid transferability of goods in case	Ownership transfers are easier due to the regulatory
of transfer/ endorsements, due to lack of legal	backup
negotiability of warehouse receipts.	

Warehouse Receipt System (WRS)

The main participants in a WRS are the following:

1. Depositor: When depositing goods in a warehouse, the depositor incurs transportation, storage, and financing costs. In return, they anticipate reduced post-harvest losses, potential price appreciation, product grading, insurance options, and credit access.

2. The Warehouseman: Upon receiving goods, the warehouseman examines, grades, and weighs them, issuing a receipt to the depositor. Warehouse operators are legally mandated to handle goods with care, safeguarding them against theft, weather, pests, and disease. They must deliver goods as specified on the receipt.

3. The Bank or Financial Institution: Depositors can use warehouse receipts to secure bank loans, typically receiving loans against a percentage of the stored commodity's market value (usually 50-80%).

4. Insurance companies, testing agencies etc.: A reputable warehouseman ensures insurance coverage for all stored goods against risks like fire, floods, and theft. The warehouse operator's integrity and performance are pivotal for instilling confidence in the warehouse receipt system (WRS).

5. The **regulator** oversees the WRS by registering warehouses, conducting inspections, and resolving disputes. Its role is crucial in maintaining stakeholder trust in the system.

 The Warehousing (Development & Regulation) Act of 2007 in India provides legal support for negotiable warehouse receipts, aiming to establish a system for all commodities, including agricultural ones, as recommended in an RBI report. The Act aimed to promote warehouse receipts as a key trading instrument nationwide, enabling easier finance against them and enabling banks to enhance lending portfolios related to goods in warehouses. However, data from several major banks indicates that financing against Warehouse Receipts is not widely
used, although there is a growing trend. Banks cite issues like lack of negotiability, absence of electronic
Warehouse Receipts, disposal difficulties in case of default, and lack of trust in receipts from private
warehouses as constraints. The group recommends passing a Warehouse Receipt Act to firmly establish the
negotiability of Warehouse Receipts.

The Warehousing (Development and Regulation) Act, 2007

The enactment of the Warehousing (Development & Regulation) Act, 2007 provided for the establishment of a comprehensive WRS, based on NWRs, for the first time in India. Among other things the Act provides for the following salient measures:

i. Establishment of the Warehousing Development and Regulatory Authority (WDRA) to exercise the powers conferred on it, and to perform the functions assigned to it under this Act.

ii. Made registration of warehouses with WDRA compulsory for those warehouses which are intending to issue Negotiable warehouse Receipts (NWRs).

iii. Defined various liabilities and duties of registered warehousemen in the interest of depositors.

iv. Defined warehouse receipt and its mandatory particulars to standardise warehouse receipts.

V. Defined the negotiability and non-negotiability of warehouse receipts and various warranties related to it.

vi. Identified various offences by warehouseman/ depositor and penalties for the offences.

vii. Recognised the lien of warehouseman on goods for recovery of all lawful charges for storage and preservation of the goods.

viii. Given special powers to warehouseman to deal with perishable and hazardous goods.

ix. Constituted an Appellate Authority to hear appeal by any person aggrieved by an order of WDRA made under this Act, or any rules or the regulations.

X. Formed a Warehousing Advisory Committee to advise the Authority on matters relating to the making of regulations under the Act and to make recommendations for effective implementation of the Act.

xi. The Act has overriding effect on anything inconsistent contained in any other law in force or any instrument having effect by virtue of any law other than this Act.

Paper Based Warehouse Receipt	e-NWR
Can be shared with prospective buyer in a one-	Help farmers/depositors to have access to many buyers
to-one mode only	nationwide with better bargaining powers
Cannot be split	eNWRs can be split with obligation to transfer only a part of
	the commodity
Prone to loss, mutilation, tampering, fudging	No possibility of any such eventuality
WR information etc.	
Inherent difficulties in efficient clearing and	Promote an efficient clearing, settlement, and delivery
trading in a transparent manner	system with transparency in trading of agricultural produce
Difficult to share vital information of the WR	It is easy to share vital information of the receipts with
with multiple stake holders	multiple stake holders. Market participants can view and
	manage their receipts via an online portal
Assaying is not mandatory	Reporting the quality of goods in eNWR is mandatory
Raising finance/ selling the goods underlying	Easing access to finance by enabling multiple transfers
the receipts is a cumbersome process.	without physical movement of goods.

Comparison between Paper based WR and e-NWR

Risk of issuing of duplicate NWR without	Not possible
following the procedure	
Fraudulent overstatement of the value of goods	Agmark.net prices are retrieved in the electronic portal
is possible	issuing eNWRs, to serve as a benchmark
Monitoring and surveillance are costly	Regularly monitored by WDRA at reduced monitoring costs.
	This builds credibility amongst market participants
Problems in valid transferability of receipts in	Being electronic in nature multiple transfers are easy, with
case of transfer/ endorsements	due backup of W(D&R) Act 2007
There are cases of Multiple finance against the	Multiple finance against the same eNWR is not possible
same warehouse receipt	due to electronic lien marking.

