International Journal of Agriculture Extension and Social Development

Stakeholder roles in storage distribution across Karnataka's regions

[1]SS Pramod Nayak and [2]Siddayya

[1]Ph.D. Scholar, Institute of Agri-Business Management, CoA, UAS, GKVK, Bangalore, Karnataka, India

[2]Professor and Head, Institute of Agri-Business Management, CoA, UAS, GKVK, Bangalore, Karnataka, India

DOI: https://doi.org/10.33545/26180723.2024.v7.i12g.1454

Corresponding Author: SS Pramod Nayak

Abstract
Agricultural commodities are critical to India's economy, contributing significantly to GDP and rural livelihoods. Efficient storage facilities are essential for reducing post-harvest losses and supporting diverse stakeholders. The study analyzed the utilization of Karnataka State Warehousing Corporation (KSWC) facilities by various stakeholders, including agencies, farmers, and traders, from 2013 to 2024. The data were collected from seven regional warehouses of KSWC across Karnataka, focusing on storage capacities, depositor types, and commodities stored. The study examined stakeholder-specific trends in storage utilization and their contributions to the total capacity. The results revealed that, agencies stored 998,522 MTs (75.50% of the total), with commodities like ragi, fertilizers, and manures dominating their portfolio. Farmers stored 71,939 MTs (5.20%), primarily paddy (38.50%), while traders stored 69,639 MTs (5.10%), focusing on paddy (25.50%) and bengal gram (19.61%). Agencies recoded the highest growth rate per annum in storage utilization, followed by traders and farmers. Correlation analysis indicated a strong relationship between agencies and overall storage capacity. Variability in storage patterns was highest for agencies and lowest for farmers. The agencies utilized the majority of storage facilities, while farmer access remained limited. Enhanced awareness, post-harvest training, and targeted subsidies could improve utilization, reducing distress sales.

Keywords: Agency, commodities, farmer, storage capacity, stakeholders and trader

Introduction
Agricultural commodities play a crucial role in the India economic, serving as a backbone for rural livelihoods, food security, and export revenues. India is one of the largest producers of various agricultural commodities, including grains (rice & wheat), pulses, oilseeds, cotton, and spices (Gilmour & Gurung, 2008) [11]. The agricultural sector contributes around 18 percent to India's Gross Domestic Product (GDP) (Pattanayak *et al.,* 2022) [12].
India's few southern state utilizations of storage capacities was 90 percent and above. In northern states like Uttar Pradesh and Bihar, it is below 50 percent. In order to improve the storage facilities, government is implementing the Agricultural Marketing Infrastructure (AMI) scheme has significantly contributed to enhancing storage facilities in India. As of June 30, 2024, a total of 48,512 storage projects have been sanctioned, providing a capacity of 93.99 million MTs across various states. Karnataka has made notable progress, with 5,062 projects sanctioned, amounting to a storage capacity of 4.49 million MTs and receiving a subsidy of approximately Rs. 216.17 crore. This initiative supports farmers and agricultural entrepreneurs by improving post-harvest management and reducing losses in agricultural produce (Singh, 2019) [7].
The Food Corporation of India (FCI), Central Warehousing Corporation (CWC), Karnataka State Warehousing Corporation (KSWC), Agricultural Produce Market Committees (APMC), and Karnataka State Co-operative Marketing Federation (KSCMF) are major government entities that play a significant role in providing storage facilities and services to various stakeholders across the state of Karnataka (Mallikarjungouda, 2007) [4].
The KSWC was established in 1957 under the Agricultural Produce (Development and Warehousing) Corporation Act of 1956. It has seven regional warehouse offices located in Bengaluru, Davangere, Shivamogga, Hubli, Raichur, and Kalburgi (Suresh, B., 2005) [6]. The KSWC has built a total of 150 warehouses with a total storage capacity of 14.13 lakh MTs, of which 13.61 lakh MTs is owned capacity and 52,051 MTs is hired capacity. The corporation provides scientific storage facilities for food grains, pulses, oilseeds, spices, sugar, fertilizers, manures, and other notified commodities, with major stakeholders including farmers, traders, merchants, and various governmental and private organizations. The utilization of storage capacity by various stakeholders from 2014 to 2024 was as follows: farmers (5.46%), FCI (14.79%), traders (5.28%), and agencies (78.52%) (Basavannavar and Banakar, 2020) [1].

