Impact of minimum support price on paddy cultivation: a micro level assessment

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The present study aims at estimating the impact of minimum support price (MSP) on rice cultivation using a quasi-experiment-based robust research design, propensity score matching applied to household survey-based disaggregated primary data. Results indicate that MSP significantly impacts price realization in the disposal of paddy. Further, MSP has a fair influence on the marketed surplus of rice and the acreage devoted to the rice crop. The study finds important correlations between farmers' decisions to avail MSP in rice. It has important policy implications from an implementation perspective to make it more effective to better off the paddy growers throughout the country.

Keywords: Impact evaluation, minimum support price, propensity score matching, rice cultivation.

THE minimum support price (MSP) policy as a safety net agricultural price policy of the Government of India has provoked debates time and again in the context of MSP favouring the food surplus states and crop specialization, mainly food crops like rice and wheat at the expense of oilseeds and pulses[1–3]. It is often argued that MSP has propelled the shift of acreage from pulses, oilseeds, and other important crops to rice and wheat and, thus, has been instrumental in creating an imbalance in the agricultural production priorities of the country. However, the overwhelming importance of rice as a staple food for 65% of the country's population can hardly be overlooked. The most important three malnutrition eradication programmes of the country – integrated child development scheme, public distribution system, and mid-day meal programme with a potential coverage of 800 million vulnerable native populations, are pivoted around rice[4]. Therefore, rice production with a proper incentive to its growers is paramount in a country like India. As MSP is a vital form of government-intervened insurance for farmers against price-fall and revenue losses, it has direct financial and social implications. Therefore, reaching a precise estimate of the impacts of MSP is crucial both from scientific as well as policy perspectives. Theoretically, the benefits of MSP should reach all the farmers of the country across crops and locations.

However, the 70th round of situation assessment survey datasets (2015) of the National Sample Survey Office indicates that more than 75% of the farm-households in India are not even aware of MSPs on the crops they grow[5]. In this context, it becomes pertinent to know the consequences of being aware of MSP and the potential benefits of availing the same at the household level. However, we did not come across a single study conducted in the recent past to precisely spell out the farm-level impacts of MSP. The present study, therefore, focuses on quantifying the benefits of MSP realized by the paddy growers in the disposal of rice crops and, thereby, its rippling effects on paddy cultivation at the micro level. Selection of the estimation procedure and a robust design, in our opinion, are the most important to outcomes with unbiased and credible estimates. The existing evaluation literature is indicative of a variety of approaches and methods of evaluation of effects, effectiveness, and impact[6–8]. Given the nature and importance of the study, we conducted a quasi-experiment employing the robust design of propensity score matching (PSM) for its proven strength over the traditional approaches to generate precise and reliable impact estimates[9,10].

Data and methodology

Sampling and data

The study locale comprised randomly selected four Indian states – Chhattisgarh, Madhya Pradesh, Maharashtra and Odisha among the twelve major states, from each of which more than 10 million tonnes of paddy procurement in MSP is done for the central pool by the Government of India. Household-level disaggregated primary data were collected through household surveys and personal interviews with the help of a pre-tested semi-structured interview schedule from October 2021 to May 2022. The survey covered 160 farm units ($n = 160$).

Model selection

Though we initially followed a randomized selection procedure to identify the MSP- and non-MSP-farmers, they were not alike in terms of observed baseline covariates

Table 1. Impact of minimum support price (MSP) on rice cultivation measured through selected parameters ($n = 137$)

Impact indicator	Estimand/no. of matched observations	Impact estimate ($\bar{y}_{msp} - \bar{y}_{non\text{-}msp}$)	t-value
Selling price of produce (rice) (Rs/quintal)	ATT/88	544.87	19.59*
Volume of marketed surplus of produce (rice) (quintal)	ATT/88	17.71	19.14
Percent marketed surplus of produce (rice)	ATT/88	9.83	0.97
Acreage under rice crop (acre)	ATT/88	2.25	1.35
Rice yield (quintal/ha)	ATT/88	2.01	0.47
(Rice) Varietal diversification	ATT/88	0.21	0.84

*Significance at <0.001.

(Table 1). It prompted us first to establish statistical equivalence between these two groups for unbiased impact estimates. We adopted the PSM procedure for constructing an artificial control group by matching each treated unit with a non-treated unit of similar characteristics. Using these matches, the statistical equivalence of the treatment group (farmers availing MSP) and the non-treated/control group (farmers not availing MSP) could be established. Let us assume that we have a binary treatment indicator Z, a response variable R, and background (observed) covariates Xs. The propensity score is defined as the conditional probability of the treatment given background covariates as follows

$$P(x) = Pr(Z = 1 | X = x). \tag{1}$$

The binary treatment indicator Z used in the present study was availing MSP in selling rice; a score of 1 was assigned if yes and 0 otherwise. Based on the results of an independent sample student's t-test to find out the significance of the difference in attributes between the treatment (MSP) and the control (non-MSP) groups, and in consultation with literature[11,12], the following three baseline covariates (observed) were used as matching variables in the subsequent procedure.

