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印度最低價格支持政策對稻米與小麥市場的影響

Impacts of Minimum Support Price Program on Wheat and Rice Sectors in India

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本論文係 Aleen Baruah 君(R09627031)在國立臺灣大學農業經濟學研究所完成之碩士學位論文，於 2022 年 7 月 5 承下列考試委員審查通過及口試及 格，特此證明。

This is to certify that the Master thesis above is completed by Aleen Baruah (Student ID R09627031) during his studying in the Department of Agricultural Economics at National Taiwan University, and that the oral defense of this thesis is passed on 5 July 2022 in accordance with decisions of the following committee members:

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"Bygone visions of life asunder, long since quelled by newfound wonder." Lemmino, 2022. The above quote has little to no significance with regards to this thesis, however, I believe it captures the essence of curiosity, which is the driving force of any researcher.

I have spent close to two years in this university, and I have a long list of people to be grateful for their contributions in getting me to this point in my life. Firstly, I would like to thank my parents for all their efforts to shape me into the person I am today. They have selflessly provided for me and gave me all their support for letting me develop my personality and career. My greatest blessing in life was to be their son and I will never disappoint them in any way.

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Abstract

The purpose of this Thesis research is to examine the impacts of Minimum Support Price Policy in India on the various aspects of the Indian agriculture sector. I create a unique pooled cross-sectional dataset for nine primary policy states and two key crops across 20 years. I use procurement quantities and MSP values to determine the impacts of this policy. Upon analyzing data with respect to the production characteristics of rice and wheat, namely, planted hectarage, production quantity, and yield we find that in all cases the policy has a significant and positive effect on their growth rate. Policy states have also been found to have higher increases in hectarage as compared to non-policy states. Production quantities are also found to be positively related to the procurement quantities, however, in the case of wheat, the specification reverts the results. In terms of procurement quantities, we could only find statistically significant estimates for Wheat, which estimates an increase of 66.69 thousand tonnes for every 1% increase in MSR. Also, there is no significant effect of this policy on the fertilizer usage, and this made sense considering the fertilizer variable encompassed the entire consumption of the state in all crops. In the case of electricity consumed by agriculture, the MSP variable estimated a larger effect for Wheat due to its inherently higher electricity requirement. For impact on cost of production, procurement quantities have little role in it. In the case of Farm Harvest Prices, I find a unit increase for every unit increase in the nominal MSP. Regarding whether storage infrastructure would improve procurement quantities, its influential only in the case of Wheat.

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Chapter 1: Introduction and a brief history of the Indian Agricultural sector

Being a student of Agricultural Economics and having studied courses on Agricultural Policy analysis and Econometrics, I thought it would be only right that I write this thesis on the Minimum Support Price policy of our country. This decision was further reinforced with the farmer protests of 2020 with regards to changes surrounding this very policy. Another reason why I chose this policy was because of its direct relevance with regards to the farmer's production decision. The announced MSPs have the power to change entire production patterns of a state or perhaps of the entire country. I was also aware that given the size of the Indian agriculture sector and the varied levels of policy implementation across the states, conclusive research would be a challenge. Most of the literature available were conducted using primary data, which was not possible for me to obtain since I am in an entirely different country. However, after going through many sources on the Internet, I have found that the Ministry of Agriculture and Farmers Welfare has been collecting and publishing many state level data for the last 20 years. Considering this finding, I decided to go ahead and start collecting and compiling this secondary data for the purposes of estimating the impacts of this MSP policy on those variables.

Agriculture, at the present times is without doubt, the backbone of the Indian economy. This holds true considering the contribution of this sector to the national GDP has reduced from about 50% during the early 1950's to about 17.8 % in 2019-2020. The importance of this sector can also be seen in the year 2020-21, as it was the only sector to have reached a growth of 3.5% during those adverse times. This sector also employs about 50 % of the entire country's workforce. On average, India has about 140 Mha

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(million hectares) of net cropped area which is just shy of USA's figure of 166 Mha. In terms of irrigation, India has about 68.32 Mha which is almost 50% of its net cropped area. The country has immense natural resources and is home to a diverse range of climatic conditions and most of the land has potential to be double cropped. Traditionally crop production accounted for almost 4/5 of Indian agriculture and the rest being livestock rearing. However, the percentage of livestock rearing has increased to about 30% in the last few decades. A shift towards production of high value crops and animal products like milk has been seen in recent years.

Prior to the 1970's Indian agricultural production wasn't sufficient enough to meet the demands of the growing population but the Green revolution during those years due to the eleventh five-year plan has improved the sector's performance significantly. The country achieved self-sufficiency in food grains during the 70's and since the mid-1990's it has been able to consistently ensure that there are enough calories available to feed its entire population. It is now the world largest producer of milk, pulses, and millets and the second largest producer of rice, wheat, sugarcane, groundnuts, vegetables, fruit, and cotton. One characteristic feature of this sector in India is its dominance by a large number of small-scale famers who are operating the farm on a subsistence level of farming. In the year 1995-96, there were a reported 115 million of these farmers with an average land holding of 1.41 ha and their number has increased to 137.6 million in the year 2010-11 with 67% of them having only a mere 0.38 ha and the rest having an average land size of 1.42 ha.

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1.1 Post-independence Agriculture scenario:

This sector has extensive government and political presence in India. Directly after Independence, India has pursued a policy of food self-sufficiency in the staple crops of Wheat and Rice. The initial policies targeted the expansion of cultivated area, introduction of land reforms, community development, and restructuring the rural credit institutions. During the mid-1960's the main policy measures adopted were input subsidies, minimum support prices, public storage, procurement, and distribution of food grains along with trade protection measures. In comparison to rising economies like Brazil and China, India's policies were relatively modest except for removal of export controls. Development in the 1990's saw two major macroeconomic reforms. We first observed a rise in the per capita income complementing a stronger domestic demand. This was followed by a relaxation in trade restrictions to ensure remunerative prices for the farmers and maintain stable prices for the domestic consumers. This was only possible after the signing of the AoA (Agreement on Agriculture) under the WTO. In short, the history of Indian agriculture can be broadly categorized under 4 major phases after independence:

1.1.1

Phase I: Pre-Green Revolution Period (1950-65): The policy decisions during this time period included placing ceiling on land holdings, state control on idle lands, and allocation of some of the unused lands to the underprivileged rural people. This consolidation of land was encouraged in part to make it easier for mechanization.

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1.1.2

Phase II: Green Revolution Period (1965-80): During this period, the Government of India focused more on importing improved seed technologies and distributing the HYVs (High Yielding Varieties) of rice and wheat for cultivation in the irrigated parts of the country. This period was also significant as a number of important institutions like the Food Corporation of India, Central Warehousing Corporation, and State Agricultural Universities were established. Major commercial banks were nationalized to improve the credit flow to the agricultural sector. Consequently, this period saw a quantum jump in yield of those crops and increased consumption of inputs like fertilizers and pesticides. This was the time period when Indian agriculture achieved its self-sufficiency status and directly impacted its input industries.

1.1.3

Phase III: Post Green Revolution Period (1980-91): During this period the caveats of the green revolution were extended to other crops and regions. This period also saw a diversification and specialization towards high value commodities like dairy, fishery, poultry, and horticultural produces. The government also started to encourage private investment in this sector.

1.1.4

Phase IV: Economic Reforms Period (1991 – present): The previous three phases were a time of sustained output growth. Starting in the early 1990s, the focus of the policy makers was to improve the operation efficiencies of the markets, reduction of excessive red tape bureaucracy, and to liberalize the agricultural trade. However, considering the past successes, there were several problems facing this sector, such as

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addressing a sharp decline in output growth during the late 90s. A steady fall in the public sector investment also called for some much-needed policy reforms to attract private investments for the sake of long-term growth and competitiveness.

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Chapter 2: Policy intervention: Minimum Support Price

Formulation and implementation of agricultural policies in India is a complicated process. It involves a number of ministries, departments, and institutions at both the central and the state levels. The Planning Commission of India, which formulates the country's five year plans guides the Union Ministry of Agriculture (MoA) on the broad set of guidelines for those policies. The respective state governments are then responsible for the administrative and executive roles. India currently has a multitude of different policies like credit, land reform, marketing reform, price, food security, research and trade.

In this thesis, the focus will be on the Minimum Support Price (MSP) which comes under the category of the Price policies. The original intent of the of the MSP was to provide a safety net to farmers against sudden price drops but as time passed the need for providing remunerative prices to farmers became all the more important for increasing farm incomes. This in turn had a big role in economic transformation in the well-equipped irrigated regions of the country. The welfare of the consumers were also kept in mind by aiming to maintain available supplies at reasonable prices in the market. However, it is worth mentioning that the MSP does not have any legal backing whatsoever. This essentially means that MSP is the price the government pays if it is to procure those listed crops but is not legally bound to do so. These prices are fixed twice every year based on the recommendations of the Commission for Agricultural Costs and Prices (CACP), which is an official body responsible for submitting reports regarding prices for the 24 listed Rabi crops, Kharif crops, sugarcane, raw jute and copra. The Central government then looks at the overall demand and supply situation of the country

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to make the final decision. The government intervenes in the market by organising purchase operations through public and cooperative agencies with the objective of maintaining market prices above the MSP.

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Table 2.1: Last 10 Year Minimum Support Prices for the listed crops

COMMODITY	VARIETY	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
KHARIF CROPS												
PADDY	Common	1000	1080	1250	1310	1360	1410	1470	1550	1750	1815	1868
	Grade A'	1030	1110	1280	1345	1400	1450	1510	1590	1770	1835	1888
JOWAR	Hybrid	880	980	1500	1500	1530	1570	1625	1700	2430	2550	2620
	Maldandi	900	1000	1520	1520	1550	1590	1650	1725	2450	2570	2640
BAJRA		880	980	1175	1250	1250	1275	1330	1425	1950	2000	2150
MAIZE		880	980	1175	1310	1310	1325	1365	1425	1700	1760	1850
RAGI		965	1050	1500	1500	1550	1650	1725	1900	2897	3150	3295
TUR		3000	3200	3850	4300	4350	4625	5050	5450	5675	5800	6000
MOONG		3170	3500	4400	4500	4600	4850	5225	5575	6975	7050	7196
lJRAD		2900	3300	4300	4300	4350	4625	5000	5400	5600	5700	6000
COTTON	Medium Staple	2500	2800	3600	3700	3750	3800	3860	4020	5150	5255	5515
	LongStaple	3000	3300	3900	4000	4050	4100	4160	4320	5450	5550	5825
GROUNDUT		2300	2700	3700	4000	4000	4030	4220	4450	4890	5090	5275
SUNFLOWER SEED		2350	2800	3700	3700	3750	3800	3950	4100	5388	5650	5885
SOYABEAN	Black	1400	1650	2200	2500	2500			3050	3399	3710	
	Yellow	1440	1690	2240	2560	2560	2600	2775				3880
SESAMUM		2900	3400	4200	4500	4600	4700	5000	5300	6249	6485	6855
NIGERSEED		2450	2900	3500	3500	3600	3650	3825	4050	5877	5940	6695
RABI CROPS												
WHEAT		1120	1285	1350	1400	1450	1525	1625	1735	1840	1925	1975
BARLEY		780	980	980	1100	1150	1225	1325	1410	1440	1525	1600
GRAM		2100	2800	3000	3100	3175	3500	4000	4400	4620	4875	5100
MASUR (LENTIL)		2250	2800	2900	2950	3075	3400	3950	4250	4475	4800	5100
RAPESEED & MUSTARD		1850	2500	3000	3050	3100	3350	3700	4000	4200	4425	4650
SAFFLOWER		1800	2500	2800	3000	3050	3300	3700	4100	4945	5215	5327
TOMA		1780	2425	2970	3020	3020	3290	3560	3900	4190	4425	
OTHER CROPS												
COPRA	Milling	4450	4525	5100	5250	5250	5550	5950	6500	7511	9521	9960
	Ball	4700	4775	5350	5500	5500	5830	6240	6785	7750	9920	10300
COCONUT (CALENDER YEAR)		1200	1200	1400	1425	1425	1500	1600	1760	2030	2571	2700
JUTE		1575	1675	2200	2300	2400	2700	3200	3500	3700	3950	4225

Source: Directorate of Economics and Statistics, Ministry of

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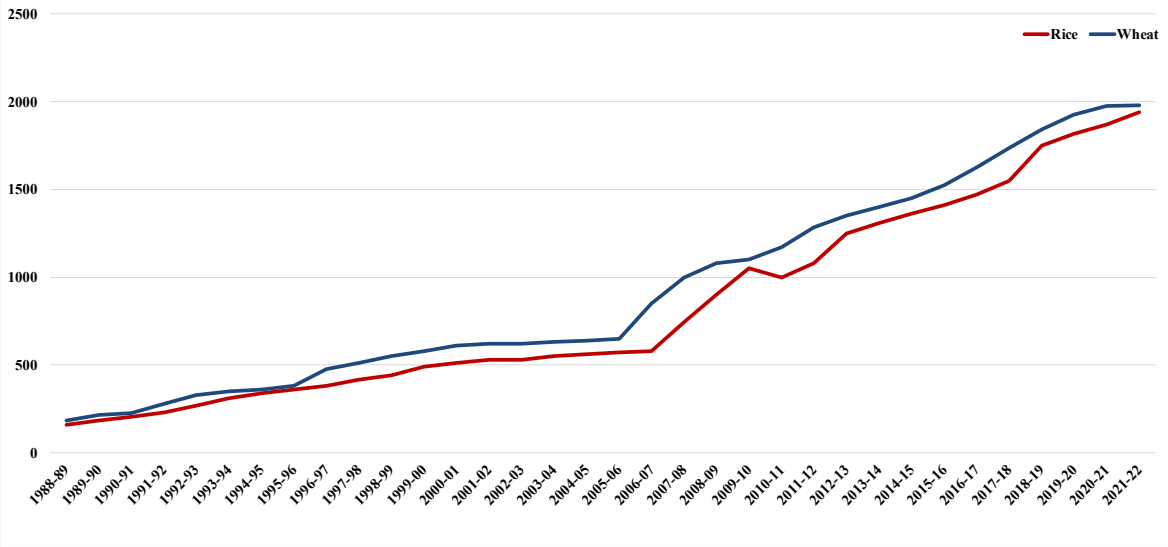
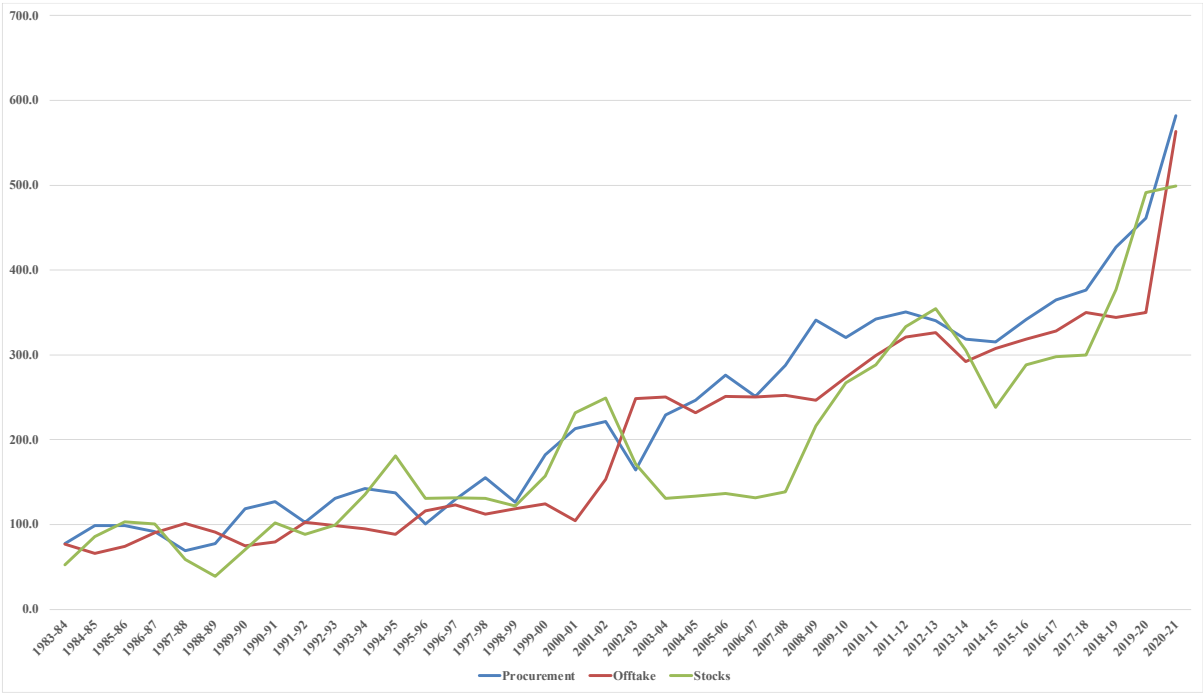
Figure 2.1: 34-year Rice and Wheat nominal MSP trend line



Source: Reserve Bank of India, 2022

Over the past three decades, the minimum support prices for all the listed crops have gradually risen due to both inflationary pressures on inputs as well as farmers demand.

Figure 2.2: 38-year Rice Procurement, Offtake and Stock levels in Lakh Tonnes



Source: Reserve Bank of India, 2022

As time progressed, more procurement infrastructures have been set-up which has led to a gradual increase in the activities of the Public Distribution System of India which

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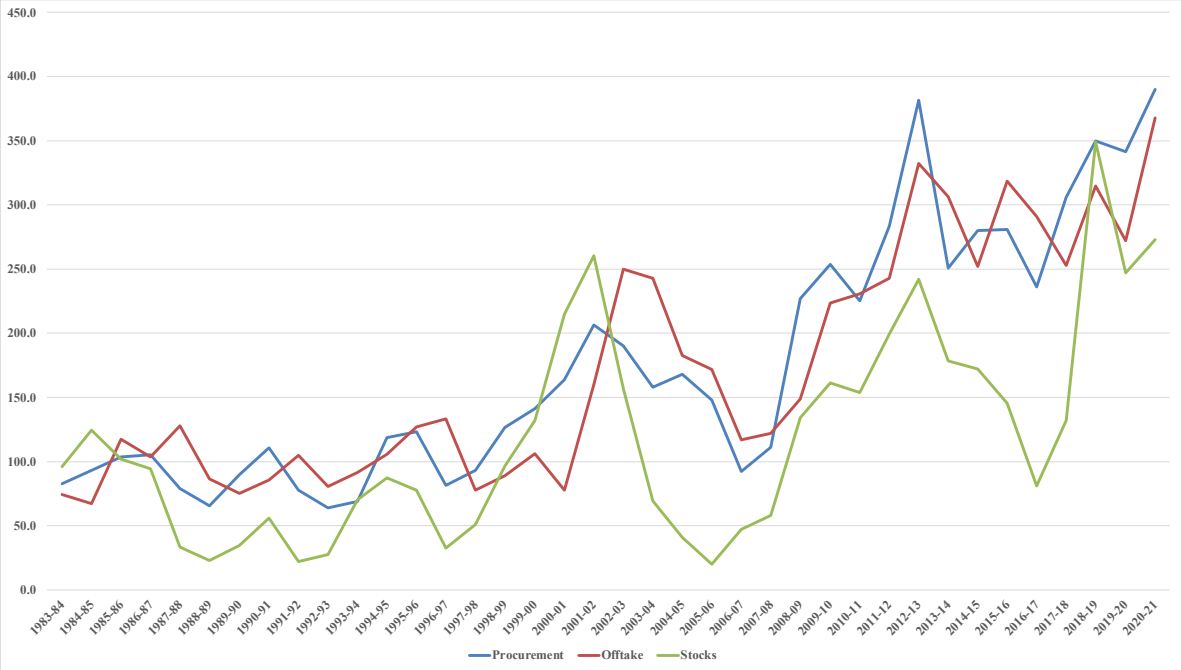
include procurement and offtake of food grains. In the above case of Rice, the dip in national stock levels from 2000-01 can be explained by the increased offtake quantities coupled with decrease in levels of procurement. The second dip 2012 can be explained by the introduction of the Open-Market Sales (OMSS) scheme in which the government sold excess rice stocks to private buyers.

Figure 2.3: 38-year Wheat Procurement, Offtake and Stock levels in Lakh



Source: Reserve Bank of India, 2022

In the case of Wheat, the situation in 2000-01 shared the same story as that of Rice but the second dip in the stock levels in 2012 is reportedly attributed to increased offtake and the Open Market Sales Scheme - Domestic (OMSS-D) of the government along with an approximately 3 million tonne export in the years 2012-13 and 2013-14.

In the following chapters, I use the inflation adjusted and unadjusted MSPs of Wheat and Rice along with procurement quantities in the 9 selected states to try and explain various characteristics of state agriculture ranging from its impacts on total

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production, costs, prices etc. Attempt is also made to study the difference of those characteristics between procurement vs non-procurement states.

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Chapter 3: Literature review

Several research works have been conducted on the various aspects of the MSP policy with regards to the to the agriculture sector in India. In this chapter, I have attempted to review some of the most relevant papers with respect to the various questions that I have proposed for this study.

In the next chapter, I collect and compile pooled cross-sectional data from relevant sources and use inflation adjusted MSPs and procurement quantities to explain two production characteristics, crop area and crop production for wheat and rice across 9 different states of India. In a working paper by Deshpande and Naikia (2002), they reveal that the MSP price did not manage to work as the reference price to determine the area under major crops in the state of Karnataka as well as locally. I will attempt to test this hypothesis in the following chapters using the collected data. They report that the cropping pattern is majorly influenced by the market prices and not the MSP set by the government. They also report that the input-use structure also had little to do with the official prices along with the finding that groundnut crop area had a positive correlation with the set MSPs.

Another question that the thesis attempts to answer is how the agricultural inputs such as total fertilizer quantities, tractors sold, and electricity consumed by agriculture is affected by the two policy variables already mentioned. Singh (2002) in a study report examined the impact of MSPs on various aspects of the economy of Madhya Pradesh such as the inputs, water and land resources, adoption of a socially acceptable, and desirable cropping patten. This was done through a primary survey, and it was observed

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that in the case of paddy, soybean, and gram there was a positive relationship between the MSP of paddy and the area, production, and yield of crop. This claim will also be tested here using the 20-year time series data of Madhya Pradesh for the wheat and rice crops.

Parikh et al. (2003) highlighted that an increase in the MSP across various years have led to the decline of agricultural and non-agricultural GDP along with the reduction of total GDP of India. This was attributed to the increase in price indices over time and a reduction of investment in the agricultural sector. The overall welfare of the country was also found to stagnate.

A similar study was conducted by Parikh and Singh (2007) for the then Planning Commission of India on the impact of MSP extension and the linked fiscal policy implications for the Rice and Wheat crops across different states of India. In contrast to the results of Parikh et al. (2003), the study demonstrated that the aggregate expenditure on rice consumption was decreasing due to an increased proportion of subsidized PDS (Public Distribution System) rice. However, in the case of Wheat it was found that the aggregate consumer expenditure was slightly increasing due to an increase in the effective price of wheat. In the same study, it was also found that the farm incomes generated by rice and wheat crops have increased due to its positive correlation with the REP (Realized Effective Price), demonstrating that extension of the MSP raises the income of both rice and wheat farmers. This line of result encouraged the policy makers to further bolster support for the procurement program.

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Work on similar grounds was done by Jha and Srinivasan (2006) where they hypothesize that since in a decentralized scenario, the PDS requirements are purchased from the open market, its costs tend to rise. But if the states reduce the MSP, the market prices will fall and therefore lead to higher consumption by all income classes. This will consequently lead to an increase in consumer welfare.

