

## **The long run equilibrium between minimum support price and production: The case of rice and wheat in India**

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### **Abstract**

*Agricultural price policy in India since independence occupied a central stage in controlling inflation and providing essential items at reasonable prices. By the formation of the CACP in 1965, this policy stance was added with the additional objective of awarding farmers with a remunerative price which ensures a reasonable level of income as inducement hoping to reduce the raging incidence of poverty and attain self-sufficiency in foodgrain production. Although the excessive focus on price inducement policy in relative exclusion of the non-price interventions in the postreform led to agrarian distress to a certain extent, the objective of self-sufficiency in production and considerable reduction in poverty have been attained. Now the government has more than sufficient buffer stock of foodgrains in its granaries and is forced to export the excess stock with a subsidy. In this context, this paper examines the long run responsiveness of production of rice and wheat to their MSPs and found cointegrating relationships. The lagged values of the MSPs have significant coefficients whereas the coefficients of lagged values of production are not at all significant. This finding has economic implications.*

**Keywords:** Cointegration, error correction, minimum support price, foodgrain production

**JEL Classification Code:** C01, C13, Q10, Q18

## 1. Introduction

Agricultural price policy has a crucial role to play in countries like India, which was liberated to underdevelopment, poverty and predominance of the agricultural sector. The ensuing analysis shows that ensuring reasonable and descent prices for agricultural crops brings food security, reduce poverty, entitles incomes to the farmers, generate demand for manufacturing goods and many more. This paper examines the long run relationship, if any that exists between the production of rice and wheat, two staple food grains in the country and their minimum support prices (MSP) declared from 2001-22 to 2021-22.

The growth of output, investment and technological innovation, productivity improvement and an increase in net sown area in the agriculture sector of an economy which is characterized with high rate of poverty and hunger has peculiar importance in its transformation towards a modern, vibrant hunger free economy. The initial goal definitely must be poverty reduction and achieving food security. An economy which is dreamt of by the classical thinkers is not suitable for protecting the livelihood, production and employment in the most vulnerable sector, the agriculture in a developing economy. Keeping this in view, planners and policy makers in India, from the very outset of independence, followed protectionist policies, which comprised price and non- price interventions. Although, India had embarked on economic reforms in the biggining of 1990s, most of the protectionist policies including price interventions continued in agriculture.

Wheat and Paddy are two crops for which the government's procurement system has been relatively robust and effective (Shweta Saini and Ashok Gulati, 2017). Major price intervention policy takes the form of a Minimum Support Price (MSP), which in its essence and consideration for inclusion of components changed a lot in the course time since its inception, has been influencing production, income for farmers, investment and innovation in agriculture by private stakeholders including farmers. The practice of protectionist agenda made the country self-sufficient in foodgrain production in 1971, and to keep sufficient or beyond those levels the buffer stocks of foodgrains required for its Public Distribution System (PDS) supplies and intra year and inter year price stabilization policies. Although, later India had sanctioned exports of rice and wheat, the international price for wheat and rice stands much lower compared to the MSP, procurement prices and open market prices in India, the export could be undertaken with a price subsidy that exert severe strain on government exchequer.

### **A brief review of agricultural price policy in India**

Although during earlier times in India, agricultural price policy was meant to regulate price increases that adversely affects the vulnerable sections of the population, the government did not deliberately kept prices at a very low level except in a brief period around 1955 when prices of agricultural commodities fell sharply. The then 'policy maker can be blamed for not following a more imaginative price policy' (Dantwala, 1967). After the formation of the Commission for Agricultural Costs and Prices (CACP) in 1965, the agricultural price policy was aimed to protect both producers and consumers alike. The Commission was asked to fix remunerative MSP to farmers. Achieving food security at the national and household levels was very important. This could be accomplished by ensuring sufficient production of foodgrains and make it available to the poor and entitle them with reasonable income. The farmers must get a remunerative price which prompt them to make investment and induce to produce more.

The cost of production was the basis of fixing the support price. Among many cost concepts, important ones are C2, C2\* and C3. Cost C2 contains all paid-out and fixed costs including imputed interest on owned fixed capital, imputed rental value of owned land and imputed value of family labour. Cost C2\* is the same as C2 with all labour evaluated at statutory minimum wages in case these are higher than the actual wages paid by the farmer. Naturally, cost C2\* is marginally higher than the cost C2 (Acharya, 1997). To account for the managerial input of the farmer, cost C3 is computed by raising cost C2\* by 10 per cent. While it may appear to be appropriate to take into account cost C3 for deciding upon the level of minimum support price, it needs to be recognised that the cost C3, besides including the imputed value of family labour and imputed interest on owned fixed capital, also includes several elements of income attributable to the farmer like the imputed rental value of owned land and return for management input of the farmer. Thus, higher the cost, higher the cost-based price and higher the income (Dantwala, 1981).