- Number of sources of income (X_1)
- Farming experience (X_2)
- Landholding size (X_3).

The response variables/impact parameters used in the study were as follows

- Selling price of the produce (rice)
- Volume of marketed surplus of the produce (rice)
- Percentage marketed surplus of the produce (rice)
- Acreage under rice crop
- Rice yield
- Varietal diversification in rice cultivation

The most commonly used matching technique in PSM is nearest neighbour matching. Since many of the times nearest neighbours are placed far apart in terms of the distance metric between propensity score of the treated and the control, we used the propensity score calliper method for matching our subjects (eq. (2))[9].

$$C[P(X_i)] = \{P(X_j)| \; ||P(X_i) - P(X_j)|| < \varepsilon\}. \tag{2}$$

The mean impact estimator of MSP on paddy cultivation was obtained from eq. (3):

$$\bar{G} = \sum \left(Y_{j1} - \sum_{i=1}^{NP} W_{ij} Y_{ij0} \right) \Big/ P, \tag{3}$$

where Y_{j1} is the household level outcome after availing MSP for household j. Y_{ij0} is the household level outcome for the ith control (non-MSP farmer) matched to the jth treated unit (MSP farmer). P is the total number of treated units. NP is the total number of control units. W_{ij}s are the weights applied in calculating the average outcome of the matched control units. The influence of different factors on rice growers' decision to avail the benefits of MSP was analysed using a probit model as in eq. (4).

$$E(Y|X) = P(Y = 1|X)$$
$$= \Phi(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n), \tag{4}$$

where Φ is the cumulative standard normal distribution function, X_i the explanatory variable ($i = 1, 2, \ldots, n$), β_j the regression coefficient ($j = 1, 2, \ldots, n$), Y the binary outcome (1/0).

Statistical analysis

Data analyses were done in the statistical language programming software R (ver. 4.2.2) using three packages – 'Matching'[13], 'rbounds'[14] and 'dplyr'[15].

Results and discussion

Factors influencing rice growers' decision to avail the benefits of MSP

Theoretically, the price of produce is the most important factor that moulds the farmers' decisions regarding marketing their produce[16]. However, in our study, the same did hardly prevail as about 36% of the farmers in our sample chose not to sell their produce (rice) in MSP despite lesser

Table 2. Results of a probit regression (outcome variable = decision to avail MSP)

Factor	Coefficient	Standard error	Z value	Pr(>|z|)	Average marginal effect
Intercept	−1.43	1.18	−1.21	0.23	−0.45
Age	0.02	0.02	1.12	0.26	0.01
Sex	0.06	0.66	0.09	0.93	0.02
Education	0.01	0.03	0.35	0.72	0.00
Multiple sources of income	1.02	0.48	2.14	0.03*	0.33
Membership in social organizations	0.47	0.30	1.56	0.12	0.15
Farming experience	−0.02	0.01	−1.17	0.24	0.00
Family size	−0.25	0.13	−1.96	0.05*	−0.08
Dependency ratio	0.19	0.17	1.15	0.25	0.06
Landholding size	0.04	0.03	1.24	0.21	0.01
Complementary enterprise(s)	−0.02	0.05	−0.39	0.70	−0.01

*Significance at 0.05; Akaike Information Criterion = 175.06; Proportion of correctly predicted values = 0.69; McFadden Pseudo R^2 = 0.14.

profit or losses incurred while selling rice to the local traders/aggregators compared to MSP. The results of a probit analysis suggested that multiple sources of income enhance the probability of availing MSP by the rice farmers. Alternate sources of income increase the risk-bearing ability of the farmers, as has been reported in several studies[17]. As a result, they perceive a lesser financial burden to bear additional costs of transportation of their produce to the public procurement centres to avail the benefits of MSP. The probit model further reveals that a larger family size reduces the probability of availing MSP. The larger the size of the family, the more the need for financial resources for survival and sustenance. The constant need for cash felt by the larger farm families compelled them to readily dispose of their produce to the local traders, even at the expense of greater profit realized while selling produce at MSP. Payments for selling rice at MSP are not received instantly by the farmers. It is a time-consuming process, and such a deferred payment system does not allow the large farm families to avail the benefits of MSP owing to the pressing need for liquidity. As learned in the process of conducting personal interviews, the farmers invariably chose to sell their produce (rice) based on convenience. The decision to dispose of the produce mostly depended on farmers' perceived ease of access to MSP. In some states, the state government offered bonuses over and above the MSP that also influenced the farmers to avail the benefits of MSP. Except for the two household-level factors – multiple sources of income and family size, the other baseline covariates hardly influenced the farmers' decision to sell their produce at MSP (Table 2).

