Agricultural Warehousing in India: Trends, Constraints, and Policies

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List of Abbreviations

AALL	Adani Agri Logistics Ltd
AMI	Agricultural Marketing Infrastructure
AMIGS	Agriculture Marketing, Grading and Standardization
APEDA	Agricultural and Processed Food Products Export Development Authority
APMC	Agricultural Produce Market Committee
BOO	Build-Own-Operate
CAG	Comptroller and Audit General of India
CAGR	Compounded Average Growth Rate
CAP	Cover and Plinth
CCMG	Commodity Control Management Group
CM	Collateral Management
CMIE	Center for Monitoring Indian Economy
CWC	Central Warehousing Corporation
DCP	Decentralized Procurement
DMIC	Delhi-Mumbai Industrial Corridor
eNWR	Electronic Negotiable Warehouse Receipt
FAQ	Fair Average Quality
FCI	Food Corporation of India
FSSAI	Food Safety and Standards Authority of India
FTWZ	Free Trade Warehousing Zone
GBY	Grameen Bhandaran Yojana
GI	Galvanized Iron
GST	Goods and Services Tax
GT	Guaranteed Tonnage
IRR	Internal Rate of Return
ISAM	Scheme for Agricultural Marketing
JLG	Joint Liability Group

JVS	Joint Venture Scheme
MCX	Multi-Commodity Exchange
MPSCSC	Madhya Pradesh State Civil Supplies Corporation
MPSWC	Madhya Pradesh State Warehousing Corporation
MPWLC	Madhya Pradesh State Warehousing and Logistics Corporation
MSAMB	Maharashtra State Agricultural Marketing Board
MSP	Minimum Support Price
mt	Million tons
MUDRA	Micro Units Development and Refinance Agency Ltd
NABARD	National Bank for Agriculture and Rural Development
NCDC	National Cooperative Development Corporation
NCML	National Collateral Management Agency
NERL	National e-Repository Limited
NIR	Near Infra-Red
NMR	Nuclear Magnetic Resonance
NSEL	National Spot Exchange Limited
NWR	Negotiable Warehouse Receipt
OMSS	Open Market Sales Scheme
PEG	Private Entrepreneurs Guarantee
PICS	Purdue Improved Crop Storage
PPP	Public Private Partnership
RKVY	Rashtriya Krishi Vikas Yojana
RSWC	Rajasthan State Warehousing Corporation
SEZ	Special Economic Zone
SHG	Self-Help Group
SOP	Standard Operating Procedure
SSL	Shree Shubham Logistics
SWC	State Warehousing Corporation

TPDS	Targeted Public Distribution System
URS	Under Relaxed Specification
VGF	Viability Gap Funding
WDRA	Warehousing Development and Regulation Authority
WIF	Warehousing Infrastructure Fund
WPI	Wholesale Price Index

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1. Introduction

The importance of good quality warehousing for agricultural produce cannot be understated, as it helps to smoothen the intertemporal availability of seasonally produced crops. Inadequate availability of warehousing can adversely affect supply chain participants—particularly, small farmers. The importance of storage facilities for agricultural production was recognized in India as early as 1928 in the Royal Commission on Agriculture (1928) report. Good quality and affordable warehousing infrastructure for agricultural commodities would allow the farmers to avoid distress sale of their produce as they can store their produce without quality loss and avail credit through pledging. Warehouses help reduce post-harvest losses, enabling producers/traders to take advantage of intertemporal price differences and thereby arbitrage opportunities and ensuring food security. However, after nearly a century, we cannot claim to have reached sufficiency in quality agricultural storage facilities for both the short and long term. Post-harvest management and cold storage facilities for agricultural produce are still inadequate in India. In this regard, the specific objectives of the study are as follows:

a. To understand the extent to which agricultural warehousing policies have achieved the intended outcomes
b. To identify the factors that constrain the achievement
c. To understand the impact of underachievement and asymmetry of information, if any, on price discovery and transmission
d. To make recommendations for significant improvements in the realization of outcomes.

Over the course of this study, these objectives have been translated into specific research questions.

Towards objectives (a) and (b), we examine two sets of questions.

In the first set of questions, we examine the evolution of warehousing policies in India, the trends in growth, and warehousing technologies, as the specific context of agriculture in India has changed along with the stages of the green revolution. We seek to examine the impact of policies on the availability and quality of warehouses and allied industries and the gaps that are yet to be addressed in the agricultural supply chain. We examine the economics of operating warehouses and the challenges faced by warehouse operators by considering the revenue and costs of a few sample warehouses.

In the second set of questions, we explore the innovations in agricultural warehousing. How do institutional innovations such as Negotiable Warehouse Receipt (NWR) and public-private partnerships affect the warehousing industry? We try to understand whether institutional or policy innovations help expand the availability or quality of warehousing in India. We seek to understand the possible regulatory changes that might help to improve the quality and access of warehousing in India. We examine the technological and process innovations related to warehousing and examine their suitability and policy support needed. We explore the impact of the intended reform legislation and the impact of COVID-19.

Towards objective (c), we analyze the impact of warehousing capacity and asymmetry of information on price volatility and wholesale-retail price spreads. Lack of availability of warehouses or poor information about their availability creates uncertainty for buyers and sellers, affecting the price discovery process. This, in turn, affects the volatility of prices and price spreads between wholesale and retail.

Towards objective (d), based on the above inquiry, we examine the key constraints in agricultural warehousing and provide the consequent policy suggestions.

This report presents a brief history of the evolution of India's agricultural warehousing policies and regulations. We present our analysis on the availability and capacity of warehouses in India. We also present some of the challenges faced by the warehousing industry beyond agricultural production – agricultural markets and supply chain, based on interviews of warehouse operators in Madhya Pradesh.

This report is organized as follows. In the second chapter, we present a brief overview of the regulatory landscape of agricultural warehousing in India. We present Madhya Pradesh state policies in detail. In chapter 3, we cover the growth and trends in agricultural warehousing along with the spatial distribution of warehousing capacities, ownership and capacity utilization. We look at warehousing technology and its implications on costs and quality in chapter 4. We also present the role of collateral managers in agricultural warehousing and innovations adopted by them in this chapter. We briefly discuss the economics of agricultural warehousing and implications of technology on the quality and profitability. We also discuss the stakeholder perspectives. Chapter 5 explores the relationship between warehousing capacity and intertemporal price variations and price spread. The impact of the WDRA Act on the growth of warehousing is presented in Chapter 6. In chapters 7, we briefly discuss the impact of recent legislations before they were repealed. The potential impact of recently institutional innovation in agricultural warehousing is discussed in chapter 8. We cover the impact of COVID-19 on agricultural warehousing in chapter 9, followed by critical challenges facing the sector in chapter 10. We conclude in chapter 11 by providing policy suggestions.

2. Review of Agricultural Warehousing Policies in India

2.1 Overview of Policies and Legislation on Agricultural Warehousing

Before Independence, the Sale of Goods Act (1930) regulated contracts related to the sale of goods between a buyer and a seller. As per the act, a contract of sale could be drawn up between buyers and sellers for existing goods or future goods with terms and conditions including price, condition, and warranty of the good and time of payment upon sale of the good. In the contract of sale formed between the seller and the buyer, the "document of title to goods" could also be a warehouse keeper's certificate.

In an independent India, the first Green Revolution aimed to achieve food security for a population at risk of hunger; this objective has been achieved. Post liberalization, a second Green Revolution aimed to modernize agriculture and make agricultural products internationally competitive. This required that any development strategy for agriculture must address agricultural production and trade, processing, marketing, and agri-business. Agri-marketing system performs the crucial function of physically transferring agricultural produce from the producers to consumers and discovers and transmits prices throughout the value chain.

All India Rural Credit Survey, in 1954, recommended the creation of storage facilities near places of production to minimize post-harvest losses and the introduction of negotiable warehouse receipts. Agricultural Produce (Development and Warehousing) Corporations Act was introduced in 1956. Provisions of the Act included the establishment of a National Co-operative Development and Warehousing Board (set up on 1st September 1956), the Central Warehousing Corporation (set up in 1957), and the State Warehousing Corporation in various States (since 1957). The objective of the Act was to establish warehouses to ease the flow of rural credit and strengthen

agricultural marketing in rural areas. The Act also encouraged the states to establish state warehousing corporations.

In 1962, the Act was bifurcated into two – the National Cooperative Development Corporation Act and the more comprehensive Warehousing Corporation Act – both passed in 1962. The National Co-operative Development Corporation Act, 1962 provides for the incorporation and regulation of a corporation to plan and promote programs for the production, processing, marketing, storage, export, and import of agricultural produce. The Warehousing Corporations Act, 1962 provides for the incorporation and regulation of corporations to warehouse agricultural produce and certain other commodities. Under the 1962 acts, the National Co-operative Development Corporation and the Central Warehousing Corporation have undertaken activities in the field under the purview of the respective state governments. The objective of these acts was to promote cooperation and warehousing facilities. Seventeen State Warehousing Corporations have been incorporated under the Act.

The leading agencies for implementing national schemes to promote supply chain infrastructure in India are the Department of Food & Public Distribution (DFPD), Ministry of Agriculture, Ministry of Food Processing Industries, Agricultural & Processed Food Products Export Development Authority (APEDA), and the Department of Animal Husbandry, Dairying & Fisheries. The Agricultural Produce Marketing (Regulation) Acts were passed and implemented in the 1960s and 70s to improve the regulation and marketing of agricultural produce, develop better agricultural markets, and promote agricultural processing and exports. In addition, the acts also seek to enhance the infrastructure available to agricultural markets and production. It requires that any warehousing operation that commences in a particular region obtain licenses that need to be renewed year on year from the Agricultural Produce Marketing Committee of the region.

With the advent of the Green Revolution, the Food Corporation of India (FCI) was set up under the Food Corporation's Act of 1964. The Food Corporations Act, 1964 provides for the establishment of Food Corporations for trading in food grains and other foods. The FCI, with its mandate to promote food security, is a significant user of warehouse space in India and is closely linked with the warehousing industry. The board of directors of the Food Corporation includes the managing director of the Central Warehousing Corporation. Most of the storage capacity of Central Warehousing Corporation (CWC) and State Warehousing Corporations (SWCs) is occupied by the FCI to store central pool stocks.

Entering the 2000s, India had been experiencing several years of surplus production in several agricultural produce leading to the storage of excess procured wheat with the Food Corporation of India (FCI). In fact, by mid-2002, FCI held almost three times the minimum required amount of wheat in its buffer stocks, and a conscious effort was made to free the capital tied up in food stocks. As a result, between 2000 and 2004, over 29.9 mt of FCI food grains were exported using subsidies to the tune of Rs 141.3 billion. Nearly 18.7 mt of wheat and rice were also sold to domestic traders through the Open Market Sales Scheme (OMSS) largely at subsidized prices. In addition, farmers were encouraged to switch production from wheat and rice to vegetables and oilseeds, citing their higher exportability and the already high food grain reserves. To that extent, increases in the MSP for wheat were capped—from Rs 610/quintal in 2001-02 to Rs 650/quintal in 2006-07 or an increase of 6.5% compared to a corresponding 28.6% increase in WPI—to limit procurement and incentivize farmers to shift production.

The introduction of the National Policy on Handling, Storage, and Transportation of Food grains in 2000 saw a major policy shift on warehousing. It promoted the participation of the private sector in building warehouse and storage infrastructure. Organized warehousing capacity in the country

has grown from 108.75 mt in 2010-11 to 143.70 mt in 2016-17. A major contributor to this growth is the warehouses in the private sector. Under the National Policy on Handling, Storage and Transportation of Food grains, 2000, integrated bulk handling, storage, and transportation facilities to the tune of 5.5 lakh tons were created through private sector participation on Build-Own-Operate (BOO) basis. Grameen Bhandaran Yojana (GBY) for constructing warehouses was introduced in 2001-02 as a capital investment subsidy scheme for construction/renovation of rural godowns that envisaged to encourage private and cooperative sectors to invest in the creation of storage infrastructure.

In addition to allowing private investment in warehousing, following the national agricultural policy in 2000, and government notification issued in 2003, futures trading can be conducted in any commodity subject to recognition by the then Forward Markets Commission (while trading in options is prohibited). Buyers and sellers use futures contracts to reduce the risk they face due to volatility in commodity prices in the spot market (Report of the Working Group on Warehouse Receipts & Commodity Futures, RBI, 2005).

The Shankarlal Guru Committee, popularly known as Expert Committee on Strengthening and Developing Agricultural Marketing and Marketing Reforms (2001), emphasized the need to improve the linkages between production, sales, and credit, include private players in the growth of warehousing, and institutionalize the use of warehouse receipts via a commodity exchange system.

> *"[Existing Government warehousing corporations] can only cover part of the field, which should be opened up to private operators, particularly those who already provide storage services. The institutionalization of the warehouse receipts system through the commodity exchanges is most likely to yield the best results in the context of promoting and*

propagating warehouse receipts, in particular electronic warehouse receipts, and a national system of warehouse receipts."

Warehouse receipts are financial instruments that can be traded, swapped, used for delivery against a futures contract, and used as collateral for borrowings. Governments may also purchase them to support prices in the market in times of volatility. However, the success of warehouse receipts depends on the availability of a well-developed warehouse infrastructure. Attempts made by the Government of India to popularize warehouse receipts in India as collateral for loans have been met with resistance from the banks, as they cannot ensure the quality of stored agricultural produce (Working Group on Agricultural Infrastructure, 10th Five Year Plan). The banks also identified as challenges to expanding financing against warehouse receipts, lack of negotiability, absence of electronic warehouse receipts, difficulty in disposing of stocks in case of default, and lack of trust in receipts issued by private warehouses (Report of the Working Group on Warehouse Receipts & Commodity Futures, RBI, 2005).

During the 12th Five Year Plan, a new scheme Agricultural Marketing Infrastructure (AMI), was introduced by merging GBY with Development/Strengthening of Agricultural Marketing Infrastructure, Grading, and Standardization (AMIGS). Now AMI is a component of the Integrated Scheme for Agricultural Marketing (ISAM). An innovative scheme called Private Entrepreneurs Guarantee (PEG) Scheme was introduced in 2008 to create storage capacity for FCI through private entrepreneurs. As per the scheme, FCI guarantees ten years of use to private investors and nine years to CWC/SWCs/State Agencies. FCI has initiated another scheme for the construction of Silos under the Public-Private Partnership (PPP) mode with Viability Gap Fund (VGF). The maximum limit of VGF is 20%. It aimed to construct silos with a total capacity of 100 lakh tons by 2020.

2.2 Policies for Improving Warehousing Quality and Ease of Transaction

Latest in the stream of policies for promoting warehouses was the introduction of the Warehousing (Development and Regulation) Act, 2007, which came into effect in 2010. Before 2010, there was no agency regulating the operation of warehouses. The mission of Warehousing Development and Regulatory Authority (WDRA) is to regulate and ensure implementation of the provisions of the Warehousing (Development and Regulation) Act, 2007 for the development and regulation of warehouses, and regulate and promote the use of Negotiable Warehouse Receipts and promote orderly growth of the warehousing business. WDRA (Negotiable Warehouse Receipts) Regulations, 2011 lays down the rules for NWRs, including terms for standardization, issuance, surrender, maintenance, and duplication of NWRs. By the end of March 2021, 1973 warehouses with a cumulative capacity of 1.1 crore tons are registered with WDRA.

In 2016, the Central Board of Excise and Customs introduced Warehouse (Custody and Handling of Goods) Regulations and Private Warehouse Licensing Regulations. The central government introduced additional rules, Warehousing (Development and Regulation) Registration of Warehouses Rules, for regulation and supervision of warehouses. Further amendments were introduced later in the year. State/UT Agricultural Produce and Livestock Marketing (Promotion & Facilitate) Act was introduced in 2017. By this Act, the government may declare a warehouse/silo/cold storage with infrastructure and facilities to function as a market sub-yard.

There has been a recent push to increase cold storage capacity available in India – with extensive tax breaks. Income Tax Act, 1961 allowed for a deduction of up to 150% on expenditure incurred towards setting up cold storage. It also allowed exemption on profits earned for the first five years and 25-30% exemption for the next five years. The setting up of cold storage is also exempted from service tax and excise duty. Basic custom and excise duty on refrigerated containers reduced

to 5% and 6% from 10% and 12.5% respectively in 2016-17. Cold Chains have been included in the priority lending list and given infrastructure status since 2011-12. In 2013-14, 31.82 mt of cold storage capacity was available, which has increased by nearly 5 mt by 2020.

However, the cold storage capacity is not sufficiently integrated into the agricultural supply chain. For instance, NCDC's 2016 report on the Strategy Options for Cold-Chain Development states that in India, for 134 million cubic metres of refrigerated warehousing space, only 10000 units of refrigerated transport capacity are available. Without adequate refrigerated transport, the capacity for cold storage remains separate and not integrated with the overall value chain for agricultural produce. And in areas where cold storage facilities are available, there is inadequate availability of other services such as pack houses, ripening chambers, etc. Therefore, there needs to be additional focus on end-to-end cold storage infrastructure.

Steel silos with bulk handling capacity are a technologically advanced and highly mechanized way of storing food grains. However, the existing silo storage capacity is still minimal. Food Corporation of India operates eight silos that are currently operational. As of June 2020, the agricultural warehousing capacity in India is estimated to be 165 mt (India Infrastructure Research, June 2020). The central government has announced a pan India (Central Sector Scheme) Agriculture Infrastructure Fund worth 1 trillion. The scheme shall provide a debt financing facility for investment in post-harvest management facilities near the small and medium farms that are most marginalized in the country.

2.3 State Policies on Warehousing

Besides the central scheme for subsidy on building warehouses, some states such as Madhya Pradesh, Maharashtra, and Gujarat have additional schemes for encouraging the warehousing

infrastructure in their respective states. Some of these schemes are now dysfunctional, while others are ongoing. This section will discuss state-led schemes for Madhya Pradesh and Maharashtra. Further details of the schemes are given in appendix 1.

2.3.1 Madhya Pradesh

Madhya Pradesh State Warehousing Corporation (MPSWC)was established in 1958 under the Agricultural Produce (Development and Warehousing) Act, 1956 with 50% of its share capital being owned by the CWC the other 50% owned by the Madhya Pradesh government. While the 1956 Act was repealed by the Warehousing Corporation Act, 1962, CWC and MPSWC were retained under the new Act. In 2003, MPSWC expanded its mandate to include the logistics and transportation of food grains and was renamed Madhya Pradesh State Warehousing and Logistics Corporation (MPWLC) to reflect the change. MPWLC is primarily responsible for fulfilling the warehousing need for procured food grains in the state with the help of its own and hired warehouses. It is also the nodal agency for forming joint ventures and PPPs with private players.
While Madhya Pradesh (MP) had been designated a Decentralized Procurement (DCP) state for wheat as early as 1999-2000, its total annual wheat procurement never exceeded 5 lakh tons before 2008-09 Table 1. As seen in the table below, in 2007-08, MP State Civil Supplies Corporation (MPSCSC)—the state procurement and PDS distribution agency—and FCI jointly procured only 57000 tons of wheat compared to a total production of 60.32 lakh tons in MP in the same year.

To reduce the dependency on FCI allocations, the MP government prioritized procuring more wheat from farmers within the state. The MP government declared a Rs 100/quintal bonus in 2008-09, which lasted till 2012-13 to incentivize wheat production. The increase in Minimum Support Price (MSP) combined with the bonus offered by the MP government and higher procurement

targets led to a massive jump in the amount of wheat production and procurement in MP, driving demand for warehousing facilities. In 2012-13, the procurement was about 65% of the production in the state. In the recent years the share of procurement has been around 40% of the production.

Table 1. Wheat Production and Procurement in Madhya Pradesh during 2000-01 to 2020-21
(Figures in Lakh tons)

Sl. No.	Year	Wheat Production in MP	Procurement			Share of Procurement in Production (%)
			State Agencies	FCI	Total (State Agencies +FCI)	
1	2000-01	48.69	3.37	0.14	3.51	7.21
2	2001-02	60.01	2.71	0.44	3.15	5.25
3	2002-03	42.85	3.61	0.77	4.38	10.22
4	2003-04	73.65	1.7	0.3	2	2.72
5	2004-05	71.77	3.14	0.35	3.49	4.86
6	2005-06	59.58	4.69	0.15	4.84	8.12
7	2006-07	73.26	0	0	0	-
8	2007-08	60.32	0.47	0.1	0.57	0.94
9	2008-09	65.22	15.72	8.38	24.1	36.95
10	2009-10	84.10	16.61	3.07	19.68	23.40
11	2010-11	76.27	32.98	2.4	35.38	46.39
12	2011-12	115.39	49.65	0	49.65	43.03
13	2012-13	131.33	85.06	0	85.06	64.77
14	2013-14	129.37	63.55	0	63.55	49.12
15	2014-15	171.04	71.88	0	71.88	42.03
16	2015-16	176.89	73.09	0	73.09	41.32
17	2016-17	179.39	39.91	0	39.91	22.25
18	2017-18	159.11	67.25	0	67.25	42.27
19	2018-19	165.21	73.16	0	73.16	44.28
20	2019-20	196.07	73.69	0	73.69	37.58
21	2020-21*	-	129.34	0	129.34	-

- As on 31.08.2020

Source: E-uparjan website of MP state govt

MP follows a decentralized procurement system. Within this system, the state government and its agencies are responsible for procuring, storing, and distributing food grains as per state allocation for Targeted Public Distribution System (TPDS) and other welfare schemes. The excess food

stocks procured are transferred to the Food Corporation of India (FCI. This contrasts with the centralized procurement (non-DCP) system. In the non-DCP system FCI directly procures food grains, or if a state government agency does so, the food grains are immediately transferred into FCI custody. Under both systems, FCI reimburses the state government agency for most of the charges.

In MP, MPSWC and MP Marketing Federation are responsible for procuring food grains from farmers and distributing them into TPDS. The procurement of food grains happens through a network of 4000-5000 procurement centers spread over 52 districts. A district-level procurement committee decides the location and area covered for each procurement center. After procurement of grains from farmers, they are transferred to the MP Warehousing and Logistics Corporation (MPWLC), which stores them until they need to be distributed or transported to other states. Distribution of food grains to fair-price shops occurs through about 223 issue centers.

As government procurement started increasing from 2008-09 onwards, the need for private warehousing by MPWLC increased rapidly. Foreseeing the increased demand for warehousing, the central government announced the Private Entrepreneur's Guarantee (PEG) scheme in 2008-09 to incentivize the construction of warehouses. Nationwide, a total of 152.4 lakh tons has been sanctioned, and 143.83 lakh tons completed as of 30 Jun 2020. Madhya Pradesh accounts for 13.03 lakh tons, as seen in Table 2. Note that states with less than 1 lakh tons of total capacity have not been included.

However, this was not enough for the government's storage needs in MP, and by 2012, the shortage of warehousing capacity was being experienced. As a result, the MP government passed the M.P. Warehousing and Logistics Policy, 2012 to incentivize building warehousing capacity further. To

that extent, a capital subsidy of 15% of the project cost or Rs 3000/ton (whichever is lower) and an interest subsidy of 5% of the loan amount was introduced. Applicants were required to construct a warehouse of a minimum capacity of 3334 tons and Rs 1 crore investment with the prescribed specifications. This subsidy was restricted to a storage capacity of 50,000 tons per tehsil and led to an additional capacity of around 15 lakh tons in MP. MPWLC also started offering partial business guarantees to private warehouse owners through the Joint Venture Scheme (JVS) in 2013-14. Under this scheme, interested warehouse owners offer some of their storage space to MPWLC on a profit-sharing basis for two years (only 60-70% of the payment to MPWLC from MPSCSC will go to the warehousing firm). In return, MPWLC guarantees to pay storage charges for 3-4 months even if the storage space is not utilized. This was a popular scheme which several warehouse operators availed.

