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Could Pradhan Mantri Garib Kalyan Yojana (PM-GKY) Mitigate COVID-19 Shocks in the Agricultural Sector

Evidence from Northern India

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Abstract

While the COVID-19 pandemic resulted about 24% decline in Indian GDP during April -June 2020 quarter, the nation's agricultural sector, somewhat surprisingly, seems to have done remarkably well during the same period. Using phone survey of a sample of previously interviewed households from Northern India, this paper examines whether the package of public transfer program announced during the lockdown, called Pradhan Mantri Garib Kalyan Yojana (PM-GKY), has helped farmers deal with the shock. Overall, results show that 95 percent of the small holders received supports from at least one of the components of the PM-GKY scheme. Direct cash transfers have performed better than the in-kind transfer schemes. The econometric analysis, using a quasi-experimental method, suggests that the fungibility of funds received under the transfer package was significant in alleviating credit constraints and increasing agricultural investments in modern inputs. This is evident from the results that when only income support program (PM-KISAN) is considered, impact was limited to seed, not fertilizer and pesticides. By contrast, farmers who received benefits from all four programs (i.e., PM-KISAN, cash transfer for women, conditional cash transfers, and free food rations-KISAN) had spent significantly more on procurement of seeds, fertilizers, and pesticides.

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Acronyms

DBT	Direct benefit transfers (DBT)
ENAM	Electronic National Agriculture Marketing (e-NAM).
FPO	Farmer producer organizations
ICAR	Indian Council of Agricultural Research
IFPRI	Indian Food Policy Research Institute
IKS	In-kind support
MGNREGA	Mahatma Gandhi National Rural Employment Act
MSP	Minimum Support Price (MSP)
NABARD	National Bank for Agriculture and Rural Development
PM-GKY	Pradhan Mantri Garib Kalyan Yojana
PM-AVY	Pradhan Mantri Garib Ann Vitran Yojana
PM-JDY	Pradhan Mantri Jandhan Yojana
PM-KISAN	Pradhan Mantri Kisan Samman Nidhi
PM-UY	Pradhan Mantri Ujjwala Yojana
PSM	Propensity Score Matching

1. Introduction

The great lockdown announced by the Indian Prime Minister in March 2020 had most likely triggered the biggest disruption of livelihoods in human history. Images in popular media—such as bustling cities coming to halt and the plight of migrant workers walking hundreds of miles on empty highways—made it abundantly clear that the COVID-19 pandemic would be a significant blow to the Indian economy. So, it is no surprise that the growth projections for 2020-21 have been drastically revised downward[1] by both World Bank and IMF, which is most likely influenced by the shrinkage of the economy by 3-5 percent in a financial year.[2] What has surprised most experts though is the performance of agricultural sector, which is expected to grow by 3.4% during the same period.[3] This is clearly good news for the country—especially from the poverty and food security points of view—as almost two-third of Indians live in the rural areas and depend on agriculture and allied services for their livelihoods (Census 2011).[4] How has Indian agriculture done so well amid an unprecedented pandemic? This question has captivated development experts and the popular media.[5] Proximate explanations include resilience of Indian agriculture, timing of pandemic, public policy responses, and strong existing rural infrastructure for social transfers. Indeed, India has had a bumper harvest during 2019-2020 Rabi season,[6] registering a 5% growth (an increase in production from 129.7 million tons to 136.7 million).[7] However, the expectation was that the

[1] Overall growth projections for 2020-21 have been revised downwards from 5.8% to 1.9% by the IMF and from 6.1% to 1.5-2.8% by the World Bank.

[2] https://economictimes.indiatimes.com/news/economy/indicators/indias-economy-to-contract-by-3-2-per-cent-in-fiscal-year-2020-21-world-bank/articleshow/76266999.cms?from=mdr. https://www.thehindu.com/business/Economy/imf-projects-sharp-contraction-of-45-in-indian-economy-in-2020/article31907715.ece

[3] https://economictimes.indiatimes.com/news/economy/agriculture/farming-sector-will-not-be-impacted-by-coronavirus-agriculture-minister/articleshow/75450174.cms?from=mdr

[4] https://censusindia.gov.in/2011-prov-results/paper2/data_files/india/paper2_1.pdf

[5] https://timesofindia.indiatimes.com/india/agricultural-sector-to-grow-by-3-push-indias-economy-amid-corona-crisis/articleshow/75457447.cms

[6] In general, Rabi season starts from November and ends by the month of April.