Conclusion

- As of December 31, 2023, the WDRA boasts over 5,000 valid warehouse registrations. Annual lending against eNWR rose to Rs. 2,442 crores in 2022-23, climbing further to Rs. 2,582 crores by December 31, 2023.
- State Bank of India has introduced a special product for farmers, offering pledge finance against eNWRs without additional collateral or processing fees. Other banks may adopt similar initiatives.
- The journey of WDRA highlights the potential of warehouse receipts as instruments for transactions and pledges, expanding the range of goods eligible for loans beyond traditional collateral like land. WDRA's regulation also promotes financial services like insurance, encouraging depositors to use registered warehouses and obtain loans, ultimately helping farmers secure better prices by avoiding distress sales at harvest.
- WDRA's regulation has effectively established a WRS in India based on NWRs, offering solutions to challenges like infrastructure, storage practices, trust, and pledge finance.
- Although warehouse registration with WDRA isn't mandatory unless e-NWRs are issued, its registered warehouses serve as examples of quality and professionalism in the sector.

INSTITUTIONALISED MANAGEMENT OF FOOD SECURITY

FCI'S ROLE IN SAFE STORAGE, DISTRIBUTION AND TRANSPORTATION OF FOOD GRAINS

India's population is 1.40 billion, about 17.5% of the global population. Government provides free food grains through PMGKAY to 81.35 crore people under National Food Security Act guidelines. 8.93 crore under Antyodaya Aan Yojana receive 35 kg/month per family, while 72.42 crore PHH individuals get 5 kg/month. Total grain requirement for all schemes adds to 610 lakh MT.

- When FCI was founded on January 14, 1965, India was food-deficient and relied on imports, especially from the USA under PL-480 agreements. The **'Short Tether Policy'** by President Lyndon B Johnson tightened food supply, causing a 'Ship-to-Mouth' crisis and challenging India's sovereignty.
- During the Green Revolution, India adopted high-yield seeds and agricultural technology to boost food production. FCI's support ensured farmers received guaranteed returns, making grain production viable. FCI's MSP purchases, particularly wheat and paddy, led to increased production.
- Continuous procurement encouraged increased production, raising procurement share. India became selfsufficient, reducing import dependence. The government cancelled imports from the USA before PL-480 agreements expired. Though floods and droughts caused intermittent stress, FCI's institutional structure managed the situation effectively.

- In 2023, the government purchased 760 lakh MT of wheat and rice, directly crediting Rs. 2,19,140 crores to 1.25 crore farmers' bank accounts.
- This long-institutionalised journey had started with four mandates given to FCI. They included:
- a) To provide remunerative prices to the farmers,
- b) To provide food grains to vulnerable sections of the society at affordable prices,
- c) To maintain buffer stock reserves for exigencies, and
- d) To intervene in market for price stabilisation.

To achieve these mandates, FCI had to constantly enhance its operations, particularly storage, transportation, and distribution of food grains.

Storage Operations for Food Grains in Central Pool

- Proper storage ensures preservation of quality for future use and consumption, playing a crucial role in food security and maintaining buffer reserves for emergencies.
- Non-perishable grains like wheat and rice, with low moisture and pH activity, can be stored for 1 to 4 years. Wheat is stored in godowns or silos, while paddy is milled into rice and stored in bagged form.

Conventional Godowns

The functional requirement of bagged wheat and rice storage are a quality conventional storage structure (warehouse/godowns) along with management practices to provide protection against all possible causes of damages during storage. FCI's storage structure has following features:

a) Robust to withstand environmental stresses for long time, less maintenance cost.

b) Able to prevent entry of rodents, birds, and other animals.

c)Walls, floor, and roof must be damp proof and prevent entry of rainwater.

d) Provision for aeration to maintain uniform temperature and relative humidity as far as possible, sampling for observing insect pest incidence, pesticides application, and fumigation.

e) Properly located and connected with roads with sufficient space for entry and exit of trucks. Locations near the kilns, flourmills, garbage dumps, tanneries, slaughterhouses, and chemical industries must be avoided.

CAP (Covered and Plinth) Storage: A Phased-Out Method in FCI

- Cover and plinth (CAP) storage, a low-cost method, was used for wheat due to insufficient covered space. Bags were stacked on a wooden frame on a raised platform, covered with thick polyethylene sheets.
- CAP sites must be elevated and away from water sources to prevent flooding, with plinths raised above ground level for termite protection.
- The main disadvantages of CAP are that the fumigation is not very effective and the covers are damaged at times of high wind and rain, bird attack, monkey attack, etc., which make food grains vulnerable. For these reasons, FCI has phased out CAP storage since 2022.

Bulk Storage - Silos

- Silo is a modern storage technique using vertical containers for loose grain storage. Silos come in varying capacities, with bulk handling, aeration, and fumigation systems. Made of masonry, concrete, or metals, they feature a conical hopper or flat bottom. Hopper-bottom bins enable self-cleaning unloading without shoveling.
- Modern silos feature temperature monitoring systems at various depths. Metal silos exhibit higher temperature gradients due to their thermal conductivity, leading to increased moisture transfer. Spout lines, formed during filling, concentrate impurities at the heap centre, causing heat and pest issues, obstructing aeration, and potentially affecting grain shelf life.

Preservation of Food Grains during Storage

To maintain and preserve the quality of stored food grains in godowns and silos, FCI regularly conducts periodical inspections by trained professional staff. Depending on the situation, food grains are inspected for classification, categorisation, disinfestation, and fitness for liquidation following the FIFO principle. Food grains are kept infestation- free by prophylactic treatment with malathion and deltamethrin and disinfected by curative treatment through fumigation with aluminium phosphide.