Materials and Methods
To investigate the stakeholder roles in storage distribution across Karnataka's regions, this study focused on seven regional warehouses of the Karnataka State Warehousing Corporation (KSWC) located in Davangere, Raichur, Hubli, Mysuru, Shivamogga, Bengaluru, and Kalaburagi.
A multistage sampling technique was adopted to select the KSWC and its different stakeholders. After selection of KSWC head office Bengaluru in the first stage, in the

seconds stage, seven regional warehouses of KSWC were selected based on the discussion and storage capacity utilized by the different stakeholders, information obtained from the KSWC. Accordingly, seven regional warehousing within the Karnataka namely, Davangere, Raichur, Hubli, Mysuru, Shivamogga, Bengaluru, and Kalaburagi. Sample of storage capacity occupied by the stakeholders were purposively selected with different warehouses of the KSWC. The regional warehousing business reports are collected from over periods of 2013 to 2024 were collected to elicit secondary information on regions, warehouses, depositor types, number of bags, quantity storage by the stakeholders, stored duration of commodities and valuation of amount through well-structured questionnaire. The data was collected during 2023-24.

To fulfill the objectives of the study, the following analytical tools and methods was employed.

Compound Annual Growth Rate (CAGR)

It is a measure used to determine the annual growth rate over a specified period of time, assuming that growth happens at a steady rate compound annually. It provides a smoothed annual rate of growth that can be easily compared across different time periods (Shreedevi and Kulkarni 2015) [10]. The growth rate in the storage capacity of different stakeholders used KSWC were analyzed using the exponential function of the form:

$$Y_t = a\, b^t\, e^u \dots \tag{1}$$

Where,
Y_t = Dependent variable for which growth rate is to be estimated (storage capacity)
a = intercept, b = trend co-efficient, e = Napierian base, t = time trend and u = Disturbance or error term

The CAGR is obtained from the linearly transformed estimating form of the above equation (1), as stated below

$$\ln Y_t = \ln a + \ln b + u \dots \tag{2}$$

CAGR percent can be expressed as:

$$CAGR\ (\%) = (Antilog\ b - 1) \times 100$$

Cuddy Della Valle Index (CDVI)

The Cuddy Della Valle Index de-trends show the exact direction of the instability. Therefore, it is a better measure to capture instability in storage capacity. A low value of this index indicates low instability in storage capacity of KSWC in different regions. CDVI was originally developed by Cuddy and Della Valle (1978) [3]. The CDVI corrects the CV as:

$$CV = \frac{Standard\ deviation}{mean} \times 100$$

CDVI (%) = CV$\sqrt{(1 - R^2)}$

Where, CV is the Coefficient of Variation in percent, and R^2 is the coefficient of determination from a time trend

regression adjusted for its degrees of freedom. The ranges of CDVI are given as follows 1. Low instability = 0 to 15 2. Medium instability = 15 to 30 and 3. High instability = 30 and above.

Coppock Instability Index (CII)

Instability in storage capacity occupied different stakeholders of KSWC from 2013 to 2014 were also analysed using CII which is calculate as the antilog of the square root of the logarithmic variance using the following function (Coppock, 1962) [2]. It checks the instability in time series of data of storage capacity utilized by the different stakeholders.

$$CII = Antilog(\sqrt{V\,log - 1}) \times 100$$

Where,

$$V\,log = \frac{\Sigma\left(\log\frac{X_{t+1}}{X_t} - m\right)^2}{n}$$

'X_t' is storage capacity, 't' is number of years 'm' is mean of the difference between logs of X_{t+1} X_t and Log V is Logarithmic variance of the series

CII is a close approximation of the average year to year percentage variation adjusted for trend and the advantage is that it measures the instability in relation to the trend in storage capacity utilized by the different stakeholders. A higher numerical value for the index represents greater instability like CDVI.

Karl Pearson was developed correlation coefficient (r) in 1948 This is most widely used statistic that summarizes the strength of association between two variables. It is also called as product moment correlation. It indicates the degree to which variation in one variable X, is related to variation in another variable Y. It takes the value between -1 to +1. -1 and +1 indicates perfect negative and positive correlations respectively and sign indicates the direction the variables move. The correlation coefficients whose magnitude fall between 0.3 and 0.5 indicates low correlation, values between 0.5 and 0.7 indicate moderately correlated and above 0.7 indicates high correlation between the variables.