This change in basic assumptions in the agricultural price policy was justified on many grounds. India had to put an end to the dependence on the US PL-480 scheme, through which low priced foodgrains depressed domestic foodgrain prices and production (Dantwala, 1967). About 40 per cent of the rural population and around 50 per cent of the urban population in the country was suffering from poverty in latter half of 1960s (Dandekar and

Rath Estimates, Dutt Rudder, 2000), and as a usual consequence children in the poverty ridden families were undernourished.

In a country with more than 45 per cent of the work force depending on agriculture for livelihood, agricultural income had a far-reaching impact on poverty reduction as well as on rural development (Kapila Uma, 2024). The world development report clearly says that “GDP growth originating in agriculture is at least twice as effective in reducing poverty as GDP growth originating outside agriculture” (WDR,2008). The approach paper to the 12th five-year plan (2012-17) states that “a one per cent growth emanating from the agriculture sector would be at least two to three times more effective in reducing poverty than the same growth coming from non-agricultural sector” (Gulati, 2012). Agriculture forms the resource base for a number of agro-based industries generating employment and income. The fact that an average Indian spends more than 50 per cent of his monthly expenditure on food establishes the centrality of agriculture in the context of food security concerns. Therefore, the agricultural price policy framed in the general goal of rural development and poverty reduction until the start of new economic policies.

This policy drift with other non-price measures including the use of HYV seeds which was supported by public investments in fertilisers, power, irrigation and credit (Gulati and Fan, 2008), produced miraculous results. The total amount of foodgrains harvested increased from 74 MT in 1966-67 to 105 MT in 1971-72. In the same year the country became self-sufficient in grain production; declined imports nearly zero (India, Ministry of Agriculture, 2003). The crux behind the real success of these measures was the favourable price policy which aimed to increase the farmer incomes. In continuation of this policy milieu, the rice and wheat production soared from 37 and 12 mt in 1964 to 63.8 and 47 MT respectively in 1986. India had for the first time a 25.4 MT buffer stock of foodgrains in the year, which made the country bravely face, the worst drought in 1987, without any loss of lives (Kapila Uma, 2024).

The new regime under the new economic policy 1991 witnessed higher reliance on price policy and price interventions resulting in relative exclusion of non-price interventions. The new regime has been characterized with ‘high-input and high-output prices’ in place of the earlier policy of ‘low-input and low-output’ (Acharya, 1997). Consequent upon this policy shift, public investment on irrigation, research, extension and related infrastructure went down which are important determinants of agricultural production in India (Dantwala, 1967).

Although initially this decline was compensated by private investment, it was stopped by late 1990s, due to complementarity between public and private investment. In effect, technology development, dissemination and adoption in agriculture faced a major setback and hence the yield growth went down leading to rising cost of production necessitated higher support prices to sustain the long run margin of 20 per cent over cost of production.

With admirable progress in maintaining food security, the farming community faced agrarian distress which had the ramifications as rising debt, loan default, negative net worth, rising hunger, sale of farm and family assets to meet family expenditure and in the extreme case, tragedies like suicides by the close of the 1980s and 1990s. Farmers even from the agriculturally developed states like Haryana, Panjab and Kerala reported to have faced it. The problem was terribly acute during 2014-15 and 2015-16 due to successive failures of monsoon and abnormal rainfall.

The agrarian distress in the country is rooted in the structural imbalance of the economy which is reflected in the share of agriculture in national income vis-à-vis its share in workforce and ratio of per worker income in agriculture vis a vis non-agriculture.

**Table 1 :** Share of agriculture and non-agriculture sectors in national income and workforce (%)

Year	Share in national income		Share in workforce	
	Agriculture	Non agriculture	Agriculture	Non agriculture
1950-51	51.81	48.19	68.85	31.15
1960-61	42.56	57.44	69.41	30.59
1970-71	41.95	58.05	69.36	30.64
1980-81	35.39	64.61	59.02	40.98
1990-91	29.02	70.98	58.38	41.62
2000-01	23.02	76.98	58.2	41.8
2010-11	18.21	81.79	54.59	45.41

*Sources of Basic data: 1. National Account Statistics, CSO, GoI. 2. Agricultural Statistics at a glance 2016, Ministry of Agriculture and Farmers welfare, GoI.*

Although during the period of sixty years ranging from 1950-51 to 2010-11, the share of agriculture in national income had declined from 51.81 per cent to 18.21 per cent, a normal outcome of the development process, the share of the work force in agriculture sector did not fall much. The relative position of the farming households deteriorated which can be attributed to the jobless growth in the nonfarm sectors, the major contributor to the national

income growth in the postreform period. The nonfarm sector has been unable to pull the work force from agriculture sector after 1981.

