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Trend and growth pattern analysis of cold storage infrastructure in Karnataka

[1]Soyal Rajesa Mujavar, [2]Lokesh GB, [3]Amrutha T Joshi, [4]Suresh K and [5]Manoj Kumar G

[1]PG Research scholar, Department of Agricultural Economics, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

[2]Professor &Head, Department of Agricultural Economics, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

[3]Professor, Department of Agricultural Economics, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

[4]Assistant Professor, Department of Agricultural Economics, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

[5]Assistant Professor, Department of Agricultural Statistics, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

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Corresponding Author: Soyal Rajesa Mujavar

Abstract

Cold storage is vital for preserving agricultural produce, reducing post-harvest losses, and ensuring food security. This study analyses the growth and distribution patterns of cold storage facilities in Karnataka from 2001 to 2023, using secondary data from 2021-23. The findings reveal an increase in cold storage units from 102 to 250, with a compound annual growth rate (CAGR) of 3.97 percent, while capacity expanded from 300,000 metric tons (Mt) to 838,950 Mt, with a CAGR of 4.57 percent. Notably, the growth rate of storage capacity outpaced the number of units, indicating enhanced average capacity per unit. Significant increases were observed in 2006, 2007, and 2023. The distribution pattern showed regional disparities, with the highest number of units in North Karnataka compared to Southern Karnataka. Within North Karnataka, Ballari district had the most units. The study suggests that policies should focus on expanding cold storage infrastructure based on regional needs, providing incentives for private investment, and improving cold chain logistics to boost agricultural productivity and reduce post-harvest losses.

Keywords: Cold chain logistics, cold storage, infrastructure, post-harvest losses

Introduction

India has emerged over the last decades as one of the leading global producers of horticultural products, experiencing a commendable increase in the production of these crops. This may be the result of India's greater inclination towards crop diversification in high- valued commodities (fruits, vegetables, and livestock products). The process of crop diversification in the country has been facilitated by a number of incentives of improving national revenue streams, reducing reliance on a restricted range of agricultural goods, and creation of better income and job prospects for small-scale farmers. The continuous increase in demand for these crops has put another dose of incentives to the farmers (Patowary and Sarma, 2023) [8].

Despite its status as the second-largest producer of fruits and vegetables globally, India grapples with relatively low per capita availability of these products. This discrepancy is largely due to substantial post-harvest losses, which are estimated to range between 5.8 to 18.1 percent for fruits and between 6.9 to 13.0 percent for vegetables. These losses, exacerbated by gaps in cold chain infrastructure, result in significant economic impacts. The high moisture content and nutrient density of fruits and vegetables make them particularly prone to spoilage, which further diminishes their nutritional value by the time they reach consumers. Annually, it is estimated that around 40 million tonnes of fruits and vegetables are lost, translating to a financial loss of approximately USD 13 billion. Key contributing factors include insufficient cold storage capacity, the lack of cold storage facilities near farms, and inadequate transportation infrastructure, all of which disrupt the cold chain required for preserving perishable goods.

The southern region of Karnataka also exhibits steady growth, focusing on the storage of fruits, vegetables, and pharmaceuticals. The distribution pattern reflects the state's ongoing efforts to enhance agricultural productivity and reduce wastage across various commodities. The expansion of cold storage infrastructure not only maintains product quality and stabilizes prices but also supports the livelihoods of farmers and benefits consumers throughout the state. By analyzing the trend and growth patterns of cold storage infrastructure is the need of the hour for better

understanding the evolving needs and future potential of this critical sector

Methodology

Sources of data

The secondary data regarding the number of establishments of cold storage units and other necessary information of Karnataka were collected from authorized websites of government institutions such as the National Horticulture Board (NHB), Directorate of Marketing and Inspection (DMI), and other published sources.

Analytical tools

1. Tabular analysis

The data collected were presented in tabular form to facilitate easy comparison. Simple tabular analysis was employed to examine the trends and patterns in the development of cold storages.

2. Compound annual growth rate analysis

The compound annual growth rates (CAGR) analysis was used to analyse the trends and patterns of cold storage establishments. The compound annual growth was computed using the exponential function of the form.

$Y_t = ab^t u_t$ ..... (1)

Where,
Y_t = Dependent variable
t = Years which take values 1, 2, …., n
a = Intercept
b = Regression coefficient
u_t = Disturbance term for the year t
For the purpose of estimation, equation (1) was transformed into log linear form and was estimated using ordinary least square (OLS) technique. The compound growth rate (g) in percentage was then computed from the following relationship,

g = (Anti log of ln b-1) *100

Results and discussion

In Karnataka, the number of cold storage units grew from 102 in 2001 to 250 in 2023, achieving a compound annual growth rate (CAGR) of 2.07%. Similarly, the installed capacity surged from 300,000 MT to 838,950 MT, with a CAGR of 12.56%. Notably, Ballari district stood out as a key player, boasting the highest number of cold storage units at 24 and the largest capacity at 144,150 MT. This growth underscored the region's critical role in the state's cold storage infrastructure. Among the commodities stored, chillies dominated at 40%, followed by potatoes at 12% and raisins at 5%. The concentration of cold storage facilities in northern districts, particularly Ballari and Haveri, reflected their significant contribution to agricultural preservation in Karnataka.