For the present study, the correlation is used identify the strength of relationship between competency determinants of the stakeholders (agency, farmer and traders) stored capacity from 2013 to 2024. For a sample of n observations, X and Y, the product moment correlation, r is given as

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2 \sum_{i=1}^{n}(Y_i - \bar{Y})^2}}$$

Where, $\bar{X}$ and $\bar{Y}$ denotes sample mean and r indicates correlation coefficient

Results and Discussion

The percentage share of stakeholders-stored commodities in KSWC from 2013 to 2024 across the seven regional

warehouses of Karnataka. The collected data was analysed, presented and discussed below (Figure 1)

The percentage share of stakeholder-stored commodities in KSWC from 2013 to 2024. Agencies led in storage by managing a total of 125 commodities with a capacity of 1,109,878 MTs, representing the highest share at 75.50 percent. This was followed by FCI (14.20%), farmers (5.20%), and traders (5.10%). Although FCI stored only 8 commodities with capacity of 2,09,080 MTs, which was significantly higher than that of traders (74,617.50 MTs) and farmers (77,121.80 MTs). Agencies primarily stored a diverse range of commodities, including fertilizers, beverages, seeds, manures, and agricultural implements. While FCI stored wheat and different from of rice for the Public Distribution System (PDS). Farmers and traders predominantly stored agricultural and horticultural commodities.
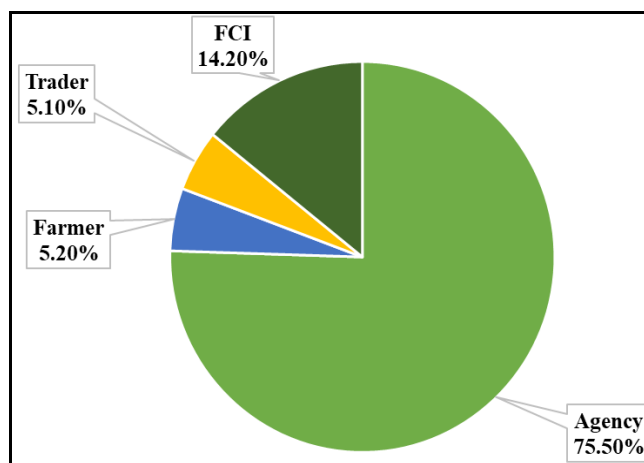

Fig 1: Percentage share of various stakeholders utilizing KSWC

Similar findings were reported by Suresh, B (2005) [6], who studied the utilization pattern and performance of KSWC and found that agencies and other entities are dominated in utilization of storage space

Major commodities stored by the different stakeholders in the KSWC warehouses

The top ten major commodities stored by the farmers in the KSWC warehouses across Karnataka are paddy, bengal gram, tur, maize, soybean, green gram, jowar, groundnut, avare, and horse gram. The total stored capacity by the farmers from 2013 to 2024 was 71939.05 MTs. The highest capacity was occupied by paddy with 27699.41 MTs, recorded of 38.50 percent followed by bengal gram (21.50%), tur (12.76%), maize (9.47%), soybean (8.20%). In contrast, the commodities with the lowest storage capacities among top ten were horse gram (0.61%), avare (0.68%), groundnut (0.68%) jowar (2.60%) and green gram (2.97%) (Table 1).

Table 1: Major commodities stored by the farmers in the KSWC warehouses across the Karnataka (2013 to 2024)

Sl. No.	Commodities	Stored quantity (MTs)	Percent (%)
1	Paddy	27699.41	38.50
2	Bengal gram	15465.59	21.50
3	Tur	9182.24	12.76
4	Maize	6810.97	9.47
5	Soybean	5900.47	8.20
6	Green gram	2133.50	2.97
7	Jowar	1868.51	2.60
8	Groundnut	578.71	0.80
9	Avare	489.55	0.68
10	Horse gram	441.21	0.61
11	Other commodities	1368.89	1.90
	Total	71939.05	100.00

The top ten major commodities stored by the traders in the KSWC warehouses across the Karnataka are paddy, benagal gram, rice, maize, tur, soybean, broken rice, groundnut, horse gram and ragi. The Table 2 shows percentage of commodities occupied to the total stored capacities of commodities from 2013 to 2024. The total stored capacity occupied by the traders was 69639.30 MTs. Among major commodities maximum stored by paddy with 17757.96 MTs, accounted for 25.50 percent followed by bengal garm (19.61%), rice (15.88%), maize (11.23%), tur (10.82%) and soybean (8.66%). Whereas, the commodities with the lowest storage capacities were ragi (0.68%), horse gram (0.83%), groundnut (1.19%) and broken rice (1.60%).