Storage Capacity in Central Pool

- By the end of 2023, FCI possesses 761.29 lakh MT of storage space across 2000 locations, even after discontinuing CAP storage. This capacity is 125 times greater than its 1965-66 capacity. FCI owns 363.69 lakh MT, while state agencies hold 397.60 lakh MT. FCI expanded by 146.5 lakh MT of covered storage via 414 conventional godowns under the PEG scheme with PPP.
- FCI is modernizing storage with 111 lakh MT of state-of-the-art silos, completing 15 lakh MT. Plans include 25 lakh MT hub silos at 36 sites and 86 lakh MT spoke silos at 249 sites. It also built 0.77 lakh MT storage in difficult terrains, with 0.83 lakh MT under construction. FCI upgraded existing godowns, introduced LED lighting for energy efficiency, reduced carbon footprint, and enhanced security with high-quality CCTV.

Transportation and Distribution of Food Grains

- To distribute grains to 81 crore people nationwide, FCI transports surplus grains from states to deficit regions. Efficient transportation connects surplus producers with deficit areas.
- FCI utilizes railways, roads, and waterways, with wheat typically transported from Punjab, Haryana, and Madhya Pradesh, and rice from various states.
- In the last 5 years, about 600 lakh MT of food grains were transported, 40 times more than in 1965-66. This involves interstate movement of 82% wheat and 66% rice procured from surplus states, with an average distance of 1200 km travelled per bag.
- Food grains transported to deficit regions are stored in local godowns for distribution to 5.45 lakh Fair Price Shops (FPSs) through state agencies. Implementation of biometric authentication and One Nation One Ration Card (ONORC) ensures transparency, efficiency, and security for migrant workers. FCI distributed about 700 lakh MT of food grains in 2023, 39 times more than in 1965-66.

Technology Integration and Reduction In Losses

- FCI has leveraged technology to improve operations, utilizing systems like Depot-on-Line (DoS) for inventory management, GPS-enabled Vehicle Tracking (VLTS), and e-procurement platforms. Initiatives like WINGS for transparency and a dedicated Call Centre enhance efficiency and accountability across the supply chain.
- Scientific norms by ICAR and online documentation improved storage losses from 0.17% in 2013-14 to 0.12% in 2022-23. Joint verification and high-security seals reduced transit losses from 0.46% to 0.22% during the same period.
- Thus, FCI's food supply chain not only ensures food security to all the needy citizens in every nook and corner of the country but also make it the world's largest food system. The efforts to modernise its operations and to take along all the stakeholders is a continuing process to improve its efficiency and effectiveness.

MEGA FOOD STORAGE PLAN CHALLENGES AND WAY AHEAD

India, the second largest food producer globally, yields around 3,100 lakh tonnes annually. Yet, its storage capacity stands at 145 MMT, leaving a 166 MMT deficit. Unlike the USA and China processing 65% and 23% of their produce, India processes only 7%. A National Academy of Agricultural Sciences (NAAS) study finds storage

as a primary cause of post-harvest losses in India. Poor handling, storage, and distribution result in losses ranging from 10-16% for major cereals to 34% for vegetables and fruits. Currently, various government bodies, including the Food Corporation of India and others, manage grain storage. However, due to inadequate storage, grains are often stored outdoors, leading to significant damage.

- It is alarming to witness grains left unprotected in market yards, leading to substantial losses for farmers. Recognizing the urgency, the Government of India aims to curb post-harvest losses through enhanced storage infrastructure. Providing secure market yards is crucial to ensure food security and fair prices for farmers. Additionally, this initiative promises economic benefits and rural development opportunities.
- The Ministry of Cooperation has greenlit a vast network of integrated grain storage facilities through Primary Agricultural Credit Societies (PACS) nationwide. This ambitious plan involves over 1,00,000 PACS serving more than 13 crore farmers. It is poised to become the world's largest grain storage initiative within the cooperative sector.
- Each integrated facility, spanning 1 acre, will be constructed at a cost of Rs. 2.25 crore, with a subsidy of Rs. 51 lakhs, while the remaining funds will come from margin money or loans. These modular PACS will feature custom hiring centres, procurement centres, primary processing units, storage sheds, container storage, and silos.
- The new plan aims to boost food grain storage capacity by 70 MMT in the cooperative sector. It employs a hub and spoke model, with 55,767 PACS serving as spokes with 1,000 MT capacity each, and 7,233 PACS as hubs with 2,000 MT capacity each.
- This initiative will decentralize storage, reduce FCI's burden, minimize farm produce wastage, and enable farmers to plan sales better. It also integrates eight existing schemes from different ministries and utilizes their funds for this purpose.
- The Indian Government approved this pilot plan on May 31, 2023, to establish the world's largest food grain storage scheme in the cooperative sector, with an allocation of about Rs. One lakh crore. It involves creating various agri-infrastructures at the PACS level using a 'Whole-of-Government' approach.
- The plan is being implemented by utilising the approved outlays of the following Government of India ministries and schemes for the creation and modernisation of infrastructure facilities at the PACS level:

Mi	nistry of Agriculture and Farmers	Mi	nistry of Food Processing	Mi	nistry of Consumer Affairs,
Welfare		Ind	lustries	Fo	od and Public Distribution
•	Agriculture Infrastructure Fund	•	Pradhan Mantri Formalisation Of	•	Allocation of food grains
•	Agriculture Marketing		Micro Food Processing		under the National Food
	Infrastructure Scheme		Enterprises Scheme		Security Act
•	Mission for Integrated	•	Pradhan Mantri Kisan Sampada	•	Procurement operation at
	Development of Horticulture		Yojana		Minimum Support Price
•	Sub Mission on Agriculture				
	Mechanisation				

- An Inter-Ministerial Committee (IMC) oversees the scheme's implementation, with authority to adjust guidelines and methodologies. The Ministry of Cooperation formed the National Level Coordination Committee (NLCC) to oversee plan implementation. States/UTs established State and District Cooperative Development Committees (SCDC and DCDC) for local oversight.
- The committees will assess various factors like storage gap, capacity utilization, connectivity, and market linkages. The program aims to build 2,000-tonne capacity godowns in every block, increasing India's food grain storage capacity by 70 MMT. Expansion plans aim for 215 MMT in five years.

Why Mega Plan Needed?

India, with 18% of the world's population (1.4 billion out of 7.9 billion), holds only 11% of cultivable land (160 million hectares out of 1,380 million hectares). Implementing the National Food Security Act, 2013, covering 81 crore people, necessitates a strong food grain storage network for food security.

Implementing Agencies

- The National Cooperative Development Corporation, with support from NABARD, NABARD Consultancy Services, Central Warehousing Corporation, and Food Corporation of India, is piloting a project across 24 PACS in different States/UTs. Construction began at five PACS in Tripura, Haryana, Tamil Nadu, Uttar Pradesh, and Madhya Pradesh.
- The project aims to establish decentralized storage capacities ranging from 500 MT to 2000 MT at PACS levels to minimize food grain wastage, enhance food security, and ensure better prices for farmers' produce. This initiative will also save costs by eliminating the need for transportation between procurement centers and fair price shops.
- The project costs per PACS vary based on factors such as storage capacity and infrastructure requirements. Interest Subvention under the Agriculture Infrastructure Fund will complement subsidies for rural godowns and agri-infrastructure units at the PACS level.

Why Implement

Several benefits can be derived by augmentation of the Storage facilities, as summarised below:

- First, the stepping-up of storage capacity will reduce transportation costs for farmers, enabling them to maximise their profits.
- Farmers would have a choice to sell their produce depending on the market conditions and not be forced into distress sale.
- The modern silos will have the facility of computerised real-time monitoring systems.
- Strengthening food security is the crucial objective of this scheme, as it will ensure a more stable and consistent supply of food grains across the country, thus reducing our dependence on imports.
- The expansion of storage facilities will create numerous employment opportunities in rural areas. The construction of godowns and the subsequent management and maintenance of these facilities will generate jobs thereby contributing to the overall development of rural folks.
- The Ministry of Cooperation aims to leverage the strength of cooperatives and transform them into successful business enterprises, aligning with the vision of 'Sahakar se Samriddhi (Cooperation for Prosperity)'.
- By establishing agri-infrastructure such as warehouses, custom hiring centres, and processing units at the PACS level, the plan seeks to empower PACS, which play a significant role in the agricultural and rural landscape.
- With over 1,00,000 PACS and a membership base of more than 13 crore farmers, the plan aims to enhance the economic viability of PACS and contribute to the growth of the Indian agricultural sector.

Challenges Ahead

Like any other new scheme, this novel concept also faces a lot of scepticism as under: -

- **Conflict with FPOs:** Promoting Farmer Producer Organisations (FPOs) aims to overcome cooperative societies' limitations and aims to cover all blocks in the country. FPOs handle post-harvest produce, sometimes conflicting with agricultural cooperatives.
- **Agri-Cooperatives:** Agricultural cooperatives face issues like elite capture and inadequate marketing, affecting small farmers' access to competitive markets and fair prices.

- Infrastructure Management and Maintenance: Creating infrastructure is simple, but its management and upkeep pose significant challenges. India struggles to maintain various infrastructures like FCI storage, water, and irrigation systems. Capital maintenance expenditure is often overlooked in annual budgets. Additionally, India's storage capacity covers only one-eighth of its perishable produce annually.
- **Food Quality Management:** Maintaining food quality is pivotal for nutrition security. Often the poor-quality grains are distributed under Public Distribution System, due to low quality storage infrastructure with primitive technologies (FCI godowns) and long spans of storage.
- Besides, multiplicity of institutions with cross- cutting objectives is likely to dilute their effectiveness.
- Policies formulated for small and marginal farmers often end up serving the interest of medium and large farmers.

Possible Solutions

The latest data shows that the value of food losses (agriculture, horticulture, milk, meat, and fish) turns out to be above Rs. 1,40,000 crore per year. Hence, finding out the practical solutions for removing the hurdles in the seamless implementation of the above scheme is necessary. Let us explore the possibilities: -

- It would be much better if this scheme is implemented in Public-Private Partnership mode. Even, implementing it through Farmers Producer Organisations seems to be better option.
- Secondly, the modernisation of the existing storage infrastructure needs to be prioritised. In fact, the storage facilities for not only food grains but also other perishable goods like fruits, vegetables, milk, and meat need to be modernised.
- Since the ambitious target of doubling the farmers' income is linked with the cultivation of high value crops, it would be highly desirable if adequate storage facilities are provided for horticultural crops.