Table 2. Warehouse Capacity Created by Different States under PEG Scheme (lakh tons)

State	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**Total**
Bihar	0.1	0.12	0.58	0.5	0.48	1.07	0.45	0.1	0.15	3.55
Chhattisgarh	0.7	1.73	1.78	0.24	0.76	0.12	-	-	-	5.33
Haryana	5.31	8.77	15.48	3.98	0.55	-	-	-	0.22	34.31
Jammu and Kashmir	0.1	0.3	0.53	0.26	0.09	0.08	0.2	0.07	0.1	1.73
Jharkhand	-	0.1	0.7	0.2	0.13	0.15	0.65	0.4	0.15	2.48
Karnataka	0.53	0.69	0.67	0.15	0.37	-	-	-	-	2.41
Madhya Pradesh	0.33	1.59	8.84	-	0.96	0.95	0.21	0.15	-	13.03
Maharashtra	0.38	1.38	3.15	0.3	0.25	-	-	-	-	5.46
Odisha	1.02	0.72	0.45	-	0.45	0.1	0.2	0.28	-	3.22
Punjab	14.05	18.28	8.44	1.08	1.39	0.4	-	-	-	43.64
Rajasthan	0.2	1.43	0.57	-	-	-	0.15	-	-	2.35
Tamil Nadu	0.6	0.2	0.75	0.05	0.4	0.55	-	-	-	2.55
Telangana	0.75	0.53	1.41	-	-	-	-	-	0.3	2.99
Uttar Pradesh	0.07	4.53	6.06	1.46	0.45	0.46	1.25	0.36	0.22	14.86
West Bengal	-	0.21	0.39	0.22	0.45	0.17	0.05	0.05	-	1.54
Total	**24.14**	**40.58**	**49.8**	**8.44**	**6.73**	**4.05**	**3.16**	**1.41**	**1.14**	**139.45**

However, by 2017-18, the business guarantee was phased out due to more competition in the private warehousing sector. Yet the profit-sharing model remained, albeit at a lower rate (75-80% goes to warehouse owner). This has created an interesting dynamic by pitting warehouse owners against each other to see whether they will accept a lower rate if it leads to a higher chance of their warehouse being occupied. As a result, some regions have a good number of warehouses under JVS (such as Rewa with 4.56 lakh tons and Bhopal with 1.33 lakh tons in Dec 2020), while others do not have any warehouses under JVS (Gwalior and Indore).

Madhya Pradesh Warehousing and Logistics Policy 2012 aims to develop the state of MP as a warehousing and logistics hub for India. Other policy objectives include encouraging private investment in developing warehousing and logistics infrastructure in the state and helping the existing farmers, agriculturists, traders, and industries by providing them with cost-effective warehousing and logistics facilities. The policy also aims to simplify the regulatory process in developing the storage infrastructure for agriculture. It encourages investments through Delhi-Mumbai Industrial Corridor (DMIC), proposed State Investment Corridors, Industrial Clusters, SEZs, Free Trade and Warehousing Zones (FTWZs), Agri Export Zones and Special Investment Regions. It seeks to establish land banks to take care of the future need for land to develop warehouse infrastructure.

Vehicle registration fees applicable for carrier goods fleet for a minimum fleet of 50 vehicles were reduced by 2% to improve the logistics infrastructure. To avail of this incentive, the minimum carrying capacity of the vehicle must be 9 tons, and the fleet owning entity should also set up a warehousing facility with a capacity of at least 10,000 tons in the same period.

2.3.2 Maharashtra

Maharashtra State Agricultural Marketing Board (MSAMB) was established in 1984. Its Agricultural Pledge Loan Scheme started in 1990, aiming to prevent the distressed sale of commodities by the farmers at a lower price because of excess supply in the market. Under the scheme, farmers can keep their produce in the APMC godown and avail the loan of 75% of its value. When the prices increase, the farmer can sell the produce at an increased market rate and repay the loan. The APMC charges an interest rate of 6% from the farmers on this loan. The maximum period of the loan is 180 days. The APMCs where the loan is repaid in time are given a 3% rebate on the interest rate. If the loan is not repaid in 180 days, the interest rate increases to 8% for the next six months. If the loan is not repaid in a year, the interest rate for the next six months becomes 12%.

Other states also have started providing subsidies for constructing storage space. For example, in Gujarat, Mukhyamantri Pak Sangrah Yojna, started in 2020-21, provides a subsidy to a farmer for constructing a small storage space. The scheme aims to preserve the quality of crops for a longer time and avoid external factors which impact their quality.

2.4 Policy Support

Policy focus on agricultural warehousing began in the late 1950s with the establishment of the National Cooperative Development Corporation and Warehousing Board. The central warehousing corporation and state warehousing corporations set up in the 1960s helped to recognize storage functions as an essential service in the marketing of agricultural produce. However, these warehouses mainly catered to the needs of Government procurement and distribution of food grains. With the increased production and surplus of agricultural produce,

government policies were extended to support private warehouses after the turn of the century. Subsidies were given to private and cooperative sectors under Grameen Bhandaran Yojana and Private Enterprise Guarantee (PEG) schemes to construct and operate warehouses. PEG scheme, introduced in 2008-09 to incentivize the construction of a warehouse, wherein the warehouse owner would construct the warehouse and then transfer it to FCI control while being reimbursed a guaranteed monthly rent (for ten years for private investors and nine years for CWCs/SWCs and State agencies) irrespective of the quantity stored. This was done to encourage the construction of private godowns while avoiding the upfront costs associated with the construction. Nationwide, a total of 143 lakh tons capacity has been created under this scheme by June 2020. PEG scheme did help in encouraging the establishment of warehouses in the private sector. However, problems reported in the administration of the scheme marred its continuity. Warehousing quality and negotiable warehouse receipt systems were introduced under the Warehousing (Development & Regulation) Act in 2007. However, the development under WDRA has been slow due to the increased cost for warehouse operators for registering and operating under WDRA. While a few states have developed additional incentive mechanisms to create additional agricultural warehousing infrastructure, the progress has not been remarkable.

Over the years, the government has adopted policies that promoted public sector and private sector participation in the construction and management of warehousing infrastructure. However, despite the policy-driven approach, the available warehousing capacity is not adequate to store the food grains produced in the country. It is estimated that food grain demand will reach 281 mt by 2020-21, and the warehousing requirement is projected at 196 mt (about 70% of production). Moreover, the distribution of warehouse capacity is skewed across states. Many states have excess or under-

utilized warehousing capacity (Report of the Committee on Doubling Famers Income, Vol III). And the average storage capacity across the available warehouses is low.

A study on warehousing in India reported that traders were the major users of warehouses (National Institute of Public Finance and Policy, 2015). Only a small proportion of farmers used organized warehousing facilities. Post-harvest losses are estimated to be as high as 18-20% without proper storage. Chaturvedi and Raj (2015) estimate that the post-harvest loss of food grains in India is as high as 12 to 16 mt each year, which values around Rs.50,000 crore per year (Singh, 2010). These losses are primarily attributable to a lack of storage infrastructure at the farm level (Ramesh, 1999). In addition, where storage is available, the adoption of modern technology in warehouses is poor, and there remains a severe shortage of trained workforce for managing warehouse operations.

In 2020, the Government of India has committed 1 trillion Rupees to develop agriculture infrastructure. Proper development of schemes and their effective execution can help bridge the current gap in agricultural warehousing.

3. Trends in Growth of Agricultural Warehouses in India

3.1 Growth Rate in Agricultural Warehousing

Agricultural warehousing remains highly fragmented and unorganized in India. However, overall capacity has grown rapidly, at a compounded annual growth rate of around 4.4% over the last decade. Table 3 presents estimates of India's agricultural warehousing capacity growth during the 2010s.

Table 3: Growth in Agricultural Warehousing Capacity

Year	Capacity in mt
2011-12	112.37
2015-16	126.96
2018-19	152.76

Source: Adapted from 'Storage Infrastructure in India 2020' by India Infrastructure Research, June 2020

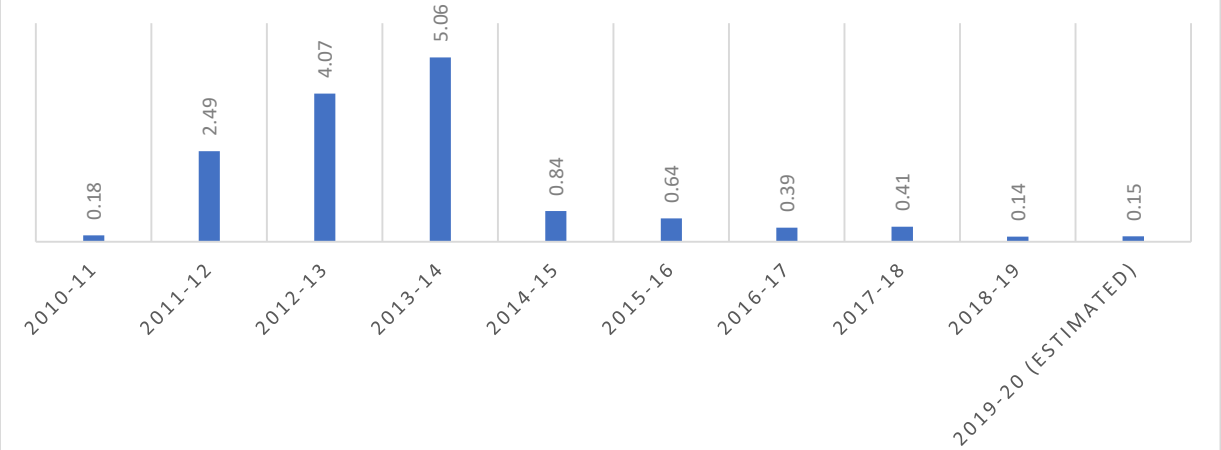
The PEG Scheme was conceptualized in 2008 to create warehousing capacity in the public-private partnership model. Under this scheme, state agencies or private entrepreneurs invest in constructing the warehouse. Once the warehouse is created, its use for 9-10 years is guaranteed by the state. In 2013-14, 5.06 mt capacity was created under this scheme. According to a CAG India report on FCI in 2017, there were delays in implementing the scheme in Punjab, resulting in excess expenditure[1]. From the start of the scheme, there was a delay of 5-7 years to augment storage capacity. The report also found that some of the ineligible private entrepreneurs were awarded contracts for building the storage space. The project guidelines stated that the warehouses with more than 25000 tons capacity be built on the sidelines of railways. But many godowns under the

[1] https://cag.gov.in/webroot/uploads/download_audit_report/2017/Report_No.18_of_2017_-_Compliance_audit_Union_Government_Food_Corporation_of_India_Reports_of_Ministry_of_Consumer_Affairs,_Food_and_Public_Distribution.pdf

scheme did not comply with the above rule. This resulted in an increased cost of loading and unloading the stock.

Further, the distance of warehouses to the railheads was miscalculated in many cases adding to increased cost. There were abnormal storage losses, and no costs were recovered for those losses. Even at the national level, the scheme did not perform according to expectations after 2013-14 as the capacity generation for storage space decreased drastically. Out of the total sanctioned 153.12 lakh tons, 118 lakh tons were already completed by 2013-14. After that, the allocation to the PEG scheme has been low. One possible reason for this decline can be the new Central Government scheme, Warehouse Infrastructure Fund (WIF), initiated in 2013-14 to enhance capacity in the agricultural warehousing space with a corpus of Rs. 50 billion, and later enhanced by another Rs. 50 billion. As of Feb 2020, 7616 projects have been sanctioned at the cost of Rs. 94.87 billion.

Figure 1: Year-wise Capacity Generation under the PEG Scheme (mt)

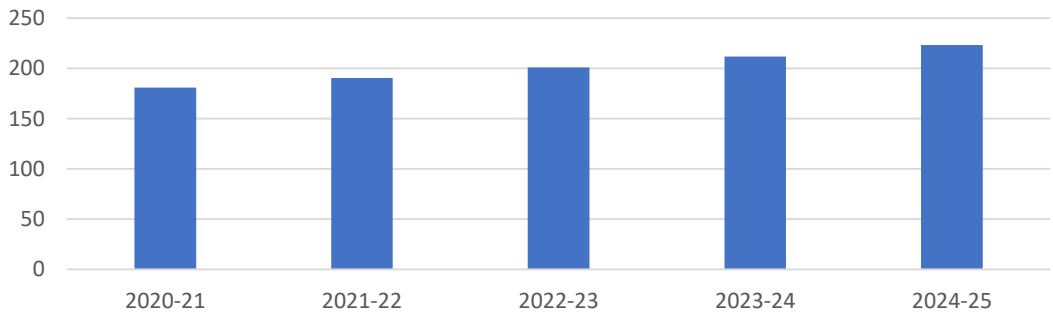


Source: Website of Department of Food and Public Distribution, Government of India: dfpd.gov.in

There have been provisions included in the recent budgets to support agricultural warehousing—including viability gap funding (VGF) announced for warehousing capacity built-in public-private

partnership mode at the taluk/block level, and village storage schemes via Self Help Groups funded by MUDRA loans and NABARD (Budget 2020). Based on the observed CAGR of the agricultural warehousing industry from 2011 onwards, the Report of the 'Storage Infrastructure in India 2020' by India Infrastructure Research estimates expected growth in the agricultural warehousing sector as in figure 2.

Figure 2: Projected Growth in Agricultural Warehousing Capacity (in mt)



Source: Report of the 'Storage Infrastructure in India' by India Infrastructure Research, June 2020

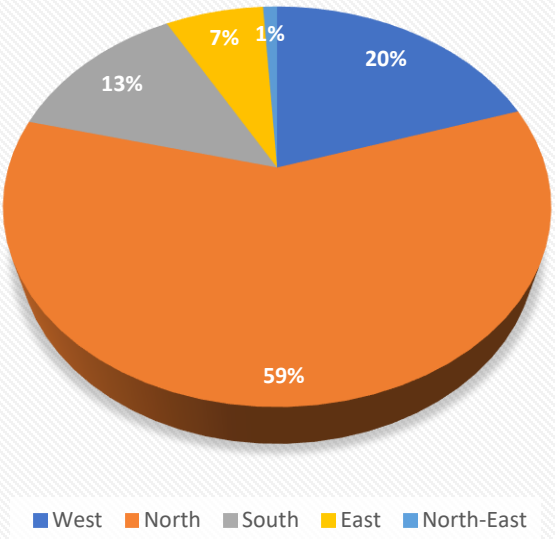
3.2 Distribution of Warehousing Capacity

The second major thrust of this study was to examine the relationship between the availability of warehousing capacity and price volatility. We present below (figure 3) region-wise aggregate storage capacity across the regions of India. The northern region dominated the warehouse capacity with 59%, followed by the western region (20%). These two regions together have a share of nearly 80%. However, the aggregate capacity across regions does not reflect variations across states and within states. There is no data on total warehousing capacity in the country. Apart from the State and Central Warehousing Corporation warehouses, there is no systematic data collected

and updated—particularly for the private sector. Therefore, estimates of warehousing capacity are generally based on the financial support provided for the construction of warehouses.

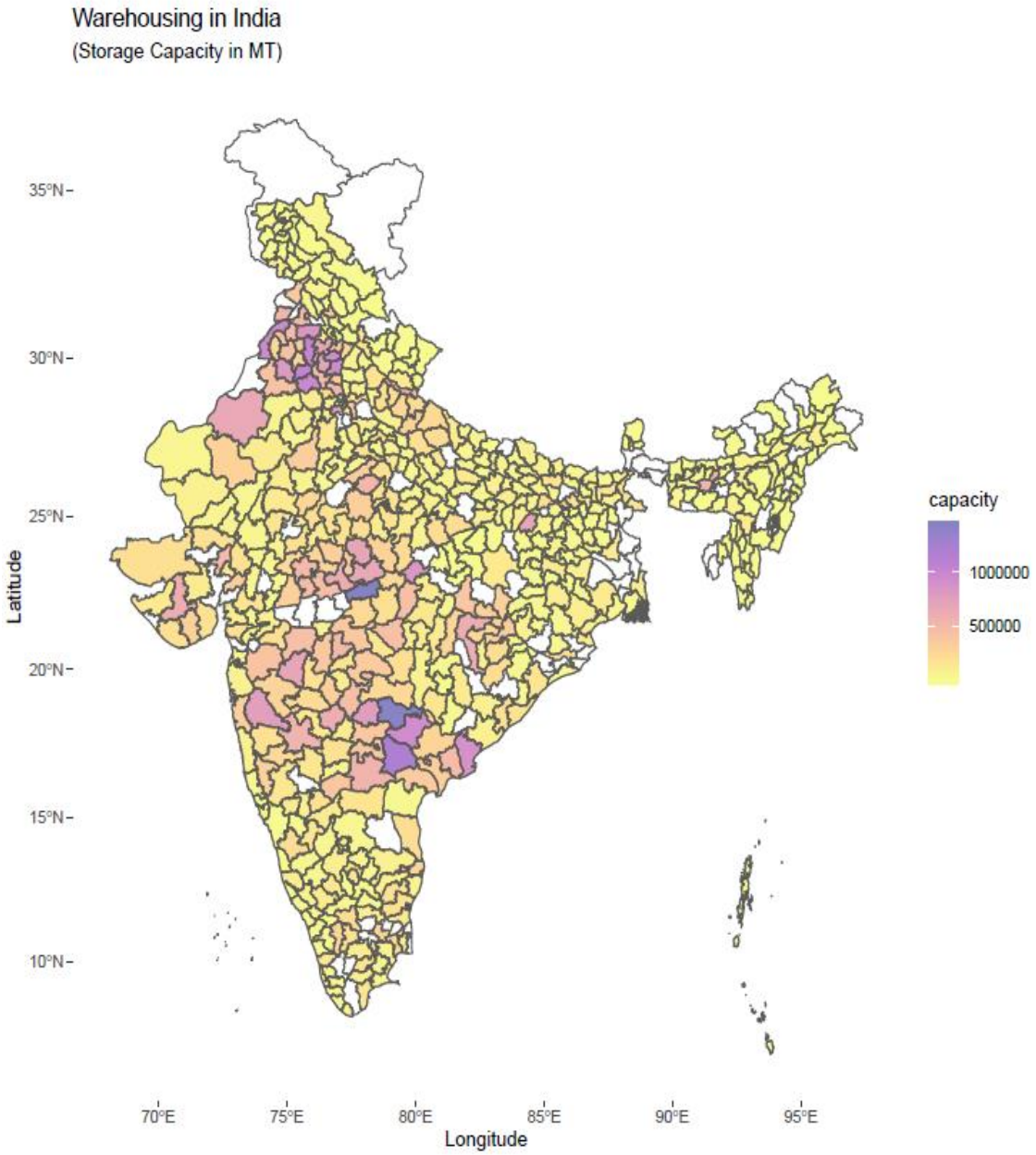
Using data compiled by NABARD, we plotted the distribution of warehousing capacity across the districts of India and by their capacities. We present two figures here. There are two main takeaways from the figures. First, India's distribution of warehousing capacity is highly skewed across states and districts within states (figure 4). Most of the states in the south and the Gangetic belt are underserved. The Gangetic belt being a major region for cereal, pulses, and oilseeds, poor growth in warehouses in this region would undoubtedly affect the value chain. Secondly, the warehousing capacity is skewed heavily towards small warehouses of less than 5000 tons (figure 5). Further analysis of the less than 5000 tons capacity warehouses reveals that over 35000 warehouses out of 51307 warehouses (68%) are of capacity smaller than 500 tons (figure 6), thus echoing the findings from the WDRA study of 2016. The small size of the warehouses constrains professional management of warehouses resulting in quality losses.