MSP of rice and wheat to support farmers has been raised substantially in post reform years too. During 1992-93 to 1999-2000, the annual increase in MSP exceeded annual average inflation [Economic Survey (2000-2001)]. For example, against the annual inflation of 7% measured in terms of wholesale price index, the MSP for rice and wheat grew at the rate of about 10% and 11% respectively (Jha & Srinivasan, 2006).

In the biggining of the new millennium too, the government offered higher minimum support prices for paddy to farmers. MSPs for paddy (rice) were increased by an average of 20 per cent per annum during the three years 2007–08 to 2009–10. The five years, 2007 to 2012 witnessed substantial MSP increases and increased support from policies and programs for cereal farmers. Close to 12 MMT of rice was added to production levels in response to price incentives except in the drought year of 2009 during the five years (Shweta Saini and Ashok Gulati, 2017). The supply elasticity of rice and wheat with respect to their minimum support price (MSP) was estimated to be 0.32 and 0.21 respectively (Mohankumar & Premkumar, 2018). Although the response was inelastic, but positive. Even amidst surplus food grain production, India has been facing the problem of hunger. Global Hunger Index 2020 highlight that about 14 per cent of Indian population suffer hunger (Vereesha, 2021). This is quite ironical.

It has been argued that an effective measure to reduce government costs would be to reduce the level of MSP, for which there is now a consensus. In the past, GOI fixed it at the level of “C2 cost of production”. However, in recent years political compulsions have led to setting of MSP at much higher levels than C2 cost. This has benefited farmers in surplus states tremendously. The large farmers in surplus states gained as much as 10 times the marginal farmers (Jha & Srinivasan, 2006). However, there are evidence that in the eastern states in India (Bihar, eastern Uttar Pradesh, Jharkhand, Odisha, and West Bengal) the realisation of MSP was around 20 per cent less due to excessive dependence of small and marginal farmers on local traders for the sale of their produce. It has been further argued that the prices that farmers receive from informal channels are less than those realised by selling to government agencies (Kumar. A, Sonkar & Bathla, 2022).

There are concerns relating to definition of cost of production on which MSP should be based. Some of the cost concepts like Cost C3 are such that the price based on those costs is

not relevant to qualify as “minimum support price”. There is a need to develop more relevant norms/ criteria for price support. (Ramesh Chand, 2003). Therefore, it is alleged that MSP for rice and wheat are at exorbitant levels now. Although, the Monetary Policy Committee (MPC) on August 1, 2018 divulged after the declaration of hike in policy rate about 0.25 basis points that the major factor contributing to domestic inflation was the escalation of demand resulting from the declared minimum support price for kharif crops, statistical evidence of correlation between retail inflation and MSPs was, however, not found significant (Mohankumar & Premkumar, 2018). The high MSP rate would not be the prime cause for rising retail inflation in India (Mohankumar & Premkumar, 2018).

**Research methods**

The study involves investigating long run relationship between Minimum Support Price (MSP) and production of rice and wheat. Advanced time series techniques which involve testing for stationarity and cointegration have been employed. The presence of a significant cointegration coefficient is the evidence for short run error correction and maintaining equilibrium between MSP and production and that reflects the effectiveness of the variations of the former on the latter.

MSP of rice and wheat are determined exogenously by the Commission for Agricultural Costs and Prices from time to time based on various considerations detailed above. Letting  $Y_{1t}$  production of rice,  $Y_{2t}$  production of wheat,  $X_{1t}$  MSP of rice and  $X_{2t}$  MSP of wheat, and assuming that  $Y_{1t}$ ,  $X_{1t-1}$ ,  $Y_{2t}$  and  $X_{2t-1}$  are integrated of order one,  $I(1)$  variables we have the following basic regressions.

$$Y_{1t} = \alpha_1 + \beta_1 X_{1t-1} + e_{1t} \dots\dots\dots (1)$$

$$Y_{2t} = \alpha_2 + \beta_2 X_{2t-1} + e_{2t} \dots\dots\dots (2)$$

Since MSPs are exogenous, equations (1) and (2) are normalised on MSPs. The long run relationship between  $Y_{1t}$  and  $X_{1t-1}$  and  $Y_{2t}$  and  $X_{2t-1}$  can be established, that these variables are cointegrated , if  $\hat{e}_{1t} \sim I(0)$  and  $\hat{e}_{2t} \sim I(0)$  . If the estimated errors are stationary in levels, we may fit the following error correction equations.

$$\Delta Y_{1t} = \delta_1 + \gamma_1 (\hat{e}_{1t-1}) + v_{1t} \dots\dots\dots (3)$$

$$\Delta Y_{2t} = \delta_2 + \gamma_2(\widehat{e}_{2t-1}) + v_{2t} \dots\dots\dots (4)$$