The Pilot is new with of course, lots of apprehensions and hurdles ahead, but every new concept brings along varied challenges. So, it would be better to remember the words of our current Prime Minister and move steadily and judiciously towards translating them into reality: - "At present, we need to pay maximum attention to processing in every sector of agriculture and for this, it is very necessary that farmers get modern storage facilities near their villages."

ENTREPRENEURIAL OPPORTUNITIES IN FOOD STORAGE INFRASTRUCTURE

India's food industry is a major global contributor to manufacturing, exports, growth, and consumption. Population growth, urbanization, innovations, and rising disposable incomes have fueled its substantial recent growth. The increasing demand for processed food presents a significant opportunity for Indian farmers, potentially boosting their income. Challenges such as inadequate cold chain and storage infrastructure contribute to high levels of post-harvest wastage, amounting to over \$310 billion annually globally, impacting producers' income and contributing to CO₂ emissions. The Food Corporation of India (FCI), Central Warehousing Corporation (CWC), and Central Railside Warehouse Company (CRWC) offer nationwide storage facilities. However, capacity and quality issues persist, including godown conditions, rising costs, and lack of farm gate storage. The Shanta Kumar Committee (2015) recommends modernization to improve grain quality, reduce losses, optimize land use, enhance operational efficiency, and attract private investment. **Entrepreneurial Possibilities in Food Storage Infrastructure**

Food system infrastructure covers everything needed in the supply chain of activity between the consumer and the producer, be that a farm, fishery or community garden. Infrastructure covers everything needed for agrifood entrepreneurs to move food from the farm to the plate or to move products. Agri- food supply chains involve:

A. Production: Inputs such as seed, feed, and harvesting services and equipment;

B. Processing: Activities such as washing, drying, and freezing food;

C. **Aggregation and Distribution:** Things such as marketing cooperatives, storage facilities, brokerage services, logistics management, and delivery trucks;

D. **Retailing:** All those who sell or serve food to consumers, from restaurants, grocery stores and hospitals, to schools, caterers, and fast-food outlets etc.;

E. Marketing: The effort that goes into promoting products such as advertising, campaigns, packaging materials, branding and so on; and

F. **Capital:** Finance, natural capital (i.e. land, water and other ecological resources), human capital, and social capital.

There are many layers of entrepreneurship possibilities in all these activities. Entrepreneurship in and around food storage infrastructure is one of the crucial components but should not be promoted independently, as these are intricately linked with other activities. Addressing funding, marketing, IT, legal, training, and mentoring gaps is crucial for sustainable enterprise development.

Box 1: Entrepreneurial Opportunities in Food Storage Infrastructure				
Custom hiring centres	Processing units (sorting and grading, powdering etc.)			
Common facility centres	Packing houses			
Transportation logistics	Various types of maintenance and repair services			
Procurement logistics	Mentoring and hand holding services			
Cold storage/warehousing facilities on rental basis	Uses of ICTs in storage			
Fumigation and sterilisation services for warehouses	Energy suppliers(electricity, solar etc.)			
Pest management services	Gunnies and packaging material stores			

Schemes and Programmes

Numerous formal institutions and agencies, along with government and NGO initiatives, promote entrepreneurship, including in food storage infrastructure. However, awareness among stakeholders, coupled with cumbersome regulatory procedures, hinders progress. Sensitizing entrepreneurs and simplifying compliance processes are crucial. PMKSY supports mega food parks, cold chain structures, and agro-processing clusters, among other schemes.

1. Mega Food Parks: The scheme employs a cluster approach, facilitated by an SPV, to link agricultural production to markets. It funds infrastructure for modern food processing units, offering a capital grant of 50-75%, up to \$7.15 Mn per project.

2. Cold chain, Value Addition and Preservation Infrastructure: The scheme targets an integrated cold chain across food processing supply chains, including Minimal Processing Centers with various facilities. It offers grants up to \$1.43 Mn for storage, transport (35%-50%), and processing (50%-75%) infrastructure. 299 projects were approved by March 2019.

3. Creation of Food Processing and Preservation Capacities: The scheme targets enhancing processing and preservation capabilities to reduce wastage, offering a capital grant of 35-50%, up to \$0.71 Mn per project. By December 2018, 134 projects were approved.

4. Creation of Backward and Forward Linkages: The scheme facilitates backward and forward integration in the processed food industry, offering financial aid for primary processing centers, collection centers, and modern retail outlets, alongside connectivity via insulated or refrigerated transport.

5. Food Safety and Quality Assurance Infrastructure: The scheme aims to enhance India's food and agroprocessing sector's competitiveness by building safety and quality infrastructure. It provides financial aid for laboratory equipment (50-70%), civil work (25-33%), and HACCP/ISO standards (50-75%). 76 food testing labs were established by November 2018.

6. Agro Processing Cluster: The scheme promotes cluster-based development of modern infrastructure for food processing units. It offers grants of 35-50% of project costs, up to \$1.43 Mn per project. 33 projects were approved by December 2018.