Figure 3: Region-wise Storage Capacity, 2020



Source: Adapted from 'Storage Infrastructure in India 2020' by India Infrastructure Research, June 2020

Figure 1: Geographic Distribution of Warehousing Capacity in India



Source: ' Web directory of warehouses', which was jointly developed by NABARD and WDRA: http://warehousedirectory.gov.in/

MT= Metric ton

Figure 2: Histogram of Warehousing Capacities

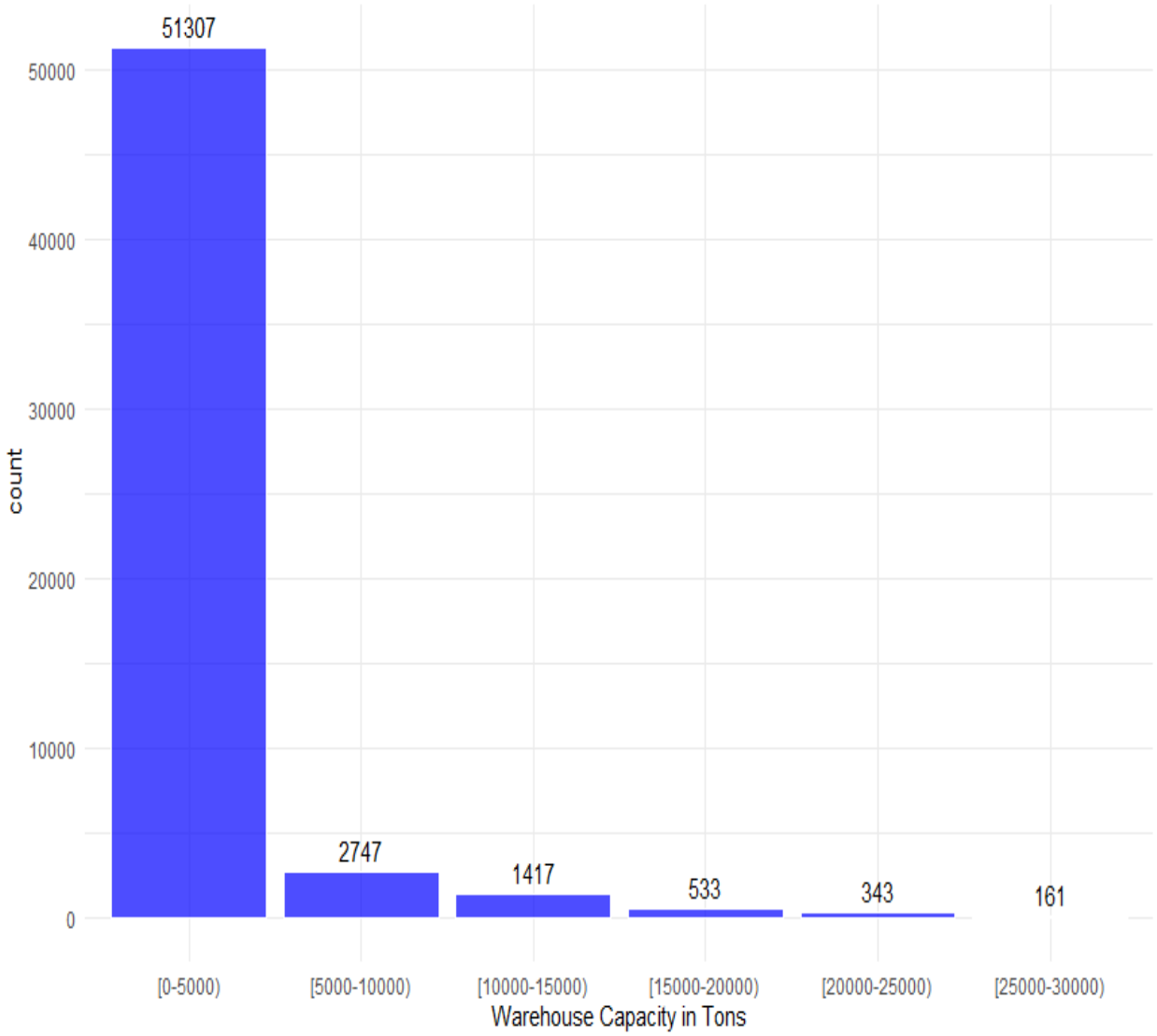


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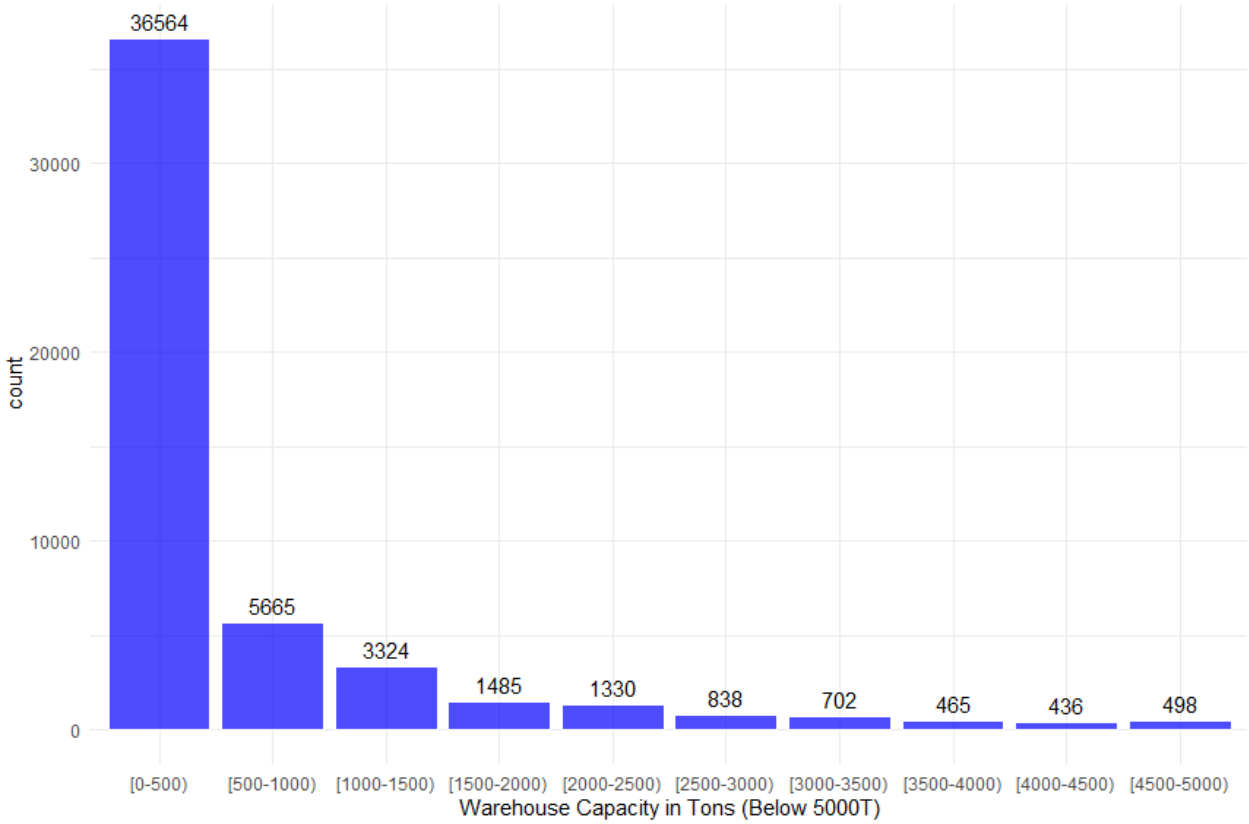
Figure 3: Histogram of Warehousing Capacities



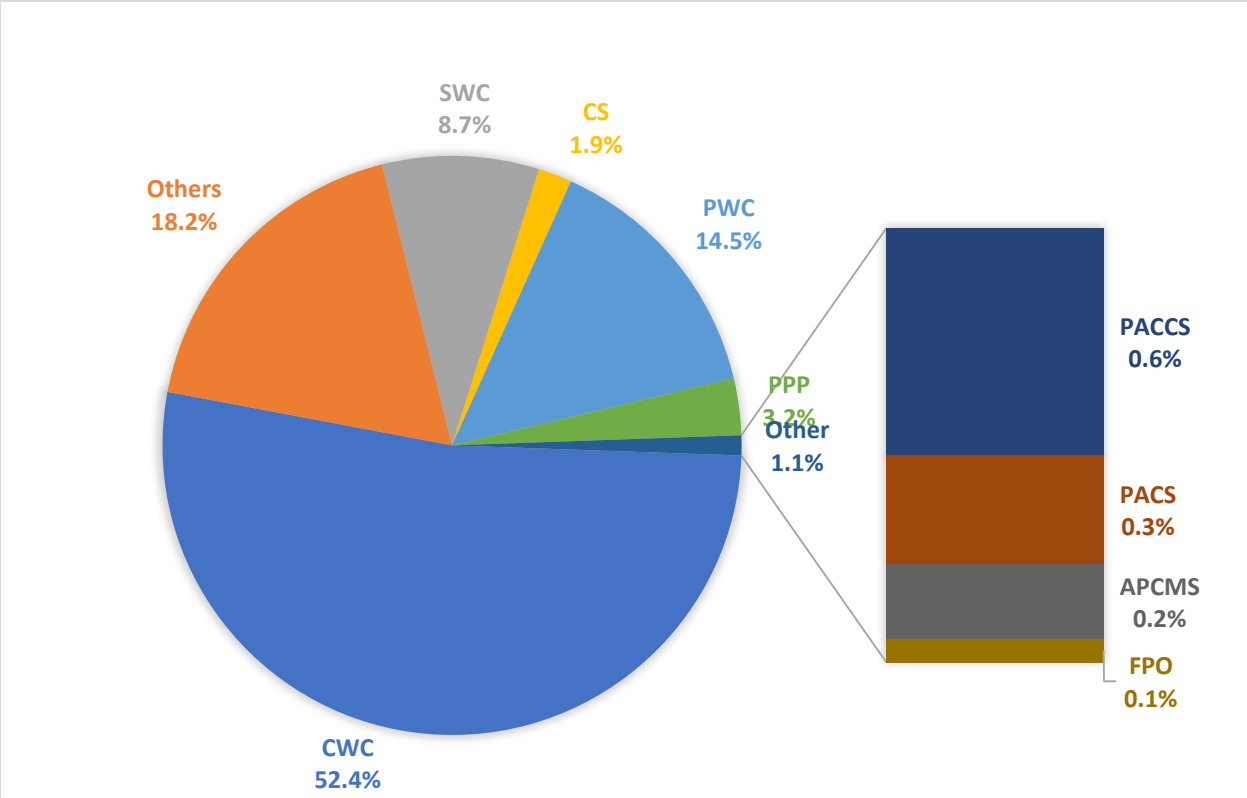
Source: 'Web directory of warehouses,' which was jointly developed by NABARD and WDRA: http://warehousedirectory.gov.in/

3.3 Ownership of Warehouses

Different value chain participants own agriculture warehousing in India. It includes central government, state governments, private owners, and collateral managers. Most of the warehouses in India are not WDRA registered. Hence, it is difficult to find their data. Figure 7 shows the ownership of the WDRA approved warehouses. More than 50% of WDRA registered warehouses are under the Central Warehousing Corporation. Around 14.5% are private warehouses (figure 7). State Warehousing Corporation consists of 8.7% of the total WDRA approved warehouses. The warehouses under public-private partnerships comprise 3.2% of the WDRA registered

warehouses. A minuscule number of warehouses is also owned by the Farmer Producers Organizations, Agriculture Producers Co-operative Marketing Society, Primary Agricultural Credit Societies, and Primary Agricultural Credit Co-operative Societies.

Figure 4: Ownership of WDRA Registered Warehouses till June 10, 2021 (Share in percent)



Source: Website of Warehousing Development and Regulatory Authority of India, WDRA: https://wdra.gov.in/

State-wise ownership is explained in table 2.

Overall capacity and ownership of agricultural warehouses in India are difficult to estimate because of the fragmented and informal nature of the sector. More reliable data is available on capacity in the public sector than in the private sector. Table presents the estimated figures of capacities across different types of ownership of warehouses in India from 2010 onwards. The

figures are published annually in the WDRA annual reports and are estimated based on secondary reports and sources.

Table 4: Ownership of WDRA registered warehouses till June 10, 2021 *(Capacity in tons)*

States	APCMS	CS	CWC	FPO	Others	PACCS	PACS	PPP	PWC	SWC	Grand Total
ANDHRA PRADESH		20584	748043	7000	29650					365055	1170332
ASSAM			42546								42546
BIHAR			145178						69384		214562
CHANDIGARH			10550								10550
CHHATTISGARH			190450								190450
GOA			12902								12902
GUJARAT		65581	192406		25430			69247	421496		774160
HARYANA		6089	419014						6637		431740
HIMACHAL PRADESH			2500								2500
JHARKHAND			36691								36691
KARNATAKA		6693	254877		66545				13500		341615
KERALA			178638						8585		187223
MADHYA PRADESH		62937	533824		1940130			145375	345309		3027575
MAHARASHTRA		10209	437236	750	35306			63704	273686	20460	841351
NCT OF DELHI			19646								19646
ODISHA			251350						10995		262345
PUDUCHERRY			7350								7350
PUNJAB			658900		97639						756539
RAJASTHAN		43585	507813		38477		16200	128374	614750		1349199
TAMIL NADU	24600		442936	100	82583	75090	19800		12476	683354	1340939
TELANGANA		13300	406132						25937		445369
TRIPURA			19250								19250
UTTAR PRADESH		5900	846523		17250				57162	55083	981918
UTTARAKHAND			51330								51330
WEST BENGAL		6200	320016		1100				9500		336816
Grand Total	**24600**	**241078**	**6736101**	**7850**	**2334110**	**75090**	**36000**	**406700**	**1869417**	**1123952**	**12854898**

Source: Website of Warehousing Development and Regulatory Authority of India, WDRA: https://wdra.gov.in/

The overall trend of ownership of warehousing capacity in India has been shifting in favour of the private sector. From 2010-11 to 2017-18, where we have comparable data, the share of the public sector in agricultural warehousing capacity has declined from 68.7% to 54.1% (Table 5). The co-

operative sector also has seen a decline from 13.9% to 9.5%, while the share of the private sector has doubled from 17.4% to 36.4% of the total available capacity. The private sector increased capacity nearly four-fold from 18.97 mt in 2010-11 to 75.84 mt in 2019-20 (Table 5).

Table 5: Ownership Share of Agricultural Warehouses

	Food Corporation of India (FCI)	Central Warehousing Corporation (CWC)	State Warehousing Corporation (SWC) & State Agencies	Cooperative Sector	Private Sector
2010-11	29.5%	9.3%	30.0%	13.9%	17.4%
2017-18	22.9%	6.4%	24.8%	9.5%	36.4%
2019-20	8.3%	6.4%	25.2%	10.7%	49.0%

Source: Website of Warehousing Development and Regulatory Authority of India, WDRA: https://wdra.gov.in/

3.4 Capacity Utilization

Given the fragmented nature of the agricultural warehousing sector, estimating capacity utilization is challenging. The India Infrastructure Research Report on Storage Infrastructure in India reports the average capacity utilization of agricultural warehouses in India to be 85% in 2019. This is a growth from 82% in 2017. However, this figure masks a wide variability in capacity utilization within and across the years and different regions. In this report, we supplement this estimate with detailed case studies of a set of 10 warehouses in Madhya Pradesh, Maharashtra, and Rajasthan, based on field visits and telephonic interviews.

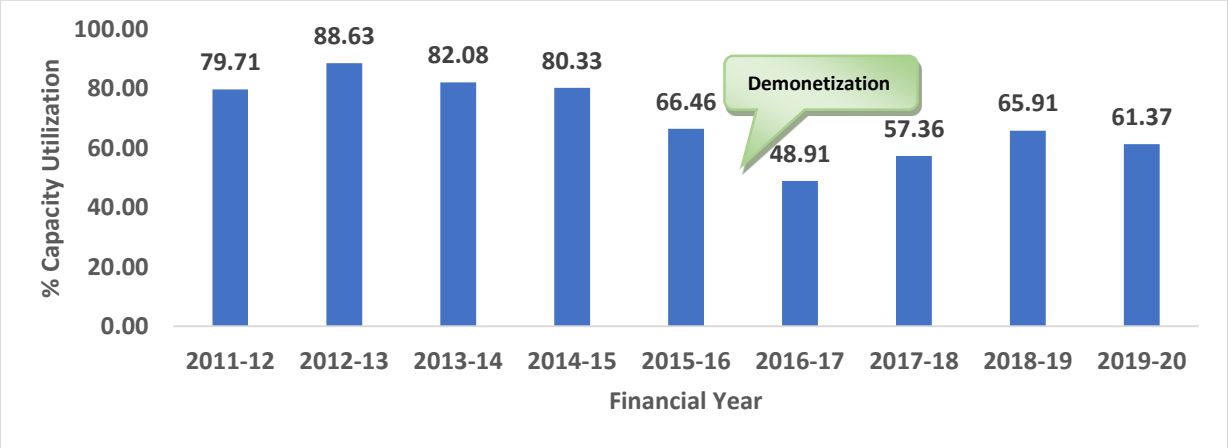
Table 6: Trends in Ownership of Warehouse Capacity (mt)

	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Food Corporation of India (FCI)	32.05	33.6	39.69	38.34	38.34	35.92	35.8	36.25	12.73 (Excluding	12.78 CAP)
Central Warehousing Corporation (CWC)	10.07	10.13	10.8	10.3	10.3	11.72	7.76	10.14	10.1	9.96
State Warehousing Corporation (SWC) & State Agencies	32.59	34.3	34.07*	34.84	34.84	45.28	42.39	39.31	35.74	39.72
Cooperative Sector	15.07	15.37	15.37*	15.37	15.07	15.07	57.75	15.07	16.51	16.52
Private Sector	18.97	18.97	18.97*	18.97	18.97	18.97		57.75	77.68	75.84
Estimated Total	**108.75**	**112.37**	**118.9**	**117.82**	**117.52**	**126.96**	**143.7**	**158.52**	**152.76**	**154.82**

Source: Data compiled by the authors from the WDRA Annual Reports of the respective years.

Our primary data collection supported the figure of 80-90% capacity utilization, although there were variations across warehouses. The average capacity utilization ranged from 43% to 90%—and varied across years—as reported by warehouse operators. Capacity utilization of 90% and above is often reported around the government procurement periods and in regions where publicly procured crops are produced. We present the detailed year-on-year capacity utilization of one of the sites as an illustration.

Figure 5: Capacity Utilization of Sample Warehouses



Source: Owner of the warehouse located in Madhya Pradesh.

3.5 Usage of Warehouses by Different Supply Chain Agents

Previous reports and findings suggest that traders and large farmers are more able to use available warehousing facilities than small farmers. Thus, warehouses cannot enhance incomes for the most marginal landholding farmers. National Institute of Public Finance and Policy undertook a study on warehouses commissioned by the Warehousing Development and Regulatory Authority. The study—Report on warehousing in India (2015)—was conducted based on a sample of nine districts chosen from five distinct regions in India. The report states that the warehouse used for agricultural commodities is driven by two primary functions, storage for preservation and storage for credit. Furthermore, traders are the primary users of warehouses for both these purposes rather than

farmers. Even amongst the few farm users, large farmers dominated the use of warehouses compared to small farmers.

Among the other supply chain members, collateral managers hold a special place in the management of warehouses. Unfortunately, data on the warehouses owned by the collateral managers (CMs) is not available in the public domain, and the CMs are reluctant to provide this information.

Government support to the private sector seems to have accelerated the growth in warehouse capacity. In the last decade, the share of private sector capacity has increased substantially. The recent announcement of spending 1 trillion Rupees on agriculture infrastructure, if appropriately implemented, should be able to create substantial-quality warehouses for agricultural produce. There is an unequal distribution of warehouse capacity in different regions and states. Some regions, particularly the Gangetic plain, need more capacity creation considering its large production. The share of farmers in using warehouses is relatively small due to limited production and distress sale.

4. Warehousing Technology and Implications on Costs and Quality

4.1 Different Warehousing Technologies

While several advancements in technology are employed in the construction, operation, and maintenance of warehouses worldwide, India is still struggling with conventional godowns. We briefly describe the different technologies that have been used/experimented based on a field study in Madhya Pradesh.

4.1.1 Conventional Godowns

Most of the warehousing capacity in India and MP comprises traditional godowns constructed with RCC columns and roof structures. The foundation is generally made of brick or stone masonry with cement mortar. Within these godowns, agri-commodities are stored in gunny bags of 50 kgs or 100 kgs capacity, stacked one upon another. Through interactions with warehouse owners, we learned that godown units are typically constructed in modules of 5000 tons. Government subsidies often limit one warehouse operator to avail incentives for construction up to 5000 tons. As a result, 5000 tons is the most common capacity for warehouses (in line with a WDRA survey which found the average warehouse capacity to be 4700 tons), and it shall be the point of reference for this study.

Due to the widespread use of these godowns, FCI and CWC have issued standardized specifications for their construction. With the materials and know-how available, godowns can be easily constructed in 3-4 months. As per CWC specifications, a 5000 tons warehouse requires nearly 1.75 acres of land for the godown unit and ancillary buildings. The godown unit can be constructed in two configurations—inner dimensions of 125.55m x 21.8m divided into three compartments or 92.8m x 28.7m divided into two compartments. After accounting for the walls

and one verandah, the size equals 126m x 24.09m and 93.26m x 30.99m for a total area requirement of 3035 sq. m and 2890 sq. m, respectively. A plinth between 0.6m to 0.9m must also be constructed to support the structure. The godown's height from the plinth to the trusses must be 5.48m. Within the godown, agri-commodities are stored in stacks of size 6.1m x 9.14m, and a total of 36 such stacks are made in a 5000 tons godown. Each stack contains between 140-150 tons of food grains stored in 2800 to 3000 gunny bags of 50 kgs each.

Once stored in the godown, regular monitoring of the food grains is conducted, and several measures are taken to ensure deterioration does not occur. The godown structure (floor, walls, and roof) and openings (doors, windows, and ventilators) are designed to be waterproof to control the moisture level. Daily aeration of the stocks is undertaken by opening the godown doors and using ventilators. Fumigation is also conducted occasionally to maintain pest control. Protection against rodents is ensured by making the plinth an outward sloping platform, and birds are stopped using 'jalis' at windows and ventilators. These measures successfully preserve grain quality, and grains can be stored in godowns for 16-18 months with minimal spoilage.

Government use of warehousing is directly linked to the state's level of procurement and its TPDS requirement. Since, traditionally, MP was not a state with high levels of food grain procurement, MP government agencies did not require a lot of warehousing capacity. In such a situation, most food stocks were stored in MPWLC owned godowns, with a small number of private warehouses being hired as needed. This trend can be observed in the table below, where the MPWLC owned capacity was significantly higher than private capacity for all years before 2009-10 (Table 7).

Table 7: MP Government Usage of Warehouses from Different Sources (Quantity in Tons)

Year	Owned	Capacity hired	JVS	Total	Occupancy	Percentage
2000-01	1333273	492756	0	1826029	1705848	93
2001-02	1359000	487000	0	1846000	1588000	86
2002-03	950577	228417	0	1178994	950449	81
2003-04	963344	203946	0	1167290	904506	77
2004-05	964788	213012	0	1177800	922336	78
2005-06	977835	210081	0	1187916	945694	80
2006-07	1153028	117498	0	1170526	825948	71
2007-08	1102960	88377	0	1191337	890772	75
2008-09	1141145	256620	0	1397765	1181510	85
2009-10	1167110	245118	639047	2051275	1688013	82
2010-11	1186619	503584	1259304	2949507	2535101	86
2011-12	1311038	612496	1729557	3653091	2966361	81
2012-13	1481129	624628	3368088	5473845	4631555	85
2013-14	1496636	291400	4070082	5858118	4761493	81
2014-15(Own+Cap)	1818299	274622	5083642	7176562	5473418	76
2015-16(Own+Cap+PEG)	2211127	210144	4900674	7321945	5095923	70
2016-17(Own+Cap+PEG)	2276917	120235	3523858	5921010	3177225	54
2017-18(Own+Cap+PEG)	2291779	415549	4609885	7317213	5897663	81
2018-19(Own+Cap+PEG)	2552073	871894	6192333	9616300	7890838	82
2018-19(Own+Cap+PEG)upto Oct 2019	2749460	992672	7331854	11073986	9774046	88

The warehouses owned and operated by MPWLC also serve as a procurement center for nearby farmers. After the harvesting season, registered farmers would bring wheat on tractors or bullock carts. A small sample of the wheat is then tested for quality on various measures—foreign matter, other food grains, damaged grains, moisture, etc. If the quality is found acceptable, the wheat is purchased from the farmer by MPSCSC officials, bagged into gunny bags, and stored in the MPWLC warehouse by manual laborers. When the stocks are needed for TPDS distribution, the gunny bags are loaded into trucks and dispatched.

With the drastic increase in procurement from 2008 onwards, MPWLC owned warehouses were unable to keep pace with the need for warehousing. The government's use of private warehouses increased exponentially—private capacity (capacity hired + JVS) increased from 8,84,165 tons in 2009-10 to 83,24,526 in 2019-20 or 9.4x in 10 years. The government's increasing reliance on private warehousing is even more striking when comparing MPWLC owned warehousing capacity (27,49,460 tons) to private capacity (83,24,526 tons)- a difference of 3x in 2019-20.

To fully understand the impact agricultural policies have had on private warehousing in MP, one must first consider the situation in the early 2000s. Traditionally, MP had been an agricultural economy and a major producer of wheat, soybean, green gram, and paddy. Due to the relatively low procurement within these crops, farmers would bring their produce to APMC mandis and sell it to local traders or agri-trading companies like Cargill and ITC. These traders would either immediately resell the produce to processing units or store the produce in private warehouses while waiting for prices to increase.

Shree Kalindi Warehousing is one such warehousing firm, established in 2003-04 in Pipiriya, Hoshangabad by Mr. Balkishan Tawri. According to his account, after the economic liberalization

in the 1990s, several new milling, and food processing units were set up in rural MP. As a result, there was an increased need for agri-warehouses, and the government allowed private investments in warehousing in 2000. The Grameen Bhandaran Yojana (Rural Godown Scheme) was introduced through NABARD in 2001-02. This scheme offered a capital subsidy to warehouse owners (25% to general category applicants; 33% to women and SC/ST applicants) at the lower of the actual project cost or Rs 3000/ton of capacity with a limit of 5000 tons for one warehouse operator. The availability of this subsidy lowered the capital investment for warehouse construction (from Rs 1.5 crores to Rs 1 to 1.125 crore for 5000 tons warehouse). It led to several new private warehouses built under the scheme, as seen in Table 8.