$\gamma_1$  and  $\gamma_2$  are cointegrating coefficients shows the speed with which respective explained variable adjusts to disequilibrium in the previous period. Substituting  $\widehat{e}_{1t-1} = Y_{1t-1} - \alpha_1 - \beta_1 X_{1t-2}$  and  $\widehat{e}_{2t-1} = Y_{2t-1} - \alpha_2 - \beta_2 X_{2t-2}$  in equations (3) and (4) and solving for  $Y_{1t}$  and  $Y_{2t}$ , we have,

$$Y_{1t} = (\delta_1 - \gamma_1 \alpha_1) + (\gamma_1 - 1) Y_{1t-1} - \gamma_1 \beta_1 X_{1t-2} + v_{1t} \dots\dots\dots (5)$$

$$Y_{2t} = (\delta_2 - \gamma_2 \alpha_2) + (\gamma_2 - 1) Y_{2t-1} - \gamma_2 \beta_2 X_{2t-2} + v_{2t} \dots\dots\dots (6)$$

Equations (5) and (6) give the long run path for  $Y_{1t}$  and  $Y_{2t}$  for given or predetermined values of the explanatory variables.

### Data sources and variables

This study is based on time series data collected from Economics, Statistics and Evaluation Division, Department of Agriculture and Farmer's Welfare, Ministry of Agriculture and Farmer's Welfare, Government of India for the period from 2001-02 to 2021-22. Data on production have been collected and compiled from Ministry's publication, 'Agricultural Statistics at a Glance 2023', and on Minimum Support Price from MSP statements for various years since 2001-02. MSP Although the kharif and rabi season ranges over June-October and October -March respectively and the harvest season relating to them ranges over September-October and April-May, each year the government did not declare MSP on a uniform date. Since paddy is both a kharif and rabi crop, and the kharif season accounted for a major share of paddy crop, the late declaration of support prices prevents farmers to plan accordingly and the decisions depends mostly on previous year MSP. Therefore, MSP for rice is assumed to affect production of rice with a one period time lag. But wheat is a rabi crop and in most years the MSP declaration of all crops including wheat happens in months prior to the sowing time, MSP during the current period itself affects wheat production.

### Results and discussion

The first and foremost step is to examine the suitability of time series data sourced above for model fitting and the type of model to be employed for which stationarity tests are important. Table 2 shows that none of the variables under consideration is stationary at levels at any of the acceptable level of significance, one per cent, five per cent or ten per cent. The first

difference of these variables, namely, production of rice, MSP of wheat and production of wheat are stationary at five per cent level of significance. The MSP of rice is stationary at 5.88 per cent which is less than the conventional 10 per cent level of significance.

**Table 2.** ADF test result

Sl. No	Variable	Variables in levels I (0)		Variables in first differences I (1)	
		ADF Value	Prob.	ADF Value	Prob.
1	MSP of rice	1.199234	0.9968	-2.963657	0.0588***
		-3.029970*	0.05	-2.666593**	0.05
2	Production of rice	-0.448431	0.8823	-10.89908	0.0000
		-3.020686*	0.05	-3.029970*	0.05
3	MSP of wheat	-0.022825	0.9436	-5.335374	0.0008
		-3.052169*	0.05	-3.091002*	0.05
4	Production of wheat	0.454901	0.8811	-5.749321	0.0002
		-3.020686*	0.05	-3.029970*	0.05

\*, \*\* Critical ADF values at 5 and 10 per cent level of significance respectively

\*\*\*significant at 5.88 per cent level.