[7] https://eands.dacnet.nic.in/Advance_Estimate/3rd_Adv_Estimates2019-20_Eng.pdf

lockdown would affect the availability of labour for harvest, even though the timely decision to relax the movement restriction for the agriculture sector mid-April may have eased the shortage of harvest labour. On the market side, it was expected to impact the procurement and prices of agricultural commodities as a consequence to the supply chain disruptions due to lockdown. Yet, thanks to government's price stabilization policies, cereal prices did not crash, and prices of essential commodities remained stable (Varshney et al., 2020), and public procurement program picked up in May and June, albeit with a slow start (Low and Ruthe, 2020).

Of particular concern, the trading in Indian agricultural markets is mainly physical and cash based where even in the absence of any crisis the phenomenon of delay in payments exists, which in turn have magnifying implications for the liquidity of farmers in the event of pandemic (Reddy, 2017). In contrast, the data suggest that, farmers have increased their investments for Kharif (summer crop) season,[8] which was expected to be most impacted by the COVID-19 lockdown. Both input use and area sown have gone up significantly. For instance, fertilizer sales increased by 2%; and area sown to Kharif crops [9] has gone up by 10% compared to 2019.[10]

Against this backdrop, this paper carries out a set of analyses to examine the role of a large package of public transfer program (worth US$25 billion), called *Pradhan Mantri Garib Kalyan Yojana* (PMGKY), announced immediately after the lockdown that included income supports, cash transfer for women, conditional cash transfer for buying cooking gas, and free food rations. The analysis is based on a unique phone survey, jointly conducted by the International Food Policy Research Institute (IFPRI) and the Indian Council of Agricultural Research Council (ICAR), during April – May 2020 in three northern states of India (Rajasthan,

[8] In general, Kharif season starts from July and ends by the month of October.
[9] Cereals (17%), oilseeds (15%) and pulses (5%)
[10] https://economictimes.indiatimes.com/news/economy/agriculture/good-progress-of-monsoon-in-august-raises-hopes-of-bumper-kharif-harvest/articleshow/77518150.cms

Madhya Pradesh, and Uttar Pradesh). The survey included a total of 1,789 farmers from an earlier IFPRI-ICAR survey conducted in 2017-18 and 2018-19, respectively. Two main objectives of this survey have been to examine (a) whether the benefits of the program had reached the farmers amid COVID-19 pandemic and (b) to what extent PM-GKY contributed to farmers investment decisions for 2020 Kharif season. In addition to descriptive assessment of program effectiveness in reaching the intended beneficiaries, quasi-experimental methods are used to econometrically quantify the impacts of PM-KISAN (a key component of PM-GKY scheme) and the role of other components (cash transfer for women, conditional cash transfer for buying cooking gas, and free food rations) on modern input procurement for 2020 Kharif season. Our results suggest that the 95% of the farmers received the benefit of at least one component of PM-GKY and the PM-GKY has had significant impacts on farm household's decision to invest in modern inputs amid the COVID-19 pandemic.

The rest of the paper is organized as follows. The next section presents a brief review of PM-GKY, which is followed by a discussion on the data and survey methodology. Section 4 presents the econometric methodology employed for impact evaluation and results are discussed in Section 5. The paper concludes with a summary and implications of the results.

2. Pradhan Mantri Garib Kalyan Yojana (PM-GKY)

Announced in March 2020, the INR 1.7 lac crore (about 25 billion US$) COVID package was designed to help both rural and urban Indians deal with the pandemic shock. The package included public supports in the form of direct benefit transfers (DBT) and in-kind supports (IKS), which are illustrated in Table 1. In India, the majority of the farmers are vulnerable and are more likely to get affected by the incumbent credit and liquidity constraint in purchasing agricultural inputs, [11] where more than 50% of farmers rely on informal credit.[12] At the same time, one-fifth of farmers buy inputs on credit in usual times, and in the event of a pandemic, the availability of agricultural inputs on credit is uncertain. We hypothesize that the PM-GKY may ease the liquidity constraints of the farmers for the investment in the 2020 Kharif season. As shown in the table, the package appears to be comprehensive in terms of coverage, types of beneficiaries, as well as size and timing of the transfers.

Table 1: Elements of the PM-GKY relief package

SN	Scheme	Beneficiary Type	Coverage (# beneficiary)	Benefit (per beneficiary)	Duration	Existing/Additional benefit
1.	PM-KISAN	Farmers	87 million	INR 2000	April-June 2020	Existing benefit (but provided early)
2.	PM-JDY	Women bank account holder	204 million	INR 1500	April-June 2020	Additional benefit
3.	PM-UY	Poor families	80 million	Income support for buying 3 cooking gas cylinders	April-June 2020	Additional benefit
4.	PM-AVY	Vulnerable households	237 million	5kg wheat / rice per member and 1 kg pulses to the family per month	April-November 2020	Additional benefit

Source : https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1608345
Note: Other elements of the package includes the wage benefits under rural employment scheme, support to senior citizens, health insurance coverage and support to low wage earners in the organized sector.