7. PM Formalisation of Micro Food Processing Enterprises (PMFME): Under the Aatmanirbhar Bharat Abhiyan, the Ministry of Food Processing Industries (MoFPI) introduced the PMFME Scheme'. With a Rs. 10,000 crore funding for 2020-21 to 2024-25, it aims to upgrade over 2 lakh micro-food processing units, including FPOs, SHGs, and cooperatives, fostering multiple benefits. It also provides assistance for capital investment, common infrastructure like Common Facility Centres (CFCs), branding, marketing, and cold storage provision under CFCs for FPOs, SHGs, and PCs to formalize and expand.

8. Common Facility Centres (CFCs) under MSE-CDP: Under cluster development programme of Ministry of MSME, there is provision of establishing Export Promotion Facilities for FPO such as for processing, storage (cold chains), Pack Houses, testing, and packaging.

9. Mission for Integrated Development of Horticulture (MIDH): Under MIDH, besides Cold Storage, financial aid is available for Pre-cooling Units, Cold Rooms, Pack Houses, Integrated Pack Houses, Preservation units, Reefer Transport, Ripening Chambers, etc. Government subsidies range from 35% to 50% of the project cost, administered through State Horticulture Missions.

10. Schemes and programs under Ministries like Agriculture, Fisheries, and Animal Husbandry, along with regulatory bodies like NHB, NHM, and APEDA, support entrepreneurship in related sectors. **Way Forward**

- Affordable food storage is crucial to reduce wastage and aid small farmers. Improvements in food quality require accessible technologies, like those used in Bihar's potato cold storage clusters. Innovations like MittiCool and Subjee-Cooler offer cost-effective, eco-friendly solutions.
- In remote areas without reliable electricity, decentralized renewable energy like solar and hydro mini-grids can provide power. Solar-based techniques such as dryers and storage help preserve food quality and reduce waste, while lowering GHG emissions compared to fossil fuels. Private investment in food processing, refrigeration, and ICT is crucial for reducing waste and stabilizing market prices.
- To expedite food waste reduction, there is a need to focus on advancing food processing, refrigeration, and storage technologies. The aim is to establish one cold storage per Gram Panchayat through detailed crop mapping, reducing transport needs, and fostering safe food demand and supply. Strong forward and backward linkages are vital to stabilize prices and benefit both farmers and consumers.

ODOP: PROVIDING FRAMEWORK FOR VALUE CHAIN DEVELOPMENT

Agricultural development is vital for India's economy, aiming for balanced regional growth through diverse mechanisms. The Aatmanirbhar Bharat initiative promotes self-reliance, elevating India's global position and adhering to the philosophy of 'Vasudhaiva Kutumbakam'.

The 'One District One Product' (ODOP) initiative, part of the 'Pradhan Mantri Formalisation of Micro Food Processing Enterprises (PMFME) Scheme', promotes inclusive development by leveraging each district's export potential, and fostering integrated local economic growth. Effective and sustainable public policy interventions ensure that benefits reach every citizen.

Progress of One District One Product (ODOP) Scheme

- The PMFME scheme, with its ODOP flagship, leverages scale for input management, common services, and local product promotion in food processing. Objectives include: (a) improved financial aid for tech upgrades, (b) skill training and technical knowledge enhancement, (c) FPO, SHG, and cooperative support, (d) formalizing informal agri-based enterprises.
- The Government of India endorsed **137 unique products across 713 districts in 34 States and UTs** under the ODOP scheme, forming the basis for value chain development and support infrastructure alignment. It supports FPOs, SHGs, and Cooperatives as SPVs, facilitating market study, standardization, packaging, quality control, warehousing, and marketing for consumer retail sales.
- The scheme aids clusters and groups in their entire value chain, including sorting, grading, storage, processing, and marketing of diverse agri-products.
- The ODOP product summary highlights India's prominence in rice, maize, onion, spices, turmeric, coconut, mushroom, mango, banana, honey, milk, apple, bakery products, Mizo chilli, etc., reflecting the diversity and usage based on origin districts or regions.
- The ODOP initiative facilitates the onboarding of sellers of identified products onto e-commerce platforms, enhancing visibility for small businesses and rural farmers. TRIFED promotes tribal products in urban markets, fostering exports and grassroots livelihoods.
- Districts and states play crucial roles in achieving 'Vocal for Local' and 'Aatmanirbhar Bharat' visions, aiming to create awareness and establish new markets at the district level, fostering self-sufficiency and global access.
- As of January 14, 2024, approximately 70,286 loans were sanctioned under the PMFME Scheme. Topperforming states include Maharashtra, Bihar, Tamil Nadu, Uttar Pradesh, and Telangana. Individual microenterprises receive 35% capital subsidy and credit linkage up to Rs.10 lakhs.
- Clusters and groups receive the same subsidy for capital investment. SHGs processing food products receive seed capital of Rs.40,000 per member for working capital and capital goods. A 35% credit-linked grant aids FPOs, SHGs, Cooperatives, government bodies, or private businesses in building common infrastructure. Additionally, 50% of branding and marketing expenditure is funded through the scheme.
- ODOP drives balanced regional development, fostering socio-economic progress nationwide. It supports local and rural economies by enhancing backward and forward linkages of selected products in districts. Widely adopted across states/UTs, it maximizes districts' export potential and national income through brand identity and product positioning.