Table 2: Major commodities stored by the traders in the KSWC warehouses across the Karnataka (2013 to 2024)

Sl. No.	Commodities	Stored quantity (MTs)	Percent (%)
1	Paddy	17757.96	25.50
2	Bengal Gram	13659.24	19.61
3	Rice	11058.24	15.88
4	Maize	7822.88	11.23
5	Tur	7572.85	10.87
6	Soybean	6031.60	8.66
7	Broken Rice	1110.90	1.60
8	Groundnut	831.67	1.19
9	Horse gram	579.78	0.83
10	Ragi	472.61	0.68
11	Other commodities	2741.56	3.94
	Total	69639.30	100.00

The major commodities stored by the agencies in the KSWC warehouses across the Karnataka are ragi, jowar, bengal gram, rice, paddy, tur, green gram and wheat. Table 3 shows percentage of commodities occupied to the total stored capacities of commodities from 2013 to 2014. The total stored capacity occupied by the agencies was 998522.25 MTs. Among the major commodities maximum stored by ragi with 782359.07 MTs with accounted of 78.35 percent across the KSWC different regional warehouses followed by jowar (13.01%) and bengal gram (3.40%). Whereas, the commodities with lowest storage capacities were wheat (0.10%), green gram (0.20%), tur (1.29%), paddy (1.81%) and rice (1.83%).

The study reported similar findings of Siddayya *et al.* (2016) [9] and Basavannavar and Banakar, (2020) [1], who studied that major commodities stored in Kalburgi and Hubli regions are tur, rice, paddy, Soybean, green gram, jowar and Sunflower in both rabi and kharif seasons.

The majority of farmers and traders stored paddy, totaling around 63,521.23 MT, across the KSWC warehouses. The major producing regions in the state are Raichur, Shivamogga, Davangere, and Mysore, primarily due to the availability of command areas and irrigation facilities. The majority of grams and jowar were stored in the KSWC regional warehouses of Hubli and Raichur, attributed to large production in these areas, favorable climate conditions, procurement by the Government of India (GOI), and prices of the commodities being lower than the Minimum Support Price (MSP).

Rice and broken rice are primarily stored in Raichur, Shivamogga, and Mysore, where a larger number of rice mills are available and there are also greater arrivals of commodities to the markets. The study consistent with findings of Singh *et al.* (2019) [7] which is indicates that the presence of rice mills in a region increases the demand for stored rice, resulting in higher returns for farmers and traders.

Table 3: Major commodities stored by the agencies in the KSWC warehouses across the Karnataka (2013 to 2024)

Sl. No.	Commodities	Stored quantity (MTs)	Percent (%)
1	Ragi	782359.07	78.35
2	Jowar	129876.81	13.01
3	Bengal gram	33994.03	3.40
4	Rice	18273.81	1.83
5	Paddy	18063.86	1.81
6	Tur	12900.34	1.29
7	Green gram	2014.17	0.20
8	Wheat	1040.17	0.10
	Total	998522.25	100.00

Davangere, Shivamogga, and Hubli are the major producing regions for soybean and maize, leading to higher storage of these commodities in these areas. The study consistent with finding of Vaishnavi *et al.* (2024) [8] MSP for maize had shown a significant increase between 1998-99 (Rs. 390/ q) to 2021-22 (Rs.1962/ q) and CAGR of MSP for maize between the same period was 7.66 percent significant at one percent level.

The storage of ragi was maximized by the agencies, totaling around 783,015.75 MT across the KSWC regional warehouses in Bengaluru, Mysore, Shivamogga, Raichur, Davangere, and Kalburgi. This is due to the Karnataka Food and Civil Supplies Corporation Limited (KFCSC) procuring ragi under the Public Distribution System (PDS) scheme from major producing regions, as well as procuring it under the MSP when prices fell below the MSP.