[11] Joshi (2015).

However, the PM-GKY included all types of beneficiaries including the section of the populations that are not directly engaged in agriculture. Therefore, the main focus of the paper will be on the Pradhan Mantri Kisan Samman Nidhi (PM-KISAN), which involves direct transfer of INR 2000 to the farming households. Since funds are fungible, we also have examined whether the other major components of the PM-GKY have had impacts on farm households' investment decisions. The other three components we have considered are: Pradhan Mantri Jan Dhan Yojana (PM-JDY), Pradhan Mantri Ujjwala Yojana (PM-UY), and Pradhan Mantri Ann Vitran Yojana (PM-AVY). The four major components represent 70% of the allocation under the PM-GKY COVID-19 package.[13]

3. The Data

3.1. Key characteristics of the study area

The survey was conducted in three large states of India—Rajasthan, *Madhya Pradesh, and Uttar Prade*sh—that together account for 28% of the total Indian population and these states are home of 93.5 million poor households.[14] The agroecological conditions and cropping patterns vary both within and across these states (Appendix Table A1). For instance, in Rajasthan, area allocated to top five crops are pearl millet (16%), wheat (12%), mustard (10%), soybean (5%) and gram (4%).[15] This is also the largest state in India with huge variations in terms of agro-ecological and production systems. The arid region has pearl millet and oilseed-based production system, cotton-wheat based system irrigated land, and oilseeds in the rainfed areas. [16] Pearl millet and soybean are grown during the Kharif season and wheat, mustard, and gram in Rabi season.

[13] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1608345
[14] https://www.rbi.org.in/scripts/PublicationsView.aspx?id=16603
[15] Other crop includes maize, groundnut, jowar ,cotton and fodder crops.
[16] http://ncap.res.in/upload_files/PME_notes/pmenotes6.pdf

In Madhya Pradesh, the top 5 crops are soybean (27%), wheat (26%), gram (9%), rice (8%), and maize (4%). In this state, most of the area fall under the rainfed agro-ecological conditions, with cropping system dominated by cereal and oilseeds. Soybean, rice, and maize are grown in Kharif season while wheat and gram in rabi season. By contrast, in Uttar Pradesh, the top 5 crops are wheat (39%), rice (23%), pearl millet (4%), maize (3%), and potato (2%). The state includes both rainfed and irrigated agro-ecological systems and had rice-wheat, sugarcane-wheat and oilseed-based production systems. Rice, pearl millet, and maize are grown in the Kharif season, and wheat and potato are grown in the Rabi season. Overall, these states provide a comprehensive coverage of arid, rainfed and irrigated agro-ecological systems. Note that, the wheat is the key Rabi season crop in all three study states. In case of wheat, these states together account 62% of the wheat area of the country.[17] Moreover, the above states account for 38% agricultural area of the country, reflecting the importance of these states in Indian agriculture.

3.2.Sample Design

The phone survey was conducted on a sub-set of samples of an earlier survey conducted by IFPRI and ICAR. The first survey, conducted during 2017-18, included a sample of 3,840 households in Rajasthan (1560) and Madhya Pradesh (2280). In 2018-19, the same survey was repeated in Uttar Pradesh on a sample of 3420 households.[18] These surveys were representative of all agro-ecological zones (AEZs) within each state. Number of districts under each AEZ was determined based on the total cropped area under selected crops. Once districts are selected, three blocks from each district and two villages from each block were selected randomly. A complete household listing was developed for each of the selected village and the households