Impact of MSP on paddy cultivation: excerpts from the PSM

The impact estimates obtained using the PSM methodology suggest that the most important advantage of MSP is its contribution to price realization for the produce. Our estimates suggest that the price realization through MSP in

paddy had been 38.15% more when compared to the other ways of disposal. The farmers selling rice at MSP could earn an average of Rs 544.87 per quintal more than those selling paddy in alternative ways (Table 1). Compared to only Rs 1428.13 per quintal price realized by the non-MSP rice farmers, the farmers availing MSP could sell their produce at Rs 1973 per quintal on average (Figure 1). During the study period (2021–22), the MSP on common grade paddy was Rs 1940 per quintal and for Grade-A paddy, it was Rs 1960 per quintal. Farmers earned as low as Rs 1200 per quintal by selling paddy locally in the open markets. In states like Chhattisgarh, on the other hand, farmers could earn Rs 2500 per quintal by selling paddy at MSP, with Rs 560 per quintal bonus offered by the state government over and above the MSP.

About two-thirds (64.23%) of the paddy farmers in our sample sold their produce at MSP. This does not align with the Shanta Kumar chaired high-level committee report, 2015 on Food Corporation of India (FCI), which informed that not more than 6% of the farmers in India sell their produce at MSP[18]. Our sample comprised farmers from the states of Madhya Pradesh and Chhattisgarh among the four states under study. These two states are among the most effective states in terms of MSP, where more than 75% of the farmers can sell their produce at MSP, as reported in past studies[5,19]. MSP might have influenced the marketed surplus of the paddy farmers, as the farmers selling rice at MSP sold an average of 9.83% more than the non-MSP farmers. Compared to an average marketed surplus of 54.80 quintals of paddy for the MSP farmers, the non-MSP farmers had only an average of 37.09 quintals of surplus paddy to be marketed. MSP might also have motivated the farmers to increase acreage under rice crops as the farmers selling at MSP had an average of 2.25 acres more area under rice compared to the non-MSP farmers. Our findings were in concordance with Ali et al.[2] who reported that the contribution of MSP towards increasing rice production in the state of Punjab had been enormous. Increasing MSP brought an additional area under paddy, and effective implementation of the MSP policy ensured efficient marketing
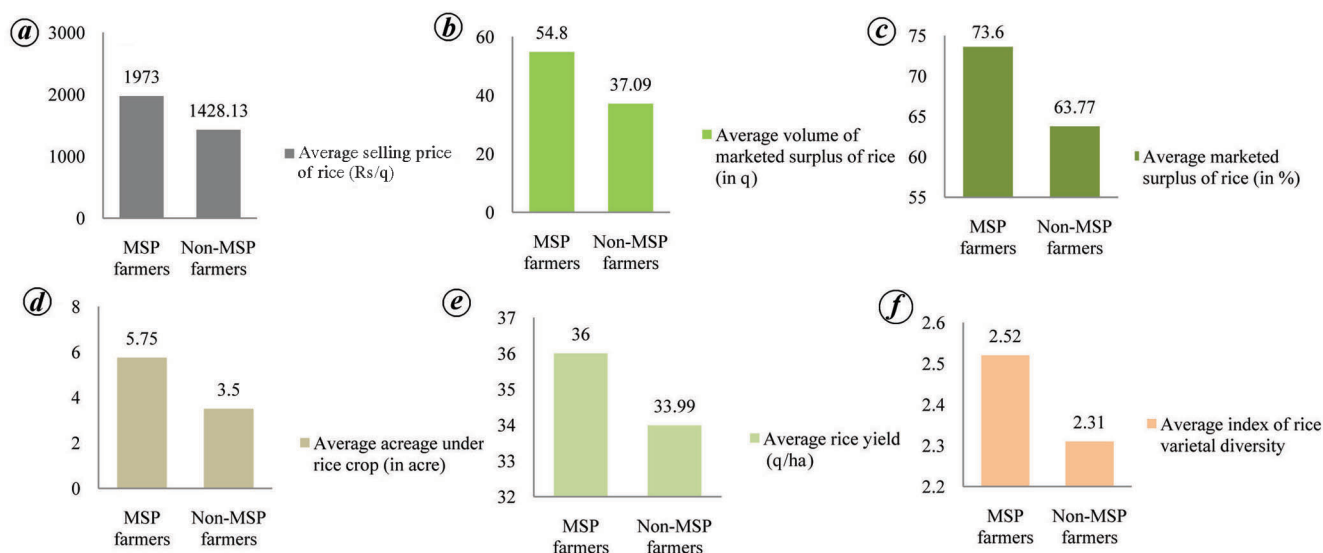
Figure 1. Comparison of minimum support price and non-minimum support price farmers with respect to six selected impact parameters.