Table 8. Storage Capacity Created Under Rural Godown Scheme in MP (in lakh tons)

Year	Capacity
2006-07	18.64
2007-08	26.23
2008-09	33.51
2009-10	39.56
2010-11	44.9
2011-12	53.13
2021-13	69.08

Source: MPWLC

Many of these warehouses were constructed on ancestral land by people already involved in the agricultural sector, like Mr. Tawri. The warehouses were often set up as partnerships with multiple people pooling capital to manage risk. Their construction is similar to government-owned

warehouses as the specifications must be followed. In MP, a Department of Food - Civil Supplies and Consumer Protection license must be obtained to run an agri-warehouse. Most warehouses were financed using debt ranging from 60% to 70% of the total project cost.

In the absence of significant government procurement in MP before 2009-10, the warehouses formed were focused on catering to private traders, processors, and farmers. An essential characteristic that distinguishes this market from government warehousing is the need for financing- traders need it to leverage their capital, processors need it to maintain working capital and farmers need it to prepare for the next cropping season. While the government has recognized the importance of developing a robust warehousing ecosystem and tried to do so, the lack of trust between private warehouses and banks persists. According to Mr. Tawri, physical NWRs issued by private warehouses were being financed by banks as early as 2003-04 despite the lack of agency or act regulating them. However, with minimal checks and balances in place, fraudulent activities eroded the trust between banks and warehouse owners. This situation led to the emergence of collateral management firms—third-party companies that would appoint personnel to reassure banks that the financed stocks are present in the godown and of the stated quality in exchange for a portion of the interest. This arrangement rose in popularity, and by 2012, most banks started insisting on the presence of a collateral management firm before extending loans. Some major collateral management firms are Shri Shubham Logistics, Star Agri, and NCML.

The business model of collateral management firms leads them to prefer large farmers, processors, and traders—their primary source of income is a markup (typically 1%) on the interest rate charged by banks. To recover the cost of hiring just one person paid Rs 20,000/month or Rs 2.4 lakhs/year, the collateral management company needs to manage stocks worth Rs 2.4 crores. When other expenses are factored in, this requirement goes up significantly. According to Mr. Tawri, collateral

management firms are reluctant to work with traders and processors with less than Rs 15 to 20 crores worth of stocks. In practice, most warehouses have a tie up with a collateral management firm responsible for helping customers get financing on all stocks stored in the warehouse. Yet, collateral management firms do not entertain small farmers since they do not add much to their bottom line (1% of Rs 1 to 2 lakhs is only Rs 1,000 to 2,000 a year). As a result, large farmers, processors and traders are the major users of warehousing and NWR financing.

Realizing the lack of formalization and disproportionate outcomes in the private warehousing industry, the government released the Warehousing (Development and Regulation) Act, 2007, and set up the Warehousing Development and Regulatory Authority (WDRA) to promote the growth of a well-regulated warehousing industry. This Act came into effect in 2010, and it was the first agency established in India to regulate warehousing. Soon after, WDRA (Negotiable Warehouse Receipts) Regulations 2011 was released to establish a standardized system for issuing electronic NWRs (e-NWRs). These e-NWRs can be traded, transferred, and auctioned online, and one can avail financing by pledging them without the need for a collateral management firm. A security deposit of 3% of the total e-NWR value must be deposited by the warehouse or borrower to deter wrongdoing.

Mr. Tawri and all other warehouse owners the authors interacted with expressed optimism about the potential of WDRA and e-NWRs to revolutionize the warehousing industry. However, they cited the lack of economic incentive as a critical issue hindering warehouse owners' widespread adoption of e-NWRs. After the customers bring the stocks to the warehouse in a conventional warehouse, the warehouse operator issues an NWR in acknowledgment. The customers then work separately with the affiliated collateral management firm, which helps them receive the loan. In this situation, no charges related to financing accrue to the warehouse operator. However, when

an e-NWR is issued, a 3% deposit of the e-NWR value must be made. It was understood that customers are reluctant to contribute towards this deposit since traditional NWR financing is available and well-established. As a result, warehouse operators have to use their capital for the deposit. In addition, more staff is required to manage the quality testing and data entry. This creates a higher demand for working capital, which leads to lower returns in combination with lower cash flows. An analysis of the returns of private warehouses of 5000 tons at different capacity utilization levels was conducted- found in a latter section- which supports this opinion. As a result, many warehouses, including Mr. Tawri's Shree Kalindi Warehousing, are registered with WDRA but continue to issue physical NWRs and work with collateral managers.

4.1.2 CAP Storage

CAP storage, or Cover and Plinth, is a temporary storage structure that consists of stacking gunny bags on a raised platform and covering them with polythene material tarpaulin to prevent damage (Figure 9). The usage of CAP storage was started in 2014 due to the unavailability of warehousing capacity near the procurement center (transportation of food grains more than 30 km is not preferred). A single CAP structure consists of 2750 jute bags or 150 food grains. CAP stack is not dissimilar to a stack in a godown except for a tarp serving as a protective medium rather than concrete walls.

Since CAP storage comprises open storage of food grains, there is a higher possibility of spoilage from rain and pests. If scientific storage specifications are followed, then spoilage can be limited to 0.1% for a 3-4 month storage period. However, if food grains are stored for longer, as is often the case, then spoilage can be as high as 5-7%. Considering this risk, the MP High Court has issued orders to MPWLC to stop the usage of CAP storage. However, due to the lack of alternatives, use

of CAP storage by MPWLC has grown to 7.8 lakh tons in December 2020. Anticipating high procurement for the crop year 2021-22, MPWLC announced tenders for the further construction of 9.6 lakh tons of CAP storage in January 2021. Due to the risk of spoilage, private players' use of CAP storage is negligible.

Figure 9: CAP Storage – Hoshangabad

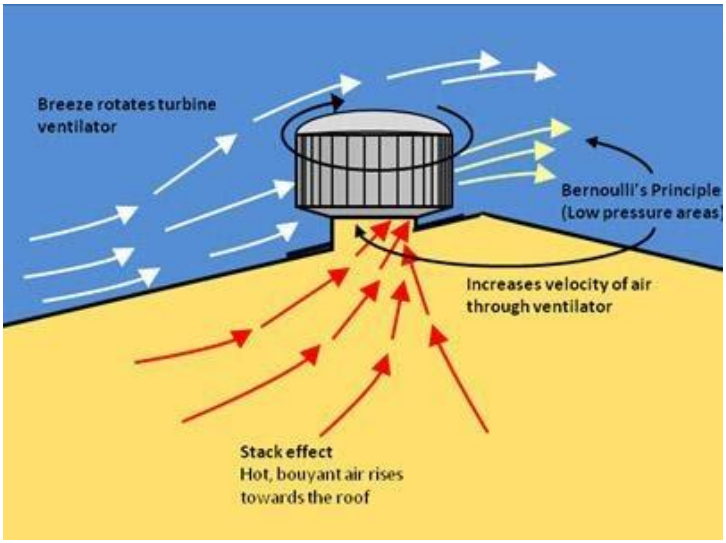
Credits: Authors

4.2 Modernization

Over time, better technologies have been developed to decrease costs associated with constructing and running a warehouse and maintaining the quality of the stored commodities. These have been adopted to various extents by warehouse owners. According to Mr. Tawri, changes made during the construction have resulted in significant differences. He explains how

warehouses constructed earlier used to have walls that were 18 ft high, but now only a 10 ft wall is constructed, and profile sheets are used for the next 10 ft. This arrangement results in a 10% cost reduction, reduces the time spent in construction and the higher height leads to better aeration. Even within profile sheets, aluminium sheets are preferred instead of GI (galvanized iron) sheets because they keep the warehouse temperature 4-5 °C lower despite costing almost double the GI sheets. In addition, aluminium does not rust, leading to lower maintenance costs and higher resale value. Another significant technology used is turbo ventilators. Turbo ventilators work by pulling out the warm air above the gunny bag stacks, which helps to keep the grains cool. The figure below demonstrates how they work.

Figure 10: Effect of Turbo Ventilator



Source: Southwest Solutions

Mr. Tawri owns an 18 ft high godown of 2268 tons without turbo ventilators and a 22 ft high godown of 2388 tons having 4 turbo ventilators. He noted that while the turbo ventilators cost Rs 28,000, the godown containing turbo ventilators had to be fumigated one less time in 6 months, resulting in a saving of nearly Rs 30,500 in fumigation expenses. Another change is in the

warehouse flooring. Earlier, stone flooring was used, but because it was uneven, cleaning process was harder, potentially leading to infestation. A smoother cement flooring is used now (Figures 11a & 11b).

Traditionally, warehouses have relied on manual labour to unload, stack, and reload gunny bags. The easy availability and low costs of hiring have made adopting any new technology economically unviable. However, according to Mr. Tawri, some larger warehouses are using a loading and unloading conveyor due to the unpredictability of availability of labour and the time and efficiency benefits. This conveyor (Figure 12) is primarily used to stack gunny bags. Still, the usage of this conveyor remains the exception rather than the norm.

Figure 11a: Stone Flooring

Figure 11b:Cement Flooring

Source: Shree Kalindi Warehousing

There is no incentive to modernise the warehouses because of how the agricultural warehousing and procurement systems are structured. As the government is the leading procurer and storer of

food grains, the government is also the biggest and preferred customer to warehouses. There is no incentive for warehouse owners and operators to modernize since the government is the biggest customer and it does not differentiate based on technology. Due to massive procurement, even warehouses that used to work solely for private traders have also switched to government agencies. Warehouse operators also prefer the government for its long holding periods. Private traders in agricultural goods seek price advantages (as opposed to food security) and, as a result, have short holding periods, while the government holds food for much longer.

Figure 12: Loading and Unloading conveyor

4.2.1 Steel Silos

As the demand for warehousing capacity increased by 2013-14, the government started exploring other storage technologies besides traditional godowns. In line with this effort, MPWLC invited bids to construct steel silos for wheat storage in ten locations across MP in 2013. Steel silos are vertical tank-like structures that maintain a controlled environment for the storage of food grains. They are a technologically superior storage method and are used extensively in countries like USA and Japan.

The steel silo (Figure 13) projects in MP were tendered under a PPP model and had a capacity of 50,000 tons each (4 bins of 12,500 tons). The life of the project was set as 30 years. Under the agreement, the private party was responsible for designing, building, financing, and operating the silos on land provided by MPWLC. Once the project life was finished, the ownership of the silos would be transferred to MPWLC. In return, MPWLC would give a revenue guarantee of 10 years to the private party at capacity irrespective of the actual quantity stored.

The bid for the steel silo at Junheta, Hoshangabad was won by Adani Agri Logistics in 2014, and operations first began in the crop year 2015-16. The project had a capital cost of nearly 30 crores, and while Viability Gap Funding (VGF) from the government was available, Adani did not utilize it. The revenue guarantee had two components—a fixed charge of Rs 5.75/quintal/month and a variable charge of Rs 0.5/quintal/month—indexed to the Wholesale Price Index (WPI). It was understood that billing was allowed at a normative capacity of 49,000 tons resulting in annual revenues of approximately Rs 4.2 crores, expenses of Rs 1.2 crores, and a profit of Rs 3 crores. These figures align with the feasibility report, which suggested a payback period of 10 years.

Figure 13: Steel Silo – Junheta, Hoshangabad

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The procurement process of food grains from farmers is also better integrated with the functioning of the steel silos. The authors learned that registered farmers from nearby locations assemble with their wheat in tractors during the procurement season. A sample of the wheat is then inspected for quality, and if approved (rejection rate is 1-2%), it is followed by weighing, cleaning, and storing the grains. The farmers receive mechanized receipts recording their deposit and avoid traveling to the mandi. Nearly 300-400 trolleys or 2000 tons of wheat can be stored through this process in a day. Once inside the silo, the quality of grains is monitored in real-time using temperature sensors at every meter. The aeration system is activated if the temperature rises above a certain level, and exhaust fans blow cool air while hot air gets vented out. Fumigation of grains is also done pre and

post-monsoon. Due to these measures, grains can be stored in silos for 2-3 years without deterioration.

Other benefits of constructing steel silos are the lower land utilization (1/3 of traditional godowns) and operational cost. As a result, steel silos are preferred compared to traditional godowns, and the FCI has set a target of developing over 100 lakh tons of steel silos around the country. However, it was noted that there was a mixing of food grains of different qualities- 20-25% of wheat is procured under relaxed specifications (URS)—due to political pressure, which is undesirable for scientific storage. Steel silos also suffer from the drawback of only storing one type of grain by design.

4.2.2 Silo Bags

Silo bags (Figure 14) are a form of hermetic storage- a technique of storage that consists of removing oxygen from the container to suppress the ability of insects, pests, or fungi to develop. Hematic storage has been in use globally and was first introduced in India in 2011 by Silo Bag India Pvt. Ltd. The authors visited one such project in Babai to learn more about this technology.

Figure 14: Silo Bags

Source: Silo Bag India Pvt. Ltd.

The silo bag material consists of a 3-layer polyethylene film of 220-to-250-micron thickness, making the bag weatherproof and protecting grains from sunlight. The length of one silo bag is either 60 or 75 m, and it can store 200 or 265 tons of grain. However, this form of storage is land inefficient as each acre can only store about 2000 tons, less than all other forms of storage. The government pays Rs 61/ton/month as a storage charge for the project at Babai and provides the land (30 acres) free of charge. However, economic estimates could not be created since private costs such as silo bag material and leveling of ground were not available. Compared to other forms of storage, a key advantage that the silo bag system has is its flexibility—it can be set up anywhere on a notice of 30-45 days.

4.3 Role of Collateral Managers in Introducing Technologies

Collateral Managers work as a link between the lenders and the farmers seeking loans against their produce as collateral. The collateral managers have developed their own scientific storage infrastructure with better technology in recent years. The primary objective of a collateral manager is to facilitate pledge finance. They assure the quality, weight, and safekeeping of produce against which the loan is taken. In addition to facilitating pledge finance, established companies like Arya Logistics, Star Agri, Adani Logistics, etc., have branched into procurement facilitation, storage, and logistics solutions, and consulting.

The business of collateral managers has grown with many new entrants in the last two decades. The collateral managers were hit by demonetization in 2016 and the introduction of the GST regime in 2017. The situation has improved in the last three years, and the profits have come to their pre-2016 levels. Some collateral managers may have seen higher growth, but the profits have not matched expectations because of the COVID-19 pandemic since March 2020. The introduction of WDRA has also impacted the consumer base of the collateral managers. Still, the impact is

small given the low rate of adoption of WDRA accreditation by the warehouse owners. Some of the collateral managers have also developed their proprietary technology and models to improve agricultural storage in India. We cover three such cases below.

4.3.1 Hermetic Storage

Hermetic storage is an airtight storage technology for agricultural commodities (Figure 15). It is used by the agricultural produce integrator, Arya Collateral Warehousing Services Pvt. Ltd. The storage uses the concept of a modified atmosphere to protect commodities that are sensitive to moisture. This technology removes the possibility of pest infestation by preventing gas exchange from the surrounding environment. Lack of interaction with the atmosphere also ensures that the stored commodities are free from toxic substances like aflatoxin. The oxygen is reduced inside the storage to make it difficult for any harmful insects to survive. No pesticides or insecticides are used for storage. Figure 15 shows the hermetic storage used by Arya Collateral WSP.

Figure 15: Hermetic Storage

Source: Arya Collateral Warehousing Services Pvt. Ltd. Website: https://www.arya.ag/

Hermetic storage is found to be ideal for storing commodities like coffee beans, cocoa, and spices that need to retain aroma for a long time. The life of hermetic storage is 10-15 years (Villers et. al. (2006)). Table 9 gives the economics for hermetic storage. The advantages and disadvantages of hermetic storage are mentioned in Table 10.

Table 9: Cost and Price of Hermetic Storage

One time Cost	$5000
Maximum Storage	300 tons
Write off after	10-15 years
Running Cost	No running cost except the rent of the place where it is located
Price of storage	1.66 times that of conventional godown

Source: Interview with the employees of Arya Collateral Warehousing Services Pvt. Ltd.

Table 10: Advantages and Disadvantages of Hermetic Storage

Advantages	Disadvantages
Can be transported	High Initial Cost
Airtight storage	High Price Compared to Conventional Warehouses
Near-Zero Insect damage	
less than 1% fungal damage as compared to 4-5% in godowns	

Source: Interview with Arya Collateral Warehousing Services Pvt. Ltd.

4.3.2 IRRI Superbags and Cocoons and Purdue Improved Crop Storage

These are superbags and storage cocoons developed by International Rice Research Institute based on the hermetic storage system principles. These storages can effectively control grain moisture content and insect activity by an airtight barrier between the grain and the outside atmosphere. The principle is that the oxygen inside the hermetically sealed container will be consumed by the biological activity and hence unavailable to insects. There is no need to use any pesticide in hermetic storage. Cocoon storage generally has a capacity of up to 2000 tons. Purdue University, USA, has developed 3-layered Purdue Improved Crop Storage (PICS) bags. These bags are used extensively in West Africa.

The hermetic storages seem to have many advantages in Indian conditions. Quality deterioration is a major concern in traditional Indian storage—hermetic storage can effectively address this concern. It would also help store organic grains as the need for the use of pesticides is removed. As per the literature, hermetic storage helps maintain moisture content, reduces insect attacks drastically, prevents discolouration of grains, leads to a higher germination rate in the case of seeds, and even maintains a better taste of the grain. A randomized controlled trial study (Ndegwa M. et al., 2015) conducted in Kenya concluded that hermetic bags are highly effective in controlling loss. The technology is economically attractive with a benefit-cost ratio of 1.6 for one season and 4.8 for three seasons. A recent study of the use of PICS bags in Afghanistan for storing wheat found that the value of reduced storage loss is greater than the cost of the bag (Ameri, S. et al., 2018). This is also considered suitable for smallholders for keeping produce for an extended period for sale or home consumption. Another recent study of maize storage in six African countries found that hermetic bags maintain the quality of maize. In countries with high or

moderate seasonal price fluctuation, these bags can be profitably used for storing for more than 50 days.

The hermetic storage bag can be used effectively in conventional warehouses to ensure quality to the buyers. Banks could recognize hermetically stored grain with the proper quality assessment to quickly process pledge loans. The additional cost of the hermetic bag can be recovered to a large extent as the quality deterioration can be prevented, and there is no need for fumigation. A new system could be developed where warehouse owners advise farmers on properly preparing grains for storage various parameters of quality benchmarks, and samples can be taken for quality assessment before sealing in hermetic bags. These bags can be kept in conventional godowns, and banks could offer pledge loans immediately. The grain can be sold on an online platform when the farmer is ready to sell. The buyer can buy on the platform and get it delivered to his warehouse as and when needed with the help of the warehouse owner and a reliable logistic company without opening the bag. This will reduce the transaction cost handling cost, smoothen the flow of goods, and keep the quality of the grain intact.

4.3.3 An Integrated Model: Apna Godam

Apna Godam is a Jaipur-based agritech start-up that converts closed factories, old sheds, and abandoned buildings into scientific warehouses. It provides warehousing, commodity finance, and market linkage to the farmers with the help of its app portal. They operate in six states and maintain warehouses near the production area. The company also has a finance company that does pledge financing for commodities stored in their warehouses. The Company only procures from Rajasthan at present. They supply the commodities to Punjab, Haryana, Uttar Pradesh, West Bengal, and Bihar. Apna Godam does procurement, storage, pledge financing, and sale of various agricultural commodities like chana, barley, guar, and mustard.

Procurement

The company procures directly from the farm gate. The company operates an app where buyers can put in their buy order at a given price. A farmer gets a notification whenever there is a buy order from the buyer. The price quoted to the farmer is equal to the price quoted by the buyer after adjusting the price of transportation and other deductions like the market fee—called the "take-home price." The quality testing of the product is done at the farm gate. The testing of physical parameters is immediate. The chemical testing required in some commodities like mustard is done by sending a sample to the lab, which takes 1-2 days to complete. The company also has a logistics division under the Rashtriya Krishi Vikas Yojana (RKVY). A transaction fee of 2% is taken from the buyer.

Storage

The company has 14 warehouses in Rajasthan. These are all rented warehouses where a dysfunctional factory or a storage space is converted into scientific storage. Each godown is of the capacity of 500-5000 tons. The total capacity available with Apna Godam is 25000-30000 tons. These warehouses were once registered with WDRA, but they were deregistered later. Reasons given for the same are as follows: -

(i) High cost of registration and transaction with WDRA registered warehouses.

(ii) Banks are unwilling to provide a pledge loan without a collateral manager, even with WDRA registration.

(iii) Buyers are not satisfied with the management of WDRA registered warehouses.

(iv) There are no additional benefits of WDRA registration.

WDRA registration is required by Apna Godam only when a buyer or a seller trade on NCDEX or MCX, which is rarely the case.

The storage cost is Rs 100/ton/month for wheat, barley, and mustard: and Rs. 130/t/month for groundnut. The revenue from the storage is shared between the owner of the warehouse and Apna Godam on a 50-50 basis. Apna Godam bears all the cost incurred for storage.

Pledge Finance

The company also has a finance wing where a pledge financing facility is available for farmers, traders, and processors. The interest rates for storage depend on the loan to value ratio and the commodity (Table 11).

Table 11: Interest Rates Levied for Different Commodities by ApnaGodam

Commodity	Loan to Value	Interest Rate per annum
Wheat	90%	15%
	60%	12%
Barley	90%	15%
	60%	12%
Chana	90%	15%
	60%	12%
Groundnut	90%	15%
	60%	12%
Mustard	70%	12%
Guar	40%	12%

Source: Interview with CEO of ApnaGodam

Impact of COVID-19 and Agricultural Law Amendments

Because of the closure of physical mandis and other markets under the COVID-19 restrictions, the sales via the mobile app increased for Apna Godam. The adoption of the app technology was rampant among the farmers. The app usage saw an increase of 300-400% in the last 1.5 years.

Analysis of price volatility and price spread shows that warehousing capacity has a significant impact on reducing volatility in the case of wheat and masur and reduction in price spread in the case of wheat. However, we see a significant mismatch between the extent of grain production and the warehouse capacity available. Newer method storage such as hermetic storage can address the problem of small size lots and quality storage. However, this has not been adopted adequately. Government support in creating such storage would help to adopt on a large scale and bring down their cost. Integrated models where multiple services are provided to the users should also be encouraged.

4.3 Capex, Opex, and Profitability

To understand the economics of agri-warehousing, we compute the profitability of a representative warehouse. For this purpose, data on capital and operational expenditures are collected from a sample of warehouses. We also considered variation in these expenditures depending on the type of warehouses and WDRA compliance. The following three types of comparisons between capital expenditure and operational expenditure in warehousing were made to understand the economic viability of agri-warehousing for entrepreneurs.