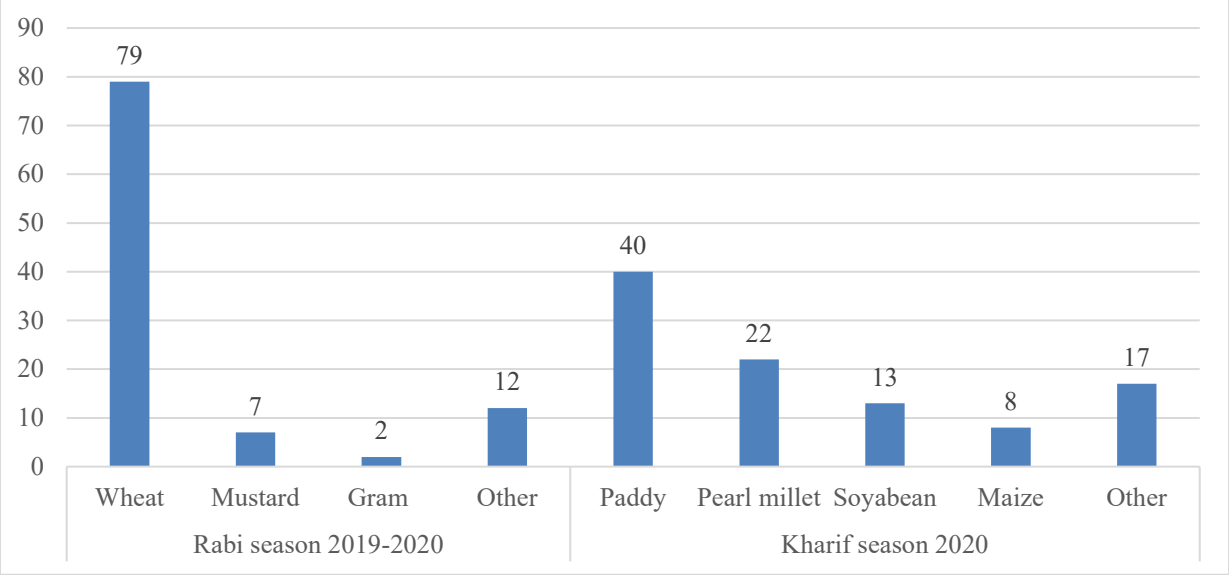
[17] Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.
[18] 90% of the surveyed farmers owned mobile phones.

were divided into four quintiles based on total cultivable land and, at the final stage, five households were selected randomly from each quintile.

The phone survey was conducted during April-May 2020,[19] involved administering interviews with about one third of the samples from the earlier surveys. To ensure representativeness of the coverage in terms of village, district, block, and agro-ecological zones (AEZs), 6-7 households from each village (out of original sample of 20 households) were randomly sampled from the original list.[20]Overall, the survey included 1789 households from 327 villages of 51 districts, representing all AEZs in all three.[21]

In the 2019-20 Rabi season, 79 percent of farmers grow wheat followed by mustard (7%), gram (2%), while the remaining 12 percent of farmers grow other crops (Figure 1). In the 2020 Kharif season, 40 percent of farmers grow paddy followed by pearl millet (22%) and soybean (13%), maize (8%) and the remaining 17 percent farmers grow other crops.[22]

Figure 1: Cropping pattern (% farmers), Uttar Pradesh, Madhya Pradesh, and Rajasthan, 2020



Source: IFPRI-ICAR phone survey 2020

[19] Our survey follows all protocols as suggested by International Review Board.
[20] Sample frame constitutes of 90% of the earlier surveyed farmers.
[21] Average time duration of the phone survey is 16 minutes.
[22] See Figure 1.

3.3.Household and Village Characteristics

Guided by the previous theoretical and empirical literature, the paper considers both household and village level characteristics that may help us determine the investment in agricultural inputs (Feder at al. (1985); Diagne (1999); Covarrubias et al. (2012); Abate et al. (2016); Varshney et al. (2020); among others). Table 2 presents the variable definitions and their summary statistics.[23] We include gender, age, education, household size, religion, social group, poverty status, access to formal credit, land size, primary occupation, farm experience, access to a smart phone, access to a tractor, and an indicator of wealth.[24] Data shows that 92% of the farmers in the sample were men; the average age of the head of the family is 44 years; the average education of head of the household is 6 years; the average family size is 6; 94% households are Hindus; 33% belonged to the Scheduled Castes (SCs) and or Scheduled Tribes caste (STs); 29% households are below poverty line (BPL) households; 42% farmers had access to formal credit through Kisan Credit Card (KCC) Scheme; average land size is 1.3 hectare; 73% farmers have cultivation as their primary source of income; 18% have primary income from livestock and other agriculture activities; 8% households have earned their income primarily from the non-agriculture sector; the average experience of the farmer is 21 years; 21% households have access to smartphones, and 19% have access to tractors. In contrast, the inclusion of some variables is straightforward.

It is useful to gain insights on some of these variables to assess how they are correlated with the investment in agriculture. For example, both SCs and STs and the BPL farmers are less

[23] We consider these variables from the earlier surveys. Rajasthan and Madhya Pradesh (2017-18). Uttar Pradesh (2018-19).

[24] Indicator of wealth is constructed using principal component analysis of asset ownership such as bicycle, radio, television, DVD player, mobile phone (non-smart), two-wheeler, four-wheeler, refrigerator, cooler, fan and computer (or laptop).

likely to apply the appropriate quantity of seeds and fertilizers.[25] Access to formal credit facilities is a positive correlate of agricultural investments.[26] During the pandemic, liquidity is a major concern for the investment in agriculture. Farmers without access to formal credit facilities are more vulnerable in terms of investment in agriculture. Access to the phone is an essential source of communication, and likely in a better position to make investment decisions. Farming experience is an essential indicator that drives agricultural investments.[27] Overall, the data reveals one-third of farmers are highly vulnerable and more than 90 percent dependent on the agriculture and allied sectors for their livelihood.