Table 3. Statistical significance of the difference in attributes between the treatment group and the control group under study

| Variable | Mean and SD | | |
	Treatment[#]	Control[##]	t-value
Age (years)	52.7 (11.8)	51.9 (13.2)	–0.35
Education (numbers of years of schooling)	9.10 (4.31)	7.86 (4.49)	–1.60
Number of sources of family income	1.94 (1.24)	1.51 (0.77)	–2.52*
Membership in social organizations (number)	0.409 (0.494)	0.184 (0.391)	–2.75**
Farming experience (years)	27.0 (12.7)	28.9 (13.5)	0.85
Family size (number)	5.98 (2.61)	6.57 (3.93)	0.95
Dependency ratio[&]	3.62 (1.46)	4.70 (3.02)	2.34*
Land holding size (acre)	4.93 (4.08)	3.34 (5.44)	–1.78*
Herd size (number)	2.45 (3.05)	2.49 (1.91)	0.08

(Data in parentheses represent sample standard deviation); [#]farmers availing MSP in selling their produce (rice); [##]farmers not availing MSP in selling their produce (rice); [&]calculated as the number of earning members divided by the family size; *significance at 0.05, **significance at 0.01.

of the produce, consequently raising the productivity and production of rice in the state. In the same tune, our study further found that the MSP farmers had about 6% more average yield (36 quintal/ha) compared to the non-MSP farmers (33.99 quintal/ha). However, the average number of rice varieties grown by non-MSP farmers (2.31) was almost the same as the MSP farmers (2.52).

Credibility of the impact estimates produced by the PSM

An important question often asked in of impact estimation is how credible the impact estimates are. The credibility of the impact estimates depends upon the credibility of the counterfactual, i.e. the degree to which a resemblance between the experimental and control groups could be established[20]. As indicated by the results of an independent sample student's t-test, 45% of the baseline covariates of

the farmers availing MSP were different from the farmers not availing MSP. The characteristics in which the treatment (MSP) and the control (non-MSP) farmers significantly differed were: the number of sources of family income ($t = -2.52$, $P < 0.05$), membership in social organizations ($t = -2.75$, $P < 0.01$), family dependency ratio ($t = 2.34$, $P < 0.05$), and landholding size ($t = -1.78$, $P < 0.05$) (Table 3). However, there was no significant difference in age ($\bar{x} = 52.3$ years), education/number of years of schooling ($\bar{x} = 8.48$), farming experience ($\bar{x} = 27.95$ years), family size ($\bar{x} = 6.28$), and herd size ($\bar{x} = 2.47$). These initial differences in the treatment and the control group did not allow us to adopt a simple with–without approach to estimate impact. Resorting to the traditional with–without approach for impact evaluation, assuming that the randomization has worked well, would have led us to biased and erroneous impact estimates. Establishing a statistical equivalence of the two groups under study was vital for drawing inferences
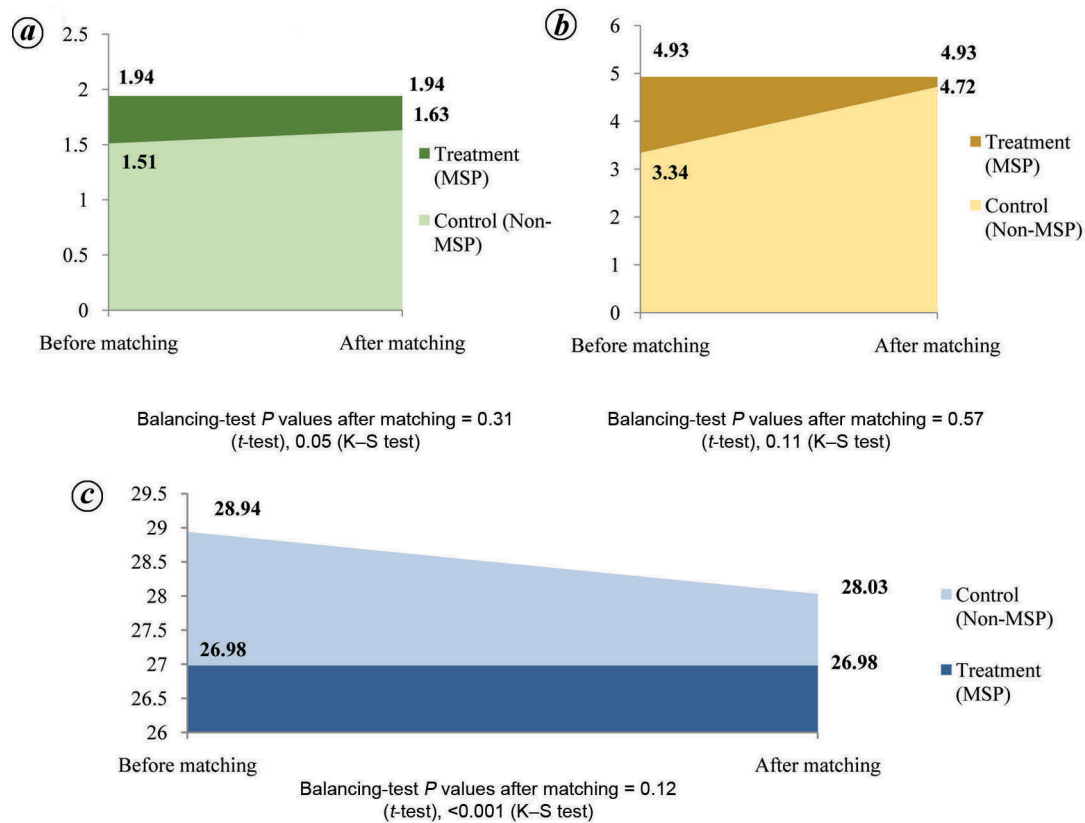
Figure 2. Balancing tests for the matching variables. *a*, Number of sources of income. *b*, Landholding size (acre). *c*, Farming experience (years).