1) Non-WDRA vs. WDRA Conventional Warehouse: Assumption is made that the storage space is used in all the 12 months

2) Conventional non-WDRA warehouse vs. CAP warehouse (for 1st year): Comparison between godown used at 70% capacity every year; CAP storage used for six months every year
3) Conventional non-WDRA warehouse vs. CAP warehouse (for 3rd year): Comparison between godown used at 70% capacity for six months every three years; CAP storage used for six months every three years

Tables 12 and 13 represent different scenarios' capital and operational costs expenditures. We observe from Table 12 that capital expenditure doesn't change with WDRA registration of the warehouse if the construction complies with the guidelines. But on the other hand, in the case of WDRA registered warehouses, the operational expenses are higher. This leads to a higher storage cost per ton in the case of a WDRA registered warehouse. If we take the life of both types of warehouses to be 25 years, the monthly cost of storing 1 ton works out to be higher by Rs. 4.6 for WDRA registered warehouse as compared to non-WDRA registered warehouse. This amounts to Rs 16500 per month and Rs 193,200 per annum for 3500 tons. Warehouse operators do not see any advantage of registration with WDRA in terms of either accessing pledge loans or distant sales by clients, which would have attracted more clients and, therefore, higher capacity utilization. Therefore, WDRA warehousing seems to be making warehouse operators incur higher costs without any additional benefit. This has made WDRA registration unattractive for warehouse operators.

Considering that storage requirements in India are highly seasonal, temporary storage such as CAP storage is an option for warehousing. The CAP storage requires less than one-third of the capital expenditure required for a conventional warehouse. On the downside, the operational expenses in the case of CAP storage are higher. Another drawback of CAP storage is a higher loss because of

spoilage. Our analysis assumes that conventional storage can be used around the year, whereas CAP storage can be used only for six months in a year. Table 13 considers the costs realized over one year from the start of the operation of both storages. When we calculate the monthly cost of storing 1 ton, we find that it is around Rs. 11 more in the case of CAP storage than in a conventional warehouse without WDRA registration.

Table 12: Costs Involved in Non-WDRA vs. WDRA Conventional Warehouse

Heads	**Non-WDRA**	**WDRA**
Warehouse capacity (ton)	5000	5000
Occupancy (%)	70%	70%
Utilized capacity (ton)	3500	3500
Costs		
Capital expenditure	15000000	15000000
Project life (years)	25	25
Yearly depreciation - SLM	600000	600000
Operational Expenditure		
Human resources	756000	756000
Grain maintenance	280000	280000
Insurance	140000	140000
Electricity	50000	50000
Godown maintenance	45000	45000
Stationary	50000	50000
Miscellaneous	60000	60000
WDRA registration	-	5000
Interest forgone	-	189000
Total		
Total annual costs (Rs)	1981000	2175000
Cost (per ton)	566	621.4
Months used	12	12
Monthly cost (per ton)	**47.2**	**51.8**

Note: Collateral Management fee is not included for Non-WDRA warehouses, as the banks insist on having collateral managers even for WDRA regesitered warehouses.
Source: Authors' computation based on the field data.

Table 13 compares the cost of conventional warehouses with the CAP warehouse for three years from the start of their operation. We assume 100% capacity utilization for CAP as it can be erected per demand. We also assume that both types are operational for only six months in all three years. In this case, the total cost per ton per month becomes Rs. 121.9 for a conventional warehouse and Rs. 70.1 for a CAP warehouse (Table 14). Under the lower demand for storage space for agricultural produce, CAP storage is better suited given its low initial cost of capital. On the other hand, in case of high demand for storage, a conventional warehouse exhibits economies of scale, and hence the cost per ton per month is reduced.

Table 13: Conventional non-WDRA warehouse Vs CAP warehouse (for 1st year)

Heads	**Godown**	**CAP**
Capacity (tons)	5000	5400
Occupancy (%)	70%	100%
Utilized capacity (tons)	3500	5400
Costs		
Capital expenditure	15000000	4860000
Project life (years)	25	25
Depreciation - SLM	600000	194400
Operational Expenditure		
Human resources	756000	546000
Cost of cover material	-	540000
Grain maintenance	280000	259200
Insurance	140000	-
Electricity	50000	-
Godown maintenance	45000	-
Stationary	50000	-
Miscellaneous	60000	180000
Spoilage loss (0.1%)	-	162000
Total		
Total annual cost (Rs)	1981000	1881600
Cost (per ton)	566	348.4
Months used	12	6
Monthly cost (per ton)	**47.2**	**58.1**

Table 14: Conventional non-WDRA warehouse vs. CAP warehouse (for 3rd year)

Heads	**Godown**	**CAP**
Capacity (tons)	5000	5400
Occupancy (%)	70%	100%
Utilized capacity (tons)	3500	5400
Costs		
Capital expenditure	15000000	4860000
Project life (years)	25	25
Depreciation - SLM	1800000	583200
Operational Expenditure		
Human resources	378000	546000
Cost of cover material	-	540000
Grain maintenance	140000	259200
Insurance	140000	-
Electricity	25000	-
Godown maintenance	22500	-
Stationary	25000	-
Miscellaneous	30000	180000
Spoilage loss (0.1%)	-	162000
Total		
Total three year cost (Rs)	2560500	2270400
Cost (per ton)	731.6	420.4
Months used	6	6
Monthly cost (per ton)	**121.9**	**70.1**

Source: Authors' estimate

4.4 Implication of Technology on the Quality of the Produce and Profitability

We analyse the profitability of various technologies used for warehousing. We consider CAP, covered, and steel silo technologies. Within the covered warehouse, we distinguish between those that are WDRA registered and those that are not registered. We held discussions with warehouse owners and other market participants to make our assumptions realistic and give the details of all the calculations and assumptions in the appendix attached with the report. We take the operational period of every storage technology to be 25 years. We take two types of CAP storage: 36 stacks and ten stacks. We find that the ten stack CAP storage does not give a positive contribution margin in any year from beginning to end. Hence calculation of IRR for a ten stack CAP storage is not reported. Table 15 presents the IRR for the CAP and covered storage.

Table 15: Comparison of IRRs in Different Warehousing Technologies

Storage Type	36 Stack	10 Stack	WDRA	Non-WDRA	General
CAP	-2.45%	NA			
Covered			19.10%	21.99%	
Steel Silo					6.23%

Source: Author's simulations

There is an additional cost in a WDRA accredited warehouse compared to a non-WDRA accredited warehouse. Hence, the IRR in the non-WDRA warehouse is the highest (Table 15). While comparing WDRA and non-WDRA warehouses, 70% utilization is considered from year three onwards. Ideally, WDRA registration can result in higher utilization of warehouses. With this assumption, the IRR for WDRA registered warehouses becomes equal to that of non-WDRA warehouses at 76% capacity utilization. Therefore, unless WDRA brings this additional capacity

utilization, WDRA registration is not attractive for warehouse owners. By registering under WDRA, warehouse owners have to incur about 9% additional cost. CAP storage is about 20% more expensive for less than a year of storage.

Further, the CAP storage has a disadvantage of more commodity loss than the covered storage. But the initial cost of setting up CAP storage is significantly less than that of covered storage. There are other technologies as well, like Steel Silos, Silo bags, and Hermetic Storages, which are helping to revolutionize the storage infrastructure in India. Adani Agri Logistics Ltd. is the leader in building and operating Steel Silos in India. According to the data provided by the company for their various silos, the technology has helped retain the quality of wheat stored in steel silos. The crop storage in their steel silos has increased by 116% from 2015-16 to 2018-19. The data is for Moga, Kaithal, Navi Mumbai, Bangalore, Coimbatore, and Chennai warehouses. Reportedly, the dust/Tailings and transit losses have been less than 0.25 % in these steel silos. The moisture has also remained less than 12% of the permissible limit over the years. The foreign material has also stayed less than 0.6% compared to the permissible limit of 0.75%—constituting anecdotal evidence of steel silos contributing to the retention of the quality of the commodity stored in them. The downside with steel silos is their high initial capital cost. This shortcoming is also visible with the low IRR of steel silos. However, they are useful for longer-period storage. Government subsidy for building a steel silo will go a long way in encouraging the technology.

India is yet to catch up with the technology in warehousing. Typical structures are conventional godowns operated manually. The small lot size is a constraint in using silo where there is a need for uniform quality of the produce. However, recent development such as hermetic storage seems to address issues such as the small size of the lot and the need for professional management, though

they can be expensive for shorter storage of bulky commodities. They can be an effective alternative for CAP storage and storing at the farm level for extended periods.

4.5 Stakeholders Perspectives

To understand the perspectives of different stakeholders of agricultural warehousing, we use the information gathered during the field study in Madhya Pradesh

4.5.1 Farmers

The government MSP acts as a price floor within the wheat market, and market prices tend to be lower than the MSP after the harvest season. As a result, farmers sell their produce to government agencies or private parties that use warehousing but are not direct warehousing users. As the procurement of wheat in MP grew from 24.1 lakh tons in 2008-09 to 73.7 lakh tons in 2019-20, farmers also increased their wheat production from 73 lakh tons in 2008-09 to 252 lakh tons in 2019-20. Due to the stability offered by the procurement in MP, farmers are switching to wheat production and avoiding moving into other crops.

Even cultivators of other crops are unwilling to wait to finance NWRs due to a lack of awareness or risk appetite. Most farmers stick to the traditional sale system, selling their produce to traders at APMC mandis, who then opt for warehousing. There is also a reluctance of collateral management firms to work with farmers due to their much smaller loan amounts. As a result, most farmers are not direct users of warehousing.

4.5.2 Financiers

Financiers such as banks or private money lenders have to be mindful of two primary risks while financing NWRs – price fluctuation in the commodity or the risk of collateral stocks not being in the warehouse/of lower quality. The risk of price fluctuation is managed by maintaining a margin-

only loans of up to 70% of the stored commodity's market value are extended. If the commodity's value falls, the borrower is asked to submit additional margin with the bank or risk liquidation of their stocks. Some banks, such as ICICI, also have a commodity control management group (CCMG) which tracks commodity market price to constantly assess if the collateral's value is sufficient given the loan extended.

The commodity not being in the warehouse or being of a lower quality than expected is considered a risk by financiers. This risk is managed by the appointment of collateral managers to monitor the quality and presence of stocks in warehouses periodically. Most of the banks insist on a collateral management firm while financing NWRs. The process of financing NWRs was said to take 5-6 days, and officials at both banks believed that farmers either were not aware of NWR financing or were unwilling to wait that long to receive funds. The most interest in NWR financing was by traders and then processors.

4.5.3 Government

While the annual PDS requirement for MP is 27 lakh tons of wheat and 10 lakh tons of rice, procurement is much higher, leading to rising food stocks in MP. MPSCSC officials communicated their concerns about the liquidation of wheat stocks to the authors, and it was found that some godowns were storing stocks over two years old (2018-19 crop year). Excess food stocks are supposed to be transferred to FCI but delay in transporting them to food-deficit states means they get spoilt and financial losses are incurred.

The high amount of procurement has also led to a shortage of warehousing capacity in some districts. While there is surplus warehousing capacity at an aggregate level, the transportation cost of grain more than 30 kms away is prohibitive, leading to the use of alternate warehousing

technologies such as CAP storage or silo bag. Storage in CAP has been found to cause significant loss of food grains if used for more than 3-4 months leading to further losses for the government.

When procuring grains from farmers, MPSCSC is sometimes compelled to accept grains that do not meet Fair Average Quality (FAQ) specifications due to political pressure. These grains procured Under Relaxed Specifications (URS) constituted over 70% of the wheat procured for 2019-20. This exercise represents a market distortion by incentivizing the production of a lower quality wheat which would otherwise have been sold at a discount to the MSP.

4.5.4 Warehouse Owners

Warehouse owners in MP have witnessed a broad shift in their customer base as increased procurement by the government has led to a rapid rise in the use of private warehousing by the government. The wheat market, in particular, has seen a decline in private traders, and even warehouses that only stored private stocks before 2008-09 have become receptive to government stocks. Storing government stocks is also beneficial to warehouse owners as the holding periods are longer than private customers. However, there is a reduced incentive to invest in modernization as the government does not mandate modern technology.

As such, with capital subsidies for setting up warehouses available, many new warehouses have opened, which has led to greater competition in the industry. Consequently, the capacity utilization of warehouses has reduced, and private players have turned to malpractices—fumigation of stocks or construction work on the road before the scheduled delivery of stocks—to retain government stocks for longer durations. However, it is impossible to assess how widespread these practices are.

A majority of the warehouses surveyed were not WDRA registered, as a security deposit, varying with capacity and value of the stocks, would need to be made every time an e-NWR is issued. This deposit would have to be borne by the warehouse operator as customers are used to direct-financing of NWRs through a collateral management firm. Non-fair average quality stocks are also ineligible to be financed through e-NWRs which would adversely affect warehouse owners' business. As a result, even warehouses registered with WDRA were working with collateral managers.

Other issues were also faced with the WDRA system, such as improper accounting for moisture loss/gain during storage, lack of SOP for conflict resolution for a lower-quality commodity, or lack of care by the warehouse owner. These issues have led to a lack of accountability as banks remain hesitant to finance e-NWRs. Warehouse owners provided suggestions for creating historical records by WDRA tracking warehouse performance on key metrics such as human resources, infrastructure facility, etc. But the underlying issue of better enforcement by WDRA remains the primary challenge.

4.5.5 Traders

Traders use different strategies to profit from price movements in agri-commodities—many of them have long-term agreements with processors to supply raw material at fixed times; others may use geographical or temporal arbitrage to benefit from price differentials; some may choose to speculate on prices. For the most part, traders have exited wheat trading in MP as the high procurement by the government at MSP affects both market prices and farmer expectations. However, trading in the premium variety of wheat- Sharbati- is still dominated by private traders and millers, and it commands prices higher than MSP.

Within non-wheat agri-commodities, trading is prevalent, but market practices have not evolved—traders the authors interacted with mentioned an instance where they deducted a share from the payment of the counterparty as the quality of soybean sent was lower than the agreed-upon quality. It was learned that this was a common market practice. While the adoption of commodity exchanges has taken place, most trading still takes place offline. The lack of standardization of produce was a key issue identified by the traders hindering more widespread use of exchanges. NWR financing availability was cited as an important deciding factor when selecting warehouses.

5. Impact of Availability of Warehousing Capacity on Intertemporal Price Variation and Price Spreads

5.1 Impact of Warehousing Capacity on Intertemporal Pricing

Theoretically, increased warehousing capacity in an area would enable farmers to hold their produce safely for longer and protect them from distress sales - thus preventing prices from dropping too low during the harvest season. This will also enable a larger supply in the off-season and help reduce the price. If this theorized relationship between agricultural warehousing capacity and agricultural prices exists, we would see that as agricultural warehousing capacity increases, the price volatility over a year would drop while controlling for the other factors that affect agricultural prices, such as agricultural production, imports, and exports.

To examine this relationship between agricultural prices and warehousing, we need to compute the volatility of agricultural prices over a season. For this, we used the wholesale price index of key commodities (cereals and pulses) from 1987 onwards, at multiple points over each year, constituting a reliable estimate of price volatility. From the whole price index, we removed the inflation component. Once the prices were deflated, we could compute the annual volatilities. We used two metrics for price volatility.

1. Range of annual prices, or difference between the highest and lowest price points and

2. The standard deviation of all prices across the year

Once the price volatility was determined, it was regressed against warehousing capacity, along with a set of control variables that included agricultural production, exports, and imports. Over the years, total annual warehousing capacity has been exceedingly difficult to estimate, and we used a proxy variable to capture the metric. We used the annual warehousing capacity with the FCI as

a proxy for the annual warehousing capacity. The measures of the annual production of agricultural commodities and exports and imports were obtained from the CMIE database. Each commodity's export and import figures were combined to a single net import measure. The basic model is specified as follows,

$$y_{it} = \beta_0 + \beta_1 W_t + \beta_2 X_{it} + \epsilon_{it}$$

where, y_{it} is the price volatility for commodity i in year t, and W_t is the warehousing capacity for year t. X_{it} is a vector of control variables including agricultural production and net import for commodity i in year t. We performed this analysis for 12 commodities: Bajra, Barley, Moong, Urad, cereals (including the cereals listed separately), Gram, Jowar, Masur, Maize, Arhar, Ragi, Rice, and Wheat. The results of this analysis are presented in this section.

One of the key objectives of this study is to determine whether warehousing availability has a notable and statistically significant effect on the price volatility of essential agricultural commodities. As mentioned earlier, two metrics were used in the analysis as indicators of price volatility - the range of annual wholesale prices and standard deviation of wholesale prices. Further estimation using both these metrics yielded similar results, and only the results using the range metric are presented here. The results of our analysis were significant only for wheat and masur. The relationship between warehousing capacity and price volatility remained insignificant for the other commodities.

We present the regression results for wheat and Masur in Tables 16 and 17, respectively. There is a significant negative relationship between the availability of warehousing capacity and price volatility for both wheat and masur. The result shows that in the case of wheat, one percent increase in the availability of warehouse capacity can decrease the price variability by nearly 2%. In the

case of masur, a one percent increase in warehouse capacity can reduce the price variability by nearly 2.7%. These results **indicate that the availability of warehouse capacities can significantly reduce the price variability of agricultural produce.**

Table 16: Estimated Regression Model for Wheat

Dependent variable:	log of Price Volatility of Wheat
Log Warehousing Capacity	-1.97**
	(0.929)
Production	0.00003*
	(0.00001)
Net Imports	-0.000
	(0.000)
Constant	6.708
	(0.610)
Observations	24
R^2	0.257
Adjusted R^2	0.146
F Statistic	2.309* (df = 3; 20)
Note:	*p<0.1; **p<0.05; ***p<0.01

Once we identified masur and wheat as the commodities where the availability of warehousing is making a significant difference, we wanted to understand the specific details of warehouse availability in the major producing states of these two commodities. The major producing states of wheat and Masur, respectively, are given in Table 18.

Figure 16 shows the capacity of the warehouses in different states according to the NABARD survey 2015. We have also plotted the state-wise total production of pigeon pea, bengal gram, groundnut, maize, paddy, green gram, black gram, and pink lentil for the Kharif crop cycle. We compare the total production of storable crops with the total agricultural storage capacity of the states. We observe that Andhra Pradesh performs the best among the states with storage capacity

higher than the Kharif production of storable crops. Jharkhand, Bihar, Uttar Pradesh, West Bengal, and Karnataka have less than 50% of the warehouse capacity as compared to the Kharif production of storable crops. In Jharkhand, it is as low as 17%, and in West Bengal 21%.

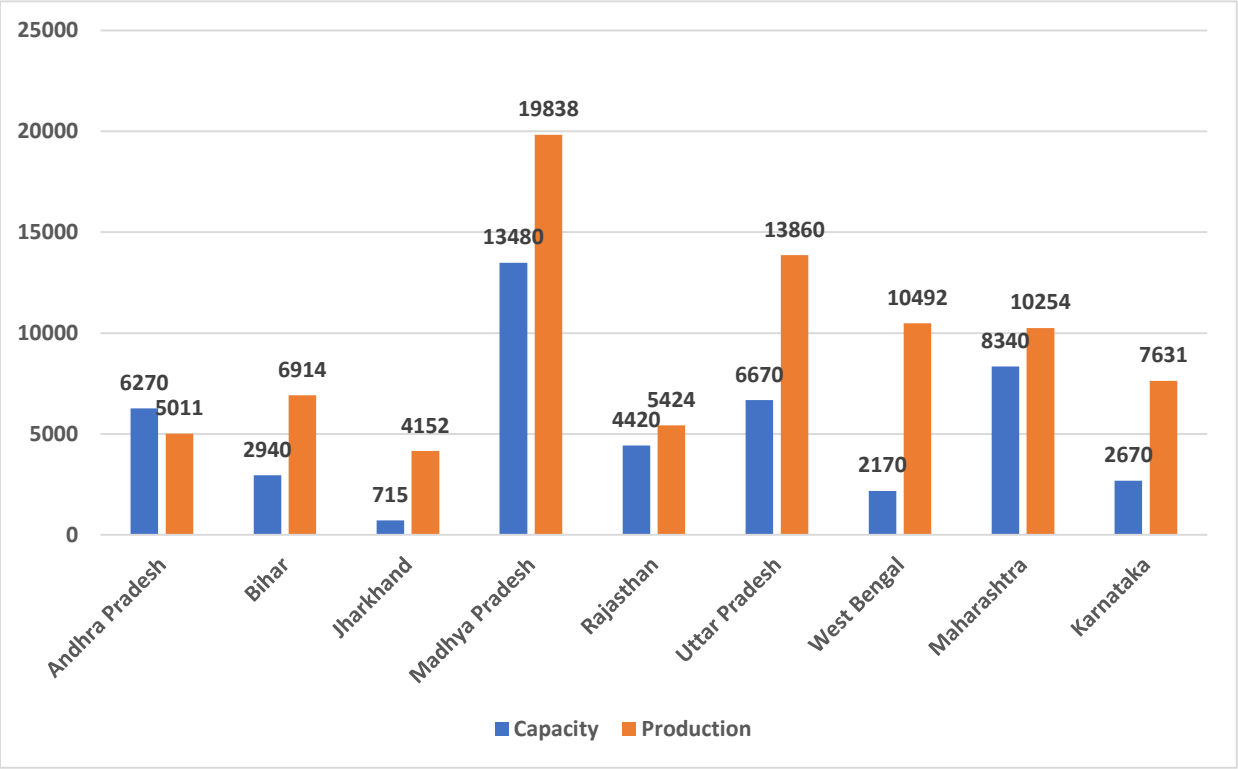
Table 17: Estimated Regression Model for Masur

	Dependent variable: log of Price Variability of Masur
Log of Warehousing Capacity	-2.688***
	(0.700)
Production	0.001
	(0.001)
Net Imports	0.000***
	(0.000)
Constant	12.363***
	(0.689)
Observations	28
R^2	0.414
Adjusted R^2	0.340
F Statistic	5.642*** (df = 3; 24)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 18: Major Producing States of Wheat and Masur

	Wheat	**Masur**
1	Madhya Pradesh	Madhya Pradesh
2	Uttar Pradesh	Uttar Pradesh
3	Bihar	West Bengal
4	Rajasthan	Bihar
5	Punjab	Jharkhand
6	Haryana	Rajasthan
7	Gujarat	Assam
8	Maharashtra	
9	Uttarakhand	
10	Himachal Pradesh	

Figure 16: Warehouse Capacity Vs. Total Storable Agricultural Production in 2015 ('000 tons)



Source: Production: Indiastat.com, Warehousing: NABARD Warehousing data from http://warehousedirectory.gov.in/

5.2 Impact of Warehousing Capacity on Price Spread

The difference between the wholesale price and retail price of the commodities is also dependent on the storage facility available for the agricultural commodities. This spread will be high if the storage facilities are not up to mark and if there are high chances of the produce rotting in storage. In Madhya Pradesh, a warehousing scheme was introduced in 2012. We take the data for state-year-product level wholesale and retail prices from indiastat.com and assign a dummy variable as 0 for all other states other than Madhya Pradesh in our regression analysis. It is 1 for Madhya Pradesh for all the observations after 2012. We make a panel for all the states from 2010 to 2020 with the following crops: Arhar, Chana, Groundnut, Maize, Masur, Mustard, Paddy, Soyabean, Wheat, Urad.