In another work, Chand (2003) studies the impact of MSP on the Indian agricultural sector and reports that this policy favors selected crops, indicating that the MSP policy remains as a safety net for the farming community in the country. The effectiveness of the MSP policy in various regions of the country was studied by Alia et. al (2012). Specific emphasis was given to states with more surplus such as Punjab, spanning from 1980 to 2007 using the simultaneous equations model. The study concluded that the MSP policy had been very effective in the surplus states like Punjab and Andhra Pradesh. However, the deficit states show the opposite. They recommend Punjab as the role model for the purposes of increasing production of rice in other potential areas of the country.

It has been found that MSP has a significant role in the producer and consumer price indices. To study whether there is a similar relationship between the producer and consumer prices, Tiwari and Shahbaz (2013) in their study has found that there is a reverse causal relationship between the two. The study by Huria and Pathania (2018), which determine the various key factors impacting the prices of food grains in India, established the existence of short-run as well as long-run relationship between price wedge and food grain price inflation.

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Similar to general findings, NITI Aayog (2016) has reported from their study that the MSP has been treated as an efficient policy tool to safeguard farmers in all corners of the country, but its effectiveness is far from the same across all the states. MSP awareness along with development of procurement infrastructure has been cited as the major area of importance regarding its efficacy.

In another study, Aditya et al. (2017) have analyzed farmers awareness about MSP and its impact on diversification of crops grown in India using national representative data collected by the National Sample Survey Office (NSSO), 70th Round, and revealed that only 23.72% and 20.04% of farmers in the rural agricultural households are aware of the MSP for the crops grown by them in Kharif and post-kharif season, respectively. The conclusion made by the study was that the MSP knowledge does not lead to specialization in cropping. In coherence to the previous paper, the study also infers that MSP needs to be supported by effective procurement coupled with awareness creation via various extension activities provided by the government. A similar and more recent study by Geetha and Mahesh (2019) assesses the relationship between MSP and production of cotton and farmers' awareness regarding the MSP of cotton in India using the NSSO dataset. Awareness level was found to be same in the case for cotton farmers for both Kharif and Rabi seasons.

Narayanamoorthy and Suresh (2013) in their paper revealed that the MSP has not risen in proportion to the costs of production and highlighted this fact by demonstrating that between 2007-08, for most crops, a substantial negative net return has been found: (-21% in Jowar, -30% in Ragi, -16% in Tur, -15% in Moong, -11% in Urad). The study expects policymakers and economists to understand that, to protect the livelihood of

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farmers and food security of the nation, MSP should be fixed at a minimum of 50% above the costs of production. This recommendation is based on an argument that a mere increase of MSP won't be of any use if the procurement machinery consisting of storage facilities, transport and post-harvest facilities does not meet the required standards and numbers.

Studies have also attempted using primary field-level data on similar topics. Gupta et al. (2020) conducted a study for paddy in the state of West Bengal. First, the paper focuses on examining the impact of MSP on the yield, market price, and area under production of the same crop. Then they predict the degree of participation using the Heckman two-stage model. The study finds that MSP has a direct correlation with productivity, independent with total production, and a slightly negative correlation with the production hectarage. The variables age, gender, education, and paddy field together had a significant and positive influence on the farmers' decision to participate in the market.

To understand the price variation withing agricultural commodities Chatterjee and Kapur (2016) used data from various government sources to answer this question for Wheat and Rice. The paper employed Shapely-Shorrocks decomposition to study the effect of MSP, procurement operations, and monopsonization on price variations. One of the startling inferences that can be drawn by this study was that the rapid improvement in communication network in the country had no effect in price stabilization. The paper also criticized the policy from the perspective of failing to provide a buffer to the crop prices as wholesale prices were lower than MSPs in nearly all the cases.

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Chapter 4: Data and Methodology

4.1 Data:

The idea for this thesis was motivated by Alia, Sidhub, Vatta (2012) where they studied the effectiveness of minimum support price policy for paddy in India with a case study of Punjab. They used the concept of measuring the deviations of farm harvest prices from the MSP as a measure of ineffectiveness and the impact of prices and technology on rice productivity. The have employed the use of a simultaneous equations model for the analysis.

However, for the purposes of this thesis I have decided to focus on the major rice and wheat growing states of India along with states having procurement operations for that crop and states without it. The reasoning behind this is simple, rice and wheat form a bulk of the MSP policy support for the farmers and are the most popular choice for cultivation for a majority of farmers. The other 23 listed crops under MSP are important as well, but obtaining practically relevant and statistically significant results from secondary data will be very challenging due to its much smaller share in the agriculture related activities. Studies have been conducted where the researchers collect primary farm level data to study the policy effects but in most cases due to budget constraints the studies are limited to specific localities or regions. As a student and given that I am in another country, research using primary data was completely infeasible. Fortunately, the Indian government has, over the past two decades made most of the relevant data available online in various websites spread across various organizations and ministries.

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The topics that I cover in this thesis primarily range from crop production characteristics like crop area, production and yield to agricultural prices to impacts on agricultural input usage. The compilation source for almost all of the data has been from the publication named 'Agricultural Statistics at a Glance' which is an annual release by the Ministry of Agriculture and Farmers Welfare and the primary source for all those data are from various departments. The details of all the variables used in the upcoming chapters, which includes source information, and units are all listed in the following table in alphabetical order.

Table: 4.1. Data used in the thesis alongside their sources and units of measurement

SI. No.	Variable name	Primary Source	Compilation Source	Units
1	Agri. Electricity consumption	Central Electricity Authority, New Delhi.	Agricultural Statistics at a Glance	Giga Watt-Hour (Gwh)
2	Consumer Price Index	International Monetary Fund, International Financial Statistics and data files	World Bank Website	Numerical units
3	Cost of cultivation	Directorate of Economics & Statistics, DAC&FW	Agricultural Statistics at a Glance	Rs. / ha & Rs. / 100 kg
4	Crop Area	Directorate of Economics & Statistics, DAC&FW	Agricultural Statistics at a Glance	Million Hectares
5	Farm Harvest Prices	Directorate of Economics and Statistics	Ministry of Agriculture and Farmers Welfare website	Rs. / 100 kg
6	Farmer categories (Area/Numbers)	Agricultural Census of India	Agricultural Statistics at a Glance	Hectares / Numerical units
7	Fertilizer consumption	Department of Agricultural Cooperation and Farmers Welfare	Agricultural Statistics at a Glance	Thousand tonnes
8	Marketed Surplus Ratio	Directorate of Economics & Statistics, DAC&FW	Agricultural Statistics at a Glance	Percentage (%)

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9	Minimum Support Prices	Commission for Agricultural Costs & Prices (CACP)	Reserve Bank of India	Rupees / 100 kg (Quintal)
10	Procurement Quantities	Department of Food and Public Distribution.	Agricultural Statistics at a Glance	Thousand tonnes
11	Production	Directorate of Economics & Statistics, DAC&FW	Agricultural Statistics at a Glance	Million Tonnes
12	Rainfall	India Meteorological Department, Hydromet Division	IMD Website	Millimetre (mm)
13	Retail Prices	Wholesale and Retail Prices Information System	Ministry of Agriculture and Farmers Welfare website	Rs. / Kg
14	State Agricultural GDP	National Statistical Office, Ministry of Statistics and Programme Implementation, Government of India.	Reserve Bank of India	Lakh Rupees
15	State GDP	National Statistical Office, Ministry of Statistics and Programme Implementation, Government of India.	Reserve Bank of India	Lakh Rupees
16	State Storage Capacity	Department of Food & Public Distribution.	Agricultural Statistics at a Glance	Lakh Metric Tonnes
17	Tractor sales	Indian Council of Agricultural Research (ICAR)	Agricultural Statistics at a Glance	Numerical Units
18	Wholesale Price Index	International Monetary Fund, International Financial Statistics and data files	World Bank Website	Numerical units
17	Yield	Directorate of Economics & Statistics, DAC&FW	Agricultural Statistics at a Glance	Kg / Hectare

4.2 Methodology:

Throughout this thesis, I used Fixed and Random Effect regressions to generate the relevant estimates. The data collected has been compiled into a panel data set where we have a 20 year time period $'t'$ along with 9 individual states representing the $'i'$ units . The data can be further segregated into rice and wheat.

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4.2.1 Data visualization:

Each chapter has two sections, the introduction and the results & discussion section. I use graphs for elaborating and visualizing the data with averages across categories. This is done because since there are 9 different states, the graphs become easily crowded and hard to interpret. Therefore, the graphs are prepared according to the crop and averages across all the states, based on presence of procurement activity or clustered regions (North, South, East, Central).

Due to the varying size of the y-axis categories, their values differ quite significantly and makes it difficult for the reader to establish visual high level trends and patterns with key explanatory variables like procurement quantities, MSPs, inflation adjusted MSPs etc. For this very reason, the data used for generating the graphs have been converted into indexes that start from 100 in the beginning x-axis time period (year). This standardises every data point and makes it easy to visualize a high level relationship between the variables plotted in the graphs and is also an accurate representation of the rate of change aspect. Converting the values into an index value is a simple process and is done using the following equation:

$$\frac{X_{t++}}{X_{t=0}} * index_{t=0} = index_{t++} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Here,

$X_{t=0}$ = Value at the starting time period of the index

X_{t++} = Value at the consecutive time period

$index_{t=0}$ = Starting value of the index at the base year

$index_{t++}$ = Calculated index value at $t++$ timeperiod

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A very similar approach was also taken for the purposes of converting nominal prices into real prices for variables like total and agricultural state level GDP, Farm Harvest Prices, Retail Prices, and Minimum Support Prices. In all the cases, the base level for conversion of the nominal into real prices was chosen to be the starting time period for the analysis, which is 2000-2001. The reasoning for this was to establish a steady inflation-adjusted trend instead of an U-shaped or inverted U-shaped price fluctuation. Selecting a time period in the middle could generate misleading results. This adjustment was done using the following equation.

$$price_t(or)GDP_t * \frac{CPI_{base\ year}(or)WPI_{base\ year}}{CPI_t(or)WPI_t} = real\ price \quad \ldots\ldots\ldots 2$$

Here,

- $price_t(or)GDP_t$ = Nominal Price/GDP value at $'\ t\ '$ time period
- $CPI_{base\ year}(or)WPI_{base\ year}$ = Price Index released by the government or world bank for the base year.
- $CPI_t(or)WPI_t$ = Price index at the $'\ t\ '$ time period
- $real\ price$ = Inflation adjusted price

4.2.2 Fixed Effects:

To analyse our panel data set, I have employed the use of Fixed effect regression with the primary independent variable being the policy variables. These are either the inflation adjusted/unadjusted MSPs or the state-wise procurement quantity figures. Besides Fixed effect models, I have also included a Random effect model for including the policy dummy variable. The purpose of this model is to address the issue of MSP

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policy being time invariant during the 20 year time period for the states, fixed effect is not feasible for estimating its effect.

To further elaborate the fixed effect regression, in the first section we generate estimates for the Crop area with the procurement quantities and this is how we can obtain the time demeaned model. In the other sections and chapter, the same method is used but they differ in the regressand and regressors.

$$Y_{it} = \beta_0 + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta_4 Z_i + U_{it} \quad \ldots\ldots\ldots\ldots\ldots 3$$

Here,

Y_{it} = Crop area (Million hectares)

$X1_{it}$ = Procurement quantity (‘000 tonnes)

$X2_{it}$ = Real State GDP (Lakh Rupees)

$X3_{it}$ = Rainfall (mm)

Z_i = Unobserved variables

i = Notation for the Indian state

t = Year notation

U_{it}= Error term

We can then combine β_0 and $\beta_4 Z_i$ as α_i. This is the fixed effect for all the 9 states and do not change over time.

$$Y_{it} = \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \alpha_i + U_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots 4$$

Instead of using dummy variables for the Z_i which will result in a huge list of variables, we can use the Demeaned Fixed effect regression.

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$$\frac{1}{T} * \sum_{t=1}^{T} Y_{it} = \beta_1 * \frac{1}{T} * \sum_{t=1}^{T} X1_{it} + \beta_2 * \frac{1}{T} * \sum_{t=1}^{T} X2_{it} + \beta_3 * \frac{1}{T} * \sum_{t=1}^{T} X3_{it} + \frac{1}{T} * \sum_{t=1}^{T} \alpha_i + \frac{1}{T} * \sum_{t=1}^{T} U_{it} \quad \ldots\ldots 5$$

Since we assume α_i is constant over time, $\frac{1}{T} * \sum_{t=1}^{T} \alpha_i$ part will simply equal to α_i

$$\frac{1}{T} * \sum_{t=1}^{T} Y_{it} = \beta_1 * \frac{1}{T} * \sum_{t=1}^{T} X1_{it} + \beta_2 * \frac{1}{T} * \sum_{t=1}^{T} X2_{it} + \beta_3 * \frac{1}{T} * \sum_{t=1}^{T} X3_{it} + \alpha_i + \frac{1}{T} * \sum_{t=1}^{T} U_{it} \quad \ldots\ldots 6$$

This then simplifies into the following equation (7)

$$\bar{Y}_{it} = \beta_1 \bar{X}1_{it} + \beta_2 \bar{X}2_{it} + \beta_3 \bar{X}3_{it} + \alpha_i + \bar{U}_{it} \quad \ldots\ldots 7$$

To demean the equation, we subtract eq (4) from eq (7)

$$Y_{it} - \bar{Y}_{it} = \beta_1 X1_{it} - \beta_1 \bar{X}1_{it} + \beta_2 X2_{it} - \beta_2 \bar{X}2_{it} + \beta_3 X3_{it} - \beta_3 \bar{X}3_{it} + \alpha_i - \alpha_i + U_{it} - \bar{U}_{it}$$

Rearranging the above formula, we can write it as

$$Y_{it} - \bar{Y}_{it} = \beta_1 (X1_{it} - \bar{X}1_{it}) + \beta_2 (X2_{it} - \bar{X}2_{it}) + \beta_3 (X3_{it} - \bar{X}3_{it}) + U_{it} - \bar{U}_{it} \quad \ldots\ldots 8$$

We thus obtain the within or the time demeaned estimator,

$$\ddot{Y}_{it} = \beta_1 \ddot{X}1_{it} + \beta_2 \ddot{X}2_{it} + \beta_3 \ddot{X}3_{it} + \ddot{U}_{it} \quad \ldots\ldots 9$$

STATA can then run an OLS regression on the above equation to obtain the estimates for the variables like Crop area, production quantities, and yield.

4.2.3 Random Effects:

To elaborate on the Random effects model, we can apply the same situation where we use Procurement quantity, Real State GDP, and Rainfall variables to estimate the effects on the Crop Area for a specific crop (rice/wheat). We begin by using the

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same unobserved effects model as before but we add the time-invariant policy dummy variable in this model alongside β_0 for making the assumption the unobserved effect a_i has zero mean.

$$Y_{it} = \beta_0 + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta_4 X4_{it} + a_i + U_{it} \quad \text{.....10}$$

Here, the additional variable is:

$X4_{it}$ = Policy effect dummy variable

When we assume that in the above equation the unobserved effect a_i is uncorrelated with the explanatory variables X_{it}, then it becomes a Random effect model.

$$Cov\,(X1_{it}, a_i) = 0,\ t = 1, 2 \ldots T$$

Random effects assumptions include all of the fixed effects assumptions alongside the additional requirement that the a_i is independent of all explanatory variables in all time periods. Here, it is interesting to note that if we hold this assumption true then the β_j can be consistently estimated by using a single cross section instead of using a panel dataset but this will ignore lot of useful information in other time periods. Using the data in a pooled OLS procedure will also produce consistent β_j estimators but will essentially ignore a key feature of the model. Upon defining a composite error term:

$$V_{it} = a_i + U_{it} \quad \text{.....11}$$

We can write the unobserved effects model as

$$Y_{it} = \beta_0 + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta_4 X4_{it} + V_{it} \quad \text{.....12}$$

Because a_i is in the composite error in each time period, V_{it} are serially correlated across time and under the Random effects assumptions

$$Corr(V_{it}, V_{is}) = \sigma_a^2/(\sigma_a^2 + \sigma_u^2), \quad t \neq s \quad \text{.....13}$$

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Where,

σ_a^2 = Var (a_i)

σ_u^2 = Var (U_{it})

This serial correlation in the error term can be quite substantial and the usual pooled OLS standard error ignore this correlation, they will not be correct. To eliminate this problem, we can use a Generalized Least Squares (GLS) transformation for addressing this problem of autoregressive serial correlation. This transformation is essentially:

$$\theta = 1 - [\frac{\sigma_a^2}{\sigma_a^2 + T\sigma_u^2}]^{1/2}, \quad \text{.....14}$$

which is between zero and 1 and transforms the equation into,

$$Y_{it} - \theta\bar{Y_i} = \beta_0(1-\theta) + \beta_1(X1_{it} - \theta\bar{X}_{i1}) + \beta_2(X2_{it} - \theta\bar{X}_{i2}) + \beta_3(X3_{it} - \theta\bar{X}_{i3}) + \beta_4(X4_{it} - \theta\bar{X}_{i4}) + (V_{it} - \theta\bar{V}_i) \quad \text{.....15}$$

In the above equation the overbar denotes the time averages and is an equation that involves quasi-demeaned data on each explanatory variable. The fixed effects estimator subtracts the time averages from the corresponding variable and the random effects transformation subtracts a fraction of that time average, where the fraction depends on σ_a^2 , σ_u^2, and the number of time periods, T. The GLS estimator is simply the pooled OLS estimator of the above equation. This transformation allows for explanatory variables that are constant over time. In the case of this thesis, the MSP policy's procurement operation presence across the states is constant within these 20 years.

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Here, we are assuming that this time invariant variable is uncorrelated with a_i, which may contain unobserved information like state administration quality, inherent quality of soil for agricultural operations, and presence of water bodies.

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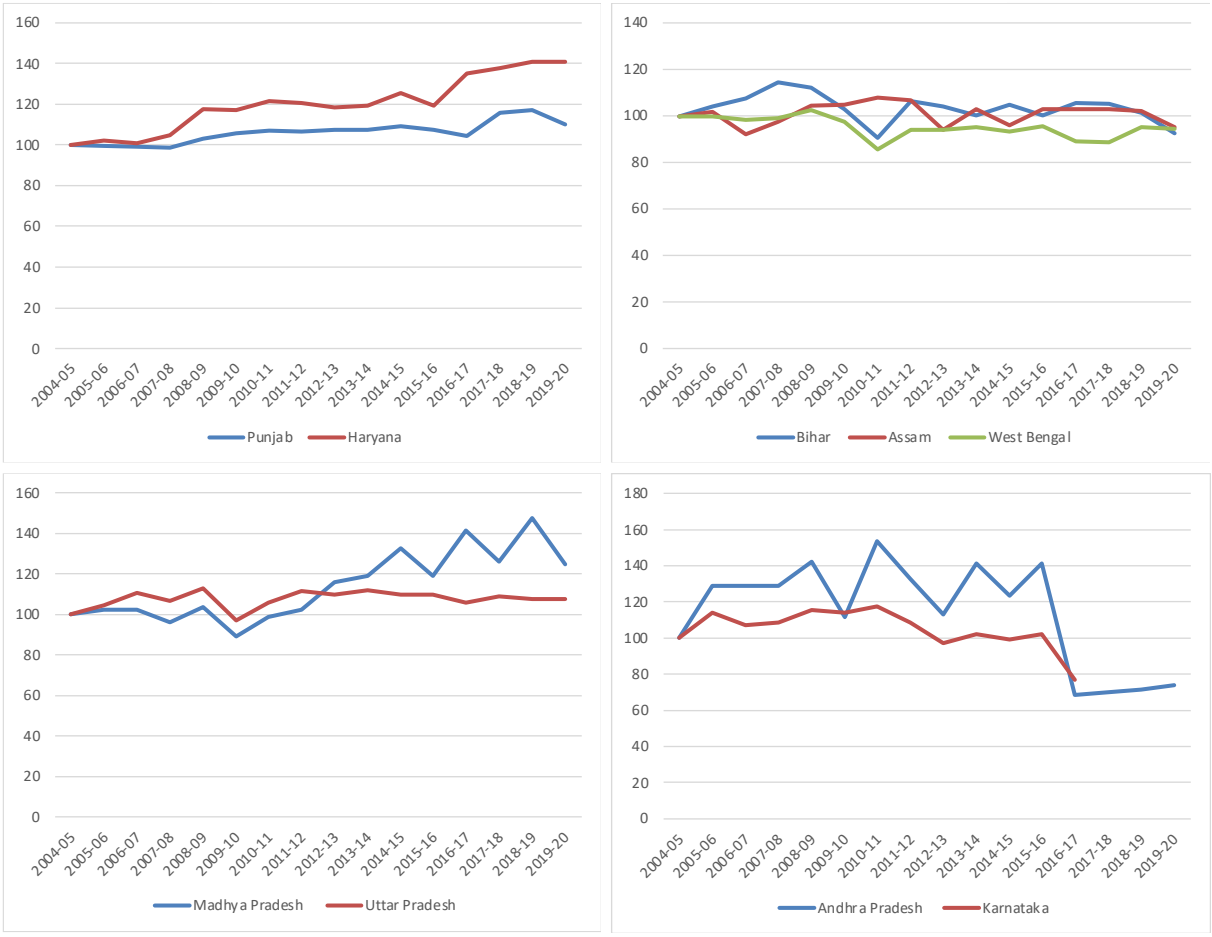
Chapter 5: Policy impacts on crop production characteristics

5.1 Chapter introduction:

In this chapter I have attempted to analyse the impacts of the Minimum Support Prices on three production characteristics of rice and wheat across the 9 selected states in the country. These states are Punjab, Haryana, Bihar, Uttar Pradesh, West Bengal, Assam, Madhya Pradesh, Karnataka and Andhra Pradesh. The logic behind this selection of states is because of its significant contribution to the overall national grain production in the case of either rice or wheat. States like Bihar, West Bengal and Assam can be classified as states where the MSP procurement machinery is absent or minimal and can hence give us a good vantage point of comparing with other states having more procurement activity.