Trends in Cold Storage Infrastructure Development in India

Trends in cold storage infrastructure development across India during the period 2000 to 2023, showed that a diverse range of growth patterns among states. Karnataka demonstrated notable progress in cold storage capacity during the study period. In Period-I (2000-11), Karnataka's cold storage unit growth rate was relatively modest at 1.20 percent, but this rate surged to 3.03 percent in Period-II (2012-23), resulting in an overall growth rate of 2.07 percent from 2000 to 2023. Concurrently, Karnataka experienced a significant increase in cold storage capacity, with growth rates rising from 19.91 percent in Period-I to 5.06 percent in Period-II, leading to an impressive overall growth rate of 12.56 percent. This substantial increase highlights Karnataka's growing role in the cold storage sector, contributing significantly to the national development of cold storage infrastructure.

Conversely, other states showed varied and less consistent growth trends. Uttar Pradesh, for instance, experienced a decline in its cold storage unit growth rate from 5.24 percent in Period-I to 1.56 percent in Period-II, with capacity growth decreased from 7.25 percent to 1.18 percent, resulted an overall growth rate of 4.30 percent. Punjab also faced a decreased in growth rates, with cold storage unit growth falling from 3.20 percent to 2.68 percent and capacity growth decreased from 5.08 percent to 2.84 percent, reflecting a cumulative growth rate of 4.00 percent. States like Gujarat and Maharashtra showed relatively stable or increasing trends in both units and capacity. Gujarat, for instance, had a substantial increased in capacity, with growth rates from 8.26 percent in Period-I to 7.18 percent in Period-II, achieving an overall growth rate of 7.74 percent. Maharashtra also showed significant capacity growth, increasing from 5.45 percent to 6.22 percent, with an overall growth rate of 5.82 percent. Overall, the data underscored Karnataka's standout performance in cold storage infrastructure development, affirming its pivotal role in enhancing India's cold storage capacity.

Pattern of Cold Storage Infrastructure Development in India

The pattern of cold storage infrastructure development in India from 2000 to 2023, is shown in Table 4.2 the results highlighted notable trends across different states. Karnataka's growth in cold storage capacity stands out markedly. The number of cold storage units in Karnataka increased from 156 in the year 2000 to 250 in 2023, reflecting a gradual rise from 3.86 percent in the year 2000 to 2.89 percent in 2023 of the total units in India. In terms of capacity, Karnataka experienced substantial growth, with the capacity expanding from 55,147 metric tons (MT) in the year 2000 to 838,940 MT in 2023, which increased its share from 0.39 percent to 2.13 percent of the total capacity. This indicates a significant enhancement in Karnataka's cold storage infrastructure, contributing to the state's growing role in the national cold storage sector.

Other states exhibited diverse trends in cold storage development. Uttar Pradesh, for instance, showed considerable increase in both the number of units and capacity, rising from 27.91 percent in the year 2000 to 28.61 percent in 2023 of the total cold storage units in India, and from 40.05 percent to 38.22 percent of the total capacity over the same period. Gujarat also showed a remarkable improvement in its cold storage capacity, increasing from 4.96 percent in the year 2000 to 9.99 percent in 2023 of the total capacity. Conversely, states like Maharashtra and Bihar

exhibited less dynamic growth. Maharashtra's share of cold storage capacity rose only slightly from 2.24 percent in the year 2000 to 2.98 percent in 2023, while Bihar's share decreased from 4.42 percent to 3.75 percent. Overall, Table 4.2 underscores Karnataka's significant progress in enhancing cold storage infrastructure, with substantial improvements in both the number of units and capacity, thereby reinforcing its critical role in the national cold storage framework. The results were in line with results reported by Patowary and Sarma (2023) [8].

Pattern of cold storage infrastructure development in Karnataka

The pattern of cold storage infrastructure development in Karnataka for the year 2023 is presented in Table 4.3. The data revealed significant disparities in the distribution of cold storage units and their capacities across different districts. Ballari emerged as the leading district with 24 units, accounting for 14.2 percent of the total units, and a substantial capacity of 144,150 MT, representing 23.82 percent of the total capacity. This dominance highlighted Ballari's critical role in Karnataka's cold storage infrastructure, reflecting its strategic importance for agricultural commodity storage specially chilli in the region. Haveri district had 23 units, contributing 13.61 percent of the total units and a capacity of 108,350 MT, which equated to 17.9 percent of the total capacity. This indicated Haveri district had substantial contribution to the State's cold storage capacity. Conversely, districts such as Koppal and Chikkamangaluru had minimal contributions, with Koppal having only one unit and a negligible capacity of 50 MT, and Chikkamangaluru also having one unit with a capacity of 1,000 MT. The low figures for these districts suggested potential underdevelopment or limited investment in cold storage infrastructure.