We include plot-level characteristics such as the type of the soil and the availability of irrigation facilities.[28] By soil, the data reveal that there is vast variation in the study area in terms of soil type. For example, 45% of farmers report sandy loam, 31% clay, 17% loam and 7% sandy—soil type matters for crop choices and hence investment in agriculture inputs.[29] In terms of the availability of irrigation facilities, the survey reveals that 40% of farmers are dependent on rainfed cultivation. We include whether farmers have access to agriculture extensions, soil health cards (that guides about the appropriate use of seeds and fertilizers), and crop insurance schemes. Data shows that 3% of farmers have access to extension services, 11% (soil health cards), and 46% (crop insurance schemes). Agriculture extension and soil health cards may affect the investment decision on agricultural investments through an information channel. Crop insurance helps to assess the farmer's risk behavior.

Our earlier surveys asked the farmers about details of three persons from their networks to whom they discussed most the agriculture decisions. Statistics reveal that only 38% of farmers

[25] See for example, Mohanty (2001).
[26] Varshney at al. (2019)
[27] Mueller and Jansen (1988)
[28] In the survey, we asked the plot level characteristics of the plot with maximum area.
[29] Lichtenberg (1989).

have social networks of friends and relatives and neighbors. Bandiera and Rasul (2006) and Conley and Udry (2010), in their seminal work, show that social networks are important for agriculture technology-related decisions. We consider the distance from the village to the nearest input market, output market, bank branch, block, and district headquarters to capture the market access. The average distance from the village to the nearest input and output markets are 7 and 9 kilometers, respectively. The distance to the nearest bank branch is about 5 km, to the block (10 km), and district headquarters (27 km).

Table 2: Variable definition and statistics of farmers in Rajasthan, Madhya Pradesh, and Uttar Pradesh

Socio-economic and agriculture profile	Mean	Standard Deviation
Gender (male=1)	0.92	0.27
Age (year)	44	13
Education (year)	6.16	4.78
Household size (number)	5.91	3.01
Religion (hindu=1)	0.94	0.23
Schedule caste and tribe (yes=1)	0.33	0.47
Below poverty line (yes)	0.29	0.45
Kisan credit card (yes=1)	0.42	0.49
Land size (hectare)	1.30	1.94
Primary source of income (cultivation=1)	0.73	0.44
Primary source of income (livestock and other agriculture=1)	0.18	0.39
Primary source of income (non-agriculture=1)	0.08	0.27
Primary source of income (other=1)	0.01	0.11
Farm experience of the head of household (year)	21	11
Smart phone (yes=1)	0.21	0.41
Tractor ownership (yes=1)	0.19	0.39
Asset index (number)	0.00	1.53
Soil health card (yes=1)	0.11	0.31
Crop insured (yes=1)	0.46	0.50
Access to extension services (yes=1)	0.03	0.18
Social network		
Discussed farming with friends, relatives, neighbors (yes=1)	0.39	0.49
Village characteristics		
Distance of village to nearest input market (Km)	6.8	5.3
Distance of village to nearest output market (Km)	9.2	6.4
Distance of village to nearest bank (Km)	5.4	4.4
Distance of village to block headquarter (Km)	9.6	6.9
Distance of village to district headquarter (Km)	26.7	20.0
Plot characteristics		
Soil type (clay=1)	0.31	0.46
Soil type (loam=1)	0.17	0.38
Soil type (sandy=1)	0.06	0.25
Soil type (sandy loam=1)	0.45	0.50
Rainfed cultivation (yes)	0.41	0.49
Number of farmers	1789	

Source: ICAR-IFPRI Survey 2017-18 and 2018-19

4. Empirical Methodology

4.1. Quasi-Experimental Methods

To evaluate PM-GKY impacts, we use on the cross-section differences between the beneficiaries and non-beneficiaries—that is, the households receiving PM-GKY benefits are considered treatment groups and the non-beneficiaries as the control group. Clearly, the simple difference between treatment and control groups cannot be interpreted as the causal impact of PM-GKY without controlling for observed and unobserved characteristics. To address this estimation issue, we use propensity score matching (PSM) technique. Identifying assumption of PSM requires that the selection of treatment assignment be solely based on observables. In other words, it accounts for the observed characteristics but not the unobserved characteristics. In the cross-sectional framework, it is one of the most widely adopted procedures to identify the impact in the absence of suitable instruments.[30]