Figure 5.1: 16 year State wise Crop Area Index for Rice



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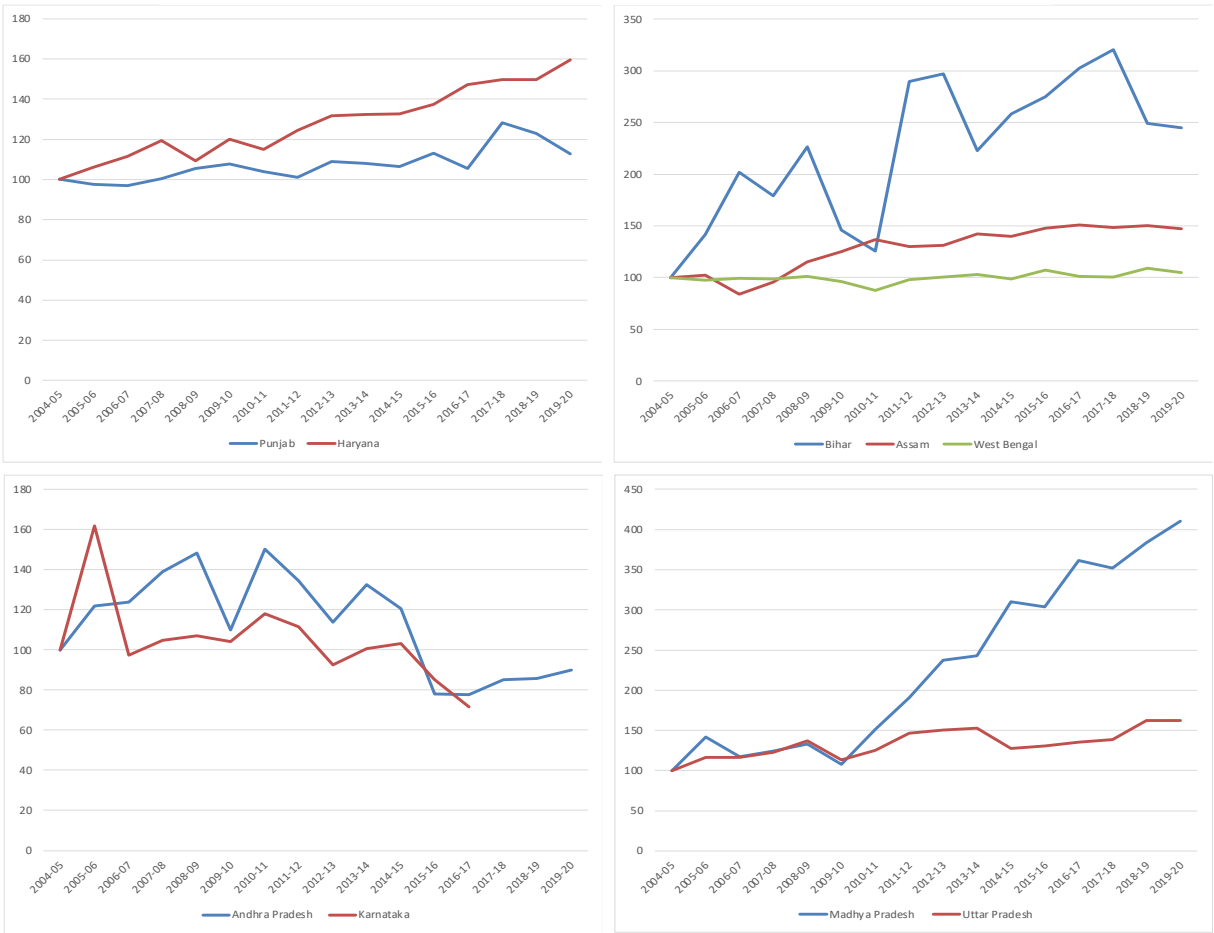
In the Figure 5.1, we can see that the crop area index with a base = 100 in the year 2004-05, has significant ups and downs over the years. The standard deviation ranges from 4.26 in the state of Uttar Pradesh to 28.23 for the state of Andhra Pradesh. The reason for this has been cited by Narayanamurthy and Suresh (2013). In their paper, they mentioned that during the Kharif season of 2011-12, farmers of Andhra Pradesh have declared themselves a 'crop-holiday' in vast areas of paddy cultivation citing poor remuneration from it. The farmers have been constantly demanding a MSP of at least Rs. 2000/quintal of paddy due to the rising costs of inputs.

Figure 5.2: 16 year State wise Crop Production Index for Rice



In terms of production for the crop of rice, we have a relatively stable growth for all the states except for the states of Bihar and Madhya Pradesh. One of the important

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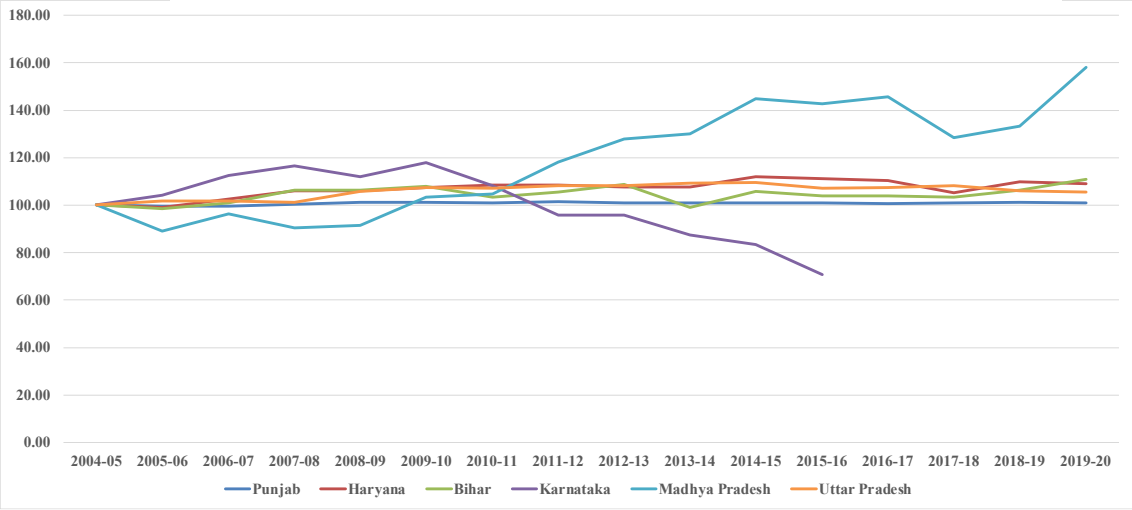
reasons for the production increase in the state of Bihar was the allocation of Rs. 400 crore [1] by the government in 2011-12 under Rastriya Krishi Vikash Yojana for extending the benefits of the Green revolution to the eastern states [2]. The steady growth in the case of Madhya Pradesh can be attributed to its overall food grain production policy which has laid increased emphasis on water availability, increased availability of certified seeds, mechanization, and power availability [3]. The effects of MSP policy variables like inflation adjusted MSPs and procurement quantities for each state will be analysed in an upcoming section of this chapter.

Wheat is another important food grain crop in India, especially considering its importance in the case of the MSP policy as its procurement magnitudes and farmer participation in its cultivation are almost on par with that of Rice in its major production states. However, states like Assam, West Bengal and Andhra Pradesh carry moderate importance from the perspective of procurement operations as data for it are completely lacking in the government databases.

Figure 5.3: 16 year State wise Crop Area Index for Wheat



[1] 1 Crore Rupees = 1,00,00,000 Rupees
[2] Time of India (2012), Rice Production Doubles in Bihar & Jharkhand
[3] Noronha. R (2016), India Today, Grain of Success: Madhya Pradesh farms a green revolution to becomes India's Rice bowl

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In terms of Wheat area cultivated, we can observe a standard deviation ranging from 0.53 for a state like Punjab where the land has reached its peak expansion limit to a standard deviation of 22.77 for the state of Madhya Pradesh which has undergone many state level policy changes with regards to its food grain cultivation sector [4]. The downtrend of Karnataka's major food grain areas (Rice & Wheat) in Figures 5.1 and 5.3 is attributed to decreased crop remuneration due to increased crop-risk brought about by alternating drought and excess rainfall patterns in the state [5].

Similar patterns could be seen in the case of Wheat production and yield with minor increases for states like Punjab and Haryana which have reached its land production peak. Effective state level food grain policy implementation for Madhya Pradesh has led to a 58% growth in wheat crop area, 130% in wheat production and 72% yield improvement.

5.2 Results and discussions

5.2.1 Policy impacts on Planted hectarage:

A. Procurement Quantity

There has been considerable variation in the crop area data for the both the crops in the last 16 years as is evident from Figures 5.1 and 5.3. In this part of the thesis, I have attempted to use the state wise procurement quantities and the inflation adjusted MSP values (in Rupees) as the independent variables to generate estimates for the crop area. Inflation adjusted state GDP and annual rainfall data has also been considered besides the policy variables.

[4] Noronha. R (2016), India Today, Grain of Success: Madhya Pradesh farms a green revolution to becomes India's Rice bowl

[5] Kulkarni. M (2015), Business Standard, Karnataka's food grain production is set to fall 2.3% in FY15

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Table: 5.1. Planted hectarage estimates with Procurement quantities

Variables	Rice			Wheat		
Procurement Quantity	0.000119***	0.000122***	0.000120***	0.000134***	0.000139***	0.000137***
	(0.0000274)	(0.0000260)	(0.0000258)	(0.0000199)	(0.0000204)	(0.0000204)
Real State GDP		-1.69e-08*	-1.58e-08*		1.24e-08	1.31e-08
		(7.89e-09)	(7.86e-09)		(9.76e-09)	(9.77e-09)
Rainfall (mm)		0.000385*	0.000400*		0.000304	0.000310
		(0.000185)	(0.000183)		(0.000258)	(0.000258)
Procure			1.089			3.354
			(1.232)			(2.540)
Constant	2.796***	2.554***	1.810	3.405***	2.908***	0.594
	(0.0740)	(0.249)	(1.049)	(0.0886)	(0.280)	(2.102)
R-squared (Within)	0.127	0.212	0.212	0.351	0.417	0.417
F	18.90	10.06		45.46	17.16	
Groups	9	9	9	6	6	6
N	140	124	124	91	81	81
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

In the Table 5.1, the last column for each crop is a random effect (RE) regression that includes the time-invariant policy variable dummy named ‘Procure’ and the coefficient on this variable is positive but is statistically insignificant for conclusions. In the ‘Wheat’ column the policy variable ‘Procurement Quantity’ has a significant effect on the planted hectarage. Upon including the real state GDP and rainfall variables, the coefficient magnitude practically remains the same. The inference that we can come to from this estimate is that for every 1000 tonne increase in procurement quantity there is an average increase of 134 to 137 hectare increase in Wheat area across these 6 wheat growing states in India. In the case of the Rice models, the addition of the other variables does not seem to change the coefficient on the policy variable too much. The coefficient is very statistically significant and implies that for every 1000

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tonne increase in the procurement of Rice, the crop area is predicted to increase by about 120 hectares on average.

B. Announced/ Nominal MSP

In this sub-section, I attempt to analyse the effects of the nominal or inflation unadjusted MSPs on the planted area of both Rice and Wheat across the 9 states.

Table: 5.2. Planted hectarage estimates with Nominal MSPs

Variables	Rice			Wheat		
MSP	-0.0000309	0.0000753	0.0000672	0.000523***	0.000623***	0.000598***
	(0.0000765)	(0.0000921)	(0.0000973)	(0.000103)	(0.000123)	(0.000142)
Real State GDP		-1.36e-08	-1.02e-08		-3.04e-09	3.66e-09
		(8.89e-09)	(9.32e-09)		(1.17e-08)	(1.34e-08)
Rainfall (mm)		0.000443*	0.000476*		0.000672*	0.000677*
		(0.000206)	(0.000210)		(0.000290)	(0.000329)
Procure			1.549*			4.358***
			(0.733)			(1.047)
Constant	3.140***	2.677***	1.556*	3.294***	2.553***	-0.509
	(0.0907)	(0.290)	(0.705)	(0.135)	(0.333)	(0.983)
R-squared (Within)	0.00127	0.0618	0.0604	0.234	0.296	0.293
F	0.163	2.480		25.93	10.22	
Groups	9	9	9	6	6	6
N	138	125	125	92	82	82
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

From Table 5.2, we can observe some significant results in the case of the wheat crop and in the case of the Rice crop we can see a statistically significant result in the case of the ‘Procure’ variable which is essentially the policy effect. The policy effect for the case of rice means that after controlling the other important variables in the model, the states with procurement operations are expected to have an increase in their rice by

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1.5 million hectares on average. In the case of Wheat this effect is both statistically and practically more significant at about 4.35 million hectare more as compared to the non-policy Wheat growing states. The addition of the real GDP and rainfall variables does not change the coefficient magnitude on the MSP variable by a huge extent and we can draw the inference that for every 1 Rupee increase in the Wheat MSP there is an estimated increase of about 600 hectare in hectarage for the same, ceteris paribas.

5.2.2 Policy impacts on Crop production:

A. Procurement Quantity

In the Table 5.3, we can see that the crop production characteristic for both Rice and Wheat is having a significant impact from the 'procurement quantity' policy variable. In both the cases, the other regressors such as real state GDP, rainfall, fertilizer and tractor sales also show significance. However, in the case of the policy variable, the Table 5.3 tells us that in the case of rice, for every 1000 tonne increase in paddy procurement the crop's production is expected to increase by 537 tonnes. The addition of the other regressors do not seem to practically and statistically influence this estimate by a big margin. This estimate is almost the same in the case of Wheat, however after controlling for the policy effects using the procurement dummy variable, the procurement quantity variable loses significance.

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Table: 5.3. Production estimates with Procurement quantity

Variables	Rice			Wheat		
Procurement Quantity	0.000545***	0.000537***	0.000537***	0.00101***	0.000577***	0.000192
	(0.000100)	(0.0000891)	(0.0000877)	(0.000119)	(0.000135)	(0.000146)
Real State GDP		-4.74e-08	-4.43e-08		0.000000128*	0.000000322***
		(2.68e-08)	(2.64e-08)		(5.40e-08)	(8.19e-08)
Rainfall (mm)		0.00147*	0.00155*		0.00245	-0.00825***
		(0.000624)	(0.000610)		(0.00144)	(0.00139)
Fertilizer		0.000132	0.000245		0.000274	0.0508***
		(0.00378)	(0.00374)		(0.00709)	(0.0111)
Tractor sales		0.0000493***	0.0000489***		0.0000701***	0.000114***
		(0.00000722)	(0.00000716)		(0.0000154)	(0.0000225)
Procure			3.454			3.630*
			(3.218)			(1.518)
Constant	6.454***	3.790***	1.379	8.457***	3.599*	4.581*
	(0.270)	(0.877)	(2.818)	(0.529)	(1.596)	(1.974)
R-squared (Within)	0.186	0.449	0.449	0.459	0.593	0.294
F	29.70	17.80		71.41	20.12	
Groups	9	9	9	6	6	6
N	140	123	123	91	80	80
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

B. Announced/ Nominal MSP

To observe the effects of the price aspect of the policy, we can use the inflation adjusted MSP (real MSP) to obtain the production estimates. In the Table 5.4, we can observe that the inflation-adjusted MSP variable has a positive effect on the production quantities of both the crops. However, the estimate for rice, loses it statistical significance after adding other variables. Controlling for the policy effect using the dummy variable 'Procure' , we find that in the case of rice, the states with procurement operations have a production increase of up to 5.4 and 4.11 million tonnes on average, compared to the non-procurement states for rice and wheat respectively.

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Real MSP also has a significant effect on the production quantities for Wheat, as it is estimated that for every 1 Rupee increase in real terms for the MSP, the production quantity is expected to increase by 17,200 tonnes.

Table: 5.4. Production estimates with Real MSP

Variables	Rice			Wheat		
Real MSP (Base: 2000-2001)	0.00577*	0.00120	0.00136	-0.00518	0.00451	0.0172**
	(0.00264)	(0.00250)	(0.00254)	(0.00525)	(0.00385)	(0.00646)
Real State GDP		-1.80e-08	-1.24e-08		0.000000131*	0.000000270***
		(3.06e-08)	(3.09e-08)		(5.99e-08)	(7.36e-08)
Rainfall (mm)		0.00162*	0.00172*		0.00273	-0.00911***
		(0.000726)	(0.000712)		(0.00160)	(0.00132)
Fertilizer		0.00492	0.00527		0.00851	0.0563***
		(0.00424)	(0.00430)		(0.00769)	(0.0104)
Tractor sales		0.0000428***	0.0000416***		0.000108***	0.000118***
		(0.00000844)	(0.00000855)		(0.0000148)	(0.0000215)
Procure			5.486*			4.112**
			(2.447)			(1.251)
Constant	4.814***	3.840*	-0.142	15.65***	0.807	-4.570
	(1.399)	(1.747)	(2.781)	(3.186)	(2.927)	(4.142)
R-squared (Within)	0.0352	0.268	0.267	0.0113	0.512	0.267
F	4.784	8.041		0.974	14.69	
Groups	9	9	9	6	6	6
N	141	124	124	92	81	81
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

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5.2.3 Policy impacts on Rice and Wheat yield rates:

A. Procurement Quantity

Under the backdrop of the 2020 farmers protests in India, Das (2022) investigates an endogenous growth model incorporating MSP as the public policy variable and empirical analysis of whether MSP has long-run relations with yield rates and total quantity of production of different food and non-food crops from 1983 to 2019. However the above study considered national level, time series aggregate production data and therefore the results would hide more information than it reveals. This can be attributed to the fact that MSP is not implemented equally across all the states. I have manage to manually collect and compile a panel data set from various publications and attempt to provide a more controlled result with the help of fixed effect regression.

Figure 5.4 (a): Rice average yield, MSP and Procurement indexes

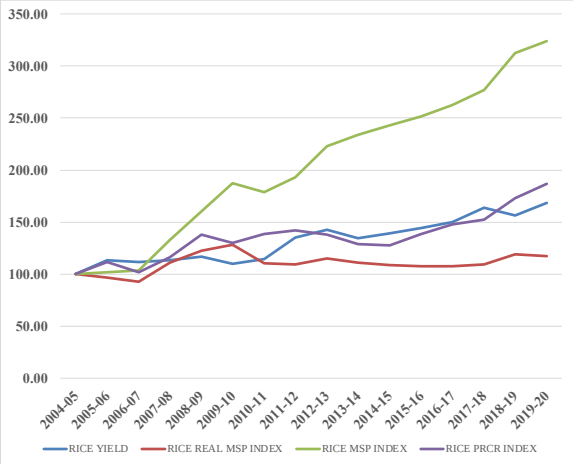

Figure 5.4 (b): Wheat average yield, MSP and Procurement indexes

The above figures represent the policy variables and the yield figures of both the crops over a 16 year period with a base = 100 to present a clearer picture of where those variables truly stand. With regards to the MSP in real terms, there has only been a slight increase for the both crops. However, the procurement levels have steadily increased

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over the years for Rice, with Wheat procurement having a higher standard deviation of 49.58 as compared to 23.11 in the case of Rice. The yield in the case of rice show a higher correlation with the procurement levels but the policy's true influence on this variable will be discussed later. It is important to note that the above figures gives us an overall view that is representative of the entire country as a whole and strong conclusions should not be drawn from them with regards to the policy effect.

Table: 5.5. Yield estimates with Procurement quantities

Variables	Rice			Wheat		
Procurement Quantity	0.0475	0.0450	0.0616*	0.145***	0.0882***	0.171***
	(0.0269)	(0.0253)	(0.0250)	(0.0180)	(0.0221)	(0.0188)
Rainfall (mm)		0.0573	0.0482		0.355	-1.782***
		(0.178)	(0.172)		(0.234)	(0.191)
Fertilizer		-1.946	-2.158*		-0.172	-2.470
		(1.080)	(1.096)		(1.162)	(1.437)
Tractor Sale		0.0114***	0.0109***		0.00928***	0.000596
		(0.00206)	(0.00209)		(0.00251)	(0.00296)
Procure			282.5			-184.9
			(479.1)			(204.5)
Constant	2429.5***	2124.1***	1946.0***	2406.4***	1946.1***	4106.4***
	(72.61)	(228.2)	(474.2)	(79.96)	(232.5)	(266.6)
R-squared (Within)	0.0234	0.226	0.222	0.438	0.491	0.154
F	3.117	8.037		65.35	16.91	
Groups	9	9	9	6	6	6
N	140	123	123	91	80	80
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

According to Table 5.5, the fixed and random effect analysis, we can see that the procurement variable does have a positive impact on the yield rates of both the crops. In the case of Rice the procurement quantity variable becomes significant only after adding the policy effect dummy variable and it estimates that for every 1000 tonnes

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increase in procurement, the Rice yield is expected to increase by 61.6 gm. In the case of Wheat, we have very statistically significant estimates in each column with the final column estimating an increase in yield by 171 gm for every 1000 tonne increase in procurement.

B. Nominal and Real MSPs

Table 5.6. Yield estimates with MSP variables

Variables	Rice			Wheat		
MSP	0.476***	0.473***	0.485***	0.776***	0.655***	1.153***
	(0.0568)	(0.0949)	(0.0991)	(0.0722)	(0.123)	(0.243)
Rainfall (mm)		0.328	0.235		0.730**	-1.853***
		(0.171)	(0.166)		(0.222)	(0.253)
Fertilizer		-1.520	-1.567		0.583	0.465
		(0.964)	(1.023)		(1.033)	(1.899)
Tractor Sale		0.00301	0.00214		0.00394	-0.0184***
		(0.00246)	(0.00254)		(0.00276)	(0.00431)
Procure			800.7*			888.4***
			(380.2)			(241.4)
Constant	2006.2***	1649.5***	1242.5**	2006.1***	1307.9***	3192.6***
	(67.36)	(233.1)	(427.4)	(95.37)	(243.0)	(475.6)
R-squared (Within)	0.354	0.350	0.347	0.576	0.561	0.0275
F	70.13	14.91		115.5	22.71	
Groups	9	9	9	6	6	6
N	138	124	124	92	81	81
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

To analyse the yield with the CPI-adjusted and un-adjusted MSP values, I find some interesting results. The real MSP variable is not being able to provide us with a statistically significant result but the un-adjusted policy variable is conforming to the intuition that higher MSP's does lead to higher yield for both the crops. This intuition

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can be supported by the farmers belief that investing more in their crop production will complement their farm returns when backed by an ever increasing nominal MSP. The inference that we can draw from our analysis is that in the case of Rice, for every 1 Rupee increase in its MSP, its yield is estimated to increase by about 485 grams on average after controlling for input and rainfall variables. In the case of Wheat, this estimate is about 1153 grams. The policy effect can be seen in the 'Procure' dummy variable estimate and is in accordance with the intuition that policy states will perform better in comparison to non-policy states. In the case of both the crops, yield estimates are similar and much higher than the states where procurement has not occurred and is higher by about 800 gm.

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Chapter 6: Policy implications of Wheat and Rice marketed surplus

6.1 Chapter introduction:

In the post-independence agriculture scenario, the Phase IV (1990 - Present) included major Economic reforms for the agricultural sector of India. These reforms have ultimately translated into significant changes with regards to increased market orientation for the farming community. In addition to the policy reforms, this could also be attributed to the process of urbanization, dietary diversification, technological improvements, export expansions, and infrastructure improvements. The age old farming tradition involved allocation of a significant portion of farm production for self-consumption, which has now changed to increasingly produce for the market (Sharma, 2011 and Sharma and Wardhan, 2014). Considering this very fact, Sharma (2016) have conducted a study on finding the determinants and distribution of marketable and marketed surplus in the case of rice and wheat in India. In this study, he points out the apparent monopsony of the government in the case of procurement for both these crops. He reports a range of 63% of total production being sold in the market for the marginal farmers to about 81% for the medium and large farmers. The study also reports that despite the increase in total production, per capita availability of food grains and higher food stocks, the prices of food grains were still relatively higher. The reason for this was cited as the marginal surplus or deficit in food grain availability having a significant effect on the price level.

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In context of the MSP policy, in this chapter, I attempted to use the procurement quantity as a dependent variable for estimating the contemporary and lagged marketed surplus ratios for both the crops.

Figure 6.1 (a): 12-year average Wheat MSR, Stock and Procurement indexes

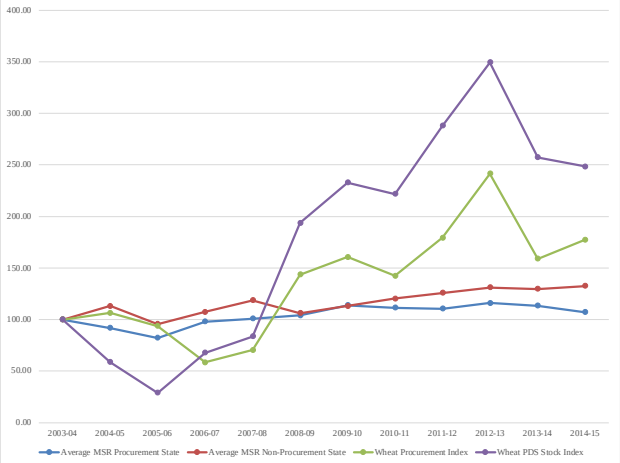
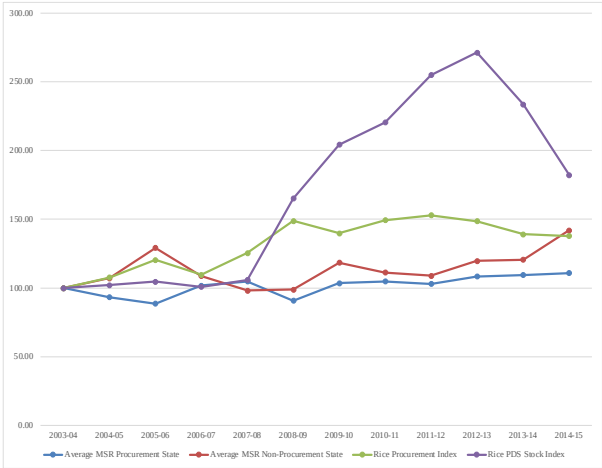


Figure 6.1 (b): 12-year average Rice MSR, Stock and Procurement indexes



The above figures represent yearly averages for the marketed surplus ratios across the 9 different rice and wheat growing states of India. These MSRs have been differentiated into the policy vs non-policy states and it is interesting to observe from a hindsight that in both cases, the average marketed surplus levels are generally seen to be higher in the non-policy states. The procurement quantities are seen to be having a minor effect in the MSR values, however we cannot jump to any conclusions from the above descriptive statistics due to unequal policy implementation and heterogenous agricultural characteristics across the states.