The overall pattern demonstrated that while some districts like Ballari and Haveri had robust cold storage infrastructure, others like Bagalkote and Gulbarga had relatively low capacities, reflecting an uneven distribution of cold storage facilities across Karnataka. This distribution pattern underscored the need for targeted investments and improvements in cold storage infrastructure, particularly in underrepresented districts, to ensure a more balanced and effective storage network. The findings aligned with Gundewadi (2013) [5], who highlighted regional disparities in cold storage development, emphasizing the need for strategic investments to address infrastructure gaps and enhance overall agricultural storage efficiency.

Table 1: Trends in cold storage infrastructure development in India, (CAGR %)

SI. No.	States/Year	Cold storage units			Cold storage capacity		
		Period-I (2000-11)	Period-II (2012-23)	Overall (2000-23)	Period-I (2000-11)	Period-II (2012-23)	Overall (2000-23)
1	Uttar Pradesh	5.24	1.56	3.47	7.25	1.18	4.3
2	Punjab	3.21	2.68	2.95	5.08	2.84	4.00
3	Gujarat	4.19	6.28	5.18	8.26	7.18	7.74
4	West Bengal	2.63	0.42	1.56	3.77	0.15	2.02
5	Maharashtra	2.38	2.71	2.54	5.45	6.22	5.82
6	Andhra Pradesh &Telangana	5.22	2.11	3.71	11.54	2.82	7.27
7	Bihar	3.41	0.42	1.97	6.85	0.51	3.77
8	Haryana	2.36	3.31	2.81	4.44	5.76	5.07
9	Madhya Pradesh	2.86	2.35	2.61	4.02	2.54	3.31
10	Kerala	5.59	0.37	3.06	6.58	3.95	5.31
11	Karnataka	1.2	3.03	2.07	19.91	5.06	12.56
12	Others	4.36	3.91	4.14	6.52	4.89	5.74
	India	4.02	2.64	3.35	6.51	2.38	4.51

Note: CAGR- Compound Annual Growth Rate,
Source: Indiastat.com, 2024

Table 2: Pattern of cold storage infrastructure development in India

SI. No.	States/Year	Cold storage units (No.)						Cold storage capacity (MT)					
		2000	%	2012	%	2023	%	2000	%	2012	%	2023	%
1	Uttar Pradesh	1129	27.91	2084	32.12	2472	28.61	5710000	40.05	13221610	43.52	15045874	38.22
2	Punjab	390	9.64	569	8.77	761	8.81	1049264	7.36	1901935	6.26	2588686	6.58
3	Gujarat	314	7.76	514	7.92	1004	11.62	707746	4.96	1834290	6.04	3932193	9.99
4	West Bengal	361	8.92	493	7.60	515	5.96	3753800	26.33	5849818	19.26	5948316	15.11
5	Maharashtra	368	9.10	488	7.52	655	7.58	319613	2.24	604300	1.99	1174075	2.98
6	Andhra Pradesh &Telangana	202	4.99	371	5.72	467	5.41	376785	2.64	1397011	4.60	1893071	4.81
7	Bihar	200	4.94	299	4.61	313	3.62	630700	4.42	1396179	4.60	1476557	3.75
8	Haryana	201	4.97	266	4.10	380	4.40	276245	1.94	465196	1.53	861670	2.19
9	Madhya Pradesh	174	4.30	244	3.76	315	3.65	645288	4.53	1035664	3.41	1364003	3.47
10	Kerala	101	2.50	194	2.99	202	2.34	29380	0.21	63105	0.21	96655	0.25
11	Karnataka	156	3.86	180	2.77	250	2.89	55147	0.39	487262	1.60	838940	2.13
12	Others	471	11.64	786	12.11	1197	13.86	1024376	7.18	2187011	7.20	3696411	9.39
	India	4045	100.00	6488	100	8639	100.00	14257584	100.00	30380275	100.00	39362000	100.00

Source: Indiastat.com, 2024

Table 3: Pattern of cold storage infrastructure development in Karnataka as on 2022