To address the issue of unobserved variables, we adopt the following approach. First, use detailed social, economic and agriculture characteristics of farmers, plot characteristics (e.g., soil type, irrigation), the social network of farmers (e.g., whether farmer interacts with friends, relatives and neighbors), and the market access (the distance of village from input and output markets, block and district headquarters) variables (see Table 2). Second, we drop those farmers from the control group who are not eligible for the scheme and retain only those as a part of the control group that were eligible but did not receive the scheme's benefits for various reasons.[31] This strategy helps to layer out the ineligible farmers whose likelihood of being different in terms of unobserved characteristics is high as compared to the eligible farmers. Third, we check the sensitivity of the results for the deviations from the identifying assumption. The presence of

[30] Mendola, 2007; Becerril and Abdulai, 2010; Abebaw and Haile, 2013

[31] For example, the error in the bank account details.

unobserved heterogeneity affects both the selection into the treatment and outcome variable simultaneously, may not produce robust results.[32] To address that, we applied a procedure proposed by Rosenbaum (2002) to assess the degree to which any significant results may rely on conditional independence assumption. Following Aakvik (2001), we calculate the Mantel-Haenszel test statistics that give bound estimates of significance levels at the given level of hidden bias under the assumption of either systematic over-or-under estimation of treatment effects.

3.4.Kernel Matching Procedure

The PSM constructs a statistical comparison group that is based on the model of probability conditional on observed characteristics. Treatment is then matched based on this probability, or propensity score, to the control group. We employ a non-parametric kernel matching algorithm to match treatment and control group, which has the advantage of matching estimator in a way that constructs the counterfactual for each treatment using weighted averages of all members in the control group.[33] This feature makes the kernel matching procedure best fit for our case where there is a limited set of control group. We may identify the impact as the mean difference in outcomes across matched treatment and control groups. However, the key identifying assumption here is that the selection is solely based on observed characteristics, and all those variables that influence the treatment, as well as potential outcomes, are observed. Another important assumption is the availability of the common support or overlap condition which ensures that treatment observations have comparison observations "nearby" in the propensity score distribution (Heckman, LaLonde,

[32] Rosenbaum (2002).
[33] Other matching algorithm such as nearest neighbour matching uses only few observations which are available in the neighbour of the treatment to construct the counterfactual.

and Smith, 1999). To assess that, we plot the distribution of matched treatment and control groups to see whether overlap condition meets.

Given the above understanding and their underlying assumptions, the average treatment effect on the treated (Heckman, Ichimura, and Todd, 1997; Smith and Todd, 2005) can be written as follows:

$$PSM\ Estimator = \frac{1}{|NT|}\sum_{i=1}^{NT}(Y_i^T - \sum_{j=1}^{NC} W_{ji} Y_{ji}^C) \qquad (1)$$

Where Y is the outcome of interest, NT is the number of PM-GKY beneficiaries, NC is the number of non-beneficiaries, and the W_{ji} are the matching weights that aggregate the outcomes for the matched non-beneficiaries.

The matching weights range from nearest neighbor to non-parametric procedures,[34] where nearest neighbors construct the counterfactual from the neighbors of the treatment observation comparing propensity score of treatment and control.[35] However, the kernel procedure constructs counterfactual using all the control observations and assigns higher weight to those control observations who are close in terms of propensity score to the treatment and provides lower weight to those who are farther in terms of propensity score with the treatment. In the present paper, the main advantage of kernel matching procedure is that it exploits all the control observations to construct counterfactual for each treatment and help balancing property to hold in the absence of large control group. We estimate the propensity score (P), including the social, economic, and agricultural characteristics included in Table 2.

We first estimate the effect of PM-KISAN (a key component of PM-GKY scheme) on the procurement of agricultural inputs, where PM-KISAN beneficiaries are defined as those who

[34] Caliendo and Kopeinig, 2008

[35] Based on the data, it is decided that the numbers of nearest neighbour required to construct the appropriate counterfactual of the treatment.

received the assistance through it and the control group as those farmers who are eligible but did not receive the benefit. Next, we examine the effect of PM-GKY on procurement of agricultural inputs. To do so, we define PM-GKY beneficiaries as those who received benefits in April 2020 under the PM-KISAN, PM-JDY, PM-UY, and PM-AVY schemes.[36] Non-PM-GKY beneficiaries as those who did not receive any benefits under those schemes.

For the purpose of robustness check, we adopted different matching algorithms such nearest neighbor matching and radius matching to examine whether the results vary by the choice of matching algorithms (for more detail on matching algorithm, see Caliendo and Kopeinig, 2008). Moreover, the study conducts a range of test such the comparison of pseudo r square statistic before and after the matching and also examines the reduction in bias after the matching.