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6.2 Results and discussion:

A. Procurement Quantity

Upon performing a fixed and random effect regression for both the crops, we obtain the following estimates in Table 6.1. The estimates for rice is not statistically significant but fortunately, in the case of Wheat we have some worthwhile findings. In the parsimonious column with only the MSR variable, we find that for every 1% increase in the MSR, the procurement quantity for wheat is estimated to increase by 66.69 thousand tonnes. After including production and yield variables into the model, this estimate increases to 73.69 thousand tonnes with an increase in the statistical significance.

Table 6.1. Procurement estimates with Marketed Surplus Ratio and its lag

Variables	Rice			Wheat		
MSR	-9.360	-19.42	-16.83	66.69*	5.776	73.69**
	(10.23)	(11.40)	(11.43)	(26.38)	(25.60)	(28.20)
L.MSR		-0.868	4.571		40.64	90.12**
		(11.30)	(11.21)		(24.91)	(29.06)
Production		486.7**	312.0**		330.3	72.87
		(147.7)	(121.0)		(176.1)	(51.43)
Yield		-0.752	-0.0713		0.891	1.316***
		(0.569)	(0.508)		(1.211)	(0.346)
Procure			2037.4			2455.2**
			(1690.1)			(939.0)
Constant	2981.5***	2040.4	-320.9	-529.7	-6411.9*	-14733.3***
	(803.6)	(1220.5)	(1685.3)	(1935.0)	(2461.5)	(2211.1)
R-squared (Within)	0.00856	0.143	0.125	0.113	0.463	0.369
F	0.837	3.551		6.388	9.257	
Groups	9	9	9	5	5	5
N	107	98	98	56	52	52
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

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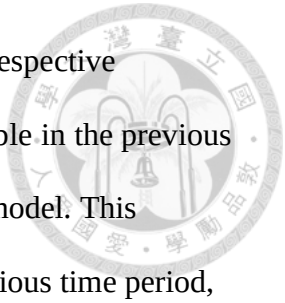

However, since the decision on the procurement levels by the respective government bodies is also dependent on the marketing surplus available in the previous harvesting season, a lag variable for the MSR was also added to the model. This variable estimates that for every 1% increase in the MSR for the previous time period, there is an expected increase in procurement for Wheat by about an average of 90 thousand tonnes, ceteris paribas. The policy effect dummy variable 'Procure' is statistically quite significant in the case of the Wheat crop and it estimates that after controlling for the other variables in the model, states with procurement operations are expected to have an average increase of 2455.2 tonnes in Wheat procurement as compared to non-procuring states.

For determination of the market surplus there may be many price and non-price determining factors like availability of cultivated land under that crop, family size, income, risk and uncertainties. Understanding these relationships can help the policy makers in designing and implementing better policies relating to agricultural marketing, buffer stocks, market infrastructure etc.

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B. Nominal MSPs

Table 6.2. Nominal MSP estimates with Marketed Surplus Ratio and its lag

Variables	Rice			Wheat		
MSR	11.64***	7.678*	4.674	20.26***	12.68***	11.26***
	(2.922)	(3.002)	(2.667)	(3.572)	(3.099)	(2.991)
L.MSR		4.484	-0.0151		10.93***	11.49***
		(2.964)	(2.585)		(3.016)	(3.082)
Production		78.29*	15.22		-4.738	26.95***
		(38.93)	(9.163)		(21.32)	(5.455)
Yield		0.0766	-0.0380		0.248	-0.115**
		(0.150)	(0.0519)		(0.147)	(0.0367)
Procure			-100.2			-145.7
			(75.83)			(99.60)
Constant	6.478	-780.5*	626.0***	-401.2	-1343.5***	-433.0
	(229.2)	(321.2)	(141.5)	(261.5)	(298.0)	(234.5)
R-squared (Within)	0.139	0.287	0	0.387	0.646	0.586
F	15.86	8.647		32.15	19.65	
Groups	9	9	9	5	5	5
N	108	99	99	57	52	52
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

The MSPs are determined by the Commission for Agricultural Costs and Prices (CACP) and during this process, the commission keeps in view the various Terms of Reference (ToR) [6] given to it in 2009. These reference points for MSP determination include aspects like farmer incentive, rational resource utilization, wage impacts, cost of living and competition. However, in Table 6.2, I have attempted an analysis to observe for any hidden linkages between the MSP and the MSR for a specific crop. We have some significant estimates for both the crops in the case of the contemporary MSR variable. In the case of rice, when controlling for variables like production and yield, it is estimated that for every 1% increase in MSR the expected MSP will increase by Rupees 7.6. In the case of Wheat, the estimates are more significant and reduces from

[6] https://cacp.dacnet.nic.in/ViewContents.aspx?Input=1&PageId=33&KeyId=0

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Rs. 20 in the parsimonious column to Rupees 11 when production and yield are controlled alongside the policy dummy variable. This finding does make intuitive sense as increasing MSR will lead to more farmers demanding for more remunerative crop disposal mechanisms from the government, which is essentially the MSP procurement machinery.

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Chapter 7: Policy impacts on agricultural input use.

7.1 Chapter Introduction

The cornerstone of any major agricultural revolution can be mainly attributed to the farmer's access to the modern agricultural inputs. These inputs can range from improved seeds, crop protection chemicals, and fertilizers to improved mechanical requirement for irrigation and cultivation. This chapter is dedicated to the effects of the MSP policy on the use of three major agricultural inputs. These are namely, fertilizer use, tractor sales, and electricity consumed by agriculture.

7.1.1 Impacts on fertilizer consumption

The fertilizer input is an important part of any agricultural operation and the typical non-organic mix is composed of three major elements, namely, nitrogen, phosphorous, and potassium. These are also referred to as NPK across the sector as well as in the literature. This chapter uses the total quantity of NPK used instead of the respective elements.

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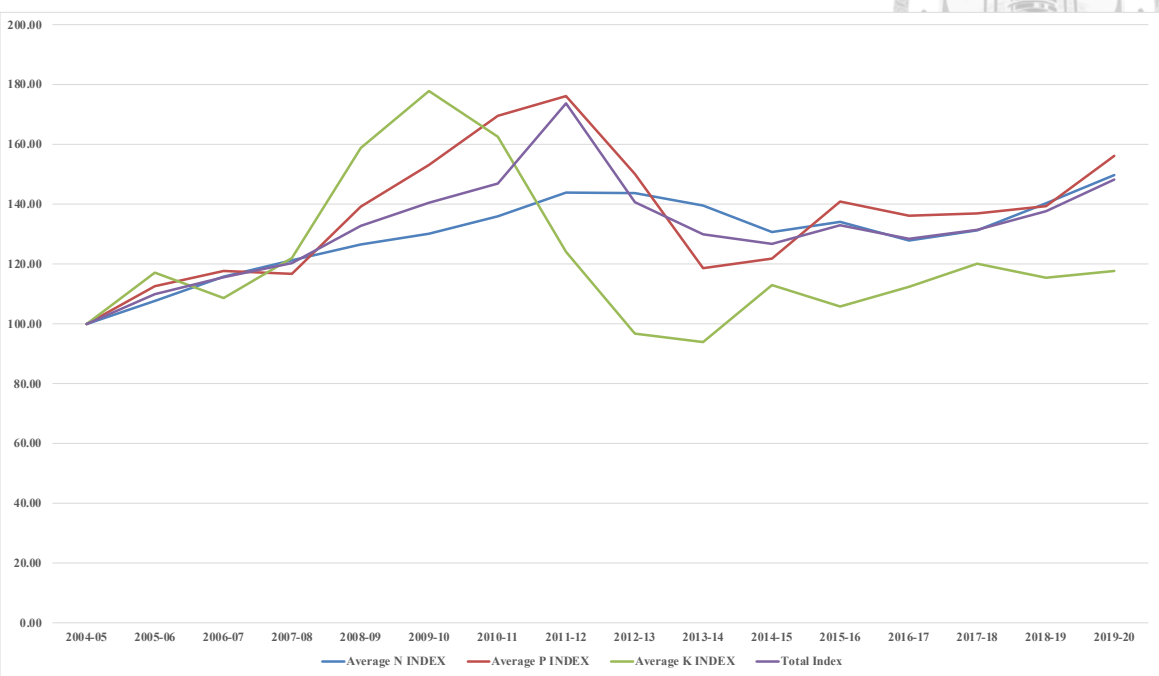
Figure 7.1. 16 year average NPK Indexes along with total fertilizer index



The popularity of chemical fertilizers has risen along with the introduction of modern agricultural practices. In a study by Pathania, Chaudhary and Kumar (2020), they found that in the last two decades the total fertilizer consumption has shown only moderate compounded annual growth of 2.54% in their 2001-02 to 2017-18 study period. In the upcoming sections, I observe the possible policy effect on this input. In Figure 7.1, we can observe that the average K (Muriate of Potash/MoP) index had a major downward trend since 2009-10 until 2013-14. The reason for this has been citied in an article in The Economic Times [7] as the rising global prices of MoP which encouraged the farming community to use more of Urea (N- fertilizer) as is evident from the blue line in the same figure. However, the role of the state-wise procurement activities and the impact of CACP announced MSP on the state-wise fertilizer consumptions will be seen in the upcoming section.

[7] The Economic Times (2012), Potash Consumption by Indian farmers drops by 23% on high global prices

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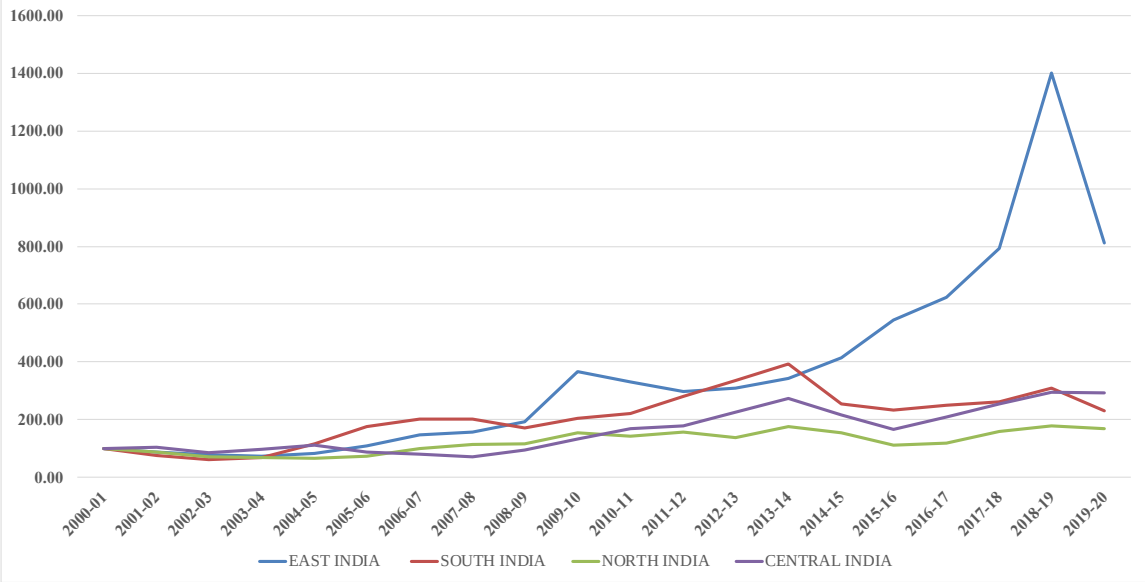
7.1.2 Impacts on Tractor sales:

Regarding the tractor/power-tiller input, in a country like India where farming and agriculture is the leading occupation of a majority of the people, a tractor plays a vital role in the life of a farmer. It has the capacity for delivering several benefits to the farmers and in-turn reduce their drudgery by a large extent.

Figure 7.2. 20 year zonal tractor sales index



Tractors play a pivotal role in any farm across the world as its usage saves in precious time and human resources along with providing for multifaceted use case scenarios by being able to be provide onsite power for other farm equipment. In the Figure 7.2 we can observe the steady growth of Tractor sales across the Central, North and South Indian states, however, the eastern zones have seen a major boost in tractor sales in the last decade and a major portion of this growth is attributed to the state of Assam. Electricity has also become a necessity in the India's agriculture sector over the decades of reform. This sector has traditionally depended on animal and human power for its various operations but the availability of commercial power has influenced the shift towards energised groundwater irrigation and mechanisation.

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7.1.3. Impacts on electricity used by the agricultural sector:

Figure 7.3 (a): 14-year zonal electricity for agriculture index

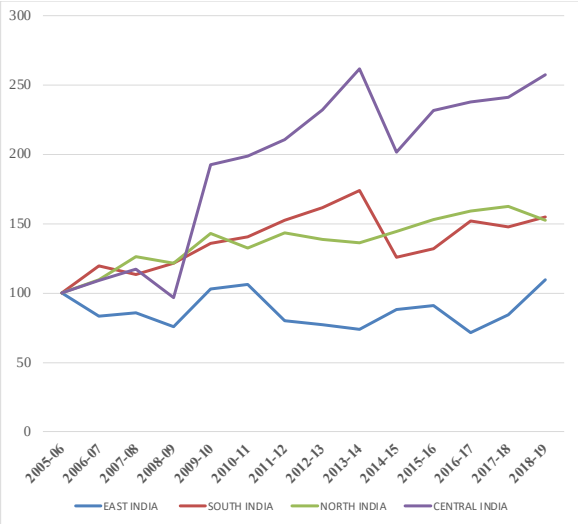
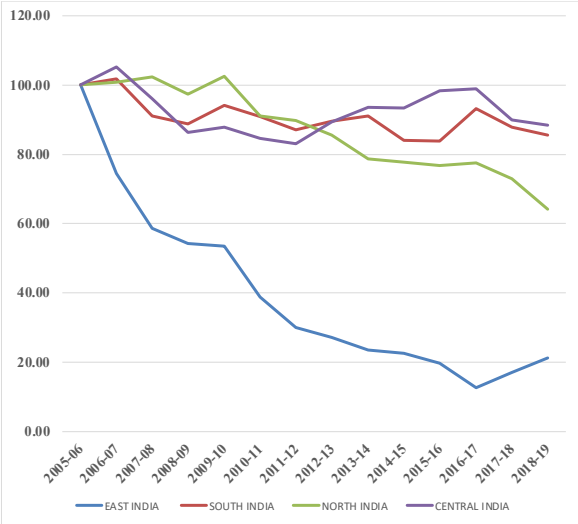


Figure 7.3 (b): 14-year zonal electricity for agriculture share in total index



From the Figure 7.3 (a), we can see that there has been a steady growth in electricity consumption for agriculture in all the four zones of the country with the eastern Indian states showing the least amount of growth. Figure 7.3 (b) on the other hand shows us the relative contribution of the electricity consumed by agriculture over the years. Due to rapid progress in other energy intensive sectors, we can observe a downward trend across all the zones. Ghosh & Nilabja (1998) have mentioned in their paper that the energy use in this sector is growing faster than its GDP along with its electricity consumption for every unit value of output generated. They compare this energy use intensity to the industrial sector and reveals that it has been stable for the past two decades. They attribute the inefficiency of the agriculture sector with regards to electricity use to the fact that this sector has been subject to the state government's power subsidies along with the central government's price policy. The real rate of electricity tariff has been decreasing and is negatively correlated to the electricity consumption. Researchers have questioned the multiple state governments decisions on

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heavy electricity subsidies because when weighed together with the MSP policy, it is rather meaningless since the MSP stay the benchmark for crop prices anyways.

7.2 Results and Discussions:

7.2.1 Policy effect on fertilizer use

A. Procurement Quantity

Table 7.1. Fertilizer use estimates from procurement quantities

Variables	Rice			Wheat		
Procurement quantity	0.00506*	0.00116	0.00117	0.00460**	0.00268	0.00151
	(0.00204)	(0.00279)	(0.00271)	(0.00154)	(0.00264)	(0.00262)
L.Procurement quantity		0.00291	0.00257		0.00148	-0.0015
		(0.00279)	(0.00271)		(0.00272)	(0.00258)
Production		3.656	3.228		-0.171	4.813***
		(2.042)	(1.789)		(1.879)	(0.5980
Rainfall		-0.00874	-0.00155		-0.0126	0.0531***
		(0.0164)	(0.0144)		(0.0241)	(0.0128)
Procure			-28.99			-10.56
			(30.69)			(15.1)
Constant	59.53***	43.86*	58.48	50.71***	65.04*	-30.89
	(5.422)	(21.4)	(32.14)	(6.629)	(26.3)	(18.58)
R-squared (Within)	0.0447	0.0708	0.0693	0.0933	0.0519	0.00843
F	6.173	2.078		8.954	0.944	
Groups	9	9	9	6	6	6
N	142	122	122	94	79	79
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

From Table 7.1, the parsimonious model of both the crops show us that procurement quantities have a positive relationship with the fertilizer quantities consumed. In the case of Rice crop the coefficient predicts that for every 1000 tonne increase in the procurement quantity of Rice the total NPK fertilizer consumption will increase by 5.06 tonnes. In the case of Wheat, this estimate is quite similar at about 4.06

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tonnes. However, after controlling for the policy lag variable by one year and other variables like production, the results become statistically insignificant. The policy effect is also statistically insignificant for this argument.

Table 7.2. Fertilizer use estimates from MSP

Variables	Rice			Wheat		
MSP	0.0125*	0.00676	-0.0147	0.0176*	0.00407	-0.151*
	(0.00545)	(0.00768)	(0.0345)	(0.00705)	(0.0126)	(0.0588)
L.MSP			0.0229			0.154**
			(0.0348)			(0.0595)
Production		3.768	3.581		2.372	3.862***
		(2.046)	(1.837)		(1.708)	(1.002)
Rainfall		-0.00250	0.000507		-0.000746	0.0290
		(0.0173)	(0.0156)		(0.0263)	(0.0188)
Procure			-16.51			-15.14
			(37.45)			(24.89)
Constant	56.96***	37.25	46.55	45.61***	33.47	13.32
	(6.504)	(23.12)	(39.05)	(9.474)	(27.21)	(32.34)
R-squared (Within)	0.0390	0.0559	0.0592	0.0664	0.0569	0.119
F	5.231	2.210		6.256	1.449	
Groups	9	9	9	6	6	6
N	139	124	124	95	81	81
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

B. Nominal MSP

Table 7.2. presents the estimates for fertilizer consumption from the yearly minimum support prices for both the crops. Similar to the other policy variable, we can see that in the first column for both the crops there is a significant and positive linkage between the two variables. It predicts that for every 1 Rupee increase in the rice and wheat MSP, there is an estimated 12.5 and 17.6 tonnes increase in total fertilizer consumption respectively. However, after controlling for a one year MSP variable along with production and rainfall variables, there is a negative linkage between the policy

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variable and the fertilizer variable only for wheat. This result does not seem to be that meaningful, but upon observing the lagged MSP coefficient in the case of Wheat, we can find a statistically significant result which show positive effect on the dependent variable. This result can provide us with a more intuitive insight as the previous year's MSP is more likely to influence the farmer's farming decision. It estimates that for every 1 Rupee increase in the wheat MSP for the previous year, there is an increase in fertilizer consumption by 154 tonnes.

7.2.2 Policy effect on tractor sales

Although tractor sales may not completely depend on the quantity of procured harvest by the government agencies, it would still be interesting to see the results of this specific model.

A. Procurement Quantity

Table 7.3. does not seem to give us very intuitive estimates for the policy variable and its one year lag. In the case of Rice, the addition of the production, yield and real state GDP variables results in the policy variable becoming more significant but its negative correlation with the dependent variable leaves more of the question unanswered.

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Table 7.3. Tractor sales estimates based on procurement quantities

Variables	Rice			Wheat		
Procurement quantity	2.096	-3.960***	-3.589**	5.799***	1.490	0.421
	(1.200)	(1.093)	(1.362)	(0.818)	(1.012)	(1.368)
L.Procurement quantity			0.649			0.240
			(1.341)			(1.378)
Production		6521.9***	4200.6***		3339.2**	2253.1***
		(1003.7)	(865.6)		(1030.4)	(391.2)
Yield		6.424	6.927		2.869	-8.787**
		(4.037)	(3.718)		(6.765)	(2.719)
Real State GDP		0.000999***	0.000979**		0.000505	0.000840*
		(0.000294)	(0.000299)		(0.000363)	(0.000388)
Procure			-367.4			-3227.7
			(11667.2)			(7135.2)
Constant	24639.6***	-37686.9***	-23232.3*	14736.2***	-23418.2*	26725.2***
	(3007.5)	(8106.6)	(11181.5)	(3324.7)	(11661.5)	(7049.7)
R-squared (Within)	0.0184	0.452	0.442	0.317	0.546	0.412
F	3.050	26.23		50.23	24.39	
Groups	9	9	9	6	6	6
N	173	140	139	115	91	90
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

However, the coefficient on the production and GDP values are highly significant and reasonable as its growth can influence the growth in tractor sales much more than procurement quantities in a direct way. A similar story can be found in the case of wheat but in this case the parsimonious column does have a very statistically significant result which is also positively related to the dependent variable. On addition of the production, yield and GDP variables, this statistical significance goes away and the coefficients on these variables are more influential with regards to tractor sales as compared to the procurement quantities.

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Table 7.4. Tractor sales estimates based on MSP

Variables	Rice			Wheat		
MSP	24.91***	20.67***	21.53***	30.34***	26.54***	33.76***
	(1.886)	(3.091)	(3.063)	(2.383)	(4.773)	(3.847)
Production		3367.7***	2968.5***		4255.7***	2333.3***
		(840.3)	(779.8)		(843.4)	(275.9)
Yield		-0.219	-1.386		-14.05*	-13.18***
		(3.988)	(3.744)		(6.611)	(1.606)
Real State GDP		-0.0000636	-0.0000294		-0.000233	-0.0000266
		(0.000276)	(0.000271)		(0.000336)	(0.000292)
Procure			4099.8			7408.7
			(15755.9)			(4684.6)
Constant	3233.6	-16842.8*	-14227.7	899.7	-2276.4	2222.4
	(2058.3)	(8092.9)	(13860.1)	(2939.7)	(10697.8)	(5329.4)
R-squared (Within)	0.512	0.519	0.517	0.589	0.672	0.629
F	174.4	33.74		162.0	42.06	
Groups	9	9	9	6	6	6
N	176	138	138	120	92	92
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

Table 7.4. contains the estimates generated from the yearly MSPs announced by the government. We can see that we obtain statistically significant results in the case of both crops. After controlling for production, yield, and real state GDP variables the estimates on the MSP variables do not seem to change as much, however it is worth pointing out that it does increase the standard errors. In the case of rice, the estimates predict that for every 1 Rupee increase in the MSP, the sale of Tractors will increase by about 21 units after controlling for the other variables. For Wheat, this estimate is slightly higher at about 33 tractors for every unit increase in MSP. The production estimates are also equally influential as was the case having procurement quantities as

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dependent variables. However, the policy effect estimate given by the 'Procure' dummy is not statistically significant for us to draw any rigorous conclusions.