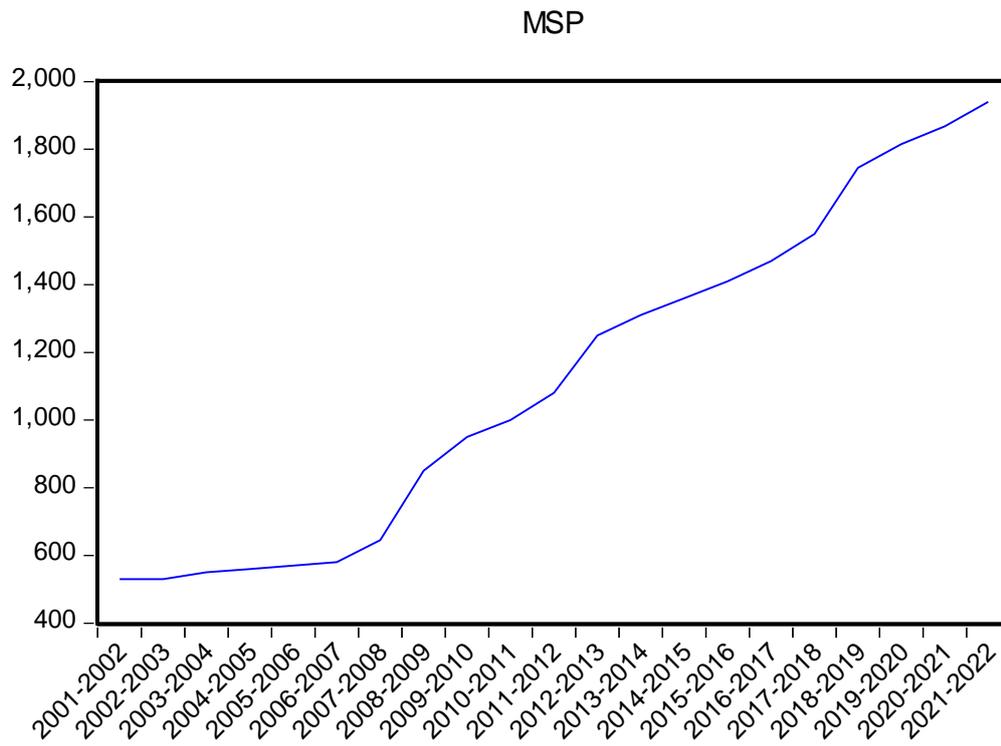
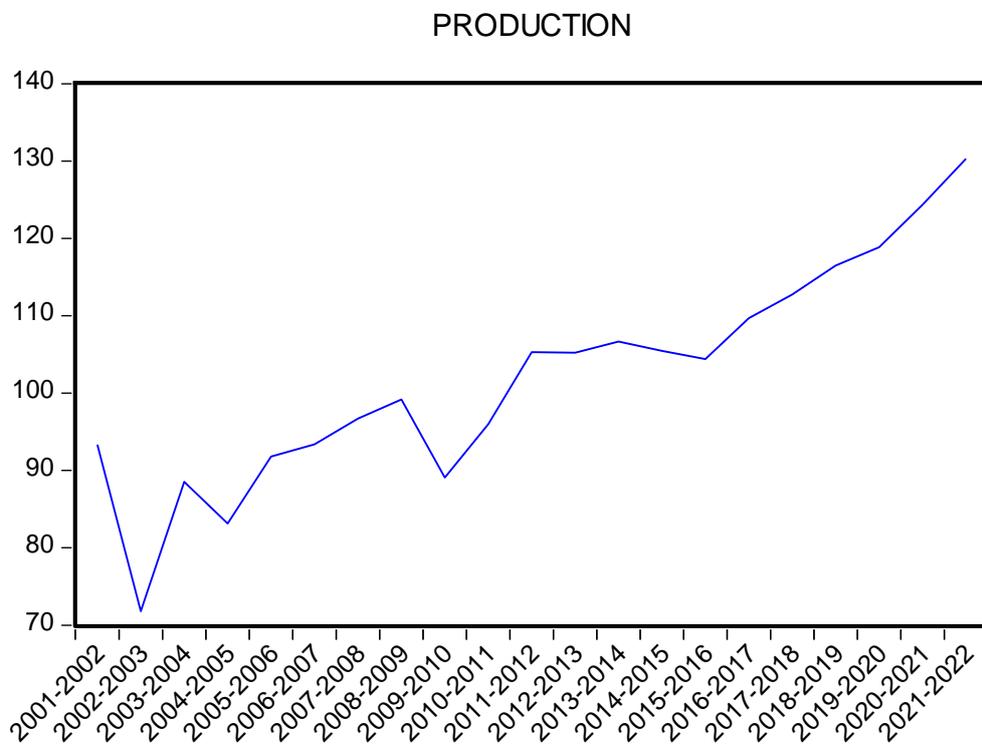
Note. MSP of rice is taken with one period lag.

Source: Author's calculation.

Since the variable are identified as I (1), it is natural to investigate for the existence of a long run equilibrium between the production of rice and its MSP and the production of wheat and its MSP. If long run equilibrium does exist, such variables are said to be cointegrated. Cointegration occurs when two or more nonstationary time series at levels have a long run equilibrium; that they move together in such a way that their linear combinations result in a stationary time series. In a two-variable case, the usual procedure is a two stage least square in which first estimate the basic regression, and testing the estimated errors for stationarity. If the estimated error is stationary at any of the acceptable levels of significance, the variables are cointegrated.

### **Trends in MSP for and production of rice**

The MSP for rice is measured in rupees (nominal) per quintal which stood at Rs. 530 in 2001-02 gradually rose to Rs. 1940 in 2021-22. Comparing the price in 2001-02, around 100 per cent increase was registered in 2011-12 and another 129 per cent in 2018-19 and by 2021-22, 266 per cent (Fig.1). In the meantime, production of rice rose from 93.34 million tonnes in 2001-02 to 105.3 million tonnes in 2011-12, to 116.48 in 2018-19 and further to 130.29 million tonnes in 2021-22 (Fig.2).

**Fig 1.** The trends in MSP for rice**Fig 2.** The trends in production of rice

### Testing for cointegration between MSP for and production of rice

Since the variables MSP for rice and production of rice are  $I(1)$ , cointegration can be checked by running regression for equation (1) and testing the estimated errors from the model for a unit root. The output of the basic regression is given in Table 3 and the unit root test result is given in Table 4.