Value Chain Development, Infrastructure and Marketing Support

Common Infrastructure: The ODOP scheme enables shared infrastructure usage in rural areas by FPOs, SHGs, and Cooperatives, while private enterprises access facilities on a hire basis, optimizing existing capacity. These facilities support sorting, grading, warehousing, and cold storage. Credit-linked grants of 35% promote common infrastructure development, recognizing its value chain contribution.

Development of Clusters: Clusters for a product in a district can extend to multiple districts, aiding value chain development and relevant support infrastructure alignment. ODOP products encompass perishables, agri-based, cereal-based, and value-added goods like tomato, litchi, mango, potato, tapioca, millets, milk, fruits, and vegetables. The scheme bolsters forward and backward linkages, offering common facilities, skill training, incubation centers, research, marketing, and branding support.

Value Addition: States and UTs in India employ a cluster-based approach, facilitating storage, processing, and marketing for ODOP products, curbing wastage, and adding value. This strategy enhances product access and customer engagement, mitigating losses and boosting value.

Branding and Marketing: Branding and marketing are essential for ODOP product accessibility. The scheme emphasizes common branding, packaging, and standards, adaptable to district, regional, or state levels as decided by State Nodal Agencies. Funding for branding and marketing is limited to permissible expenses.

Institutional Architecture: The ODOP project establishes committees at district, state, and national levels for planning, execution, and monitoring. Project Management Units (PMUs) comprising experts guide State Nodal Agencies (SNAs), State Level Approval Committee (SLAC), District Level Committee (DLC), and Project Executive Committee (PEC). This institutional framework ensures viability, value, and sustainability in development processes.

ODOP Prospects and Benefits

The ODOP scheme has variety of benefits for the local and rural community, for different states and for the nation, which can be summarised as:

(a) Local and community development like in-situ employment, empowering rural women and youth, nurturing the sustainable livelihoods, thus improved standard of living;

(b) Promoting and preserving the local best practices/ micro-enterprises, thereby creating the local ecosystems of self-reliance;

(c) Skilling, upskilling. reskilling and training of local talent to enable localised entrepreneurship and regionspecific innovations; and

(d) Promoting local to global trade boosts exports, bolstering inclusive development and contributing to the 'Aatmanirbhar Bharat' movement through agri-based MSME growth.

When these aspects are considered, the development can be balanced, holistic and inclusive, by benefiting all the key stakeholders, by ensuring equity and equal distribution of opportunity, income, growth, and development

- The digital ODOP GIS map showcases district-wise ODOP details in 713 districts, 216 Integrated Tribal Development Areas, 112 Aspirational districts, and 35 SC districts with 40% SC population. This visualization aids beneficiaries in resource identification, highlighting growth potential for ODOP products.
- Effective utilization of government-invested cold chain infrastructure remains a supply-side bottleneck. Uneven distribution, limited financial and market access across districts are additional concerns. Addressing these hurdles can realize integrated development objectives.

Way Forward

- Success in achieving "Democracy and Swaraj" hinges on planning for the unplanned, reaching the unreached, and optimizing contributions from every sector and district.
- ODOP under PMFME ensures inclusive development by enhancing value chains for various products, including agriculture, marine, dairy, and processed goods.
- ODOP's bottom-up approach garners praise for its role in India's integrated development. It aims at district transformation, local employment, rural entrepreneurship, and inclusive growth. Through systematic marketing, branding, and cluster development, ODOP fosters economic growth and realization of 'Aatmanirbhar Bharat' goal.

AN OVERVIEW: TRADITIONAL STORAGE INFRASTRUCTURE AND PRACTICES IN INDIA

In 2022-23, India achieved a significant milestone with food grain production reaching 329.687 million tonnes, surpassing the previous year's production of 315.616 mt tonnes. This also exceeds the average production of the previous five years by 308.69 mt tonnes. India's self-sufficiency in food grain production and its position as a leading exporter underscore the importance of adequate storage infrastructure for maintaining food security at the national level.

Securing food supply has been a historical concern, evident from Vedic times. Granaries of various materials like wood, cane, hay, cow dung, and clay were used, still seen in villages. Around 2000 B.C., Aryan settlements featured communal granaries indicating an organized food distribution system. Evidence from Harappa and Mohen-jo-daro suggests similar practices, echoed in the Mahabharat era. Today, traditional storage methods remain eco-friendly, supporting small farmers who are unable to afford modern facilities. Certain studies have estimated that nearly 60-70 per cent of the food grains produced in the country are stored at a home level in indigenous structures by using traditional practices. Therefore, it is very important to understand these practices and incorporate them into our policy circles.

Traditional Storage Structures in India

1. Andhra Pradesh farmers maintain century-old storage pits, preserving grains for up to a decade. These rectangular pits, at least 6 feet deep, are filled with hay and clay. Harvested grains are stored inside and sealed with mud, protecting against rain, theft, or fire. Regularly coated with cow dung and traditional rangoli, these pits serve as sacred spaces for farmers.

2. Bukhari: The Bukhari is a square structure made of mud, brick, or cement with a ground-level opening. Its upper part is mud and straw plastered, covered with polythene to prevent moisture. Raised on a wooden or masonry platform, it holds 3.5 to 18 tonnes.

3. Morai: In rural eastern and southern India, cone-shaped structures store paddy, maize, and jawar. Improved versions feature circular wooden floors supported by pillars with timber joints. Vertically placed bamboo splits line the inner surface without gaps, matching the structure's height for desired grain storage. A mud plaster layer smoothest the surface over the rope, with a conical roof and rat-proofing cones on pillars to prevent damage.