7.2.3. Policy effect on agricultural electricity consumption

A. Procurement Quantity

Table 7.5. Agricultural electricity estimates based on procurement quantities

Variables	Rice			Wheat		
Procurement quantity	0.412	-0.0963	0.0289	0.876***	0.191	0.490
	(0.261)	(0.278)	(0.320)	(0.207)	(0.194)	(0.265)
L.Procurement quantity			0.297			0.988***
			(0.308)			(0.269)
Production		875.1**	394.2		770.2***	-282.3***
		(268.1)	(237.2)		(216.9)	(76.94)
Yield		-2.758*	-1.507		-1.185	-2.968***
		(1.066)	(0.988)		(1.343)	(0.536)
Real State GDP		0.000216**	0.000177*		0.000310***	0.000674***
		(0.0000738)	(0.0000733)		(0.0000673)	(0.0000779)
Procure			2014.1			3557.5*
			(3776.8)			(1479.3)
Constant	7535.3***	6066.8**	4789.8	6125.7***	-1539.2	4775.2***
	(686.1)	(2279.9)	(3464.8)	(884.2)	(2269.5)	(1407.4)
R-squared (Within)	0.0213	0.145	0.130	0.193	0.584	0.324
F	2.486	4.621		17.90	24.17	
Groups	9	9	9	6	6	6
N	124	122	121	82	79	78
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

Like the other variables, electricity used in agriculture sector will also depend on policy variables for other crops. Considering the fact that rice and wheat on average account for a major share of state agricultural operations, is expected to provide us with some conclusive estimates for this input use. It is also worth mentioning that most of the electricity consumed by agriculture is for irrigation pump operation. Upon conducting the analysis, we find that only the parsimonious model in the case of wheat has a

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significant estimate, which loses its statistical relevancy after adding production, yield and GDP variables. Therefore, we can safely conclude that procurement quantities have no significant effect on the electricity consumed by the agricultural sector of a state. The policy effect is positive for both cases but is only statistically significant in the case of Wheat, which essentially estimates that, as compared to non-procuring states the electricity consumed by agriculture will be higher by 3557.5 GwH [8].

B. Nominal MSP

Table 7.6. Agricultural electricity estimates based on MSPs

Variables	Rice			Wheat		
MSP	3.436***	3.628***	3.664***	7.526***	4.350***	7.334***
	(0.721)	(0.882)	(0.871)	(0.803)	(0.963)	(1.266)
Production		154.1	85.08		545.0***	23.95
		(231.1)	(216.6)		(119.1)	(90.46)
Rainfall		1.622	1.378		-3.773*	6.679***
		(1.900)	(1.796)		(1.763)	(1.731)
Procure			5432.7			6791.8**
			(5347.8)			(2172.1)
Constant	4521.3***	1196.8	-1577.9	-213.0	345.0	-11013.2***
	(865.1)	(2642.0)	(5195.0)	(1073.2)	(1983.6)	(3189.3)
R-squared (Within)	0.165	0.172	0.170	0.536	0.617	0.384
F	22.72	7.108		87.78	35.47	
Groups	9	9	9	6	6	6
N	125	115	115	83	75	75
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

Table 7.6 presents the electricity estimates consumed by the agriculture sector, divided by the rice and wheat crops. Here, the MSP variable is the independent variable

[8] GwH – Giga Watt per Hour

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and its coefficient estimates are producing significant estimates for this input consumption. In the case of rice, the estimate and its standard error does not seem to be changing by a large amount even after controlling for production and rainfall variables. It estimates that for every 1 Rupee increase in the MSP, the electricity consumed by agriculture is expected to increase by 3.6 GwH. In the case of wheat, the estimate tends to decrease after controlling for the production and rainfall variables but rises after adding the policy effect dummy variable 'Procure'. It estimates that for every 1 Rupee increase in the MSP, the electricity consumed will increase by about 7.3 GwH on average. These estimates do make practical sense since wheat is sown during the Winter season and it is usually drier during that time, and therefore it requires more irrigation operations resulting in more electricity consumption. The policy effect is also positive and statistically significant in the case of Wheat and it estimates an average increase in electricity consumption by 6791.8 Gwh for the procuring states upon Rupee 1 increase in MSP.

Increase in the MSP will also lead farmers to grow more of this crop, which also helps explain the results.

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Chapter 8: Policy impacts on Agricultural Costs and Prices

8.1. Chapter Introduction

The economic viability of the crop production sector is an essential point of discussion across many policy decision making processes along with sustaining the interests of the farming community. A part of this importance stems from the fact that the agricultural sector in India engages more than 60 percent of the rural workforce and inherently partakes in improving the overall welfare of society. In 2013, National Sample Survey Office conducted its 70th round of the Situation Assessment Survey and it shows that nearly 50 percent of the farmers' income comes from crop cultivation. In this context, it becomes crucial for the farming community and policy makers to maintain accurate information on the latest cost of production (COP) numbers. This is especially true in the case of devising the yearly MSPs and in the case of farmers' decisions with regards to allocation of limited resources among alternate crop choices.

8.1.1 Cost of Production (COP)

As mentioned in the introductory chapter, the Commission for Agricultural Costs and Prices (CACP) in the Ministry of Agriculture would recommend MSPs for 23 crops and it considers various factors while recommending the MSP for a commodity which also includes the costs of production for that crop. However, in the Budget for 2018-19, it was announced that MSP would be fixed at one and half times the production cost as a pre-determined principle. This essentially meant that the CACP's job for MSP determination had gotten simpler as they can just use this '1.5 times the production cost' formula. It is also worth mentioning that the CACP, does not do any field-based cost by itself and merely makes estimates based on data published by the Directorate of

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Economics and Statistics (EANDS) under the Ministry of Agriculture and Farmers Welfare. Based on this publication by the EANDS, the CACP further projects estimates for every crop at the state and national levels. In their database, A2 costs cover all paid out costs directly incurred by the farmer both in cash and kind on various inputs like seeds, fertilizers, pesticides, hired labour, leased in land, fuel, irrigation etc. A2+FL costs include the previous costs including the imputed value of unpaid family labour. However, for our purposes, I have used the more comprehensive 'Revised C2' costs which factors in rentals and interest forgone on owned and fixed capital assets on top of the 'A2+FL' costs.

Figure 8.1 (a): 14-year Nominal COP per quintal of Rice and MSP index

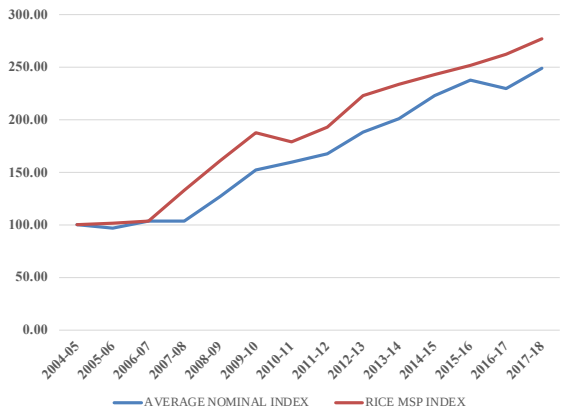


Figure 8.1 (b): 14-year Nominal COP per hectare Rice and MSP Index

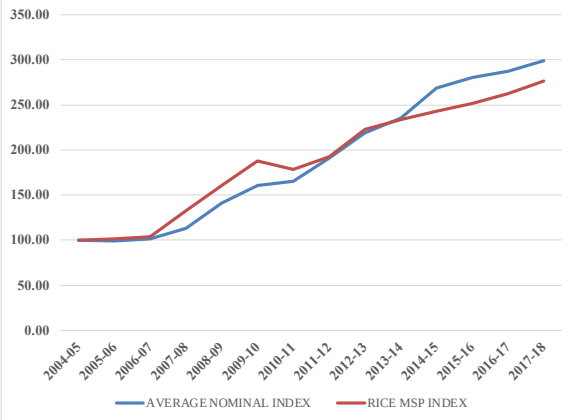


Figure 8.1 (c): 14-year Real COP per quintal of Rice and MSP index

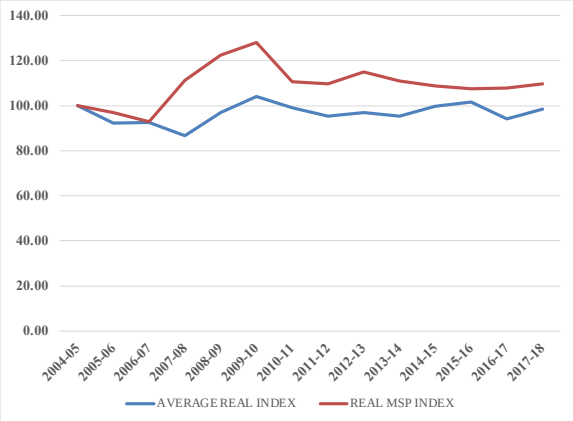
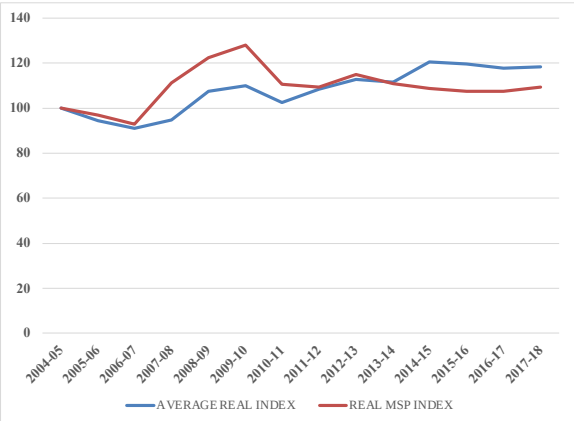


Figure 8.1 (d): 14-year Real COP per hectare Rice and MSP Index



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The Figures 8.1 are a nominal vs real representation for the Rice crop across the 9 different states that have been chosen for this thesis. Indexes have been generated for all the variables for easier comprehension with a base = 100 for the year 2004-05. To compare the costs of production (COP) per quintal of rice in nominal terms plus the growth of nominal MSP, we can observe that the Commission for Agricultural Costs and Prices (CACP) has managed to do a decent job with regards to setting these benchmark prices above the average nominal COP per quintal across the states. However, with respect to COP per hectare, we can see that the growth in MSPs have been lower for the past few years since 2012-13. The reason for this is still unsure. In real terms, we can observe part (c), where it is clear that the CACP has also managed to stay clear of the COPs per quintal even after considering the price inflation. Part (d) however, is similar to part (b) as we can see that the per hectare costs has started to grow much faster than the MSP growth even in real terms.

Figure 8.2 (a): 14-year Nominal COP per quintal of Wheat and MSP index

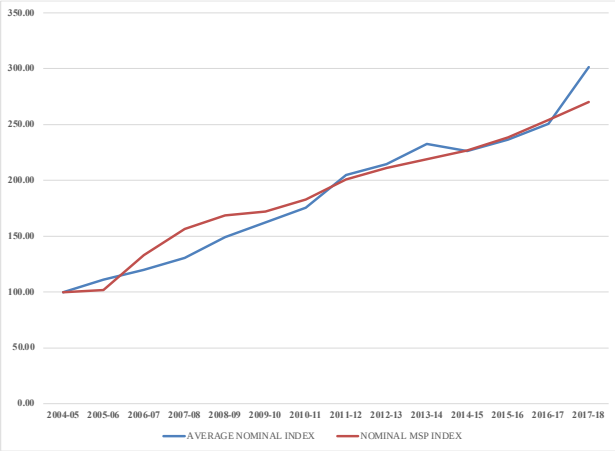

Figure 8.2 (b): 14-year Nominal COP per hectare Wheat and MSP Index

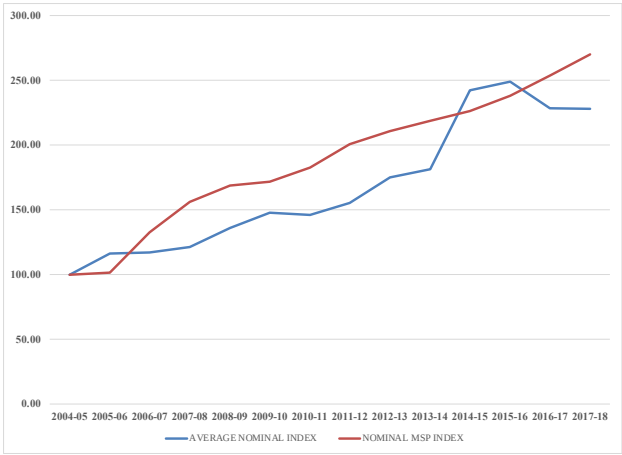

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Figure 8.2 (c): 14-year Real COP per quintal of Wheat and MSP index

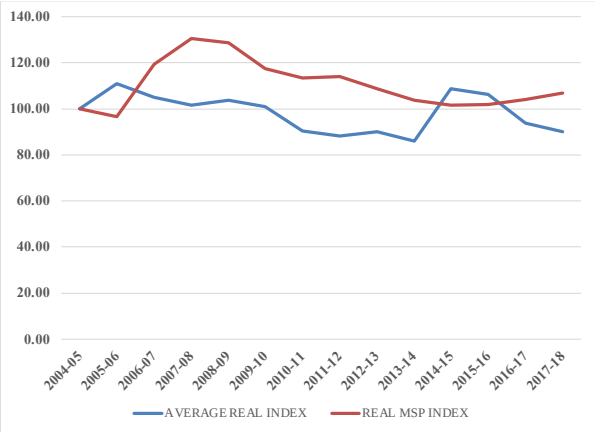
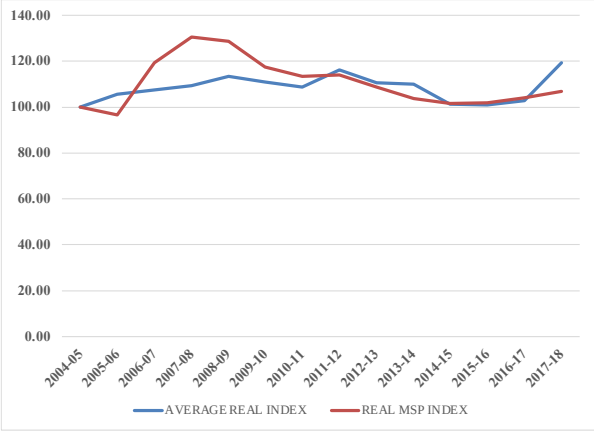


Figure 8.2 (d): 14-year Real COP per hectare Wheat and MSP Index



Similar to the graphs for Rice, the Figures 8.2. represent a 14 year trend in the nominal and real trends for Wheat COPs per hectare and quintal alongside its MSP indexes. Comparing part (a) for both the crops, we can see that in the case of Wheat, the nominal MSPs stayed above the COP per quintal of harvested crop for just above 5 years after which the COP has been either higher or on par with the set MSPs. In fact, after 2016, COP for Wheat has been higher than the set MSP which is definitely a cause for concern regarding the decision making process of the policy makers. However, in real terms, the COPs per quintal has been on a decreasing trend and its respective inflation adjusted MSPs are higher. The nominal COPs per hectare has been on a slower growth pace in comparison to the nominal MSPs, however according to Figure 8.2. (d), we can observe that after 2011 real COP index per hectare has a higher rate of growth or is on par with the inflation-adjusted MSP. This is definitely something that the policy makers must look at if they want to conform to the '1.5 times production cost' formula for coming up with the MSPs.

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8.1.2 Farm Harvest Prices (FHP)

Coming to the topic of the agricultural prices, I have chosen Farm Harvest Prices (FHP) in addition to the retail prices to study the policy effects. The former is a crucial variable from the perspective of determining the incomes in the farming community. It is also used quite often to approximate the agricultural contribution to national incomes. Durga and Swaminathan (2018) in their article for the Foundation for Agrarian Studies [9] has stated that the national data available on these FHPs are quite likely to be the wholesale price and not really the price received by the farmer for their produce. They also mention that the these prices are more on the highly aggregated side and it does not do a good job at identifying the locations where a farmer might be getting a lower than market price. Their suggestion for the agencies is to improve the accuracy and frequency of this database to enable a more accurate decision making process.

The Food and Agriculture Organization (2018) has defined FHP or farm gate prices as "the prices received by farmers for their produce at the location of farm. If the produce is sold at another location, the costs of transporting from the farm gate to the nearest market or first point of sale and market charges (if any) for selling the produce is, by definition, not included in farm gate prices." However, in India, the Directorate of Economics and Statistics (2016) has defined the FHPs as, "the average wholesale price at which the commodity is disposed of by the producer to the trader at the village site during the specified marketing period after the commencement of harvest." In cases where village site transactions do not take place, the price reported relates to what the farmer receives for his produce, and is obtained by subtracting transport and other

[9] Durga, A.R. & Swaminathan, N. (2018)., Foundation for Agrarian Studies, A Note on Farm Harvest Prices

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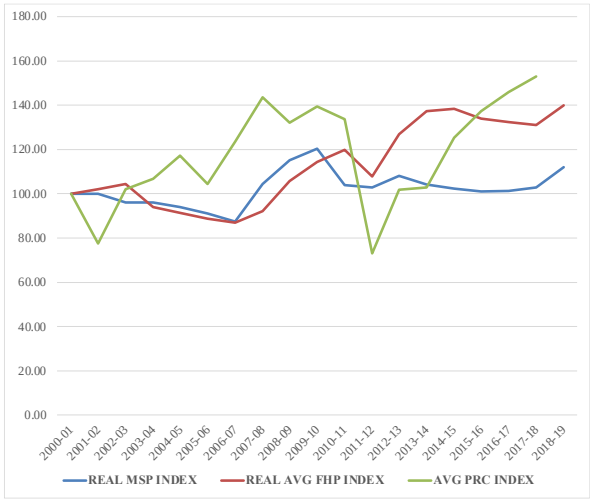
marketing charges from the wholesale prices quoted at the mandi where the produce is disposed of. This definitely does emphasize the importance of the FHPs as a grassroot level indicator for the income performance of the farming sector and in the coming sections we will observe the policy effects on this variable.

Figure 8.3 (a): 19-year Nominal average FHP vs MSP indexes for Rice crop

Figure 8.3 (b): 19-year Real average FHP vs MSP vs Procurement quantity indexes for Rice



In the above Figure 8.3 (a) we can observe the trendlines for the nominal FHP and MSP index in the case of Rice and we can see that for the better part of those 19 years the rate of increase of the MSPs has been almost on par or above the growth rate of the FHPs with the exception of the 2012 to 2016 period where the average FHPs across the 9 states saw an increased rate of inflationary pressures. However, it is commendable that for the last few years the MSP index levels have been on the higher side. In Figure 8.3 (b), we adjust the prices with the World Bank Wholesale Price Index (WPI) for India. In real terms, the pace of MSP increase after the year 2010 has not been able to keep up with the real average FHPs across these states. The growth rate gap has in fact increased over the last few years and this is a good sign since the ultimate goal of the MSPs were to act as a benchmark price for the farmers. However, it will be wrong to draw a conclusion on true policy effects from descriptive statistics alone and the upcoming

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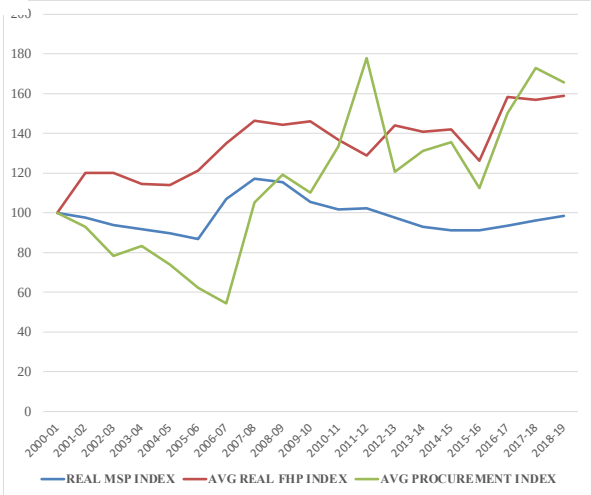
analysis sections will give us a better picture of the underlying mechanics. The sharp decrease in the average procurement levels for rice across these states are also seen to be corresponding with a drop in the real FHP which can be indicative of the cross linkages.

Figure 8.4 (a): 19-year Nominal average FHP vs MSP indexes for Wheat crop

Figure 8.4 (b): 19-year Real average FHP vs MSP vs Procurement quantity indexes for Wheat crop



Comparing the Figures 8.3 (a) and 8.4 (a), we can see that the growth rates of the average FHPs in the case of the Wheat crop has been consistently higher in these 19 years. When the prices are adjusted using the World Bank WPI for India, we see that the MSP index is always below the adjusted FHP index which is a good indication that the policy has been able to maintain its goal to serve as as a benchmark price. As mentioned before, we still have to refer to more conclusive analysis in the further sections to arrive at convincing conclusions.

8.1.3 Retail Prices

Retail prices, as defined by the Directorate of Economics and Statistics, are the ultimate prices that's consumers pay when purchasing from a retailer. These prices have implication from the perspective of the MSP policy as one of its purposes for existence

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in the first place is its goal to provide remunerative prices in terms of stabilizing farmers income as well as ensuring consumer affordability.

Figure 8.5 (a): 19-year Nominal average Rice retail price vs average FHP vs MSP

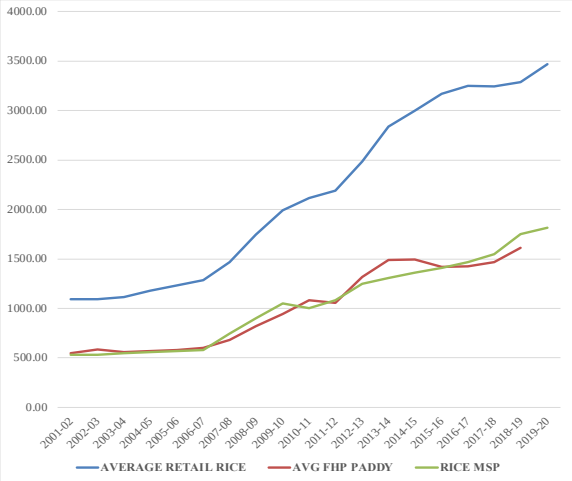
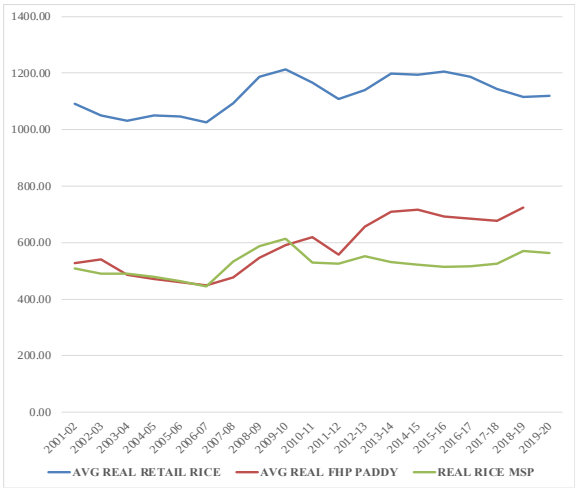


Figure 8.5 (b): 19-year Real average Rice retail price vs average FHP vs MSP



Although having access to wholesale prices of Rice across the state would have given us a better picture of the margin spread between the retailers and the producers, FHP of Rice is the next best alternative that is easily available and can be a good substitute for wholesale Rice prices. In nominal terms, we can see that the spread between the farm levels prices (FHP and MSP) and the final retail prices is becoming larger with time. The reasons attributed to this can go towards increasing logistics costs along with increasing margins for the middle man, the latter of which is not at all conducive for the policy plans to enhance the farmer income. However, upon adjusting for the inflation we can see that this very gap is on the decreasing trend.