The Table 4 presents the correlation analysis between the total storage capacity and the individual stakeholders of the KSWC from 2013 to 2024 reveals distinct relationships. The agency shows a very strong positive correlation with the total storage capacity, with a correlation coefficient of 0.993764, indicating that changes in the agency's storage capacity are closely aligned with the overall storage capacity. In contrast, the correlation between farmers and the total storage capacity was moderate, with a coefficient of 0.431719, suggesting a positive relationship that is not as strong as that of the agency. Similarly, the correlation between traders and the total storage capacity was also moderate, at 0.593592, indicating that the storage capacity of traders positively influences the overall storage capacity, but again, not as strongly as the agency.

Table 4: Correlation between storage capacity of different stakeholders of KSWC (2013 to 2024)

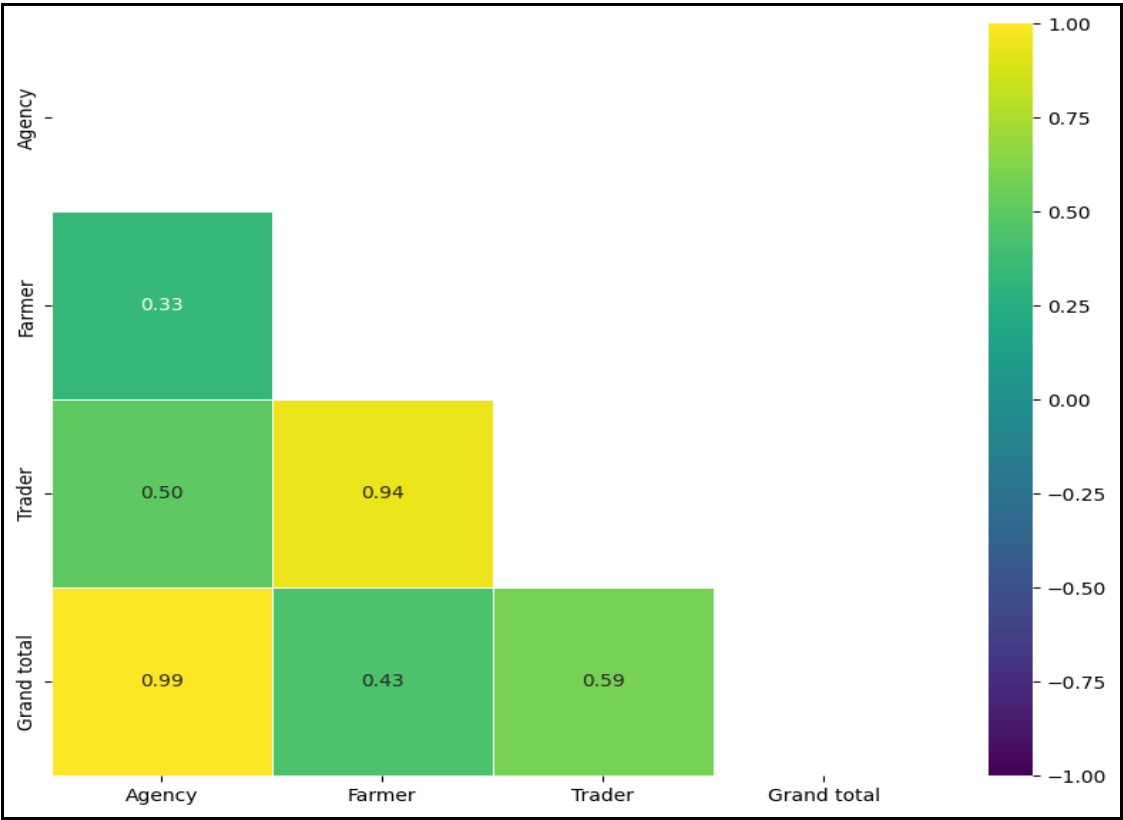| Correlation	Agency	Farmer	Trader	Total
Agency	1	0.33009	0.501375	0.993764
Farmer	0.33009	1	0.939048	0.431719
Trader	0.501375	0.939048	1	0.593592
Grand total	0.993764	0.431719	0.593592	1

Fig 2: Correlation between storage capacity of different stakeholders of KSWC

The strong positive correlation between agencies and total storage capacity, followed by farmers and traders, is due to the highest storage capacity and space occupied by agencies, which account for 75.50 percent of the total compared to the other stakeholders (Fig. 1).