4. Kothar: Common in northern India, this elevated wooden box structure stores paddy, maize, sorghum, wheat, and barley, holding 9 to 35 tonnes. The roof, either plank or corrugated metal, has ample overhang. Rat-proofing cones are placed on timber pillars above ground level.

5. Cylindrical Grain Bins: These structures store various food grains, holding 10 to 40 tonnes. Supported by columns on a concrete base, they feature two openings for grain access. The top opening, with a locked hinged cap, allows cleaning access for a person and is sealed with a watertight steel lid.

6. Rectangular Grain Bin: Various grains grown on farms require versatile storage solutions. This type features multiple storage bins under one roof. Bin walls, 11.5 cm thick, are laid in cement mortar, with a rectangular hole in the front wall for grain retrieval.

7. Bharola: It is an egg-shaped earthen yet portable storage bin that has a capacity of at least 40-80 kgs of food grains.

8. Kupp: Kupp is an economical method to store chaff and wheat straw for cattle fodder. A circular boundary of straw and sticks is laid, filled with chaff tightly packed in layers, secured with rope or wire.

9. Crib: This structure, made of bamboo, wood, and metal wires, features a thatched straw roof allowing perpendicular airflow. Raised 0.5m to 1m above ground, it has rat-proof legs and facilitates grain drying through natural ventilation.

10. Kanaja: Kanaja, an underground bamboo grain storage, features a round base with a wide top opening. Varying in height and capacity, it's plastered with mud and cow dung to prevent spillage and pilferage.

11. Sanduka: These boxes store smaller amounts of grains, pulses, and seeds, with capacities ranging from 3 to 12 quintals. Partition walls enable storage of multiple grain types. Raised 12 inches above ground, they are maintained by regular polishing.

Traditional Storage Practices in India

1. In the northern part of the country, farmers indigenously store wheat after drying it in the sun and cleaning it by sifting it. It is scientifically agreed that this process reduces the chances of attack of storage pests.

2. Farmers mix red gram with table salt before storing, then pack the mixture into jute gunny bags. Salt's corrosive action on insect skin prevents movement, preserving the red gram for 6-8 months.

3. A 1:4 ratio of ash is used to store sorghum seeds in airtight jute bags. In Rajasthan and Punjab, moth bean and moong are mixed with ash to repel beetles, with farmers reporting an 80% reduction in crop damage.

4. In Tamil Nadu, farmers employ neem and thumbai leaves for ragi storage, providing inexpensive, organic, and pest-free protection. Neem seed kernel extract treats jute bags for safe grain storage.

5. Camphor is also being used by the farmers to repel pests and insects during the storage of pulses and grains. The strong Odor of camphor can protect grains for 3 months from the pests.

6. To prevent Indian meal moth larvae webbing in oil seeds, Gingelly seeds are mixed with paddy before storage for 3 months. In some Indian regions, Gingelly oil is preserved with palm jaggery in tin containers for 18 months, avoiding rancidity. To address spoilage in stored oil, farmers heat a long iron rod on an earthen stove until red, then dip it in the oil for 5 minutes and seal the container with a cotton cloth.

7. There is a practice of storing tamarind in earthen pots with salt. This will help in loosening the flesh of tamarind and prevent it from pests and moths.

8. For 40 years, farmers have stored grains with sweet flags. Mixing grains and pulses with powdered sweet flags deters infestation due to its strong Odor.

Traditional food grain storage methods are eco-friendly, cost-effective, and regionally appropriate. They evolved to minimize losses from insect infestation, adapting to India's diverse agro-climatic conditions with varied designs and materials. However, they may not suffice for national food security. Integrating traditional methods with modern technology can create sustainable, large-scale structures for national operations.

Before storage, proper handling of grains is crucial. Following specific steps and precautions can significantly minimize crop losses. Here are some recommendations:

- 1. The harvesting time of the grains should be appropriate. Harvesting should be done at the right time to ensure grains' optimum moisture level and maturity. Premature grains, with higher moisture and enzyme content, are more vulnerable to damage, raising drying costs before storage. Delayed harvesting increases risks of pest, rodent, and fungal attacks on crops. In Karnataka, India, delayed harvesting led to a 10.3% rise in paddy harvesting losses.
- 2. India, a labour-intensive country, relies on traditional harvesting methods like sickles and knives, accessible to small farmers. Yet, these methods lead to significant grain loss. Machinery is increasingly necessary to mitigate losses.
- 3. Cleaning and winnowing are the common methods to clean the grains after threshing. But again, manual methods result in substantial grain loss. However, an India-based hand-driven mechanical winnower is a simple, eco-friendly, and efficient technique that not only minimises the loss of grains but also provides a 90 per cent cleaner product.

- 4. The loss of grains can also be minimised by using solar dryers which is an environmentally friendly and costeffective way to remove moisture from the grains and make them ready for storage. The other conventional methods result in the wastage of grains.
- 5. Traditional grain transportation methods pose risks of spillage, damage, and contamination. Encouraging innovative methods like solar-powered vehicles and improved bags at the farm level is vital. Government support for fuel-efficient vehicles and rural infrastructure investment can cut costs and enhance rural living standards.