on the impact estimates more confidently. If and only if the baseline characteristics of the two groups under study were similar, the differences in outcomes whatsoever could be considered as the direct impact of the treatment (MSP in our case). The balancing tests, namely, the K–S test and independent sample student's *t*-test as employed in the study, indicated that the baseline covariates in the treatment and control groups were not significantly different after the PSM procedure was carried out. PSM constructs an artificial comparison group by identifying, for every possible observation under treatment, a non-treatment observation (or set of non-treatment observations) with the most similar characteristics possible[20]. The insignificant *P* values of the balancing tests (after matching) for all the three baseline covariates, number of sources of income ($P_t = 0.31$; $P_{K–S} = 0.05$), farming experience ($P_t = 0.57$; $P_{K–S} = 0.11$) and landholding size ($P_t = 0.12$; $P_{K–S}$ significant) imply that the matching worked well to have produced credible impact estimates (Figure 2). The improvement in characteristics of the non-MSP farmers' group after the matching to be considered a credible counterfactual for comparing with the MSP farmers' group, can be seen in Figure 2. An initial 3.34-acre average landholding size of the non-MSP farmers' group improved to 4.72 acres, comparable to the treatment/MSP-famers' group (4.93 acres). Similar improvements could also be seen with respect to the other two matching variables – alternate source of income and

farming experience. The impact estimates, therefore, can be considered precise and credible.

Conclusion

There is no dearth of social protection schemes and safety net policies in the country[21,22]. However, no such policies received attention the way MSP has received in the recent past, which naturally instigates one to look into the benefits of this unique price policy. The results of the present study are quite encouraging as they show that MSP positively impacts paddy cultivation. Given that the larger size of farm families, greater dependency ratio, and rice farming as the sole source of family income affect the probability of availing MSP, policy interventions are required to ensure timely payment at public procurement centres. Another concern about MSP is that it is perceived as lower vis-à-vis the cost of cultivation. The farmers were unhappy with the amount of MSP declared for paddy procurement, as the personal interviews showed. Several experts have opined that MSP should be increased to cover the entire range of cost of production and to make farming as a whole remunerative to help farmers stay motivated and confident in the pursuit of farming. Crops like paddy, in light of their share in the total foodgrains production and the number of producers and consumers, should get more attention while declaring MSP. MSP is not uniformly implemented in all

the states; it is relatively more successful in surplus states. Given that the favourable prices for the produce and ease of marketing create an enabling environment in agri-business, the price policy of the country should be implemented effectively in the potential areas. Special attention should be given to the MSP-ineffective states to better address the farmers' problems, constraints and limitations to help them sustain their livelihoods.

Conflict of interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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