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Figure 8.6 (a): 19-year Nominal average Wheat retail price vs average FHP vs MSP

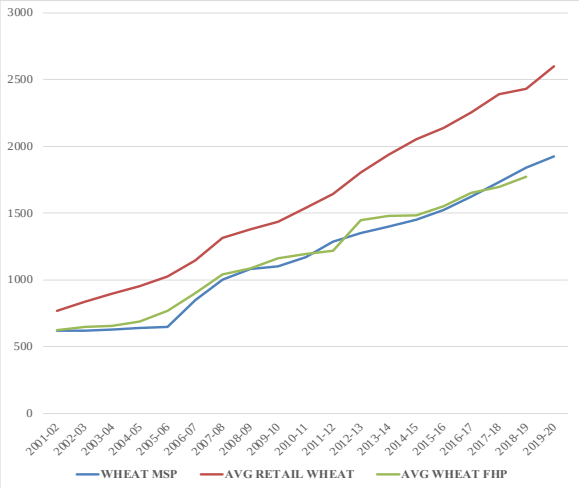
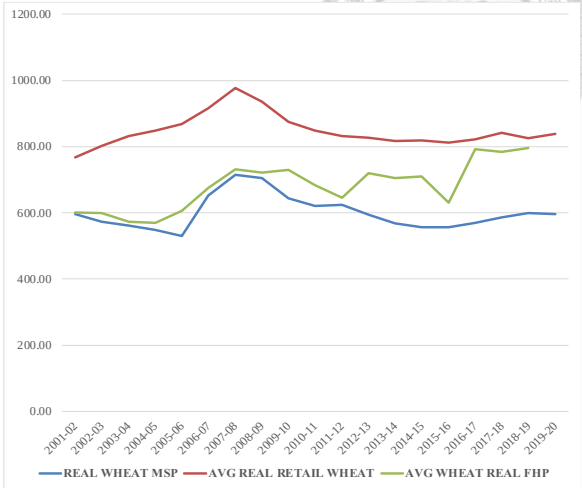


Figure 8.6 (b): 19-year Real average Wheat retail price vs average FHP vs MSP



In the case of Wheat, we can see from the Figures 8.6 (a) that the 19 year average retail prices across the 5 Wheat growing states chosen for this thesis has been on a steady upward trend. However, the gap between the wholesale level prices (FHP and MSP) has increased significantly since 2001-02 and is worrisome if majority of this increased margin is going into the pockets of the middle men. Chatterjee and Kapur (2016) have mentioned the possibility that selective intervention of the government for procurement through the APMC has created a virtual monopsony and the idea that there might be competition amongst the local intermediaries have been ruled out by limited evidence of collusion amongst them. Policy makers must account for such malpractices during annual policy revisions.

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8.2 Results and Discussions:

8.2.1 Implications on the Cost of Production (COP)

A. Procurement Quantity

Table 8.1. Cost of production per hectare estimates from Procurement quantities

Variables	Rice			Wheat		
Procurement quantity	0.194	-0.00638	0.0948	0.119	0.0073	0.255
	(0.205)	(0.167)	(0.1650	(0.164)	(0.192)	(0.14)
Real Average State FHP/ 100kg		7.029***	7.619***		7.434*	3.344
		(1.615)	(1.624)		(2.935)	(3.65)
Real Retail Price/ 100kg		1.729	1.488		5.749	-16.64**
		(1.326)	(1.357)		(5.592)	(5.696)
Real Agricultural GDP		0.000699***	0.000636***		0.000327	-0.0000906
		(0.000181)	(0.000182)		(0.000322)	(0.000242)
Real State GDP		0.0000163	0.000014		-0.0000586	0.0000249
		(0.00005)	(0.0000508)		(0.0000802)	(0.0000799)
Procure			2596.3			1950.9
			(3059.3)			(1423.5)
Constant	20965.2***	11848.1***	10292.7***	17640.1***	7802.2	26984.1***
	(526)	(1595.4)	(2967.4)	(744.1)	(4788.8)	(4647.6)
R-squared (Within)	0.00772	0.429	0.426	0.00793	0.174	0.0000113
F	0.895	15.78		0.528	2.605	
Groups	9	9	9	6	6	6
N	125	119	119	73	73	73
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

Table 8.1, we find that the procurement quantities for both the crop have no statistical significance with regards to the cost of production per hectare. However, we can see that the Farm Harvest Prices (FHP) per 100 kg (quintal) does have a significant

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and positive influence on the costs. In the case of Rice, upon controlling for the other variables in the model, including the policy effect, the coefficient on the variable estimates that for every Rupee 1 increase in the real FHP, the expected costs will rise by Rs. 7.61 on average. In the case of Wheat this estimate is about the same at Rs. 7.43 for every rupee increase in the FHP. In the case of Rice we can also observe a very significant and positive effect of the agricultural GDP on the costs but this same variable is statistically insignificant for Wheat.

B. Inflation adjusted MSP

Table 8.2. Cost of production per hectare estimates from inflation adjusted MSP

Variables	Rice			Wheat		
Real MSP (Base: 2000-2001)	19.53***	9.751*	9.294*	8.400	6.070	24.04***
	(4.561)	(4.483)	(4.652)	(5.000)	(6.667)	(6.608)
Real Average State FHP/ 100kg		5.859***	6.587***		7.001*	6.754*
		(1.654)	(1.676)		(2.915)	(3.157)
Real Retail Price/ 100kg		1.038	0.851		2.024	-28.01***
		(1.331)	(1.380)		(6.579)	(4.983)
Real Agricultural GDP		0.000690***	0.000633***		0.000369	-0.000131
		(0.000173)	(0.000176)		(0.000281)	(0.000223)
Real State GDP		0.0000418	0.0000375		-0.0000562	0.0000214
		(0.0000501)	(0.0000514)		(0.0000777)	(0.0000724)
Procure			2872.2			851.2
			(2782.4)			(1299.7)
Constant	11215.2***	7951.6**	6564.1	13032.8***	7243.9	21590.0***
	(2398.2)	(2364.4)	(3351.4)	(3026.9)	(4615.1)	(4572.9)
R-squared (Within)	0.136	0.453	0.452	0.0404	0.185	0.0388
F	18.32	17.59		2.822	2.852	
Groups	9	9	9	6	6	6
N	126	120	120	74	74	74
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

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In Table 8.2, we have used inflation-adjusted MSPs and other relevant price related variables to generate estimates for cost of production per hectare over the 20 years across the 9 states. We do find some interesting results for the main policy variable, Real MSP. In the case of Rice, the statistical and practical significance reduce from the parsimonious model to the model with all the other variables including the policy effect dummy variable. It estimates that for every Rs. 1 increase in the MSP in real terms, the cost of production is estimated to go up by about Rs. 9.2 per hectare for Rice. In the case of wheat, the coefficient gains very high practical and statistical significance upon controlling for the other variables. It estimates that the cost of production per hectare will increase by Rs. 24.04 on average for every Rs.1 increase in the MSP in real terms.

8.2.2 Implications for the Farm Harvest Prices (FHP)

Table 8.3. Farm Harvest Price estimates from policy variables

Variables	Rice			Wheat		
MSP	1.054***	1.110***	1.094***	0.960***	0.916***	0.968***
	(0.0408)	(0.0645)	(0.0671)	(0.0220)	(0.0357)	(0.0342)
Procurement quantity		-0.00107	-0.0414		-0.00591	-0.0271***
		(0.0302)	(0.0277)		(0.0113)	(0.00757)
Degree of procurement		0.799	5.779		1.451	3.554***
		(3.372)	(3.111)		(1.572)	(1.043)
Procure			0			0
			(.)			(.)
Constant	0.227	2.037	-36.49	70.16**	67.92	41.89
	(43.61)	(99.49)	(134.6)	(26.10)	(38.67)	(41.98)
R-squared (Within)	0.807	0.799	0.794	0.948	0.963	0.960
F	666.0	106.1		1905.3	443.0	
Groups	9	6	6	6	4	4
N	169	89	89	112	58	58
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

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To analyse the relationship of the MSP policy with the base level price (Farm Harvest Prices) in the crop supply chain, we have used both the key policy variables i.e. MSP and procurement quantity as independent variables for generating the estimates. In the Table 8.3. we find some interesting and statistically significant effects on the FHP from the unadjusted MSP variables. In the case of rice, the estimate on the MSP variable remains practically unchanged even after controlling for other variables. The coefficient effectively translates into an increase in FHP by about Rs. 1 for every Rs. 1 increase in the announced or nominal MSPs and the same can be said in the case of wheat. This can be a good indicator of the fact that the annual prices announced by the Commission for Agricultural Costs and Prices definitely works to keep the prices received by the farmers at a stable level. On the other hand, the estimates generated by the procurement quantities is irrelevant and gains a high level of significance in the case of Wheat after controlling for the other variables. This is unintuitive as its relationship with the FHP is negative and does not make sense as we would presume higher levels of procurement would have a positive effect on the Farm Harvest Prices. The statistical insignificance for the most part in the case of this variable does make sense as procurement operations would not be powerful enough to influence the FHPs, but the information about the announced MSP reaches a greater range of recipients, which can then influence the prices received by the primary stakeholders of the supply chain.

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8.2.3 Implications for the Retail Prices:

Table 8.4. Retail Price estimates from policy variables

Variables	Rice			Wheat		
MSP	0.0203***	0.0178***	0.0177***	0.0135***	0.0114***	0.0122***
	(0.000655)	(0.000539)	(0.000529)	(0.000377)	(0.000501)	(0.000510)
Procurement quantity		-0.000446	-0.000592**		0.000231	-0.0000128
		(0.000260)	(0.000202)		(0.000164)	(0.000118)
Degree of procurement		0.0638*	0.0900***		-0.0267	-0.0165
		(0.0288)	(0.0225)		(0.0226)	(0.0161)
Procure			0			0
			(.)			(.)
Constant	0.394	0.773	0.342	0.0758	0.606	0.546
	(0.730)	(0.831)	(0.895)	(0.472)	(0.550)	(0.644)
R-squared (Within)	0.860	0.937	0.937	0.922	0.957	0.953
F	963.8	413.4		1279.6	410.7	
Groups	9	6	6	6	4	4
N	167	92	92	116	63	63
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

The effects of the Minimum Support Prices announced by the government will also carry over to the retail prices as shown in Table 8.4. We observe some significant effects for the MSPs on the end retail prices. The estimates for this variable are significant for both the crops. In the case of Rice, after controlling for variables such as procurement quantities and degree of procurement, the coefficient on MSP estimates that for every Rs. 100 increase in the announced paddy MSP per quintal, the Rice retail price per kg will increase by Rs. 1.77. In the case of Wheat this estimate predicts an increase in Wheat retail price per kg of Rs. 1.2 for every Rs. 100 increase in the announced wheat MSP per quintal of harvested crop.

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Chapter 9: Implications of grain storage infrastructure on policy factors

9.1 Chapter Introduction

In most developing countries, the procurement operations have gotten increasingly more challenging due to the direct effect of population growth on food demand and post-harvest losses. The current popular opinion with regards to a higher level solution is for government to focus their efforts on building more procurement centres in all major surplus states ahead of the harvesting season. The benefits of this will be that the stakeholders of the agricultural sector such as farmers, government procurement agencies, logistics service providers will be able to make a more informed decision with regards to their production activities. A well-functioning and efficient public procurement system addresses issues like inefficiency, corruption, and waste. Thus, it facilitates the development process by improving the public administration (Jones, 2007).

Keeping this in mind, public procurement is one of the functions of the government that is most prone to corruption. Some World Bank studies indicate that more than a trillion USD were paid in bribes in a year across developing countries.

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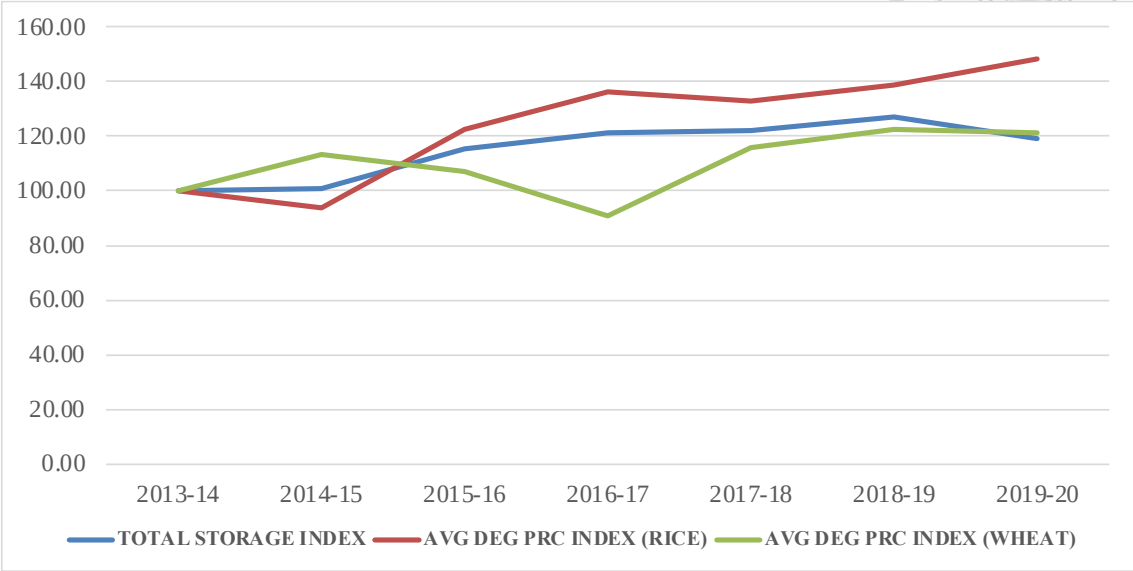
Figure 9.1: 7-year growth in total grain storage capacities vs average procurement % of total production (Rice/Wheat)



In Figure 9.1, the average growth rates of the food grain storage capacities are plotted alongside the average degree of procurement for both the crops. In the case of Rice, we can see an increasing trend as the storage capacities of the states are increased but in the case of Wheat, there has been a drop from the year 2014 to the year 2017. This can be primarily attributed to the states of Madhya Pradesh and Uttar Pradesh as the degree of procurement as a function of total production reduced by 50% and 70% respectively.

According to a study conducted by Gustavsson et al. (2011) for the United Nation's Food and Agricultural Organization (FAO), he found that more that 1/3rd of the food produced is wasted annually. This finding is significant for the case of India. A study by Kumar and Kalita (2017) found that this country loses about 67 million tonnes of food, which is higher than the national output of developed countries like UK and France. When it comes to the supply chain network of food grains in India, the first link is the procurement operation followed by intra and inter-state logistics, which is

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distribution to district level warehouses (DLWs) to the end delivery points referred to as the Fair Price Shops (FPS). The last stage of this supply chain where the food grains reach the end beneficiary from the FPS is the Public Distribution System (PDS).

In this chapter, I attempt to analyse the effects of the increase in number of the procurement centres over time on the procurement performance of these states. The commonly accepted null hypothesis that would be accepted by any rational individual or researcher would be that the increase in procurement centres would quite likely increase the procurement quantities in the state. Whether or not this hypothesis stands, is yet to be seen.

9.2 Results and Discussions

Table 9.1. State wise procurement quantity estimates for rice and wheat

Variables	Rice			Wheat		
State Storage Capacity	6.377	4.443	4.92	0.0215	-1.125	20.15***
	(4.736)	(3.581)	(3.418)	(7.653)	(5.864)	(4.447)
Degree of Procurement (%)		70.86***	70.98***		144.8***	92.80***
		(9.06)	(8.631)		(23.150	(11.480
Procure			0			0
			(.)			(.)
Constant	2140.7***	276.4	226.6	4637.5***	609.7	241.9
	(330.4)	(512.4)	(1050.1)	(714.8)	(1268.2)	(524.6)
R-squared (Within)	0.0331	0.655	0.655	0.000000225	0.64	0.358
F	1.813	32.26		0.00000788	19.56	
Groups	9	6	6	6	4	4
N	63	42	42	42	28	28
Notes: Standard errors in parentheses. Significance level: * p < 0.05, ** p<0.01, *** p<0.001						

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The Table 9.1. displays the estimates for the effects of state storage capacities on the procurement quantities for either rice or wheat in that state. In this analysis, for the state storage capacities variable, we find that it only gains significance for the wheat crop after controlling for variables like degree of procurement and procurement dummy for policy effect. This coefficient is very statistically significant and it estimates that for every 100,000 metric tonnes increase in storage capacities the procurement quantity is estimated to increase by 20.15 thousand tonnes.

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Chapter 10: Policy implications on the farm holding area based farmer categorization.

10.1 Chapter Introduction

In India, the farmers are classified according to their size of land holding and the Department of Agriculture, Co-operation and Farmers Welfare conducts an agriculture census every five years to collect data on structural characteristics of agricultural sector including size of agriculture land holdings in the country. These farmer categories are as follows:

1. Marginal farmer: This category includes the farmers with less than 1 hectare of agricultural land.
2. Small farmer: Farmers with 1 to 2 hectares of agricultural land are grouped in this category.
3. Semi-Medium farmer : Farmers with 2 to 4 hectares of agricultural land is included in this group.
4. Medium farmers: Farmers with 4 to 10 hectares of land are included in this category.
5. Large farmer: This is the largest category of in the classification of the Indian farmers which includes farmer with agricultural land holdings of 10 hectares or greater.

From the perspective of this categorization, the agricultural sector of India is also characterized by the presence of a large number of farmers belonging to the second category of small scale farmers. These farmers are also operate their farms on a subsistence level of farming. Subsistence here refers to type of farming that is done for

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the sole purpose of meeting the needs of the farmer's family and is inherently lacking technology and which use household labour only. In the year 1995-96, there were a reported 115 million of these farmers with an average land holding of 1.41 ha and their number has increased to 137.6 million in the year 2010-11 with 67% of them having only a mere 0.38 ha and the rest having an average land size of 1.42 ha.

According to the latest Agriculture Census, the average size of the all the operational holdings in this sector have decreased from 2.28 hectares in the 1970-71 period to 1.84 hectares in 1980-81, to 1.41 hectares in 1995-96, and to a low of 1.08 hectares in 2015-16.

Figure 10.1 (a): 16-year trends in the farmer categories based on area for the Policy states

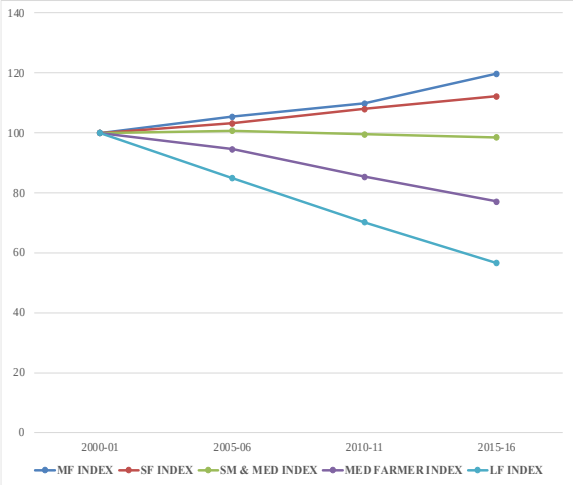
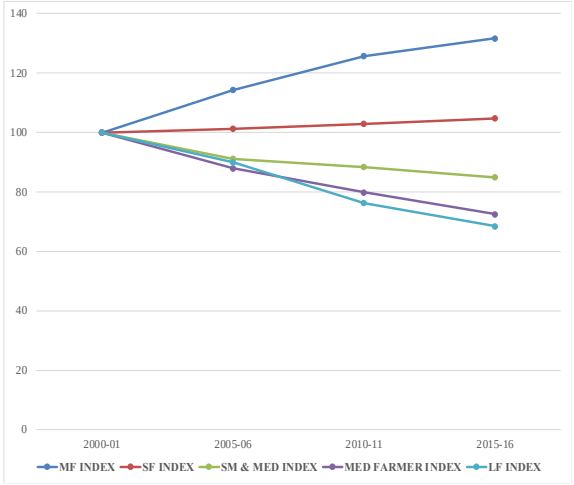


Figure 10.1 (b): 16-year trends in the farmer categories based on area for non-policy states



The Figures 10.1, represent the current trends across the 9 states from the year 2000 to the year 2016 in the various farmer categories. Part (a) is for the states where procurement of rice and wheat occurs at MSP and part (b) represents the states with no procurement activity for these crops and are thus classified as non-policy states. The general trend for all the categories are in the same direction for both the cases but it is interesting to observe that the rate of increase in the number of marginal famers (MF index) in the case of the states with no procurement operations (non-policy states) is much

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higher than the case of policy states. However, the other categories do not seem to differ much and the large farmer area (LF index) has been decreasing the most in both cases.

Figure 10.2 (c): 16-year trends in the farmer categories based on numbers for the Policy

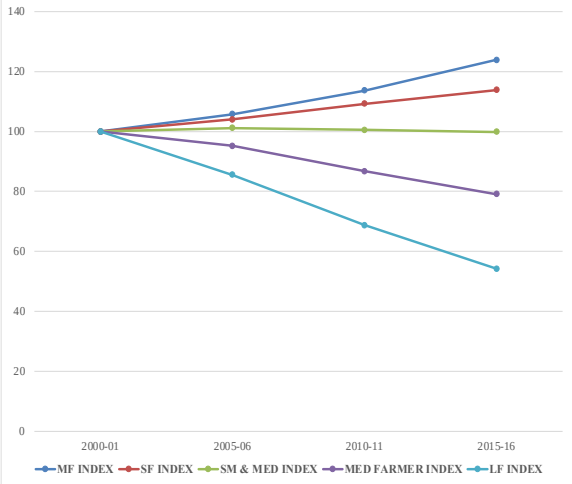
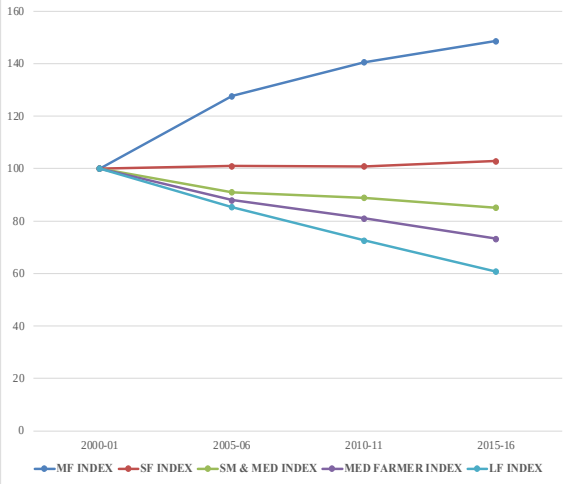


Figure 10.2 (d): 16-year trends in the farmer categories based on numbers for non-policy



The Figures 10.2 are similar to the previous figures but it represents the total number of farmers for each category over those years. It tells a similar story because the increase in the marginal farmers (MF index) is a bit higher for the non-policy states. However, causality cannot be claimed so simply with regards to the presence or absence of government procurement resulting in this increase in magnitude for the marginal farmers and their total hectarage. Holdings by small farmers make it difficult to increase the economic efficiency of agricultural operations, and therefore effecting the aspect of profitability and earnings for the farmers associated with such holdings. The previous point can then lead to perpetual indebtedness of the small farmers which then drives them into a poorer quality of life. Considering this declining trend in the size of farm holdings from the past and estimated increase in the future with the population, fragmentation of agricultural land will continue and the aggregate average size will reduce over time. The government has attempted to tackle this issue and aid in augmenting farm incomes by taking several initiatives like adoption of modern technologies and practices such as

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intercropping and integrated farming systems. The Indian Council of Agricultural Research (ICAR) has research programmes that aim in producing location specific varieties and Package of Practices (PoPs) for improving the productivity of these small farms. Other examples of miscellaneous government interventions include schemes like Interest Subvention Scheme, Mission for Integrated Development of Horticulture (MIDH), National Food Security Mission (NFSM), Neem Coated Urea, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Pradhan Mantri Fasal Bima Yojana (PMFBY), and National Mission for Sustainable Agriculture (NMSA) etc.