SI. No	Districts	No. of Cold Storage Units	%	Cold Storage Capacity (MT)	%
1	Bagalkot	3	1.78	5350	0.88
2	Bangalore R	4	2.37	15000	2.48
3	Bangalore U	14	8.28	15779	2.61
4	Belgaum	9	5.33	6015	0.99
5	Ballari	24	14.2	144150	23.82
6	Bidar	4	2.37	3035	0.5
7	Vijayapura	21	12.43	26820	4.43
8	Chikkaballapur	1	0.59	14500	2.42
9	Chikkamagaluru	1	0.59	1000	0.17
10	Chitradurga	4	2.37	17100	2.83
11	Dakshina Kannada	2	1.18	3650	0.6
12	Dharwad	6	3.55	25500	4.21
13	Gadag	4	2.37	7026	1.16
14	Gulbarga	2	1.18	9799	1.62
15	Hassan	9	5.33	58120	9.62
16	Haveri	23	13.61	108350	17.9
17	Kolar	7	4.14	22500	3.72
18	Koppal	1	0.59	50	0.01
19	Mysore	5	2.96	13859	2.29
20	Raichur	10	5.92	62500	10.33
21	Ramanagara	3	1.78	30186	4.99
22	Shivamogga	2	1.18	9400	1.55
23	Tumkur	6	3.55	2390	0.39
24	Uttara Kannada	3	1.78	661	0.11
25	Yadgir	1	0.59	2500	0.41
	Total	169	100	605240	100

Source: Karnataka at a glance, 2023

Conclusion

The study highlights Karnataka's remarkable progress in the development of cold storage infrastructure, showcasing its growing significance in the national cold storage sector. Between 2000 and 2023, the state witnessed a compound annual growth rate (CAGR) of 2.07% in the number of cold storage units and 12.56% in installed capacity. This growth underscores Karnataka's increasing focus on reducing post-harvest losses, stabilizing market prices, and improving agricultural profitability. Within Karnataka, Ballari district emerged as a leader, boasting the highest number of units and storage capacity, reaffirming its strategic importance in the state's agricultural supply chain.

Nationally, cold storage infrastructure exhibited uneven growth patterns. While states like Karnataka, Gujarat, and Uttar Pradesh showed substantial progress, others such as Bihar and Maharashtra experienced slower growth. Karnataka's significant improvement in cold storage capacity-from a marginal 0.39% share in 2000 to 2.13% in 2023-reflects its pivotal role in enhancing India's agricultural supply chain resilience. However, the disparities observed across states point to the need for state-specific strategies to drive equitable growth.

Within Karnataka, the distribution of cold storage infrastructure revealed regional imbalances. Ballari and Haveri districts demonstrated robust infrastructure development, while districts like Koppal and Chikkamagaluru lagged, contributing minimally to the state's overall capacity. These findings emphasize the need for targeted investments to address underdeveloped areas and create a more balanced cold storage network across the state.

This research reinforces existing knowledge about the role of cold storage in reducing agricultural losses and enhancing economic outcomes for farmers. By identifying Karnataka's progress and pinpointing areas needing attention, the study provides a clearer understanding of the sector's evolution. Future efforts should focus on implementing policy measures such as subsidies and tax incentives, integrating renewable energy solutions to reduce operational costs, and adopting advanced technologies like IoT and AI to enhance storage efficiency. These interventions will contribute to a more sustainable, resilient, and equitable cold storage infrastructure, benefiting both farmers and the agricultural economy at large.

References

1. Anonymous. Spatiotemporal Dynamics of Green Infrastructure in an Agricultural Peri-Urban Area: A Case Study of Baisha District in Zhengzhou, China. Land. 2021. Available from: www.mdpi.com/journal/land
2. Anonymous. cold storage number and capacity in India. Indiastat.com. 2024. Available from: www.Indiastat.com
3. Anonymous. cold storage number and capacity in Karnataka. Karnataka at a glance. 2023. Available from: www.Karnataka.
4. Chandran KP. Growth of potato production in India: a non-parametric analysis of time series data. Potato Journal. 2015;38(1):32-40.
5. Gundewadi BB. Role and performance of cold storages in Indian agriculture. International Journal of Scientific Research. 2013;2(11):323-324.
6. Kulkarni BS, Patil SM, Ramchanpra VA. Growth trends in area, production and export of onion from

India - an economic analysis. International Journal of Commerce and Business Management. 2017;5(2):159-163.
7. Paul KSR, Farukh M, Rambabu VS. Trends, growth and variability of ground nut crop in Andhra Pradesh. Arts and Education. 2019;2(6):74-78.
8. Patowary, Sarma. Economics of cold storage facilities in assam: issues of availability and requirement. India Journal Of Marketing. 2023;38(2):59-74.
9. Prasad PR, Supriya K, Bhave MHV, Vijayakumari R. Growth trends of maize crop in Telangana region of Andhra Pradesh. Journal of Research ANGRAU. 2012;40(4):104-107.
10. Sendhil R. Production and export performance of onions - an exploratory study. Agricultural Situation in India. 2014;69(7):355-362.