**Table 3** Basic regression of production of rice on MSP of rice.

Dependent Variable: Production of rice Method: Least Squares Sample (adjusted): 2 21 Included observations: 20 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	72.21414	3.383444	21.34338	0.0000
MSP(-1)	0.027971	0.002883	9.703794	0.0000

Source: Author calculation

The one year lagged values of MSP for rice has a significant coefficient on the production of rice. The constant is also significant. Thus, there are valid and explainable linear combinations between values of MSP for rice and the values of production of rice. The estimated errors  $\hat{e}_{1t}$  is stationary, because the estimated ADF test statistic  $-4.537677$  with probability  $0.0001$  is less than the critical value of the test statistic  $-1.9601171$  at five per cent level (Table 4). Since  $\hat{e}_{1t}$  not having a unit root, cointegration do exist between the production of rice during period and the MSP fixed for rice in the period  $,t-1$ .

**Table 4** Unit root test result

Null Hypothesis: E1T has a unit root Exogenous: None			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		$-4.537677$	$0.0001$
Test critical values:	5% level	$-1.960171$	

Source: Author calculation

### Estimation of the speed of short run adjustment

The existence of cointegration between MSP for rice and production of rice confirms the long run relationship or equilibrium between them. Most probably, the source of short run disequilibrium is the exogenously changing MSP. Once there is a shock, that MSP changes, production aligns with the MSP. The short run (annual) response of rice production to

variations in its MSP or the speed of adjustment in the system can be estimated using equation (3) in which change in production is defined as a function of the error.

**Table 5** Regression for short run error correction

Dependent Variable: d (Production of rice)				
Method: Least Squares				
Sample (adjusted): 2 21				
Included observations: 20 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.847500	1.266406	1.458853	0.1618
$\hat{\epsilon}_{1t}$	0.966404	0.226585	4.265089	0.0005

*Source: Author calculation*

The regression output gives surprising result. The constant is not significant even at 10 per cent level of significance and hence its value can be regarded as zero instead of 1.8475. The error is corrected at the rate 96.64 per cent per period. As we assume a one-year lag to the MSP to affect production, it implies that 96.64 per cent of the shock in the previous period is corrected in the current period production of rice.

### Estimating production of rice

The long run movement of production of rice can be estimated using equation (5) which is arrived at by solving for the variable rice production instead of using change in production as the dependent variable. It is evident from equation (5) that current year production of rice is a function of previous period production and two period lagged values of the MSP fixed by the government. Running OLS, the regression output is shown in Table 7.

**Table 6** estimation of rice production

Dependent Variable: Production of rice				
Method: Least Squares				
Sample (adjusted): 3 21				
Included observations: 19 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	56.96732	12.56606	4.533428	0.0003
PRODUCTION(-1)	0.257019	0.168122	1.528760	0.1459
MSP(-2)	0.020336	0.004967	4.094051	0.0008

*Source: Author calculation*

The constant, 56.96732 of the regression is highly significant. Although the lagged MSP values significantly affect current period production of rice with the coefficient, 0.02 with probability 0.0008, the coefficient 0.257 is less precise with high standard errors makes it

insignificant. This result is astonishing that the previous period production is not at all affecting current period production. Farmers can keep land as well as capital goods for farming idle, if the price condition is not suitable. The only explanatory variable that affects the current period production of rice is the two period lagged values of MSP. If we omit the unnecessary or insignificant variable from the model that estimated in table 6, the coefficient of the two period lagged MSP values improves with greater precision (low standard error) Table 7.