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10.2 Results and Discussions:

Table 10.1. Estimates for procurement quantities based on farmer categories

RICE	**Constant**	**Marginal Farmer holding area**	**Small Farmer holding area**	**Small and Medium Farmer holding area**	**Medium Farmer holding area**	**Large Farmer holding area**
Procurement qt.	4870.1	-0.000188	0.00263	-0.00756	0.00869	-0.00983*
	(3065.8)	(0.000857)	(0.00262)	(0.00478)	(0.00468)	(0.00488)
R-squared (Within)	0.221	F-Stat		Groups	9	Number of Obs = 30
WHEAT	**Constant**	**Marginal Farmer holding area**	**Small Farmer holding area**	**Small and Medium Farmer holding area**	**Medium Farmer holding area**	**Large Farmer holding area**
Procurement qt.	13682.0***	-0.00190*	0.0168***	-0.0314***	0.0235***	-0.0219***
	(2714.6)	(0.000832)	(0.00440)	(0.00663)	(0.00486)	(0.00577)
R-squared (Within)	0.0194	F-Stat		Groups	9	Number of Obs = 20
RICE	**Constant**	**Marginal Farmers**	**Small Farmers**	**Small and Medium Farmers**	**Medium Farmers**	**Large Farmers**
Procurement qt.	3151.1	-0.0000771	0.00264	-0.0123	0.0281	-0.0764
	(2589.0)	(0.000198)	(0.00372)	(0.0130)	(0.0254)	(0.0633)
R-squared (Within)	0.133	F-Stat		Groups	6	Number of Obs = 30
WHEAT	**Constant**	**Marginal Farmers**	**Small Farmers**	**Small and Medium Farmers**	**Medium Farmers**	**Large Farmers**
Procurement qt.	11018.3***	-0.000549**	0.0173***	-0.0642***	0.0999***	-0.224***
	(2098.8)	(0.000203)	(0.00459)	(0.0140)	(0.0218)	(0.0660)
R-squared (Within)	0.00924	F-Stat		Groups	6	Number of Obs = 30

In the analysis we assume that the unobserved effects such as inherent properties of soil, rainfall intensity, and farming culture for the 9 different Indian states are not correlated with the farmer categories. Keeping this assumption in mind, a Random

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Effect regression is used to analyse the effects of the varying farmer categories over the last two decades on the procurement quantities. In the case of the variation in hectarages, we can observe an un-intuitive and statistically significant effect in the case of the 'Larger Farmer' category for both rice and wheat crops. It estimates a negative relationship between this category and the procurement quantity and it predicts that for every 1 hectare increase in this category, the rice procurement will reduce by 9.83 tonnes and Wheat procurement by 29 tonnes. This estimate is questionable as a major contributor in terms of share of procurement quantities are farmers belonging to this category. The marginal farmer category for both the crops contain estimates that are intuitive to popular belief and also statistically significant for the case of Wheat crop and it predicts that for every 1 hectare increase in this category there will be a reduction in procurement quantity by 1.9 tonnes. Small farmer and Medium farmer categories both show statistically significant and positive relationship with the procurement while the Semi-Medium farmer category has a negative relationship with it. A very similar pattern can also be noticed in the case of the farmer categories classified by the total number of farmers.

All the estimates generated by the above analysis should be taken with a grain of salt since the generally accepted hypothesis with regards to procurement quantities and farmer categories is that the increase in holding area for categories containing larger farmers will has a positive influence on the procurement quantities and vice versa with the smaller farmers. This does not seem to be exactly the case here and more data accompanied by a suitable methodology should be more capable to produce more precise estimates.

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Chapter 11: Conclusion

The MSP policy has been a point of major contention in the country amongst various academics and policy makers. Multiple papers have been published which focus on both its shortcomings and positive effects on the farming community. The over-stocking of the Food Corporation of India (FCI) warehouses with food grains leading to issues of food and resource wastage has also been a contentious point in the debates surrounding the benefits and challenges of the procurement operations and the MSP regime.

11.1 Chapter 5: Policy impacts on crop production characteristics

The impacts of the policy has been studied on production characteristics of wheat and rice, including crop area, production, and yield. We find some statistically significant results with regards to the effects of the MSP and procurement quantities. In all the cases, we observe a positive relationship between the policy variables and the production characteristics. Based on the notion that increases in crop area, production, and yield for food grain crops like wheat and rice is something that fortifies the countries' food security, we must look at it from another perspective. The National Sample Survey Office, in one of its recent survey, has indicated that the country's population has shifted its food consumption pattern from cereals to protein-rich foods. However, from our analysis as well as other evidences available in literature and government surveys, we have not seen any proportional shift with regards to the sowing or production in protein-rich food like pulses. This is especially of major importance considering the fact that India is the largest producer and consumer of pulses in the

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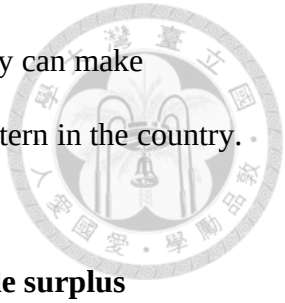
world, but 25% of the pulses consumed are imported. The MSP policy can make accommodations to mitigate the increasingly distorted production pattern in the country.



11.2 Chapter 6: Policy implications of Wheat and Rice marketable surplus

Marketable Surplus Ratio (MSR) for the case of Rice and Wheat is another parameter chosen for the purposes of this thesis. Its importance stems from the point of view of policy design with respect to commercialization of agricultural operations. This ratio ultimately influences the flow of food grains and prices in the market and thereby affects the market participation rate of the farming community. A high MSR value is always desirable. By analysing this variable for both the crops across all states and all years, we found some significant estimates for the case of Wheat. It shows that for every 1% increase in the Wheat MSR, the contemporary procurement quantities increased by about 70 thousand tonnes for every 1% increase in the MSR for the lag period, there was an increase in procurement quantity by 90 thousand tonnes. Another finding was that in the case of wheat, the policy states saw an increase in procurement quantities by 2455 tonnes when compared with non-policy states. These estimates essentially translates into the fact that the government corporations responsible for procuring the food grains are enlarging their efforts in specific states, and therefore adding to the self-fulfilling prophecy of 'MSP benefiting only a few states'. This finding is of no surprise since states like Punjab and Haryana have the lion's share of food grain procurement and have the highest percentage of farmers directly benefiting from the MSP. MSR is also taken into consideration while devising the annual MSP and in the second part of this chapter we used nominal MSP as the dependent variable alongside the MSR and its lag as the independent variable. From this analysis we found

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that for every 1% increase in the MSR of rice, the nominal MSP was estimated to increase by about Rs. 7 and in the case of Wheat by Rs. 11. This line of finding does make reasonable sense as increasing MSRs will lead farmers demanding for more remunerative crop disposal mechanisms from the government, which is essentially the MSP procurement machinery.

11.3 Chapter 7: Policy impacts on agricultural inputs

Attempts were also made to study the policy effects on the use of agricultural inputs in the country, including fertilizers, tractor sales, and electricity. Although there is no literature that directly studies this aspect of the sector, I believe that we might observe some interesting linkages between the policy and these variables. For the case of the fertilizer use, we don't obtain statistically relevant estimates for both policy variables. The reason behind this can be the fact that our 'Total Fertilizer' variable not only encompasses the fertilizer quantity used in the rice and wheat cultivation, but also all the other agricultural crops cultivated within the state, and therefore the estimates are acceptable even though it has no relevance. In the case of the tractor sales, the procurement quantities have modest influence on it, however, the announced or nominal MSP have a high statistically significant relationship with the sales. It has been estimated that for the crop of rice, every Rs. 1 increase in the nominal MSP, will increase the tractor sales by 21 units and in the case of wheat this estimate is about 33 units. The policy effect in the case of Wheat was significant and it showed a positive effect with regards to the tractor sales in the states with procurement operations. The real world application of this result can be extrapolated to the indirect promotion of improved technology in the form of these tractors by the policy.

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In the case of the electricity consumed by agriculture, it was found that procurement quantities had no significant effect, however the estimates generated by the nominal MSPs were significant even at the 0.001 alpha levels. It essentially translates into a 3.6 Gwh and 7.3 Gwh increase in the case of Rice and Wheat respectively. These estimates do make practical sense since the higher number generated for Wheat is indicative of the fact that since Wheat is sown during the Winter season, electricity use is directly proportional to the irrigation pump operations. Upon controlling for the policy effect we find that the use of this input is much higher in the states with procurement operations by 6791.8 Gwh in comparison to states without these operations, for every Re. 1 increase in the nominal MSP.

11.4 Chapter 8: Policy impacts on agricultural costs and prices

The MSP policy was examined from the perspective of the agricultural costs and prices. With regards to the costs, the 'Revised C2' Cost of Production (COP) data was obtained and analysed as these figures were obtained after factoring in rentals and interest forgone from own and fixed capital assets. I find that the growth in per quintal costs for rice has always remained below the growth rates for the MSP. This indicates a win regarding the policy meeting its goal of providing farmers with decent margins on their crops. However, in case of Wheat the nominal costs have always grown on par with the MSP and in real terms, a growth margin could be observed in favour of the farmers. Per hectare costs for the crops shared similar growth rates both in real and marginal terms. In a more rigorous analysis with the policy variables, we were unable to find any statistically significant estimates from the procurement quantities. However, upon replacing this policy variable with the inflation adjusted MSP, we find that in the

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case of rice, the production costs per hectare are expected to rise by Rs. 9.2 for every Rs. 1 increase in the real MSP and by Rs. 24.4 in the case of Wheat. These estimates have a more inflationary implication and must be examined in more detail by considering other variables that may affect the cost of production/ hectare as Parikh et al. (2003) has highlighted in that MSP increases have led to the increase in producer price indices over time.

Farm Harvest Prices (FHPs) are one of the most important indicators for the performance of the farming sector from the perspective of income. One of the major objective of the MSP policy is to increase this very income level. The results are quite intuitive and also statistically significant as it estimated that the FHPs always kept almost an unit pace with the increase in the MSP. This is a good indication that the MSP announced by the CACP (Commission for Agricultural Costs and Prices) has done a good job of increasing the prices received by the farmers in a proportional manner. The carry over effect of the MSPs has also been observed on the final retail prices. We find that for every Rs. 100 increase in the per quintal MSPs, the Rice retail price per kg is expected to increase by Rs. 1.77 and in the case of Wheat it is about Rs. 1.2. However, it would be wrong to just look at these positive relationships and call it a policy success since more work must be done with regards to identifying what proportion of this retail price increase is actually received by the farmer.

11.5 Chapter 9: Implications of grain storage infrastructure on policy factors

The smooth functioning of the procurement machinery is always ensured via the availability of storage infrastructure in which the acquired crops can be stored. This would mean the later would have a direct impact on the procurement quantities and this

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section attempts to test this hypothesis. By using the degree of procurement and state storage capacities as the independent variable, we found some significant findings in the case of wheat. It estimates that for every 100,000 metric tonnes increase in storage capacities, the procurement quantity is estimated to increase by 20.15 thousand tonnes. This shows the importance of developing better infrastructure that will support the policy objectives. It would also need to cover the logistics network development as well.

11.6 Chapter 10: Policy implications on the farm holding area/number based farmer categorization

Over the years, the 5-year agricultural census have captured much information from the farm sector and it also included the composition of the various farmer categories in the country. These categories are based on the farmer's land holding size (hectares) and data from 4 censuses have been collected to analyse the changes in farmer population and hectarage they hold in them on the state level procurement quantities. Graphically, we have always observed an increase in the number marginal and small farmer categories alongside a decrease in the larger categories of farmer. This finding was true for both the policy and non-policy states but only differed in the rates as the states without procurement activity saw a much greater growth in the smaller categories and faster decline in the larger categories. The practical implication of this finding is that with the marginal and small farmer category increasing, the rate of mechanisation and adoption of new technologies will slow down by a huge margin. Furthermore, when performing a random effects regression, we find that for some reason there is an alternating pattern within the categories for the positive correlation

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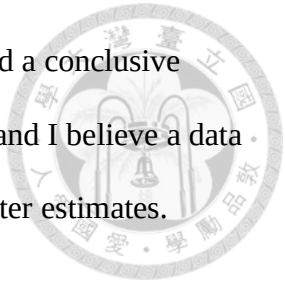
with the procurement quantities. This finding does not manage to shed a conclusive light on the effects of these categories on the procurement quantities and I believe a data set with more years along with suitable methodology may give us better estimates.



11.7 Final thoughts: MSP implications and future directions

This policy and all the operations involved under it has significant macro-economic implications with regards to the farm economy and as things stand in the present, there are major hurdles that the policy makers must aim to overcome. These hurdles can be anywhere from the monopsonies in the APMC (Agriculture Produce Market Committee) controlling the prices received by the farmers to the overflowing of food grain stocks in the warehouses leading to massive wastages and inefficiencies. Considering the fact that the MSPs are announced for 23 crops, it will be quite unfair to say that the Government has kept the best interests of all the farmers associated with these crops in mind. The lacking infrastructure with regards to storage and logistics has made it almost impossible for farmers all across the country to make their crop production decisions based on the MSP alone. This regime has ended up promoting the cultivation of the already popular rice and wheat crops which are very water intensive and as expected the ground water levels in the state of Punjab and Haryana have receded to its lowest levels. Keeping these in mind, the government should work closely with academics to develop better solutions which focus on the efficiency and sustainability aspect of the price policy when it comes to the financial support for the farmers. The direct payment tool has been proved time and again to be a much better alternative in terms of efficiency and minimizes the budgetary burden on the government agencies arising from procurement operations.

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This thesis included various aspects of the agricultural sector with respect to the 9 major rice and wheat growing states and the results can be used as an indicator regarding where and how the policy should be leaning toward. Findings with regards to the production characteristics, costs, and prices can be used as a starting point upon which more rigorous research using on primary data can be conducted. Other granular topics such as effects of Marketed Surplus Ratios on the procurement quantities can help the general public, farmers or researchers to understand the consequence of oversupply of food grains with the farmers on the procurement quantities. This is due to the fact that the government follows an 'Open Ended Procurement scheme' and can assist the infrastructure development for related operations.

Agriculture is the most important sector of any economy, let alone that of India and I hope that efforts to support our farmers and remove all the problems associated in their sector are always paramount in our policy formulations. As a student of Agricultural Economics, writing and conducting research on this topic was my way of showing support towards our community of farmers and if these findings ever contribute in anyway, it would be a successful attempt in doing so.

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References

Aditya, K. S., Subash, S. P., Praveen, K. V., Nithyashree, M. L., Bhuvana, N., Sharma, A. (2017). Awareness about minimum support price and its impact on diversification decision of farmers in India. Asia & the Pacific Policy Studies, 4(3), 514–526.

Alia, S. Z., Sidhub, R. S., Vatta, K. (2012). Effectiveness of minimum support price policy for paddy in India with a case study of Punjab. Agricultural Economics Research Review, 25(2), 231–242.

Arora, V.K.S. (2013) Agricultural Policies in India: Retrospect and Prospect, Agricultural Economics Research Review, Vol. 26 (No. 2), pp. 135-137.

Chand, R. (2003). Minimum support price in agriculture: Changing requirements. Economic and Political Weekly, 38(29), 3027–3028.

Chatterjee, S., & Kapur, D. (2016, July). Understanding price variation in agricultural commodities in India: MSP, government procurement, and agriculture markets. In India Policy Forum (Vol. 3, pp. 12-3).

Chem / Fertilisers - Ind'l Goods/SVS - industry. The Economic Times. (n.d.). Retrieved February 12, 2022, from https://economictimes.indiatimes.com/industry/indl-goods/svs/chem-/-fertilisers

doi:10.6342/NTU202202490

Commission for agricultural costs and prices. Commission for Agricultural Costs and Prices. (n.d.). Retrieved February 14, 2022, from http://cacp.dacnet.nic.in/

Das, R. C. (2021). Does Minimum Support Price Have Long-Run Associations and Short-Run Interplays with Yield Rates and Quantities of Outputs? A Study on Food and Non-food Grains in India. Review of Market Integration, 13(1), 42–65. https://doi.org/10.1177/09749292211065192

Deshpande, R. S., Naika, T. R. (2002). Impact of minimum support prices on agricultural economy: A study in Karnataka [Working Paper]. Agricultural Development and Rural Transformation Unit, Institute for Social and Economic Change, Bangalore.

Geetha, R. S., Mahesh, V. (2019). Minimum support prices (MSP) and its influence on cotton farming in India. Asian Journal of Agricultural Extension, Economics & Sociology, 30(4), 1–8.

Ghosh, N. (1998). Electricity use in Indian agriculture. Indian Journal of Agricultural Economics, 53(3), 304. Retrieved from https://www.proquest.com/scholarly-journals/electricity-use-indian-agriculture/docview/201526690/se-2?accountid=14229

Gustavsson, J., Cederberg, C., Sonesson, U., Van Otterdijk, R., & Meybeck, A. (2011). Global food losses and food waste. https://doi.org/10.1108/JOPP-07-01-2007-B001

doi:10.6342/NTU202202490

Huria, S., Pathania, K. (2018). Dynamics of food inflation: Assessing the role of intermediaries. Global Business Review, 19(3). https://doi.org/10.1177/0972150918788763

Jha, S., Srivasan, P. V. (2006 January). India reforming farm support policies for grains [Working paper no. PP-052]. Indira Gandhi Institute of Development Research.

Jones, D.S. (2007), "Public procurement in southeast asia: Challenge and reform", Journal of Public Procurement, Vol. 7 No. 1, pp. 3-33.

Kaufman, D. (2004, August 8). “The Costs of Corruption.” [Online]. Available at http://www.worldbank.org/wbi/governance/index.html

Kumar, D., & Kalita, P. (2017). Reducing postharvest losses during storage of grain crops to strengthen food security in developing countries. Foods, 6(1), 8.

Madhura Swaminathan https://fas.org.in/author/madhura/. (2022, January 31). A note on Farm Harvest prices - fas - foundation for agrarian studies. FAS. Retrieved February 16, 2022, from https://fas.org.in/a-note-on-farm-harvest-prices/

Narayanamoorthy, A., & Suresh, R. (2013). An uncovered truth in fixation of MSP for crops in India. Review of Development and Change, 18(1), 53-62.

doi:10.6342/NTU202202490

NITI Aayog . (2016, January). Evaluation study on efficacy of minimum support prices (MSP) on farmers (DMEO Report No. 231). Development Monitoring and Evaluation Office Government of India.

Noronha, R. (2016, September 10). Grain of success: Madhya Pradesh Farms a green revolution to become India's rice bowl. India Today. Retrieved February 19, 2022, from https://www.indiatoday.in/magazine/nation/story/20160919-madhya-pradesh-rice-paddy-farmer-829527-2016-09-08

Parikh, K. S., Ganesh-Kumar, A., Darbha, G. (2003, 1–7 March). Growth and welfare consequences of rise in MSP, Economic and Political Weekly, 38(9), 891–895.

Pathania, Ankit & Chaudhary, Rashmi & Kumar, Krishan. (2020). Analysis of Agriculture Input Consumption by Indian Farmers. International Journal of Economic Plants. 7. 086-090. 10.23910/2/2020.0369.

PTI / Updated: Mar 27, 2012. (n.d.). Rice production doubles in Bihar, jharkhand - times of India. The Times of India. Retrieved February 16, 2022, from https://timesofindia.indiatimes.com/business/india-business/rice-production-doubles-in-bihar-jharkhand/articleshow/12427699.cms

Rakesh Kumar Gupta, Vikash Kumar, Piyush Kumar Singh, Md. Danish and Nilesh Dehariya. 2020. Impact of Minimum Support Price on Agricultural Production in Western India.Int.J.Curr.Microbiol.App.Sci. 9(6): 2291-2303. doi: https://doi.org/10.20546/ijcmas.2020.906.281

doi:10.6342/NTU202202490

Sharma, V. P. (2016). Marketable and marketed surplus of rice and wheat in India: distribution and determinants. Indian Journal of Agricultural Economics, 71(2), 137-159.

Singh, S. J. (2002, September). Impact of minimum support prices on the agricultural economy of Madhya Pradesh(by Agro-Economic Research Centre for Madhya Pradesh and Chhattisgarh J.N.K.V.V., Jabalpur (M. P.) Study Report No. 87).

Standard, B. (n.d.). Economy news: Indian Economy News, GDP growth, World Economy News, government policy news. Business Standard. Retrieved February 17, 2022, from https://www.business-standard.com/economy-policy

Tiwari, A. K., Shahbaz, M. (2013). Modelling the relationship between wholesale price and consumer price indices: Cointegration and causality analysis for India. Global Business Review, 14(3), 397–411.