Hence our data is in a crop-year-state level panel. The dependent variable was the spread between the retail and whole prices ($spread_{cst}$). The independent variable was the dummy variable explained above (wh_{st}). We also clustered our standard errors at the state and commodity levels. We further control for commodity-year (ω_{ct}), commodity-state (γ_{cs}) and region-year (θ_{rs}) fixed effects. Our baseline equation is as follows: -

$$spread_{cst} = \alpha + \beta wh_{st} + \gamma_{cs} + \omega_{ct} + \theta_{rs} + \varepsilon$$

We can see from the estimated result in Table 19 that the warehousing scheme in Madhya Pradesh has resulted in a significant decrease in the spread between retail and wholesale prices. **This indicates that warehouse availability can reduce the price spread between wholesale and retail, benefitting consumers and producers**.

Table 19: Estimated Effect of Storage on Price Spread

Dependent Variable: Retail-Wholesale Price Spread	
wh	-0.298***
	(1.42e-10)
Constant	5.551***
	(1.37e-10)
Observations	2,071
R-squared	0.610

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.3 Information on Availability to Supply Chain Participants

There is no information system providing information on the availability of capacity, charges, etc. of warehouses located in different places—leading users to call the warehouse operators for this information. A proper online information system regularly updated, like in the case of hotels, would be helpful for users. The users should be able to book the capacity using an online system.

Another area of concern is the lack of professional management of warehouses. Agricultural produce storage requires a proper understanding of the storage to prevent pest attack, quality deterioration, moisture loss and ensure safety. Credit agencies will be hesitant to lend pledge loans without professional management. Over the years, collateral managers have come up to fill this gap.

6. Impact of Warehousing (Development & Regulation) Act

6.1 Trend in Registration of Warehouses

Though organized players are increasing in warehousing, the sector remains mostly unorganized. Investments from organized players are made more in e-commerce and third-party logistic players than in agricultural warehousing. Agricultural warehousing remains fragmented, and financial institutions such as banks remain reluctant to finance investments into the sector. Lower levels of investment in the sector mean that the vast number of agricultural warehouses in India are small and are only covered spaces. Technology adoption is low, and there is high dependence on manual labour, all of which affect the efficiency and profitability of the minor players who are active in this sector.

The fragmented and unorganized nature of the industry also affects standardization and certification, thus placing hurdles in attaining economies of scale. Also, the capacity of the average warehouse remains small. A study commissioned by WDRA in 2016 found that the average storage capacity was 4700 tons. For comparison, the average capacity of refrigerated warehouses in the United States was 162,977 tons.

On the regulator side, warehouse regulation is a state subject. Operators of public warehousing must obtain licenses from state governments. WDRA requires prior state licensing for issuing NWRs. In addition to a plethora of crisscrossing regulatory requirements across the central and state acts, the WDRA needs to be an effective regulatory body. It was set up to regulate negotiable warehouse receipts (NWR). If a warehouse wishes to issue NWR, it must be registered with WDRA. This registration is voluntary. Thus, the WDRA cannot mandatorily regulate all warehouses but only those that intend to issue NWRs.

Currently a small percentage of warehouses have been accredited and are eligible to issue negotiable warehouses receipts compared to the total number of warehouses in the country. Warehousing (Development & Regulation) Act, 2007 makes provisions for duties and liabilities of warehouses. But the incentives for warehouses to register with WDRA for issuing warehouse receipts are not clear. The Act regulates that only those warehouses registered with WDRA can issue NWRs. The registration process is cumbersome, the quality parameters and staffing requirements of warehouses are stringent. WDRA has empanelled a few agencies for processing the accreditation. The process is slow, and the capacities are limited. The requirement of insurance coverage is another hurdle. WDRA insists on the insurance of 100% storage capacity for accreditation/registration of cold storage. However, the average annual capacity utilization would be much lower. Hence, cold storage owners are reluctant to take insurance policies based on 100%

capacity utilization. There have been several requests and recommendations to simplify and ease the accreditation/registration process.

6.2 Trend in Issuing NWR and e-NWR

Warehouse receipt financing has been slow to catch on in India. According to the estimates of National e-Repository Limited (NERL), the actual warehouse receipt financing business is Rs. 35,000 crores. Loans against NWRs are far lower. A large majority of the customers of warehouse receipt finance and users of warehouses are traders and not farmers. In the case of cereals such as wheat and rice, due to high procurement at MSP and assured prices, farmers have no incentives to store agricultural produce in some states. Thus, farmers tend not to use warehousing facilities. Thus, small farmers are often excluded from access to pledge finance. And the progress of loans against NWR has been inadequate. For a lender, NWR means moving from credit risk to commodity risk and requires venturing into an area of expertise outside of their core competence—managing commodities.

The purpose of introducing NWR or e-NWR has been to facilitate both financing and sales of the stocks kept in the warehouses. A lender should be able to finance without the requirement of collateral managers, hence reducing the cost of warehousing and financing. Table 20 compares costs with e-NWR (WDRA eco-system) and the cost charged by collateral managers. For this purpose, three different slabs of storage capacity, i.e., 500 tons, 10000 tons & 25000 tons, have been considered. The table clearly shows that the additional cost to the warehouse user is more than 4 times in the case of collateral managers compared to the WDRA eco-system.

Table 20: Comparative Cost Analysis for WDRA Eco-system and Collateral Managers

Particulars	**Registered Capacity / Storage up to 500 tons**	**Registered Capacity / Storage up to 10,000 tons**	**Registered Capacity / Storage up to 25,000 tons**
A. Application fee for registration of warehouses	Rs. 5,000 one time for five years, i.e., Rs. 1,000 p.a.	Rs. 20,000 one time for five years, i.e., Rs. 4,000 p.a.	Rs. 25,000 one time for five years, i.e., Rs. 5,000 p.a.
B. Fix and dynamic security deposit as payable to WDRA as prescribed vide the above gazette notifications.	Rs. 2,50,000/-	Rs. 98,50,000/-	Rs. 1,85,50,000/-
C. Net interest cost @ 5% for obtaining a bank guarantee towards the above security deposits. It is assumed that fixed deposits up to 40% of the value of bank guarantee would be submitted to banks as a collateral	Rs. 5,000/-	Rs. 1,97,000/-	Rs. 3,71,100/-
D. Charges, towards deposit as well as pledge as prescribed by WDRA, payable to Repository as well as Repository Participants. The pledge fees @ Rs. 5 per ton per month levy able to banks for assumed 9 months is also included.	Rs. 37,500/-	Rs. 7,50,000/-	Rs. 18,75,000/-
E. Total Cost towards pledging of eNWR (A+C+D)	Rs. 43,500/-	Rs.9,51,000/-	Rs. 22,51,000/-
Average rate of stored commodities in eNWR per ton	Rs. 40,000/- per ton	Rs. 40,000/- per ton	Rs. 40,000/- per ton
Total WDRA Cost per ton/month	Rs. 7.25/-	Rs.7.93/-	Rs. 7.50/-
Total WDRA ecosystem cost as a % of value per annum	0.22%	0.24%	0.23%
Collateral management cost per annum as per market sources	0.75% to 1%	0.75% to 1%	0.75% to 1%
Collateral Management Cost per ton/month @1%	Rs. 33.33/-	Rs. 33.33/-	Rs. 33.33/-

Source: NERL

From the financier perspective, there are two main risks in financing NWRs - price fluctuation in commodity and risk of a commodity not being in warehouse/commodity being of lower quality in case of default and liquidation. In general, they handle the risk of price fluctuation by extending loans up to only 70% of stored commodity's market value; some banks (ICICI) have a commodity control management group (CCMG) which tracks commodity prices to see if the collateral is sufficient, if not the farmer/processor/trader is asked to submit more margin with the bank.

The physical status and quality of the commodity also becomes important—where are the commodities stored, how are they stored, availability and quality of warehouse facilities, commodity quality standards, shelf-life, market prices, and so on. Another model is Madhya Pradesh Grameen Bank financing NWR without collateral managers in Tanara town in Ujjain district for warehouses financed by bank. Since collateral management service costs 20000 to 25000 a month, it is not feasible for small loans by farmers and traders as this cost is often passed on to the customer.

The NWR ecosystem relies on other players such as warehouses, collateral managers, and quality checking agencies. A robust ecosystem with all of these services is required before lenders can be assured of their returns on investment. However, the ecosystem is not well developed and is still nascent. There are very few collateral managers operating in the country. These intermediaries have a relatively significant impact on identifying the customer base for NWR loans. The state of the ecosystem plausibly explains the poor achievement under NWR.

NWR financing is also a big deciding factor for traders when selecting warehouses, but the lack of enforcement and conflict resolution by WDRA has led to some scams in the past; as a result, some banks do not lend to traders at all, while others which lend demand a collateral manager. This cost is passed on to traders as higher interest rates and thus might not be feasible for smaller

traders. In addition, warehouse operators do not perceive WDRA registration to be beneficial as it is inefficient for small farmers and traders. e-NWR also requires posting 3% collateral by warehouse, which is often not economically viable.

Similarly, the warehouses owned by the Collateral Managers are generally not WDRA registered. They don't see any advantage of NWRs and eNWRs. The bank loan provided against any agricultural produce is generally given when the collateral managers in a warehouse manage it. The trust shown by a bank in a collateral manager is more than the trust they show in WDRA registration of a warehouse. The collateral managers only register their warehouses under WDRA when they use them for storing the commodity bound for delivery at NCDEX or MCX. Table 21 shows a trend in issuing NWRs and eNWRs by WDRA registered warehouses in India. e-NWRs were initiated in 2017-18, and since 2020-21 only eNWRs have been issued. We observe that the number of eNWR issued and the quantity stored under eNWR have increased since their introduction.

Rajasthan, Gujarat, and Maharashtra are the major states contributing to more than 80% of the quantity stored under eNWR (Table 22). Madhya Pradesh, Andhra Pradesh, Punjab, Tamil Nadu, and Uttar Pradesh have issued eNWR for a sizeable stock. Other states are yet to issue eNWR in significant numbers and quantities.

Major commodities stored under eNWR are Bengal gram, cotton seed cake, mustard, and soybean (Table 23). Guar seed, guar gum, castor seed, paddy, sugar, and groundnut are the other major commodities. Though wheat and maize are produced in large quantities, their shares have been less than 2%. Many commodities are stored for more than six months (Table 24). In 2020-21 raw cashew nuts were stored for more than a year. The duration of storage depends on the market conditions.

Table 21: Trend in NWRs and e-NWRs by WDRA Registered Warehouses in India

Year	No. of registered warehouses	No. of NWRs/e-NWR issued	Total Quantity of Stocks against NWR/e-NWR (in Lakh Ton)	Total loan against NWRs/e-NWR (Rs. In crores)
2011-12	240	8056	1.35	591
2012-13	92	8242	1.39	105.65
2013-14	68	6121	2.57	108.02
2014-15	234	16993	5.12	388.42
2015-16	588	15178	5.69	203.47
2016-17	214	19350	3.58	148.4
2017-18	261	12313	3.47947	118.51
	(Online- 106)	(eNWR-114)	(eNWR – 1.79947)	(eNWR- 0.20)
2018-19	607	89114	7.215309	135.5974
	(Online – 601)	(eNWR-151)	(eNWR- .01515)	(eNWR-28.2774)
2019-20	1005	138637	9.49649	437.9965(eNWR-379.7265)
		(eNWR-22528)	(eNWR – 1.54544)	
2020-21 (eNWR only)	124 (till Nov)	26445	2.03255	284.5874 (till Nov)

source: https://dfpd.gov.in/wdraNew.htm

Table 22: Number and Quantity of Commodities Stored Under eNWR in Different States.

	19-20		20-21		Share (%) in 2020-21	
State	**No of eNWRs**	**Qty (tons)**	**No of eNWRs**	**Qty (tons)**	**No of eNWRs**	**Qty (tons)**
RAJASTHAN	37646	317200	37911	340618	49.50	46.92
GUJARAT	69154	382540	17122	151633	22.36	20.89
MAHARASHTRA	12217	87072	16157	101685	21.10	14.01
MADHYA PRADESH	2872	27063	2391	43009	3.12	5.92
ANDHRA PRADESH	483	7613	833	24472	1.09	3.37
PUNJAB	0	0	101	20402	0.13	2.81
TAMIL NADU	502	10016	745	16320	0.97	2.25
UTTAR PRADESH	163	3953	370	12146	0.48	1.67
TELANGANA	369	2456	322	5251	0.42	0.72
KARNATAKA	153	2890	220	5122	0.29	0.71
BIHAR	1310	13248	325	3240	0.42	0.45
PUDUCHERRY	24	459	82	1989	0.11	0.27
HARYANA	12	486	3	111	0.00	0.02
Grand Total	**124905**	**854997**	**76582**	**725998**	100.00	100.00

Source: NERL

Table 23: Major Commodities Stored Under eNWR and Their Numbers and Quantities

FY	19-20		20-21		Share (%) in 20-21	
Commodity	No of eNWRs	Qty (tons)	No of eNWRs	Qty (tons)	No of eNWRs	Qty (tons)
CHANA WHOLE (BENGAL GRAM)	9075	92805	12978	150927	16.95	20.79
COTTON SEED OILCAKE	8187	81859	11012	112593	14.38	15.51
MUSTARD	8506	85694	8941	92461	11.68	12.74
SOYABEAN	11524	70904	16898	85562	22.07	11.79
GUAR SEED (CLUSTER BEANS SEED)	8732	59528	6855	43509	8.95	5.99
GUAR GUM	5812	31076	4516	30698	5.90	4.23
CASTOR SEED	61935	312236	5575	29104	7.28	4.01
PADDY (DHAN)	534	13835	657	23164	0.86	3.19
INDIAN SUGAR	51	2771	132	22541	0.17	3.10
GROUNDNUT PODS (RAW)	34	712	534	15732	0.70	2.17
WHEAT	3534	35810	384	11339	0.50	1.56
MAIZE	1538	16351	582	11158	0.76	1.54
BARLEY	888	8811	781	11016	1.02	1.52
CORIANDER SEEDS	1197	12700	1629	10206	2.13	1.41
URD WHOLE (BLACK GRAM/URD BEANS)	72	3455	153	8598	0.20	1.18
ARHAR /TUR (RED GRAM) WHOLE	128	3489	303	8483	0.40	1.17
COTTON BALES	205	5423	262	7147	0.34	0.98
TURMERIC	1480	8542	1000	6502	1.31	0.90
GUR(JAGGERY) IN COLD STORAGE	0	0	305	6396	0.40	0.88
CUMMIN SEED (JEERA)	1160	3474	1757	5656	2.29	0.78
GROUNDNUT	18	260	219	5228	0.29	0.72
MOONG WHOLE (GREEN GRAM)	24	592	248	5153	0.32	0.71
MATKI/MOTH WHOLE	30	648	67	3482	0.09	0.48
OTHERS	241	4022	794	19341	1.04	2.66
Grand Total	**124905**	**854997**	**76582**	**725998**	100.00	100.00

Source: NERL

Table 24: Average Holding Period of eNWR Stored Commodities in 2020-21

Period	Commodities
More than 1 year	Raw Cashewnuts
9 Months to 1 year	Yellow peas (whole), Bajra,
	Fine Broken Rice, Moong (whole),
	Deshi Chana, Lentil (Masur),
	Moog Split (Husked), Paddy (dhan),
	Chana Split (Husked), Guar Seed,
	Guar Gum
6 months to 9 Months	Sesame Seeds, Red Gram Whole,
	Rice, Raw Milled Common Rice,
	Indian Sugar, Wheat, Methi Seeds,
	Red Gram Split, Parboiled Milled
	Superfine/fine Rice, Fennel Seeds,
	Barley, Cotton Bales, Urd Whole,
	Cotton Seeds, Chillies, Taramira
	Seeds, Isabgol, Raisins, Moth Whole,
	Jowar, Gur
3 Months to 6 Months	Saffron, Turmeric, Maize, Chana
	Whole, Cotton Seed Cake,
	Safflower, Coriander Seeds,
	Castor Seeds, Urd Split, Groundnut
	Pods, Cummin Seed Masoor Split,
	Cup Copra, Groundnut
Less than 3 Months	Chickpeas, Soyabean, Soyameal,
	Mustard, Sunflower Seed, Coffee

Source: Extracted from NERL data.

6.3 Constraint on Issuing NWR and eNWR

The eNWR aimed to encourage pledge financing, making transactions easy and providing farmers an opportunity to sell their produce at a better price. Seventy-five percent of the product's value kept in WDRA registered warehouses can be given as a loan against the product as collateral. But the scheme is yet to achieve the expected results. Banks are still more inclined towards giving loans against the produce kept in a warehouse managed by collateral managers. The major reasons are the lack of trust in WDRA registered warehouses and additional costs related to it. In the case

of warehouse-based sales, Re. 1.5 per quintal is charged by NERL from the depositor while depositing the commodity in the warehouse. The buyer is charged the same fee when the product is taken out from the warehouse. And a fee of Re. 1 per quintal is charged when a loan is taken against the produce kept in a WDRA registered warehouse. Costs are also incurred in collateral managers maintaining the product in a regular non WDRA registered warehouse[2].

We compare the cost of availing pledge finance facility against the commodity stored in WDRA accredited warehouses and the commodity stored in non WDRA accredited warehouses. In the case of non-accredited warehouses, the banks avail the services of a collateral manager to assure the quality of the commodity stored. The collateral manager can charge from 0.5-2% as interest on the loan's value given by the bank against the commodity. On the other hand, the cost of pledge finance in WDRA approved warehouses is according to the quantity on which the pledge finance is provided. This value is over and above the interest rate paid by the loanee to the bank. In table 25, the estimated costs of pledge financing in a WDRA warehouse and that in the non-WDRA warehouse but with the help of a collateral manager are presented. We consider the loan amount to be 75% of the value of 10 tons of a commodity. As the charges of NERL are Re. 1/quintal in WDRA warehouse, pledging 10 tons will cost Rs. 100 regardless of the commodity. We assume that in the case of a non-WDRA warehouse, the interest charged by the collateral manager on the loan value is 1%. Hence, the cost of pledging 10 tons will vary according to the commodity's price. It is high for high-value commodities like mustard and soybean and low for commodities like wheat and paddy. But as is evident from Table 25,the additional cost of taking a loan with the help of a collateral manager is 10-70 times more than taking a loan while the commodity is stored in a WDRA accredited warehouse. The higher the value of the commodity, the more costly it will be

[2] http://www.nerlindia.com/wp-content/uploads/2019/09/04.09.2019_Transaction-charges-for-usage-of-eNWR.pdf

to pledge in a non-WDRA accredited warehouse. Sometimes, a bank demands a collateral manager even if the commodity is stored at a WDRA registered warehouse. In that case, the loanee will have to bear the cost of both NERL charges and the collateral manager.

Table 25: Additional Cost of Pledge Financing above the Bank Interest Rate for 10 tons Produce

Commodity	Price/Qtl (July 2021)	Value of 10 tons	WDRA	Collateral Manager (1% of Loan Value Value)
Arhar	5500	550000	Rs. 100	4125
Chana	4600	460000	Rs. 100	3450
Groundnut	5300	530000	Rs. 100	3975
Maize	1350	135000	Rs. 100	1012.5
Masur	5300	530000	Rs. 100	3975
Mustard	6800	680000	Rs. 100	5100
Moong	5500	550000	Rs. 100	4125
Paddy(Basmati)	3000	300000	Rs. 100	2250
Paddy(Common)	1800	180000	Rs. 100	1350
Urad	5000	500000	Rs. 100	3750
Soyabean	7000	700000	Rs. 100	5250
Wheat	2000	200000	Rs. 100	1500

Source: Website of WDRA, wdra.gov.in

6.4 Commodity Exchanges and WDRA

By January 2018, NCDEX had completed the WDRA accreditation of all its warehouses. A similar trend was seen in the MCX warehouses. After the NSEL scam of 2014, there was a demand to regulate all the warehouses of commodity exchanges. Capital and commodity market regulator SEBI has shown interest in bringing warehouses under its ambit for smooth trading on the exchange's platform. WDRA has come up with a program for commodity exchanges. All the

WDRA accredited warehouses are required to comply with the FSSAI guidelines. The chemical testing required for assuring the FSSAI quality has increased the delivery cost of a commodity at the exchange. In some commodities like plantation crops, the volumes have fallen drastically in the futures market. With no quality harmonization across the markets, the exchanges face an uphill task to maintain the contracts of consumable food items.

The problem first came to light when mineral oil was found in 6400 tons of pepper stored in an NCDEX warehouse in 2012, necessitating a cleaning process before delivery. NCDEX has since maintained that the liability of cleaning pepper was not theirs. But this made the regulator stress the consumables quality kept in the exchange warehouses. In 2017, some rules were added to WDRA Act. One of them was that the quality of commodities stored at a WDRA accredited warehouse should follow the FSSAI guidelines and abide by their quality standards. With only physical checks on the quality of pepper and cardamom in the spot market, it became costly to test for harmful substances in them through chemical testing. The cost of testing a lot of pepper increased by three times, and cardamom increased by eight times, discouraging traders from taking a short position in the market. This snowballed into reducing trading volumes at the exchanges for these commodities.

7. Impact of Recent Legislation on Agricultural Sector Reforms[3]

The Government of India enacted three farm laws – The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act 2020, The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act 2020, and The Essential Commodities (Amendment) Act 2020 – to deregulate agricultural marketing in the country. In this note, we examine the likely impact of these legislative reforms on agricultural warehousing along the dimensions of demand

[3] Recent repealing of these laws by the Government of India is likely to negate the impact.

for warehousing facilities, quality, and capacity utilization. As empirical data is yet to come by, our analysis is conceptual to generate a few testable hypotheses. We argue that there will be a surge in demand for warehouse facilities both in production and consumption centers of agricultural produce. The quality will improve because of the adoption of better technology and storage practices. However, the improvements are more likely to benefit traders and agri-businesses than farmers, as the former uses warehouses more.

7.1 Deregulation of Trading

The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020, attempts to deregulate how agricultural markets are organized in India. Its main highlight is the "freedom" it provides farmers and traders to conduct trade and commerce in a trade area. The definition of trade area is quite liberal—it could be farm gates, factory premises, warehouses, silos, cold storage, or any other structures or places. The Act permits trade outside the notified APMC markets (mandis) without paying state taxes or fees. Other features include removing license requirements for buyers, changes in market fees and levies for farmers, facilities for inter-state trade, and encouraging framework for electronic trading. Among these, two features merit detailed examination from the perspective of warehousing: declaring warehouses as trade areas and permitting inter-state trade.

Warehouses are now formally recognized markets where agricultural products can be traded. The inclusion of warehouses under this provision is universal. The Act does not spell out any specifications related to construction, facilities available, storage technology, ownership, or license requirements for a warehouse to be converted to a market site. This means a great deal of flexibility for traders and processors to procure agricultural produce from farmers. As the trade happens at

the warehouse, buyers could save transportation costs from markets to warehouses. The provision for inter-state trade opens more avenues for traders to purchase from. This may result in the trading of large volumes of agricultural produce from distant places. There will be greater demand for warehouses in primary and terminal markets and better capacity utilization of existing ones.

7.2 Contract Farming

The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, 2020 facilitates contract farming and direct marketing. It provides a national framework for farming agreements—trade & commerce agreements and production agreements. A serious attempt is made to promote contract farming through provisions for a guaranteed price, institutional arrangements for registering written contracts, and mechanisms for dispute settlement. The new provisions aim to address several frequently cited concerns such as delay in payments, price reduction, and undue rejections.