Table 5: Growth and instability of utilization of storage capacity by different stakeholders (2013 to 2024)

Particular	Agency	Farmer	Trader	Grand total
Average (Lakh MTs)	0.92	0.06	0.06	1.05
SD (Lakh MTs)	1.77	0.11	0.13	1.88
R^2	0.39	0.42	0.46	0.45
CV	191.15	165.00	208.99	178.81
CDVI	149.51	125.95	154.13	132.89
CII	6581.10	211.06	1077.02	475.83
CAGR	293.38***	38.58**	87.52**	98.95***

Note: Significant level based on *P- value* at 1 percent (***) and 5 percent (**) and N. S. (Non-significant)

Table 5 presents the growth and instability of utilization of storage capacity by different stakeholders from 2013 to 2024. The total average storage capacity was 1.05 lakh MTs of different stakeholders across the KSWC warehouses. The total storage capacity of stakeholders was significantly increasing at 98.95 percent annually and which is highly recoded variability of stakeholders' storage occupation (CDVI: 132.89 & CII: 475.83)

Among the stakeholders, the total average storage capacity of agency was highest of 0.92 lakh MTs and significantly increasing at 293.38 percent per annum with higher variation in the occupation of storage space (CDVI: 149.51 & CII: 6581.10) followed by farmer (0.06 lakh MTs) with significantly increasing annual growth of 38.58 percent,

with more stable performance compare to other stakeholders (CDVI: 125.06 & CII: 211.06). The trader stored total average capacity of 0.06 lakh MTs with significant increasing growth of 87.52 percent per annum, which shows higher variability with storage occupation with CDVI and CII value of 132.89 and 475.83 percent respectively.

Conclusion

The KSWC warehouses are mostly utilized by the agencies, FCI and traders for storage. Farmers have utilized only 5.20 percent of the total storage capacity across the seven regions. So, the study suggested that awareness and better utilization of storage capacity can reduce market distress sales and provide minimum rebates to farmers. Implementing training programs for farmers on post-harvest management and innovative storage techniques will ensure better quality and reduce losses, even with lower storage demand. This holistic approach can bridge gaps, improve storage utilization, and enhance the overall efficiency of the agricultural sector.

References

1. Basavannavar N, Banakar B. Analysis of benefits accrued by stakeholders from storage of different commodities in the warehouses in Karnataka. Journal of Farm Sciences. 2020;33(2):260-263.
2. Coppock JD. International Economic Instability. New York: McGraw-Hill; 1962. p. 523-525.
3. Cuddy JDA, Valle DPA. Measuring the instability of time series data. Oxford Bulletin of Economics and Statistics. 1978;40(1):79-85.
4. Mallikarjungouda Patil. Performance of Warehousing in Karnataka – A Comparative Analysis. [MBA

Thesis]. University of Agricultural Sciences, Dharwad; 2007.

5. Pearson K. Early Statistical Papers. Cambridge: University Press; 1948.

6. Banakar S. An economic analysis of utilisation pattern and performance of Karnataka State Warehousing Corporation. [M.Sc. Thesis]. University of Agricultural Sciences, Bangalore; 2005.

7. Singh R, Kumar P, Singh S. Impact of rice mills on the storage and marketing of rice in India. Journal of Agricultural Marketing. 2019;46(1):1-12.

8. Vaishnavi, Lokesha H, Vedamurthy KB, Venkataramana MN, Jagannath Olekar, Somashekar, Surendra HS. Analysis of trend and forecast of Minimum Support Price (MSP) in India. Archives of Current Research International. 2024;24(6):426-438.

9. Siddayya, Reddy V, Kammar SK, Patil C. An economic analysis on warehouse receipts in Hyderabad-Karnataka region: A protective measure against distress sale of agriculture produce. Indian Journal of Economics and Development. 2016;12(1):265-270.

10. Shreedevi BC, Kulkarni VS. Trends in area, production and productivity of cotton in India: an economic analysis. International Journal of Agricultural and Statistical Sciences. 2015;11(2):533-536.

11. Gilmour B, Gurung R. India agricultural policy review. Agriculture and Agri-Food Canada. 2008;4(3):1-5.

12. Pattanayak KP, Brijal Mallik, Chitrasena Padh. Potential of the agri-business sector to foster India's economic growth: A review. Plant Archives. 2022;22(2):286-291.

13. Available from: https://pib.gov.in/PressReleasePage.aspx?PRID=2037655.