**Table 7** estimation of rice production (excluding insignificant variable)

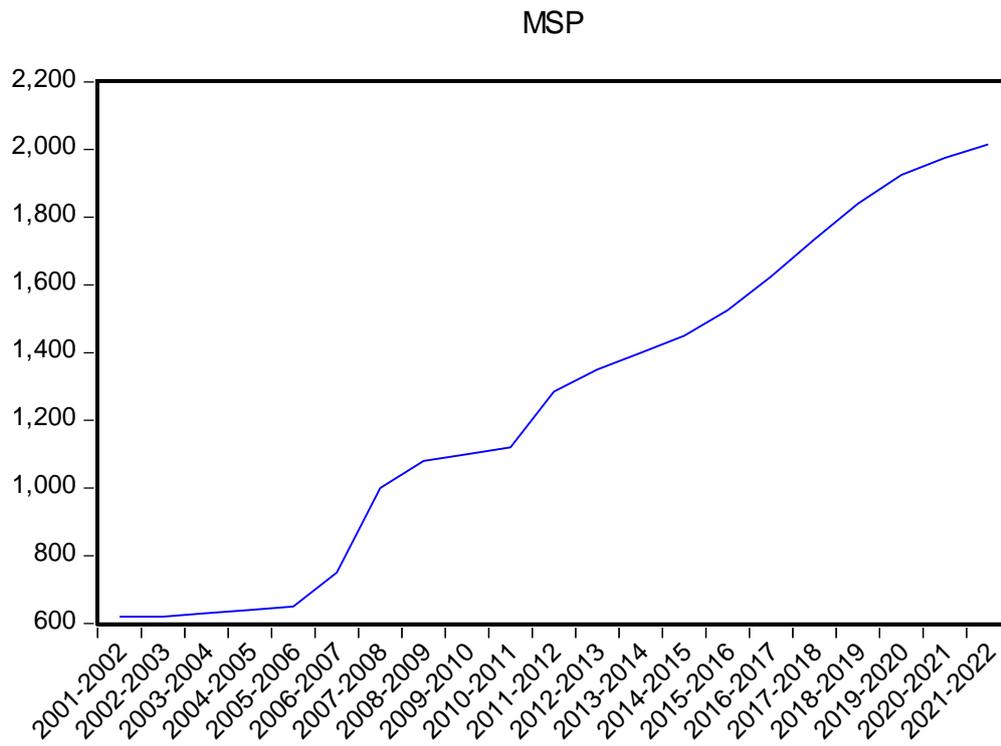
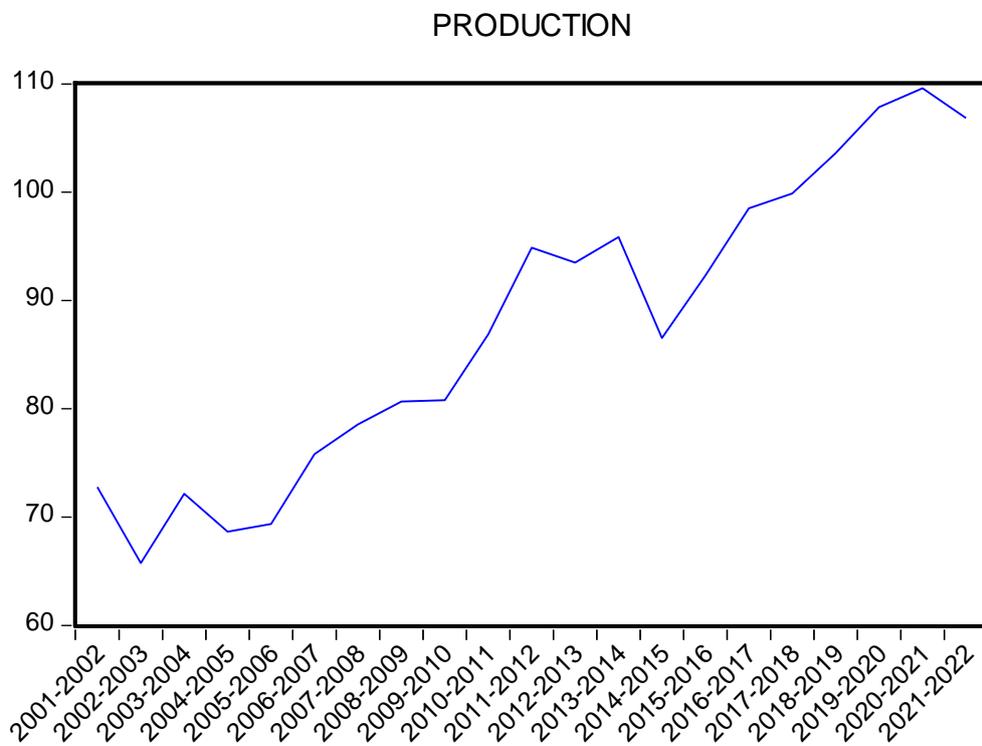
Dependent Variable: Production of rice				
Method: Least Squares				
Sample (adjusted): 3 21				
Included observations: 19 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	75.81460	2.525799	30.01608	0.0000
MSP (-2)	0.027174	0.002244	12.10788	0.0000

*Source: Author calculation*

### **Trends in MSP for and production of wheat**

Although, a little bit repetitive, for the academic interest, one may be eager to examine the same type models hold good for the production of wheat, since both are the important staple food, in the country. One difference of assumptions that could be noticed is that MSP for wheat affects its production in the current period itself.

The progression of wheat price also fetches the same pattern as that for rice. The MSP for wheat per quintal remains at Rs. 620 in 2001-02 and it increased to Rs.2015 in 2021-22, 225 per cent growth over the period. The cumulated growth rate of MSP for wheat compared to the year 2001-02 as base crossed the 100 per cent level in 2011-12 and around 200 per cent in 2018-19 (Fig.3). Meanwhile production of wheat increased from 72.77 million tonnes in 2001-02 to 94.88 million tonnes in 2011-12, further to 103.6 million tonnes in 2018-19 and 106.84 million tonnes in 2021-22 (Fig.4).