Additional Robustness

We also examine the impact estimates through a) Bias-Corrected Estimator (proposed by Abadie and Imbens, 2011); and b) Reduced Probit Model Specification (by dropping potentially endogenous variables from the main specification), to assess the robustness of the results. Brief description of each method is given below :

Bias-Corrected Estimator

Abadie and Imbens (2006) show a conditional bias in the matching estimators, and the matching estimator is not $N^{1/2}$ consistent. To address this concern, Abadie and Imbens (2011) proposed a method to correct for the biases in the matching estimators. Bias corrected matching estimator adjusts the imputation under the simple matching estimator by the difference in the estimated regression function using observed variables and corresponding matched values (for more detail, see Abadie and Imbens, 2011). Their simulation results confirm that bias-corrected procedure

[36] Benefit under first three cash transfer schemes for the month of April 2020 is transferred in the first week of April itself. Free food rations under PM-AVY is distributed in the later part of the April.

performed well in terms of bias, root means squared error and coverage rates. To examine the extent of bias, we also estimated the results by correcting for biases.[37]

Reduced Probit Model Specification

We re-estimate the probit model for calculating propensity scores that exclude potentially endogenous variables such as poverty status, access to- formal credit, soil health card, extension services and crop insurance. Then, we re-estimate the results using a kernel matching procedure to examine the robustness of the estimates.

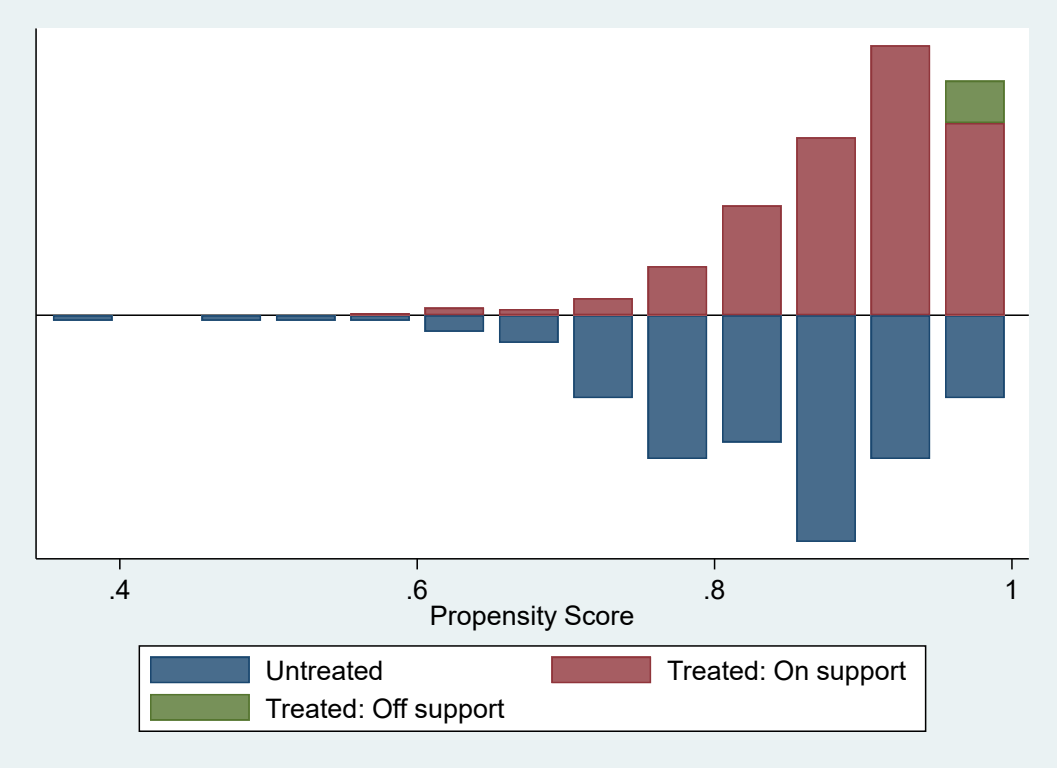
4.3. Outcome Variable and the Comparison Group

Since the study objective is to assess the impacts of PM-GKY on investments in modern inputs, the phone survey collected information about whether the farmers had purchased three main agricultural inputs (Seeds, fertilizer, and pesticides) for the 2020 Kharif season, after receiving the assistance, with a set of follow up questions. Based on this information, we construct three variants of outcomes, which are defined as (a) '*agricultural inputs*', (b) *'seed'*, and (c) '*fertilizers and pesticides'.* The first variable takes 1 if farmers purchased any of the three inputs, 0 otherwise; the second variable takes 1 if farmers bought seed and 0 otherwise; and finally, the third variable takes 1 if farmers bought only fertilizer and pesticides, 0 otherwise. Our data shows that 20 percent of farmers bought the farm input while the remaining 80 percent farmers did not, immediately after receiving the assistance.[38] Of the households who purchased the agricultural inputs, 82% purchased seeds and 18% purchased fertilizers and pesticides. It is not surprising as fertilizers and pesticides accounts for higher input costs as compared to seeds.