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Appendix

Table 1 : 34-year Rice and Wheat MSPs

Year	Rice	Wheat
1988-89	160	183
1989-90	185	215
1990-91	205	225
1991-92	230	280
1992-93	270	330
1993-94	310	350
1994-95	340	360
1995-96	360	380
1996-97	380	475
1997-98	415	510
1998-99	440	550
1999-00	490	580
2000-01	510	610
2001-02	530	620
2002-03	530	620
2003-04	550	630
2004-05	560	640
2005-06	570	650
2006-07	580	850
2007-08	745	1000
2008-09	900	1080
2009-10	1050	1100
2010-11	1000	1170
2011-12	1080	1285
2012-13	1250	1350
2013-14	1310	1400
2014-15	1360	1450
2015-16	1410	1525
2016-17	1470	1625
2017-18	1550	1735
2018-19	1750	1840
2019-20	1815	1925
2020-21	1868	1975
2021-22	1940	1980

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Table 2: 38-year Rice Procurement, Offtake and Stock levels in Lakh Tonnes

Year	Procurement	Offtake	Stocks
1983-84	77.3	76.7	52.4
1984-85	98.6	66.1	85.8
1985-86	98.8	74.0	103.4
1986-87	91.6	90.3	100.4
1987-88	69.0	101.1	59.1
1988-89	77.3	90.8	38.6
1989-90	118.7	74.8	70.6
1990-91	126.7	79.1	102.1
1991-92	102.5	102.6	88.6
1992-93	130.5	98.9	99.3
1993-94	142.6	94.6	135.5
1994-95	137.1	88.5	180.8
1995-96	100.5	116.3	130.6
1996-97	129.6	123.1	131.7
1997-98	155.5	112.0	130.5
1998-99	126.0	118.3	121.6
1999-00	182.3	124.2	157.2
2000-01	212.8	104.2	231.9
2001-02	221.3	153.2	249.1
2002-03	164.1	248.5	171.6
2003-04	229.0	250.4	130.7
2004-05	246.7	232.0	133.4
2005-06	275.8	250.8	136.8
2006-07	251.1	250.6	131.7
2007-08	287.4	252.3	138.4
2008-09	341.0	246.2	216.0
2009-10	320.3	273.7	267.1
2010-11	342.0	299.3	288.2
2011-12	350.4	321.2	333.5
2012-13	340.4	326.4	354.7
2013-14	318.5	292.1	305.5
2014-15	315.5	307.3	238.2
2015-16	341.4	318.2	288.1
2016-17	364.8	327.9	298.0
2017-18	376.0	350.1	300.0
2018-19	426.8	344.0	377.0
2019-20	461.0	349.8	491.5
2020-21	581.9	563.2	499.3
2021-22	119.6	134.4	444.6

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Table 3: 38-year Wheat Procurement, Offtake and Stock levels in Lakh Tonnes

Year	Procurement	Offtake	Stocks
1983-84	82.9	74.5	96.2
1984-85	93.0	67.2	124.7
1985-86	103.5	117.2	102.1
1986-87	105.4	103.5	94.4
1987-88	78.8	127.8	33.4
1988-89	65.4	86.6	23.1
1989-90	90.0	75.1	34.6
1990-91	110.7	85.8	56.0
1991-92	77.5	104.8	22.1
1992-93	63.8	80.6	27.4
1993-94	68.9	91.4	70.0
1994-95	118.7	105.9	87.2
1995-96	123.3	127.2	77.6
1996-97	81.6	133.2	32.4
1997-98	93.0	77.6	50.8
1998-99	126.5	89.0	96.6
1999-00	141.4	106.3	131.9
2000-01	163.6	77.9	215.0
2001-02	206.3	159.9	260.4
2002-03	190.3	249.9	156.5
2003-04	158.0	242.9	69.3
2004-05	168.0	182.7	40.7
2005-06	147.9	171.7	20.1
2006-07	92.3	117.1	47.0
2007-08	111.3	122.1	58.0
2008-09	226.9	148.8	134.3
2009-10	253.8	223.5	161.3
2010-11	225.1	230.7	153.6
2011-12	283.4	242.6	199.5
2012-13	381.5	332.1	242.1
2013-14	250.9	306.2	178.3
2014-15	280.2	252.2	172.2
2015-16	280.9	318.4	145.4
2016-17	236.3	291.0	81.0
2017-18	306.0	252.8	132.0
2018-19	349.9	314.9	349.0
2019-20	341.3	272.2	247.0
2020-21	389.9	367.7	273.0
2021-22	433.3	106.7	564.8

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Table 4: 16 year State wise Crop Area Index for Rice

Year	Punjab	Haryana	Bihar	Assam	West Bengal	Andhra Pradesh	Karnataka	Madhya Pradesh	Uttar Pradesh
2004-05	100	100	100	100	100	100	100	100	100
2005-06	99.62	101.94	104.17	101.68	100.00	128.80	113.74	102.47	104.49
2006-07	98.87	100.97	107.69	92.02	98.44	128.80	106.87	102.47	110.86
2007-08	98.49	104.85	114.42	97.48	98.96	128.80	108.40	96.30	106.93
2008-09	103.21	117.48	112.05	104.38	102.69	141.97	115.57	103.85	113.00
2009-10	105.74	116.99	103.00	104.87	97.41	111.36	113.74	89.24	97.19
2010-11	106.79	121.36	90.71	107.98	85.47	153.72	117.56	98.77	105.99
2011-12	106.42	120.39	106.41	106.72	93.94	132.69	108.40	102.47	111.42
2012-13	107.55	118.45	104.17	94.12	93.94	112.94	96.95	116.05	109.74
2013-14	107.55	119.42	100.32	102.94	95.33	141.10	102.29	119.14	111.99
2014-15	109.06	125.24	104.81	95.80	93.25	123.30	99.24	132.72	109.93
2015-16	107.55	119.42	100.32	102.94	95.50	141.10	102.29	119.14	109.74
2016-17	104.15	134.95	105.45	102.94	89.10	68.28	77.10	141.36	105.81
2017-18	115.85	137.86	105.13	102.94	88.58	69.90		125.93	108.80
2018-19	116.98	140.78	101.28	102.10	95.33	71.52		147.53	107.68
2019-20	110.19	140.78	92.63	95.38	94.46	74.11		124.69	107.49
St. Dev	5.46	13.59	6.04	4.65	4.58	28.93	10.66	17.11	4.26

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Table 5: 16 year State wise Crop Production Index for Wheat

Year	Punjab	Haryana	Bihar	Assam	West Bengal	Andhra Pradesh	Karnataka	Madhya Pradesh	Uttar Pradesh
2004-05	100	100	100	100	100	100	100	100	100
2005-06	97.61	106.29	141.70	102.31	97.51	121.88	161.69	141.88	116.42
2006-07	97.13	111.59	202.02	84.15	99.13	123.65	97.18	117.09	116.32
2007-08	100.48	119.54	178.95	95.68	98.92	138.75	104.79	124.79	123.22
2008-09	105.36	109.21	226.33	115.52	101.06	148.34	107.10	133.31	137.00
2009-10	107.62	120.03	145.72	124.95	96.38	109.77	103.94	107.74	113.08
2010-11	103.83	114.90	125.51	136.60	87.70	150.21	118.03	151.28	125.42
2011-12	100.96	124.50	289.88	130.26	98.19	134.38	111.55	190.60	146.65
2012-13	108.91	131.79	297.17	131.41	100.54	113.65	92.39	237.61	150.73
2013-14	107.95	132.45	223.08	142.07	103.29	132.50	100.56	242.74	153.14
2014-15	106.42	132.78	258.30	140.06	98.86	120.52	103.10	310.26	127.82
2015-16	113.22	137.42	275.30	147.84	107.19	78.02	85.07	303.42	130.75
2016-17	105.65	147.35	302.83	150.72	101.41	77.60	71.55	361.54	135.46
2017-18	128.16	149.67	320.24	148.70	100.60	85.21		352.14	138.81
2018-19	122.80	149.67	249.39	150.43	109.14	85.73		383.76	162.66
2019-20	112.84	159.60	244.94	146.97	104.64	90.00		410.26	162.34
St. Dev	8.57	17.62	68.59	21.93	4.81	24.61	20.84	109.83	18.11

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Table 6: 16 year State wise Crop Area Index for Wheat

Year	Punjab	Haryana	Bihar	Karnataka	Madhya Pradesh	Uttar Pradesh
2004-05	100.00	100.00	100.00	100.00	100.00	100.00
2005-06	99.71	99.14	98.52	104.17	89.13	101.78
2006-07	99.71	102.59	100.99	112.50	96.38	101.78
2007-08	100.29	106.03	106.40	116.67	90.34	101.33
2008-09	101.32	106.12	106.32	112.08	91.43	105.70
2009-10	101.21	107.41	108.04	117.92	103.28	107.44
2010-11	100.86	108.62	103.45	108.33	104.83	107.11
2011-12	101.44	108.62	105.42	95.83	118.12	108.11
2012-13	100.86	107.76	108.87	95.83	128.02	108.11
2013-14	100.86	107.76	99.01	87.50	129.95	109.33
2014-15	100.86	112.07	105.91	83.33	144.93	109.44
2015-16	100.86	111.21	103.94	70.83	142.75	107.22
2016-17	100.57	110.34	103.94		145.65	107.33
2017-18	100.86	105.17	103.45		128.50	108.33
2018-19	101.15	109.91	106.40		133.33	106.00
2019-20	100.86	109.05	110.84		158.21	105.56
St. Dev	0.53	3.73	3.53	14.48	22.77	3.03

Table 7: Rice average yield, MSP, and Procurement indexes

Year	Rice Yield	Rice Real MSP Index	Rice MSP Index	Rice Prcr. Index
2004-05	100.00	100	100	100
2005-06	113.63	96.90	101.79	111.80
2006-07	111.75	92.94	103.57	101.78
2007-08	113.33	111.16	133.04	116.50
2008-09	116.94	122.46	160.71	138.22
2009-10	110.09	128.17	187.50	129.83
2010-11	114.29	110.63	178.57	138.63
2011-12	135.42	109.52	192.86	142.03
2012-13	142.46	115.00	223.21	137.98
2013-14	134.74	110.83	233.93	129.10
2014-15	139.32	108.81	242.86	127.89
2015-16	144.24	107.51	251.79	138.39
2016-17	149.87	107.65	262.50	147.87
2017-18	163.98	109.52	276.79	152.41
2018-19	156.26	119.09	312.50	173.00
2019-20	168.48	117.41	324.11	186.87

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Table 8: Wheat average yield, MSP, and Procurement indexes

Year	Wheat Yield	Wheat Real MSP Index	Wheat MSP index	Wheat Prcr. Index
2004-05	100.00	100	100	100
2005-06	101.99	96.69	101.56	88.04
2006-07	105.47	119.18	132.81	54.94
2007-08	109.09	130.56	156.25	66.25
2008-09	110.14	128.58	168.75	135.06
2009-10	110.27	117.49	171.88	151.07
2010-11	116.04	113.26	182.81	133.99
2011-12	121.72	114.02	200.78	168.69
2012-13	118.45	108.68	210.94	227.08
2013-14	122.15	103.64	218.75	149.35
2014-15	119.28	101.51	226.56	166.79
2015-16	123.64	101.74	238.28	167.20
2016-17	126.25	104.13	253.91	140.65
2017-18	131.25	106.96	270.31	182.14
2018-19	132.41	109.56	287.50	208.27
2019-20	127.21	108.96	300.78	203.15

Table 9: 12-year average Rice MSR, Stock and Procurement indexes

Year	Average MSR Procurement State	Average MSR Non-Procurement State	Rice Procurement Index	Rice PDS Stock Index
2003-04	100.00	100.00	100.00	100
2004-05	93.25	107.20	107.73	102.07
2005-06	88.54	129.16	120.44	104.67
2006-07	101.80	108.73	109.65	100.77
2007-08	104.86	98.05	125.50	105.89
2008-09	90.74	98.91	148.91	165.26
2009-10	103.46	118.50	139.87	204.36
2010-11	104.82	111.18	149.34	220.50
2011-12	102.91	108.83	153.01	255.16
2012-13	108.33	119.75	148.65	271.38
2013-14	109.53	120.69	139.08	233.74
2014-15	110.88	142.06	137.77	182.25

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Table 10: 12-year average Wheat MSR, Stock and Procurement indexes

Year	Average MSR Procurement State	Average MSR Non-Procurement State	Wheat Procurement Index	Wheat PDS Stock Index
2003-04	100.00	100.00	100	100
2004-05	91.76	113.02	106.33	58.73
2005-06	82.14	95.54	93.61	29.00
2006-07	97.93	107.27	58.42	67.82
2007-08	100.81	118.60	70.44	83.69
2008-09	104.10	106.22	143.61	193.80
2009-10	113.79	113.15	160.63	232.76
2010-11	111.46	120.21	142.47	221.65
2011-12	110.54	125.77	179.37	287.88
2012-13	116.06	131.04	241.46	349.35
2013-14	113.46	129.71	158.80	257.29
2014-15	107.05	132.59	177.34	248.48

Table 11: 16 year average NPK Indexes along with total fertilizer index

Year	Average N INDEX	Average P INDEX	Average K INDEX	Total Index
2004-05	100.00	100.00	100.00	100.0
2005-06	107.76	112.56	117.07	109.9
2006-07	115.76	117.69	108.55	115.5
2007-08	121.28	116.75	122.03	120.2
2008-09	126.56	139.13	158.78	132.9
2009-10	130.03	153.21	177.84	140.5
2010-11	136.03	169.63	162.53	146.9
2011-12	143.88	176.20	124.07	173.6
2012-13	143.78	150.13	96.74	140.7
2013-14	139.51	118.71	93.96	129.9
2014-15	130.78	121.78	112.93	126.8
2015-16	134.05	140.90	105.71	132.9
2016-17	127.93	136.21	112.34	128.4
2017-18	131.17	136.84	120.20	131.5
2018-19	140.39	139.40	115.50	137.7
2019-20	149.76	156.18	117.76	148.2

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Table 12: 20 year zonal tractor sales index

Year	East India	South India	North India	Central India
2000-01	100.00	100	100.00	100.00
2001-02	86.92	74.72	88.36	104.98
2002-03	77.37	61.06	71.81	86.02
2003-04	73.65	68.49	68.59	97.27
2004-05	82.27	116.51	65.52	112.51
2005-06	109.42	176.47	73.27	88.35
2006-07	146.96	201.34	100.35	81.16
2007-08	157.91	201.38	114.59	72.05
2008-09	191.83	171.07	116.11	94.96
2009-10	367.46	205.01	155.08	132.58
2010-11	329.62	221.35	143.52	169.56
2011-12	296.93	281.24	157.57	178.82
2012-13	309.45	335.37	138.50	226.48
2013-14	342.12	393.36	176.90	273.81
2014-15	414.49	255.56	154.91	216.19
2015-16	545.34	231.96	111.19	165.25
2016-17	624.75	249.55	118.06	209.01
2017-18	792.83	262.80	159.95	254.40
2018-19	1399.54	309.38	177.81	294.90
2019-20	811.70	231.27	168.11	292.50

Table 13: 14-year zonal electricity for agriculture share in total index

Year	East India	South India	North India	Central India
2005-06	100.00	100.00	100.00	100.00
2006-07	74.48	101.88	100.74	105.20
2007-08	58.60	91.07	102.43	96.09
2008-09	54.26	88.83	97.41	86.28
2009-10	53.56	94.20	102.50	87.77
2010-11	38.76	90.89	91.05	84.63
2011-12	30.06	87.01	89.70	83.00
2012-13	27.16	89.57	85.64	89.40
2013-14	23.50	91.15	78.62	93.59
2014-15	22.62	83.97	77.76	93.40
2015-16	19.75	83.80	76.83	98.39
2016-17	12.66	93.17	77.60	98.95
2017-18	16.99	87.82	72.94	90.03
2018-19	21.27	85.64	64.16	88.40

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Table 14: 14-year zonal electricity for agriculture index

Year	East India	South India	North India	Central India
2005-06	100	100	100	100
2006-07	83.43	119.80	109.74	109.15
2007-08	85.51	113.49	126.13	117.02
2008-09	75.90	121.46	121.29	96.56
2009-10	102.73	135.78	142.86	192.65
2010-11	106.03	140.76	132.64	198.85
2011-12	80.13	152.45	143.30	210.38
2012-13	77.30	161.45	138.49	232.28
2013-14	73.66	173.74	136.31	261.80
2014-15	88.17	125.68	144.44	201.64
2015-16	90.95	131.77	152.74	231.69
2016-17	71.33	151.93	159.17	237.82
2017-18	84.37	147.77	162.50	241.19
2018-19	109.42	155.00	152.47	257.19

Table 15: Average Nominal and Real Cost of production indexes for the Rice Crop (Per Hectare & Per 100 kg)

Rice	Cost of Production Index per Hectare				Cost of Production Index per 100 kg			
Year	Avg. Nominal Index	Rice MSP Index	Avg. Real Index	Real rice MSP Index	Avg. Nominal Index	Rice MSP Index	Avg. Real Index	Real rice MSP Index
2004-05	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2005-06	99.28	101.79	94.516	96.904	96.91	101.79	92.262	96.904
2006-07	101.59	103.57	91.164	92.941	103.26	103.57	92.659	92.941
2007-08	113.41	133.04	94.766	111.165	103.75	133.04	86.692	111.165
2008-09	141.33	160.71	107.685	122.456	127.15	160.71	96.882	122.456
2009-10	160.80	187.50	109.918	128.171	152.04	187.50	103.930	128.171
2010-11	165.58	178.57	102.586	110.633	159.75	178.57	98.970	110.633
2011-12	190.73	192.86	108.312	109.523	167.76	192.86	95.268	109.523
2012-13	219.16	223.21	112.912	115.001	188.34	223.21	97.033	115.001
2013-14	235.69	233.93	111.670	110.834	201.00	233.93	95.233	110.834
2014-15	269.15	242.86	120.586	108.807	222.75	242.86	99.797	108.807
2015-16	280.56	251.79	119.796	107.509	237.67	251.79	101.483	107.509
2016-17	287.26	262.50	117.803	107.650	229.36	262.50	94.058	107.650
2017-18	299.26	276.79	118.413	109.521	248.86	276.79	98.472	109.521

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Table 16: Average Nominal and Real Cost of production indexes for the Wheat Crop (Per Hectare & Per 100 kg)

Wheat	Cost of Production Index per Hectare				Cost of Production Index per 100 kg			
Year	Avg. Nominal Index	Wheat MSP Index	Avg. Real Index	Real Wheat MSP Index	Avg. Nominal Index	Wheat MSP Index	Avg. Real Index	Real Wheat MSP Index
2004-05	100.00	100.00	100.00	100	100.00	100	100.00	100
2005-06	110.88	101.56	105.56	96.69	116.36	101.56	110.78	96.69
2006-07	119.80	132.81	107.51	119.18	117.17	132.81	105.15	119.18
2007-08	130.75	156.25	109.25	130.56	121.40	156.25	101.45	130.56
2008-09	148.86	168.75	113.42	128.58	136.06	168.75	103.67	128.58
2009-10	162.18	171.88	110.86	117.49	147.84	171.88	101.06	117.49
2010-11	175.48	182.81	108.72	113.26	146.01	182.81	90.46	113.26
2011-12	204.88	200.78	116.35	114.02	155.56	200.78	88.34	114.02
2012-13	214.71	210.94	110.62	108.68	175.06	210.94	90.19	108.68
2013-14	232.39	218.75	110.10	103.64	181.35	218.75	85.92	103.64
2014-15	225.96	226.56	101.24	101.51	242.53	226.56	108.66	101.51
2015-16	236.55	238.28	101.00	101.74	248.99	238.28	106.31	101.74
2016-17	250.36	253.91	102.67	104.13	228.51	253.91	93.71	104.13
2017-18	301.51	270.31	119.30	106.96	227.93	270.31	90.19	106.96

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Table 17: Average Nominal and Real Farm Harvest Price, MSP and Procurement Indexes for Rice Crop

Rice	MSP Index	Avg. FHP Index	Real MSP Index	Real Avg. FHP Index	Avg. Procurement Index
2000-01	100.00	100.00	100.00	100.00	100.00
2001-02	103.92	105.77	99.88	101.92	77.62
2002-03	103.92	112.64	96.00	104.45	102.11
2003-04	107.84	107.51	95.99	94.06	106.77
2004-05	109.80	109.89	93.96	91.25	117.15
2005-06	111.76	112.38	91.05	88.85	104.36
2006-07	113.73	115.78	87.33	86.85	123.45
2007-08	146.08	131.50	104.45	92.25	143.48
2008-09	176.47	158.80	115.06	105.68	132.07
2009-10	205.88	182.02	120.43	114.27	139.32
2010-11	196.08	208.95	103.95	119.78	133.55
2011-12	211.76	203.69	102.91	107.77	72.95
2012-13	245.10	254.78	108.06	126.79	101.90
2013-14	256.86	287.71	104.14	137.20	102.78
2014-15	266.67	289.30	102.24	138.41	125.36
2015-16	276.47	274.32	101.02	133.93	137.26
2016-17	288.24	275.78	101.15	132.41	145.96
2017-18	303.92	283.49	102.91	131.05	152.95
2018-19	343.14	311.67	111.90	139.81	

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Table 18: Average Nominal and Real Farm Harvest Price, MSP and Procurement Indexes for Wheat Crop

Wheat	MSP Index	Avg. FHP Index	Real MSP Index	Real Avg. FHP Index	Avg. Prc Index
2000-01	100.00	100.00	100.00	100	100.00
2001-02	101.64	103.83	97.69	120.05	92.94
2002-03	101.64	107.85	93.89	120.01	78.45
2003-04	103.28	109.19	91.92	114.63	83.45
2004-05	104.92	114.48	89.78	114.07	74.00
2005-06	106.56	127.82	86.81	121.26	62.41
2006-07	139.34	150.06	107.00	135.07	54.47
2007-08	163.93	173.69	117.22	146.22	105.17
2008-09	177.05	180.66	115.44	144.27	119.24
2009-10	180.33	193.85	105.49	146.04	110.31
2010-11	191.80	198.71	101.69	136.70	133.52
2011-12	210.66	203.15	102.37	128.99	177.88
2012-13	221.31	241.14	97.57	144.00	120.81
2013-14	229.51	246.31	93.05	140.94	131.21
2014-15	237.70	247.36	91.14	142.01	135.47
2015-16	250.00	258.45	91.35	126.18	112.60
2016-17	266.39	274.99	93.49	158.43	150.01
2017-18	283.61	282.57	96.03	156.75	172.95
2018-19	301.64	295.26	98.37	158.94	165.71

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Table 19: 19-year Nominal and Real MSP, Retail prices and FHP for Wheat

Wheat	Wheat MSP	Avg. Retail	Avg. FHP Wheat	Avg. Real Retail price	Avg. Real FHP Paddy	Real Wheat MSP
2001-02	620	768.23	623.17	768.23	600.46	595.91
2002-03	620	835.27	647.33	802.79	600.24	572.73
2003-04	630	898.98	655.33	832.50	573.36	560.74
2004-05	640	952.93	687.12	848.43	570.55	547.67
2005-06	650	1024.01	767.17	867.98	606.49	529.55
2006-07	850	1145.92	900.67	915.54	675.58	652.72
2007-08	1000	1313.52	1042.50	977.22	731.36	715.06
2008-09	1080	1378.87	1084.34	935.41	721.59	704.19
2009-10	1100	1436.59	1163.52	874.33	730.45	643.46
2010-11	1170	1538.85	1192.67	848.83	683.70	620.30
2011-12	1285	1644.64	1219.33	831.56	645.18	624.47
2012-13	1350	1803.50	1447.33	827.28	720.24	595.19
2013-14	1400	1936.94	1478.33	817.07	704.95	567.62
2014-15	1450	2053.17	1484.67	819.00	710.30	555.92
2015-16	1525	2138.18	1551.20	812.85	631.13	557.22
2016-17	1625	2252.70	1650.50	822.52	792.43	570.27
2017-18	1730	2389.72	1696.00	841.88	784.02	585.79
2018-19	1840	2431.27	1772.17	824.91	794.98	600.04
2019-20	1925	2600.61		838.75		596.73

Table 20: 7-year indexes for grain storage and degrees of procurement for Rice and wheat across the states

Year	Total Storage Index	Index of Avg. degree of Procurement Rice	Index of Avg. degree of Procurement Wheat
2013-14	100.00	100.00	100.00
2014-15	100.90	93.74	113.11
2015-16	115.25	122.43	106.91
2016-17	121.07	136.10	90.87
2017-18	121.96	132.73	115.66
2018-19	126.89	138.76	122.58
2019-20	119.14	148.10	121.21

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Table 21: 16-year area indexes for farmer categories across the 9 states

Policy state	Marginal farmer Index	Small farmer Index	Semi-Medium farmer Index	Medium farmer Index	Large farmer Index
2000-01	100	100	100	100	100
2005-06	105.39	103.22	100.68	94.59	84.94
2010-11	109.80	108.02	99.55	85.36	70.21
2015-16	119.74	112.23	98.52	77.07	56.58
Non-policy state	Marginal farmer Index	Small farmer Index	Semi-Medium farmer Index	Medium farmer Index	Large farmer Index
2000-01	100	100	100	100	100
2005-06	114.35	101.31	91.21	87.95	89.92
2010-11	125.74	102.88	88.45	79.86	76.30
2015-16	131.70	104.74	84.87	72.49	68.43

Table 22: 16-year total count indexes for farmer categories across the 9 states

Policy state	Marginal farmer Index	Small farmer Index	Semi-Medium farmer Index	Medium farmer Index	Large farmer Index
2000-01	100	100	100	100	100
2005-06	105.76	103.96	101.14	95.21	85.54
2010-11	113.62	109.29	100.54	86.77	68.74
2015-16	123.85	113.82	99.91	79.09	54.19
Non-policy state	Marginal farmer Index	Small farmer Index	Semi-Medium farmer Index	Medium farmer Index	Large farmer Index
2000-01	100	100	100	100	100
2005-06	127.64	100.93	91.04	87.92	85.38
2010-11	140.55	100.92	88.86	80.99	72.66
2015-16	148.68	102.90	85.14	73.22	60.80

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