**Fig 3.** The trends in MSP for wheat**Fig 4.** The trends in production of wheat

### Testing for cointegration between MSP for and production of wheat

As we have noticed that the variables MSP for wheat and production of wheat are I (1), the existence of likely long run relationship or whether these variables are cointegrated can be checked by running regression for equation (2) and testing the estimated errors for a unit root. The result of such a regression and the Augmented Dickey Fuller test details for the errors derived from the basic regression are presented in Tables 8 and 9 respectively.

**Table 8** Basic regression of production of rice on MSP of rice

Dependent Variable: Production of wheat				
Method: Least Squares				
Sample (adjusted): 1 21				
Included observations: 21 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	52.50041	1.973010	26.60930	0.0000
MSP	0.028032	0.001471	19.05077	0.0000

Source: Author calculation

All the coefficients for the basic regression of production of wheat on its MSP are highly significant. The estimated errors do not have a unit root because the estimated ADF statistic -4.086012 with probability 0.0003 is sufficiently lower to reject the null hypothesis that has a unit root. Thus, the estimated errors are stationary indicating the presence of a log run equilibrium between the production of and MSP fixed from time to time for wheat.

**Table 9** Unit root test result

Null Hypothesis: E2T has a unit root		
Exogenous: None		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.086012	0.0003
Test critical values:	5% level	-1.959071

Source: Author calculation

Once cointegration is detected, it is imperative to estimate the speed with which a disequilibrium condition is getting corrected period after period. This entails the estimation of the error correction model based on equation (4) as done in Table 10. Both coefficients, the constant and error correction are significant at five per cent level of significance. It is interesting to not that the error correction coefficient has a value 1.02. It means that the system corrects more quickly in an explosively manner and eventually leads to instability in

the prediction of the explained variable, production of wheat. The long run equilibrium need not be a stable one.

**Table 10** Regression for short run error correction

Dependent Variable: d (Production of wheat)				
Method: Least Squares				
Sample (adjusted): 2 21				
Included observations: 20 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.850921	0.776961	2.382256	0.0284
$\hat{e}_{2t}$	1.020376	0.254600	4.007761	0.0008

*Source: Author calculation*

With our formulation in equation (6), the production path for wheat can be estimated using OLS as is shown in Table 11. The constant 46.04307 and the coefficient for one period lagged values of MSP, 0.024691 are significant at one per cent level. However, the coefficient 0.142230 for the lagged values of production of wheat is less precise and not significant even at 10 per cent level of significance. In the case of wheat also, the long run determinants do not include lagged values of production of wheat. Instead, the lagged values of the MSP alone determine current period production of wheat.

**Table 11** Regression for long run production of wheat

Dependent Variable: Production of wheat				
Method: Least Squares				
Sample (adjusted): 2 21				
Included observations: 20 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	46.04307	15.33940	3.001622	0.0080
PRODUCTION(-1)	0.142230	0.290308	0.489929	0.6304
MSP(-1)	0.024691	0.008490	2.908463	0.0098

*Source: Author calculation*

### Summary and conclusions

Cointegrating or long run relationship exists between the MSP for and production of both rice and wheat for the last 20 years, ranging over the period 2001-02 to 2012-22. The features of the data set and the particular nature of the movement of the MSPs and production over time for these commodities are more or less similar. The long run equilibrium between MSP for and production of rice is stable and converging since the error correction coefficient is less than one. However, the cointegrating relationship between the MSP for wheat and its

production is over correcting and hence unstable, in the context that the error correction coefficient is greater than one. Although instability do exist, it may not highly explode because the coefficient was 1.02. The long run production path for both crops has similar pattern too. The lagged values of the dependent variable, production, is not at all a factor determining current values of production. The capital investment and other circumstances including labour employment is not preventing the farmers not to cultivate. The sole factor affecting the production is the lagged values of the explanatory variable, only the MSPs in both cases. Therefore, MSP can be a policy variable too.

The error correction behaviour of production in response to disturbances to MSPs or the long run behaviour of production to adjusts to MSP variations, shows that production of rice and wheat can be manipulated by varying the MSPs. The mounting buffer stocks of food grains in India is the result of transmitting every increase in MSPs into the quantity of production.

However, the downward revision of the MSP is not tenable and sound. Nominal prices, once increased are expected to be inflexible downward. The common and small-scale farmer's income immediately turns out as demand for manufacturing goods and services. Therefore, the mutually reinforcing interdependence of the agriculture and non-agriculture sectors would bring forth the economy in a sustained high growth path. This follows that, a better policy option is to diversify agriculture by extending more financial support to the cultivation of fruits and pulses, the production and consumption of which remains at very low levels even today in the country. Further, the buffer stocks of food grains should be distributed to the extremely poor based on reasonable criteria to wipe out hunger from the country.

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