Growth in contract farming arrangements is likely to increase the demand for quality warehousing facilities near production sites. According to the Act, the delivery of farming produce under contract is to be taken by the entity entering a contract with the farmer at the farm gate within the agreed time. The quantity of agricultural produce purchased under the provisions of this Act is exempted from the stock limits applicable under the Essential Commodities Act. The produce thus collected would need interim storage before being transported to processing centres. Corporate houses and agri-business firms engaged in contract farming would require storage facilities to store inputs. The contract terms would require them to supply farm inputs and services. That agri-business firms would demand the warehouse facilities is likely to improve the quality of those facilities. Better technology and storage practices would be adopted.

7.3 Amendments to Essential Commodities Act

A significant feature of The Essential Commodities (Amendment) Act, 2020 is that it deregulates stock limits imposed for essential commodities, except under *extraordinary circumstances*. Important considerations of the amendment are facilitating ease of doing business and attracting private investment by removing regulatory uncertainties. Stock limit regulations do not apply to processors and value chain participants if the stock "does not exceed the overall ceiling of installed capacity of processing or the demand for export in case of an exporter." A broad view is taken in defining the term 'value chain participants' to include any participant that adds value at any stage from the production of any agricultural produce in the field to final consumption, including processing, packaging, storage, transport, and distribution. The amended provisions are expected to increase private investments in more formal warehouses.

7.4 Users of Warehouses

The study on warehouses conducted by the National Institute of Public Finance and Policy in 2015, based on a sample of nine districts selected from five different regions, including rural and urban, found that traders were the primary users of warehouses. A minor proportion of farmers used warehouses, and those who did were large farmers. The recent reforms are unlikely to change this scenario. As may be inferred from the discussion above, better utilization of existing warehouses, construction of additional facilities, and improved quality are likely to occur in locations where traders are active.

7.5 Agriculture Infrastructure Fund

A financing facility of ₹1 lakh crore was announced as part of *Aatmanirbhar Bharat Abhiyan* for developing farm-gate level infrastructure. Following this, National Agriculture Infra Financing Facility was set up under the Ministry of Agriculture and Farmers Welfare. It provides medium-

and long-term debt financing facilities to a set of eligible beneficiaries, including farmers and various forms of their collective organizations, National & State Federations of Cooperatives, Federations of Farmers Producers Organizations (FPOs), State Agencies/APMCs, Self Help Groups (SHGs) and their federations, Joint Liability Groups (JLG), Agri-entrepreneurs, Start-ups, and Central/State agency or Local Body sponsored Public-Private Partnership Projects for creation of post-harvest management infrastructure and community farming assets. Tentative allocation of more than 50% of the total fund is to 6 states – Uttar Pradesh, Rajasthan, Maharashtra, Madhya Pradesh, Gujarat, and West Bengal. According to the latest data released by the Ministry, 9031 applications were received and projects to the tune of Rs. 4286 crores were sanctioned (Table 26).

Table 26: Status of Agriculture Infrastructure Fund

	PACS	**Others**	**Total**
No. of applications received	4822	4209	9031
No. of projects sanctioned	4822	1397	6219
Amount sanctioned (Rs. crores)	2884	1402	4286

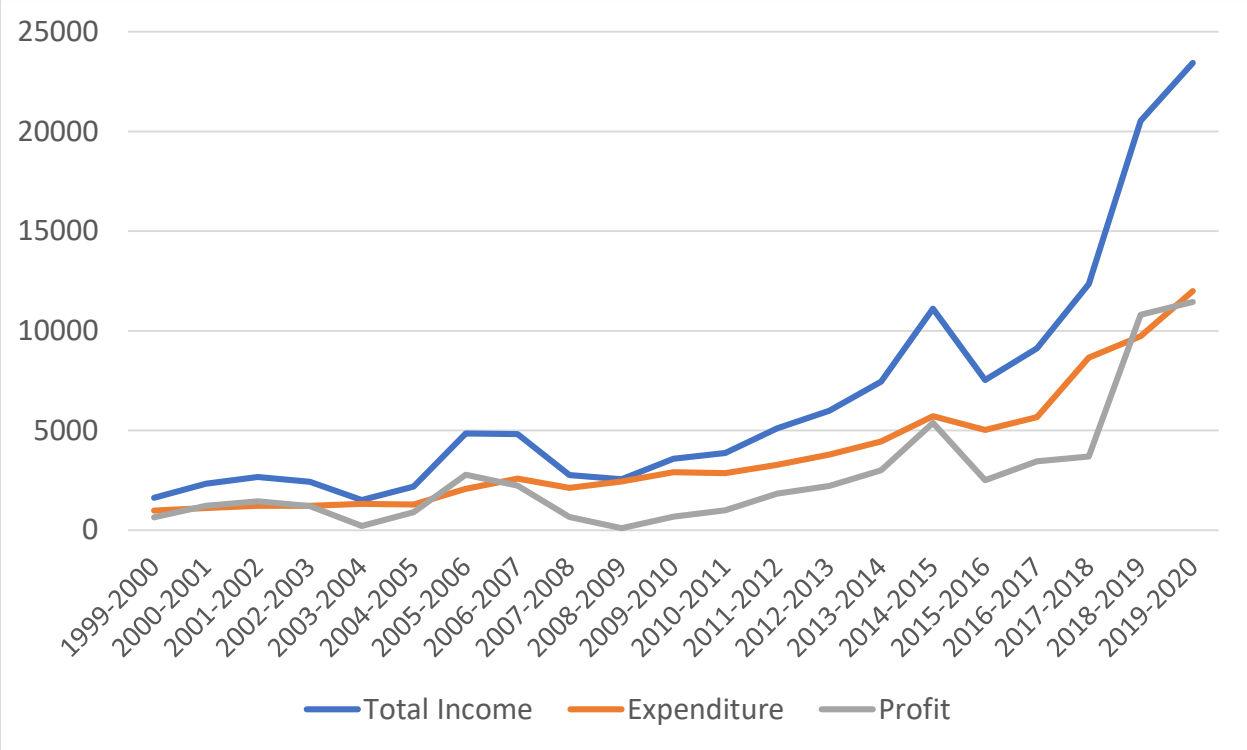
Source: https://agriinfra.dac.gov.in/Documents/Circular/C4B8822BAC3442DAB969F81FCD8BFEBF.pdf

8. Institutional Innovation Impact on Agricultural Warehousing

8.1 Public-Private Partnership in Warehousing by Central and State Agencies

In the early 2010s, a push for public-private partnership in warehousing came from the state government of Rajasthan. In 2010, the Rajasthan government awarded 38 of its 90 warehouses to Shree Shubham Logistics (SSL), a private firm[4] , through a Swiss Challenge[5] bid process. The revenues and profits of Rajasthan State Warehousing Corporation (RSWC) have seen a multi-fold increase since then (Figure 17).

Figure 17: Income, Expenditure, and Profit of RSWC (in Lakh Rs)



Source: RSWC Website https://agriculture.rajasthan.gov.in/content/agriculture/en/RSWC-dep.html/#

[4] https://timesofindia.indiatimes.com/city/jaipur/ppp-model-for-warehouse-management-gains-weight/articleshow/21131861.cms

[5] Swiss challenge is used if the idea and conceptualization of privatization was first proposed by a private party, in which case after open competitive bids for the specified project, the proposer is given a 'First Right of Refusal' to match the wining bidder.

Revenue of around Rs. 1 Crore was recorded in 2010-11, which rose to Rs. 11.5 Crores by 2019-20. Even by 2013-14, the profits generated by the 38 warehouses maintained by Shree Shubham Logistics gave more than double the profit of the remaining 52 warehouses under the control of the RSWC. The storage capacity also improved from 47% per warehouse to 102% in the outsourced warehouses[6]. SSL has upgraded and computerised the RSWC warehouses with 60/100 tons electronic weighbridges each, modern testing & certification laboratories, and other infrastructure facilities leading to a more efficient warehousing system. Given the success of this partnership, the Rajasthan Government is going for bids to privatize the remaining warehouses too. Some other State Governments are bringing in private investments and management in this domain, including Madhya Pradesh.

On the other hand, the public-private partnership between Adani Agri Logistics Ltd. (AALL) and FCI was marred by some issues. In 2000, FCI announced a PPP model under which the foodgrains will be procured, stored, and moved in bulk. The FCI then floated a tender for Build Own Operate (BOO) for two circuits, Moga (Circuit 1) and Kaithal (Circuit 2). The field depots for circuit 1 were at Coimbatore, Chennai, and Bangalore, and that for circuit 2 was in Hooghly and Navi Mumbai. AALL bid for Rs. 2415/ton which was the lowest bid. FCI guaranteed to pay for the handling, storage, and transportation of 4 lakh tons of wheat to seven depots mentioned above. AALL spent Rs. 650 crores for building and operationalizing the silos in the locations mentioned between 2005-2007.

[6] https://timesofindia.indiatimes.com/city/jaipur/ppp-model-for-warehouse-management-gains-weight/articleshow/21131861.cms

AALL had to buy 400 railway wagons to transport the food grains through 8 rakes. The tendering process for the wagons took place after four years of AALL getting the FCI contract. During this time, the transportation capacity increased from 20.3 tons per axle to 22.9 tons per axle. Each wagon has four axles, and hence the per wagon capacity went up from 81.2 tons to 91.6 tons. As a result, fewer wagons were required to be bought to transport the same amount of food grains. It was agreed that 349 wagons would be bought instead of 400. FCI wanted the Rs. 29 crores of savings accrued from fewer wagons procured to be passed to them from AALL. Further, there was another issue. The completion of the silo building was delayed in Bangalore, and delayed the start of Guaranteed Tonnage (GT) charges to be provided by the FCI.

In 2016, FCI again inked a pact with AALL to build two silos in Kotkapura (Punjab) and Katihar (Bihar). The project cost was Rs. 80 crores, and the combined storage capacity to be built was 75,000 tons. FCI would provide the rent assurance for 30 years. The rate was fixed at Rs 97 per ton per month for the first year[7]. In the future, the PPP models present significant opportunities in the warehousing sector, combining the better technology of private players with high procurement done by the state agencies.

8.2 Blockchain in Warehousing

In the current status of warehousing, there is a lack of trust between warehouse owners, financing institutions, and users. One way to address this and simplify the transaction is to use blockchain in warehouse management. Blockchain helps build a network of stakeholders such as warehouse owners, banks, FPOs, and traders to connect through an immutable record of every

[7] https://economictimes.indiatimes.com/news/economy/agriculture/fci-inks-pact-with-adani-group-for-construction-of-2-silos/articleshow/52672814.cms?from=mdr

transaction between them. Every member of the network can access the stored record facilitating transparency, traceability, and information on the quality of the stored goods.

The process of adopting blockchain would require the initial concurrence of stakeholders such as warehouse owners, banks, FPOs, processors, exporters, and traders to form the network and agree on the governance structure and operating rules. Required software need to be installed by all the network members. The process of quality testing of lots at the time of receiving and periodical testing and reporting needs to be decided. As this information is available to everyone, the parties will have greater trust in the quantity and quality of the warehoused product, facilitating easier transactions.

9. Impact of COVID on Agricultural Warehousing in India

At the all-India level, there was a decline in the market arrival of all major crops in 2020 compared to previous years (Table 27). This was despite a rise in production quantities. The decline in wheat, maize, and soybean is substantial. In the case of paddy also the market arrival has declined significantly; however, this trend has been there even in previous years. The weekly market arrival of crops in 2020 in peak seasons never reached the levels of previous years (Figure 18). This was true even for Kharif crops that were harvested months after the 3-week long stringent lockdown imposed in the country.

However, heterogeneity in market arrival was observed across states (Table 28). A few states recorded an increase in market arrival in 2020 compared to the corresponding period in 2019. This higher market arrival was offset by a drop in many other states, recording an overall decline in the market arrival of crops. For instance, Chattisgarh and Haryana recorded an increase in the market arrival of paddy, whereas Punjab, a leading rice and wheat producer, recorded a significant decline. The market arrival of paddy in Punjab dropped by around 45 percent. Similar observations can be made in the cases of maize and moong. Also, there is wide variation in the extent of the decline in market arrival. In Madhya Pradesh, there was a marginal decline in wheat market arrival, whereas in Punjab, the decline was around 55 percent. Heterogeneity is also observed across crops within states. In Madhya Pradesh, for instance, there was a decline in the market arrival of wheat and maize while there was an increase in the case of moong. Similarly, in Karnataka, the market arrival of moong declined while that of maize increased.

Table 27: Comparison of Production and Market Arrival of Major Crops

Production (mt)

Crop	2017-18	2018-19	2019-20	2020-21*
Rice	112.76	116.48	118.87	121.46
Wheat	99.87	103.6	107.86	108.75
Maize	28.75	27.72	28.77	30.24
Tur	4.29	3.32	3.89	4.14
Urad	3.49	3.06	2.08	2.38
Moong	2.02	2.46	2.51	2.64
Lentil (Masur)	1.62	1.23	1.1	1.26
Groundnut	9.25	6.73	9.95	10.12
Soyabean	10.93	13.27	11.23	13.41

Market arrival (mt)

Crop	2017-18	2018-19	2019-20	2020-21^
Rice	54.53	48.5	40.53	32.22
Wheat	30.13	29.77	27.13	17.77
Maize	6.85	6.25	4.94	3.74
Tur	0.2	0.28	0.28	0.17
Urad	0.09	0.12	0.11	0.07
Moong	0.16	0.1	0.09	0.05
Lentil (Masur)	0.09	0.19	0.12	0.03
Groundnut	1.5	1.47	1.67	1.53
Soyabean	6.14	6.95	5.69	3.77

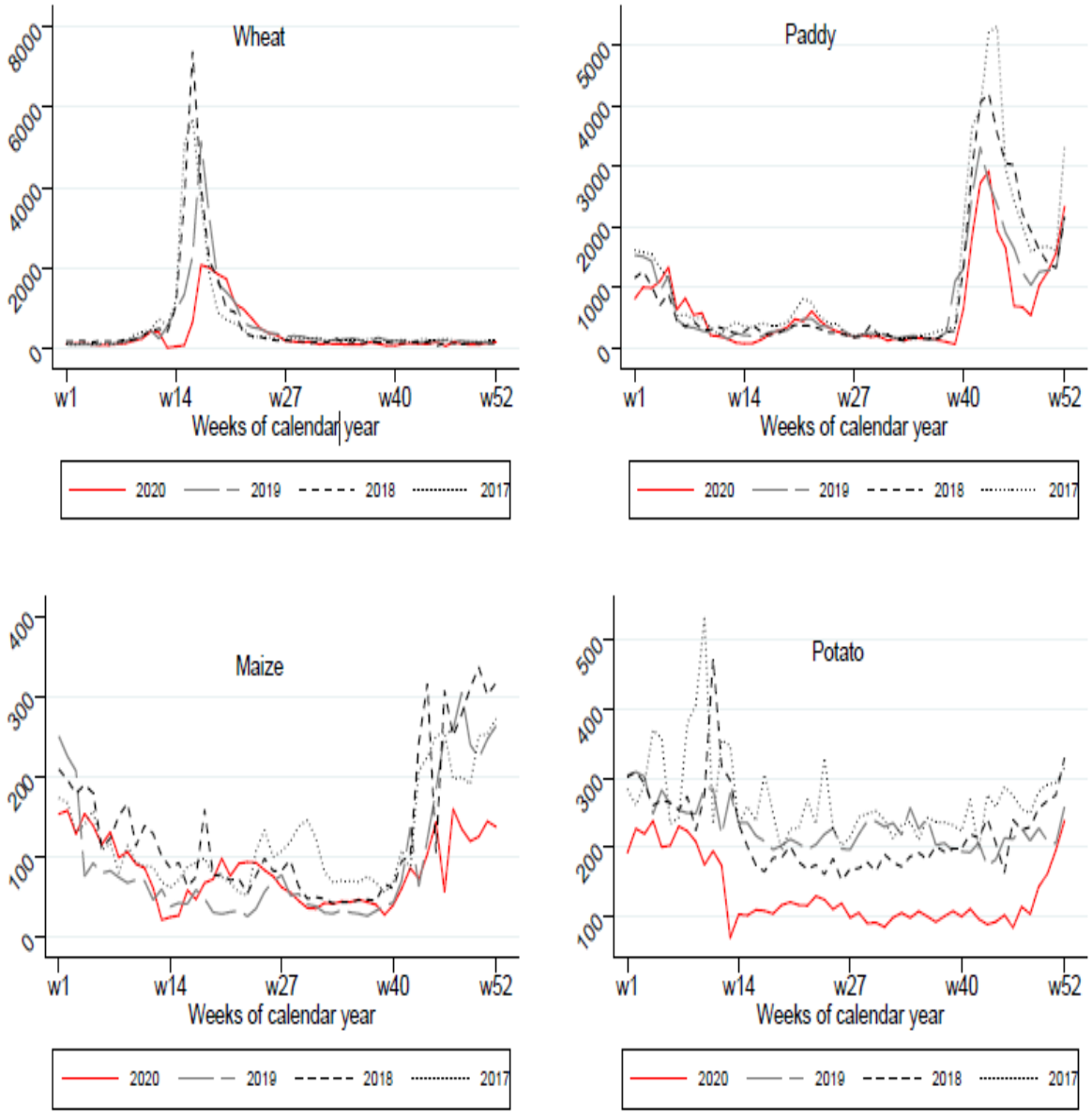
Market arrival as share of production (%)

Crop	2017-18	2018-19	2019-20	2020-21
Rice	48.36	41.64	34.10	26.53
Wheat	30.17	28.74	25.15	16.34
Maize	23.83	22.55	17.17	12.37
Tur	4.66	8.43	7.20	4.11
Urad	2.58	3.92	5.29	2.94
Moong	7.92	4.07	3.59	1.89
Lentil (Masur)	5.56	15.45	10.91	2.38
Groundnut	16.22	21.84	16.78	15.12
Soyabean	56.18	52.37	50.67	28.11

Source: Production - https://eands.dacnet.nic.in/Advance_Estimate/Time%20Series%203%20AE.%202020-21%20English.pdf
Market arrival - https://agmarknet.gov.in/

*3rd Advance estimate as on 25th May, 2021
^Market arrival till 15th March, 2021

Figure18: Weekly market arrival (‘000 tons) of a few select crops – comparison across years



Source: https://agmarknet.gov.in/

The decline in market arrival was not reflected in the quantity stock in the central pool for rice. The monthly stocks in 2020 were either higher or at least comparable with stocks in previous years (Table 29).

Table 28: Heterogeneity of Market Arrival Across States

Crop	State	Market arrival ('000 tons)	
		2020	2019
Paddy (Dhan) (Common)	Chhattisgarh	5,693.74	4,938.78
	Punjab	5,655.09	10,239.94
	Haryana	5,251.40	4,267.05
Wheat	Madhya Pradesh	6,195.08	6,262.18
	Punjab	2,467.51	5,518.09
	Uttar Pradesh	1,696.25	2,391.54
Maize	Karnataka	1,770.03	1,578.19
	Madhya Pradesh	1,297.33	1,903.48
	Maharashtra	580.11	386.43
Moong	Madhya Pradesh	164.06	111.10
	Rajasthan	139.64	146.16
	Karnataka	48.76	69.45
Soybean	Madhya Pradesh	2,700.51	4,506.60
	Maharashtra	1,176.90	1,395.01
	Rajasthan	427.44	507.69

Source: NICR Monthly Commodities Report, June 2020

Note: The periods for which data is presented for wheat are 01/04/2020-30/06/2020 & 01/04/2019-30/06/2019; For all other crops, the periods are 01/10/2019-30/06/2020 & 01/10/2018-30/06/2019

Table 29: Comparison of Rice Stock in the Central Pool

	Rice stock in the central pool (Qty. in lakh tons)				
Month	2020	2019	2018	2017	2016
January	237.15	182.91	162.06	134.75	126.89
February	274.51	227.96	198.93	170.28	162.39
March	309.76	263.91	232.79	204.07	194.24
April	322.39	293.94	248.73	230.81	221.61
May	285.03	290.56	253.62	228.28	213.20
June	274.44	275.81	242.70	221.00	207.91

Source: NICR Monthly Commodities Report, June 2020

10. Constraints in Agricultural Warehousing in India

In the second part of our survey, we sought information about the challenges that warehouse owners and operators face. Many operators identified storage gain and loss laws as a chief point of contention. In Madhya Pradesh, with wheat storage, 1% of storage gain is considered standard, and the warehouse operator is expected to show 1% gain. However, wheat's storage gain depends on storage time, duration of storage, quality of stored produce, time of retrieval from storage, and the intensity of the monsoons in the locality in any particular year. Suppose the actual storage gain is lower than 1%. In that case, the difference is automatically deducted from the storage charges paid to the warehouse operators, which could be a considerable amount depending on the amount stored. The wheat procurement begins in April, goes on until the end of June, and is lifted from July. If the wheat is lifted at the start of the rainy season, there is not enough time or moisture for the storage gain to materialize, and the warehouse operators are penalized.

To avoid facing such loss, warehouse owners often engage in malpractice (such as adding water to gunny bags to adjust their weight). Such malpractice could be avoided by regulatory adjustments - making the storage gain/loss charges sensitive to the weather patterns and the time and duration of storage. Moisture loss policy during storage leads to loss for warehouse owners; policies are based on agro-climatic zones, which often do not reflect ground conditions; warehouse owners do not prefer rice due to this reason. Warehouse operators also feel like there are insufficient conflict resolution procedures when a commodity's lower quality is found, proper care not taken by warehouse owner, etc. Currently, there is no way to differentiate between warehouses based on historical performance (grades by WDRA based on human resources, infrastructure, track record). More enforcement by WDRA is vital to building trust among market participants

In addition, the warehouse operators also face challenges with the security given to the government and the storage charges that the government owes. At the storage of agricultural produce, a security deposit is made to the government by the warehouse operator. Even after the commodity is lifted, there is often further delay in returning the security deposit to the warehouse operator. In addition, warehouse operators also face a delay in getting the monthly charges due to be released from the respective state departments. The difficulty in working with the government is a significant source of problems for the warehousing industry because small private players in the warehousing industry are highly dependent on the storage of government-procured produce.

Our survey also revealed a counter-intuitive problem that arises due to how procurement and distribution are structured amongst the different agencies handling food. The procurement agency may vary from state to state, but when it comes to distributing the food grains that have been procured, it is FCI that takes the grain from the warehouses. FCI has processes to take infestation-free food grains from where they are stored. This leads to a counterintuitive situation where if the warehouse operator stores produce scientifically and keep it infestation free, the storage period and thus earnings will be less for them. On the other hand, if a warehouse does not practice scientific storage and cannot keep the product at a certain quality, they get more storage period due to FCI's preference for good quality products to be lifted first.

Smallholdings of farmers in India create many challenges of scale economies in storage. At the individual farmer level, storage capacity must be smaller but of standard quality to protect the grains' quality. While traditionally farmers had the know-how to store grains properly, it was labour intensive, and the knowledge was not carried forward. Therefore, there is a need for small-scale modern storage techniques that will keep the quality of the agricultural produce intact. Innovation in this direction is hermetic bags and cocoons. However, the economics of using these

storage alternatives are not always favorable, particularly for short periods and bulky commodities. Availability of such storage materials is also restricted. As these materials seem to protect the product for a longer period once they are sealed and not opened in between, there is a need to evolve a system where using these materials and proper quality assessment, quality can be maintained throughout the journey of the produce in the value chain till it reaches the final user. Such systems are easy to implement in vertically integrated firms. For others, there is a need for a service provider to guarantee the quality assessment of the sealed bag. Blockchain systems can also be used to build trust and ensure traceability. Such systems will be beneficial to Farmer Producer Organizations and storing agricultural commodities in the exchange accredited warehouses for delivery on the commodity exchanges.

In the case of large volume procurement of grains by Government agencies and the private sector, hermetic storage would be beneficial. Government procurement often uses conventional bags and CAP storage for long periods, resulting in significant quality loss and wastages. The use of hermetic storage will substantially reduce wastage and quality loss. The challenge here is to make sure that grains meet the quality requirements during procurement and packing, particularly in terms of moisture content and insect infestation. To assess their suitability, there is a need to study the profitability of using hermetic storages for different scenarios such as duration of storage, grains stored, the extent of quality deterioration, and wastage. Such studies are scarce in India at present. There is a need to build research capacity in these areas.

11. Policy Suggestions

While there has been a healthier growth in the warehousing capacity in recent years, there are still substantial gaps considering the growth in agricultural production. More importantly, many warehouses do not meet the standards specified by WDRA, leading to high wastage and significant quality deterioration. Proper warehousing technology and management are prevalent in only a few units. Some of the policy suggestions for addressing these issues are as follows.

1. Substantial research support is needed to improve warehousing in India. Some key areas of research that need to be undertaken are as follows.
    a. Moisture loss: there seems to be a lack of scientific understanding of moisture loss and gains for different commodities when they are stored under different conditions and locations. This seems to affect warehouse owners and often leads to malpractices and disputes. A scientific study should be conducted to arrive at a guideline for moisture loss/gain based on various factors such as location, storage conditions, changes in weather conditions, commodity stored, etc.
    b. Packaging technology: Studies should be conducted on effective packing technologies for storing different commodities under different situations. For example, studies should determine under what conditions it is profitable to use hermetic bags and cocoons. Hermetic bags may need different handling as hooks, generally used in handling bags, cannot be used. The use of types of machinery for such handling needs to be established.

c. Storage conditions: Studies should establish the right temperature and humidity for different commodities during their storage in the warehouses. Fumigations and their impact on grain quality also need to be established.
d. The problem of poorer quality grains brought to the warehouses is also common. Proper study on preparing produce for storage needs to establish guidelines and create awareness among farmers. Also, in some cases, warehouses themselves may provide services such as drying and cleaning of commodities, so that good quality produce is stored.
e. Newer technologies such as computer visioning, near-infra-red, nuclear magnetic resonance, etc., should be explored to facilitate quick and cost-effective quality assessment, mainly when keeping the stocks in the warehouses.

2. WDRA may set up an effective conflict resolution mechanism for resolving disputes between warehouse owners and users. Such a mechanism could be an online facility.
3. Use of hermetic storage: Hermetic bags and cocoon storage may be encouraged to prevent wastage and quality loss. This can be used at all levels – individual farmer, Farmer Producer organization, Government procurement, and private sector. There is a need to encourage research on hermetic storage and create awareness of these storages. Hermetic bags seem particularly useful for long storage and high-value commodities.
4. There is also a need to incentivize usage of hermetic bags in the initial 2-3 years of adoption. This will help overcome the initial hesitation of using new technology and create scale economies, which will bring down the per-unit prices of this storage equipment. This will help save grains and keep the quality of the product intact,

particularly for those products where pesticide usage is rampant and organic character needs to be preserved.

5. Government procurement should use hermetic storage instead of CAP storage. This will help in adopting high-quality storage at procurement centres. This has the advantage of creating small capacity high-quality storage quickly and can be transported easily. With a good procurement process and quality assessment and tracking system, traceability can be enhanced and enable easier handling.
6. Government schemes should encourage the creation of quality warehouse capacity by Farmer Producer organizations and the private sector. This additional capacity could be mainly used hermetic storage technology. For large-scale handling, silos should be encouraged.
7. The PEG scheme should be revived with proper implementation procedures considering CAG observations.
8. Incentives should be provided to develop a quick and reliable quality assessment and traceability system so that value chain transactions are streamlined. If quality produce is hermetically bagged and quality assessment is available, the product should go through the value chain without opening the bag till it reaches the ultimate users. A good digital traceability system will enhance the efficiency of transactions in the value chain. This will act as a warehouse receipt system, and banks may also come forward to finance more easily.
9. Creating incentives for WDRA registration: In the current system, there is no incentive for warehouse owners to register their warehouse under WDRA. An easy pledge loan finance without paying collateral management fees for those stocks stored in the WDRA

facility will make it attractive for warehouse owners. A more accessible pledge loan enhances capacity utilization, and capacity utilization is the primary driver in the profitability of warehousing. Interest subvention for storage by farmers should be provided so as to make it attractive to store their produce duing peak harvest season and benefit from higher prices during lean season.

10. The adoption of warehouse-based sales is increasing slowly. Warehouse-based sales can significantly reduce the intermediaries and smoothen the transaction in the value chain. The government should encourage online transactions and the flow of goods without frequently checking the quality. Hermetic storage techniques with proper quality assessment could be helpful in this direction.
11. Courses on warehouse technology and management for degree students and internships should be introduced in colleges offering degree, diploma, and certificate courses on agribusiness.
12. A portal can be created to access online information on the availability of warehouses. The information needs to include the location and contact and details about the warehousing technology and pledge loan facility. Star rating of warehouses could also be encouraged so that users from distant places have adequate information about the warehouses.
13. There should be ease of doing business for warehouse owners with the Government. Delays in payment by the government can cause substantial losses to warehouse owners.
14. FCI should encourage warehouses that manage the commodities better through differential payment of charges and keeping the good quality stocks for an extended period.

15. Due to possible quality variations and long-distance transactions, the agricultural commodity value chain suffers from trust between the parties. Blockchain has been the emerging technology in enhancing trust and, therefore, is well-suited for agribusiness transactions, particularly the part of the value chain dealing with warehousing. Government should encourage the adoption of blockchain technology in warehousing operations.

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Appendix 1: State Schemes for Warehousing

1.1 Incentives in Madhya Pradesh Warehousing and Logistics Policy 2012

The incentives in the scheme are divided into two parts: Part A and Part B. Part A entails long-term incentives. Part B had early bird incentives applicable for the first two years to create a maximum storage capacity of 20 lakh metric tons. The capacity of a warehouse is calculated by using the following formula:

$$Capacity\ in\ Metric\ Tonnes(MT) = Length\ (ft) \times Width\ (ft) \times \frac{Height(ft) - 2}{80}$$

The Part A incentives include the following: -

1. The proposed greenfield industrial estates/clusters shall reserve 10% land for warehousing facilities (excluding amenities).
2. The proposals for setting up warehouses in the existing industrial estates will be approved based on demand for warehousing facilities, availability of land in the industrial estate, connectivity and facilities for handling truck traffic.
3. A minimum of 50 acres of land in 10 identified districts will be earmarked and developed as 'Warehouse Zone' for setting up warehouses/silos.
4. The land for setting up warehouses in greenfield industrial estates and Warehouse Zones will be allotted on a long-term lease basis at the same rates as applicable to Small Scale Industry Units.
5. Various models of business guarantee may be introduced periodically for existing warehouses, based on requirement, to increase warehousing capacity and promote innovations such as Silo Bags and other new technologies.
6. All proposals/projects based on this policy will get the benefits of "Single Window Clearance" through TRIFAC.

Part B incentives which were applicable only for 2 years had following benefits: -

1. The warehousing projects with capital investment of more than Rs 1 Crore will be eligible for Capital Subsidy of 15% of the infrastructure development cost (excluding cost of land) upto a maximum of Rs 2.25 Crores for a warehousing capacity of 50,000

tons per investor per project. The cost of infrastructure development in warehousing projects will be calculated at the rate of Rs. 3,000/- per ton.

2. All new warehousing projects with an investment of Rs. 1 Crore and above will be eligible for a 5% per annum interest subsidy on term loan for a period of 7 years from the year of commencement of operations subject to an upper limit of Rs 1.7 Crores for a capacity of 50,000 tons per investor per project. The cost of infrastructure development in warehouse projects will be calculated at the rate of Rs 3,000/- per ton.
3. Expansion of existing warehousing capacity involving capital investment of at least Rs. 1 Crore will be treated as a new project so as to avail all available incentives provided in this policy. Such incentives will only be available to such warehouses who have obtained licence prior to publication of the notification of this policy.
4. This policy aims to promote creation of warehousing capacity of 15 lakh tons by projects which have not availed of any other subsidies or business guarantee schemes of State Government or Central Government.
5. To promote quality certification such as WDRA and ISO:9000 of newly constructed warehousing facilities under this policy, 50% of the cost of certification or Rs 1 lakh, whichever is less, will be reimbursed.

Additional incentives were provided to encourage silos of 5 lakh tons: -

1. Such projects shall be implemented by Design-Build-Finance-Operate- Transfer (DBFOT) mode.
2. The land shall be provided by the State Government on long term lease basis for 20 years which shall be extendable by another 10 years.
3. The State Government shall provide upto a maximum of additional 20% Viability Gap Funding (VGF) support, if required, in addition to 20% VGF by Government of India under the VGF Policy. However, such projects will not be eligible for Capital Investment Subsidy and Interest Subsidy as mentioned in points 7 and 8 of this policy.
4. Such projects shall be awarded through a transparent bidding process and such project shall be eligible for business guarantee for 10 years.

1.2 Pledge Loan Scheme of MSAMB (Maharashtra)

The following table shows the commodity wise loan limit and the rate of interest:

Commodity	Limit of Loan	Period	Rate of Interest
Soyabean, Tur, Moong, Udid, Paddy, Safflower (Kardai) Sunflower, Turmeric and Gram, Jawar, Bajra, Maize & Wheat	75 % of total cost (as per market rate or MSP which is less)	180 days	6%
Ghewda (Rajma)	75 % of total cost. Or maximum Rs. 3000/- per Quintal (which is less)	180 days	6%
Cashew nuts	75 % of total cost. Or Rs. 100/- per Kg (which is less)	180 days	6%
Betel nuts (Supari)	75 % of total cost. Or Rs. 100/- per Kg (which is less)	180 days	6%
Raisin (Bedana)	75 % of total cost. Or maximum Rs. 7500/- per Quintal (which is less)	180 days	6%

MSAMB has disbursed Rs.23,324.75 Lakhs Agricultural pledge loan to the farmers of Maharashtra State through APMCs since 1990-91 up to 2019-20 as a marketing initiative.

Following are the highlights of Pledge Loan Scheme of MSAMB: -

1) Only the producer farmers are eligible for the pledge loan. Traders are not eligible under this scheme.
2) The cost of Produce is determined by the market price of the day or the MSP announced by the government, whichever is less.
3) Calculation of rate of interest on loan amount is – up to 180 days 6%, 180 days to 365 days 8% & after 365 days 12%.
4) Market Committee which makes repayment of loan within the prescribed period of 6

months (180 days) are applicable for 3% interest subsidies on loan amount from MSAMB.

5) Market committees are also eligible 3% incentive interest subsidies on the loan amount which distributes the pledge loan from the self-fund.
6) The market committee takes responsibility of storage, monitoring and security of the mortgaged goods free of cost. And the responsibility of the concerned market committee to insure mortgage of the goods.
7) Mortgage loan is also provided by the market committees on receipt of warehouse receipts of State or Central Warehousing Corporation

1.3 Mukhyamantri Pak Sangrah Yojna (Gujarat)

Following are the main points of the scheme: -

(i) It is a 100 % Gujarat state sponsored scheme.
(ii) It started in 2020-21
(iii) Any farmer from Gujarat can avail the scheme
(iv) The structure of minimum 20 square feet area has to be constructed and the crop storage as shown in the resolution has to be prepared as per the specification of the structure. Details of assistance are subject to resolution.
(v) The scheme pays for the 50 per cent of the total cost or Rs. 30,000 (thirty thousand) whichever is less (in two installments: first installment: Rs. 15,000 / - after completion of plinth level and second and final installment: Rs. 15,000 / - after completion of complete operation of crop storage structure)
(vi) Government of Gujarat has created an online portal for applying to the scheme: https://ikhedut.gujarat.gov.in/

Appendix 2:

2.1 Comparative Analysis of Collateral Management Company (CMC) with WDRA Ecosystem

Particulars	**Collateral Management Company (CMC)**	**WDRA ecosystem**
Why we need Collateral Manager or WDRA	Banks being financer have limited understanding of warehousing and storage, commodity varieties etc. They have limited trust on warehouse owners. Collateral managers fill this gap between banks and warehouse owners. Banks being regulated by RBI, always ring-fence their exposure to minimise the risk. In the absence of regulatory environment in warehousing, adopted closed user group (CUG) approach of high cost with limited transparency. Large WSP (warehouse Service providers) offers collateral management services to banks in owned or leased warehouses.	WDRA objective is to create a regulated, homogenous and transparent warehousing ecosystem for all the participants as per the WDR act. This will lead to trust in warehouse owners and will remove the overlaps for reducing the finance cost and will bring efficiency and transparency. Digital centralised record management for promoting trade, storage and finance in agricultural marketing. Bringing more participation in warehouse receipt funding helping farmers and agri participants
Criteria for warehouses	There are no defined criteria. Generally any type of structures based on market reference / requirement and feedback are accepted.	Defined criteria are infrastructure of warehouse (BIS, FCI standards), positive net worth of warehouse operator and skilled manpower.
Security	Collateral managers have owned or lease / subleased warehouses. They take full control on these lease / sublease warehouses. They offer 100% guarantee for quality and quantity of commodities financed by the banks in their managed or owned warehouses.	WDRA being regulator brings the regulated warehousing ecosystem with defined rules, guidelines on repositories and centralised digital platform for ensuring the fiduciary trust on WDRA ecosystem WDRA takes Rs.1lacs per warehouse as security deposit and then has slab wise structure of accepting bank guarantees based on asset under management (AUM) in eNWRs WDRA ensures 100% insurance coverage of the commodities being stored, at the time of WDRA registration. PACS and other cooperatives have discounted fee structure as compared to private sector warehouses.

State Warehousing Act / WDR Act	Collateral Managers perform their assigned duties as per the state warehousing act to manage the warehouses within the state There is no specific regulatory authority / body to regulate state warehousing act. In most states, these acts were enacted in 1970s or 1980s and they do not reflect the current scenario of warehousing like have no specific commodity quality guidelines, quality and quantity of the commodity is the core work of warehouse operator is not being covered in the state act. For example, these acts are limited to licensing of warehouses and they are silent on digitization, negotiability, transferability of electronic warehouse receipt, surveillance and inspection of warehouses. These acts do not mention any registration criteria for warehouses like structure, financials and skills.	WDRA has prescribed standard operating norms for smooth operations of warehouse operators. • Warehousing (Development and Regulation) Registration of warehouses Rules 2017 • Online Application for registration • Warehouse operator Net worth and Infrastructure Requirement • Ownership and effective control • Fees Based on WH capacity • Warehouse SOP & KYD • Surveillance and Monitoring mechanism • Mandatory Issuance of electronic negotiable warehouse receipt (eNWR) or electronic non-negotiable receipt (eNNWR) • Customer grievances mechanism State Governments should merge their state warehousing acts to align them with the WDR Act 2006. A uniform warehousing act at national level will help to create one nation-one market in agriculture.
Monitoring and Supervision of the warehouses	No such Monitoring and supervision mechanism is prescribed.	Detailed monitoring and Supervision mechanism (pre, during and post storage) prescribed in provisions and guidelines laid down by the WDRA. Digital and physical monitoring mechanism is prescribed at regular intervals.
Grievance Redressal	No grievance redressal mechanism prescribed.	WDRA on December 06, 2017 issued Guidelines on redressal of Grievances and Resolution of disputes (including arbitration) in order to provide a central forum for registration, tracking and monitoring of grievances against the WDRA, inspection agencies, repositories and warehouse operators. Any person aggrieved by an order of WDRA makes an appeal to the Appellate Authority.

Digital platform	Warehouse receipts are mostly issued in physical form. Collateral managers are converting physical warehousing receipts in the electronic storages receipt for the banks but it carries operational risk of issuing double receipt for the same stock	WDRA has created the robust digital, web based platform through their repositories. The registration of warehouses, their audit and inspection is regulated digitally and through physical inspections. All transactions of eNWR (deposit, sale, pledge etc) in registered warehouses are conducted digitally and their audit trail is available for stakeholders. It is removing all current paper based activities and reducing the hurdles in offering finance to depositors, Higher TAT for receiving the loan from banks due to receipt in physical form and requirement of stock verification from CM. It is also helping depositors to participate in exchange or non-exchange trade easily through eNWR unlike paper bases receipt. Also, registered warehouses are not allowed to issue paper-based receipts hence NWRs issued by registered warehouses provide negotiability with legal backing of the W (D&R) Act, 2007.
Standardisation of warehouses and commodities stored-	No such standardisation prescribed	WDRA is registering the warehouses on the basis of infrastructure and financial parameters. Only AGMARK grade agricultural commodities are allowed to be stored in these registered warehouses. The objective is to create a homogenous environment in agriculture trade and finance by standardising the warehouses and commodities stored for easy finance, trade and market access.
eNWR – the trusted collateral instrument	There is lack of trust between banks and warehouse operators under current collateral warehousing system.	Enhancing the trust between depositors, warehouse operator and Banks. Currently depositors and banks lack trust in warehouse operator in the absence of any specific warehousing regulation thus damaging the trade and finance against warehouse receipt. The trust can be built only by allowing WDRA to regulate, monitor and supervise the warehousing ecosystem.
eNWR – the trusted settlement instrument	Warehousing receipts issued by collateral managers in unregistered warehouses are not permitted to be used as a settlement instrument by SEBI regulated stock exchanges.	The SEBI directives issued on September 27, 2016 on "Revised Warehousing Norms in the Commodity Derivatives Market for Agricultural and Agri-processed Commodities Traded on the National Commodity Derivatives Exchanges" says that; "4. At the outset, it is clarified that the norms prescribed in this circular are the minimum requirements/standards for compliance by the Exchange accredited WSPs, warehouses and assayers and are to be complied with in addition to those laid down by Warehousing Development and Regulatory Authority (WDRA), any other government authority

		from time to time. The Exchanges are at liberty to prescribe additional norms/guidelines for compliance by their accredited WSPs, warehouses and assayers, if they deem so fit, in addition to the norms laid down hereunder, for ensuring good delivery of commodities by them. Provided that such additional norms specified by the exchanges are not in contravention with the instruction issued in this circular." "J(a) The exchanges shall ensure that all the warehouses of a WSP accredited by them are registered with the statutory authority viz., WDRA. The exchanges shall take necessary steps to ensure that warehouses which are not registered with the WDRA are registered by WDRA within 6 months from the date of such accreditation, failing which the accreditation given to the WSP in respect of such warehouses shall expire."
Centralised Record keeping System for better transparency	Limited transparency as the warehouse receipts issued by collateral managers in physical form or through disintegrated systems.	Online real time stocks information available as all registered warehouses are enrolled with repositories. The records of eNWR issued for deposits stored are easily available with WDRA ecosystem on real time basis. The government will know the private stock availability along with its quantity, quality and locations of storages. This will help the government to take informed decision in market intervention for removing abnormalities in price fluctuations damaging the customer sentiments.
Connecting farmers to markets as a one nation – one market	Disintegrated system and fragmented across India	Promoting the Warehouse as marketplace. Current ordinance on farmers produces trade and commerce announced warehouses / cold storages / silos as "trade area" for promoting the warehouse-based sale. WDRA ecosystem of repositories promotes the trade of eNWR through regulated exchanges, spot / auction platforms and eNAM.
Notified commodities for scientific storage	No such notified commodities list available.	As per the provisions of rules and instructions issued by the WDRA, warehouse operator is mandated to issue only eNWR/eNNWR against deposit of WDRA notified commodities in registered warehouses. In case of violation, WDRA may proceed to initiate action to suspend/cancel the registration of warehouse.

Conflict of Interest	WSP plays a pivotal role in commodities cycle like procurement, grading, storage, financing, bilateral trades etc. and needs to be between trusted parties. Though the arrangements may be governed by the commercial agreements, the deals happen mostly between known parties i.e. in the CUG (close user group). Working in a CUG group is the biggest hurdle in growing credit facility to the Farmers and other users, in absence of the trust, Farmers are not getting easy storage and credit facility. However, it may be also interesting to note here that since many roles are carried out by a single entity or through a network of associated entities, fairness of transactions for all parties may be difficult to ensure due to possibility of conflict of interest, lack of regulatory supervision, transparency.	The Repositories are independent market infrastructure entities and are not having any conflicting interest in trade, lending or storage of commodities.
Cost	The fees paid by banks to Collateral Manager are in the range of 0.75% to 1.25% for asset under management.	WDRA don't have collateral charges. As mentioned WDRA have the dynamic security requirement in terms of bank guarantees which is based on the asset under management in the warehouses.
Interest subvention	Not permitted	Interest subvention RBI vide its circular no. RBI/2017-18/48, FIDD.CO.FSD.BC.No.14/05.02.001/2017-18 dated August 16, 2017 on, "Interest Subvention Scheme for Short Term Crop Loans during the year 2017-18" stated that "In order to discourage distress sale and to encourage them to store their produce in warehouses, the benefit of interest subvention will be available to small and marginal farmers having Kisan Credit Card for a further period of up to six months post the harvest of the crop at the same rate as available to crop loan against negotiable warehouse receipts issued on the produce stored in warehouses accredited with Warehousing Development Regulatory Authority (WDRA)

Source: NERL

2.2 Cost of WDRA eNWR for Warehouses

Total registered Warehouse Capacity (in tons) for warehouse operators	**Fixed Security Deposit**	**Dynamic Security Deposit**	**Total Security Deposit Limited to the amount.**
A	**B**	**C**	
Up to 100 tons	Rs. 50,000/- per warehouse	NIL	Total Limited to Rs. 50,000/-
101 – 500 tons	Rs. 50,000/- per warehouse	3% of T	Total Limited to Rs. 2.50 Lakh
501 – 1000 tons	Rs. 50,000/- per warehouse	3% of T	Total Limited to Rs. 5.00 Lakh
1001 – 1500 tons	Rs. 50,000/- per warehouse	3% of T	Total Limited to Rs. 7.50 Lakh
1501– 2000 tons	Rs. 50,000/- per warehouse	3% of T	Total Limited to Rs. 10.00 Lakh

Source: NERL

Appendix 3. Applications and Benefits of Hermetic Bags

No	**Various Application**	**Benefits of Hermetic bags**
1	Storage of all food grains, pulses, lentils, millets, cereals.	Safe from storage pests, moisture ingress, and aflatoxin growth
2	Storage of all types of nuts and dry fruits.	Prevents rancidity
3	Storage of dry herbs.	Prevents fungus, mould and external atmospheric contamination
4	Storage of coffee beans, tea leaves and cocoa beans.	Retains original moisture content
5	Innovative technology for storage of whole spices and ground spices.	Excellent preservation of aroma, taste, colour and freshness.
6	Storage of seeds to maintain seed viability	Maintains High Germination Rate of seeds.
7	Environment friendly	Recyclable, Reusable and Low carbon footprint
8	All types of flours and hygroscopic substance/powder	Protection from moisture and retains nutritional value for more than 18 Months
9	Hermetic Bags are safe	Chemical free storage method

Source: Proharvest.com


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