[37] See, Jann (2017), for the implementation of Abadie and Imben (2011) bias corrected estimator.
[38] Our survey captures the agricultural input procurement as of 15th May 2020. For 2020 Kharif season, the sowing starts in the month of July. Therefore, it is possible that more farmers may purchase modern inputs later.

Figure 2 presents the common support region for PM-KISAN beneficiaries vs. eligible non-beneficiaries. It clearly shows that the overlap condition is met, and treatment observations have enough comparison observations "nearby" in the propensity score distribution.

Figure 2: Common support region, for PM-KISAN beneficiary and eligible non-beneficiary farmers



Source: Author's calculation

Table 3 presents the standardized difference of treatment (PM-KISAN) and control (eligible non-PM KISAN beneficiary). It shows that the kernel matching procedure reduces biases significantly. The second set of analyses compares the procurement of agricultural inputs such as fertilizers and pesticides and seeds across PM-GKY beneficiaries vs. non-beneficiaries.

Table 3: Unmatched and matched characteristics of farmers in the PM-KISAN program, control, and treatment groups

Variables	Unmatched characteristics					Matched characteristics				
	Mean		% Bias	T-Test		Mean		% Bias	T-Test	
	Treatment	Control		T Statistic	p>|T|	Treatment	Control		T Statistic	p>|T|
Gender (male=1)	0.93	0.92	0.4	0.05	0.96	0.93	0.93	-3.4	-0.87	0.39
Age (year)	43.9	45.0	-8.1	-0.97	0.33	44.0	43.6	2.8	0.70	0.49
Age squared (year)	2085	2187	-8.7	-1.04	0.30	2092	2059	2.8	0.70	0.48
Education (year)	6.22	5.76	9.5	1.12	0.26	6.20	6.29	-1.7	-0.43	0.67
Household size (#)	5.87	6.47	-17	-2.33	0.02	5.87	6.18	-8.5	-2.40	0.02
Religion (hindu=1)	0.94	0.98	-20.6	-2.07	0.04	0.96	0.96	-1.3	-0.32	0.75
Schedule caste and tribe (yes=1)	0.32	0.34	-2.3	-0.28	0.78	0.33	0.30	6.4	1.59	0.11
Below poverty line (yes)	0.27	0.34	-14.6	-1.78	0.08	0.28	0.27	0.4	0.10	0.92
Kisan credit card (yes=1)	0.43	0.45	-3.8	-0.45	0.65	0.43	0.45	-3.6	-0.89	0.38
Land size (hectare)	1.34	1.88	-19.9	-3.07	0.00	1.37	1.47	-3.7	-1.25	0.21
Primary source of income (cultivation=1)	0.75	0.72	7.4	0.89	0.37	0.74	0.74	-0.4	-0.10	0.92
Primary source of income (livestock and other agriculture=1)	0.16	0.22	-13.3	-1.65	0.10	0.17	0.18	-2.1	-0.54	0.59
Primary source of income (non-agriculture=1)	0.08	0.06	8.7	0.97	0.33	0.08	0.07	2.5	0.60	0.55
Farm experience of the head of household (year)	21.1	22.5	-12.1	-1.49	0.14	21.1	21.0	1.2	0.29	0.77
Smart phone (yes=1)	0.20	0.24	-9.5	-1.15	0.25	0.21	0.22	-1.8	-0.45	0.65
Tractor ownership (yes=1)	0.20	0.18	4.9	0.57	0.57	0.19	0.20	-3.1	-0.75	0.45
Asset index (#)	0.00	-0.20	12.8	1.49	0.14	-0.04	-0.02	-1.5	-0.37	0.71
Soil health card (yes=1)	0.11	0.09	6.4	0.73	0.46	0.11	0.12	-4.9	-1.13	0.26
Crop insured (yes=1)	0.44	0.41	6.4	0.76	0.45	0.44	0.43	1.9	0.46	0.65
Access to extension services (yes=1)	0.03	0.07	-17.6	-2.47	0.01	0.03	0.04	-2.2	-0.64	0.52
Social network of friends/neighbors/relatives	0.38	0.39	-2.6	-0.31	0.76	0.39	0.34	9.4	2.34	0.02
Distance of village to nearest input market (kilometre)	6.96	7.33	-7.5	-0.81	0.42	6.89	7.31	-8.5	-2.11	0.04
Distance of village to nearest output market (kilometre)	9.15	9.66	-7.8	-0.97	0.33	8.98	9.45	-7.3	-1.94	0.05

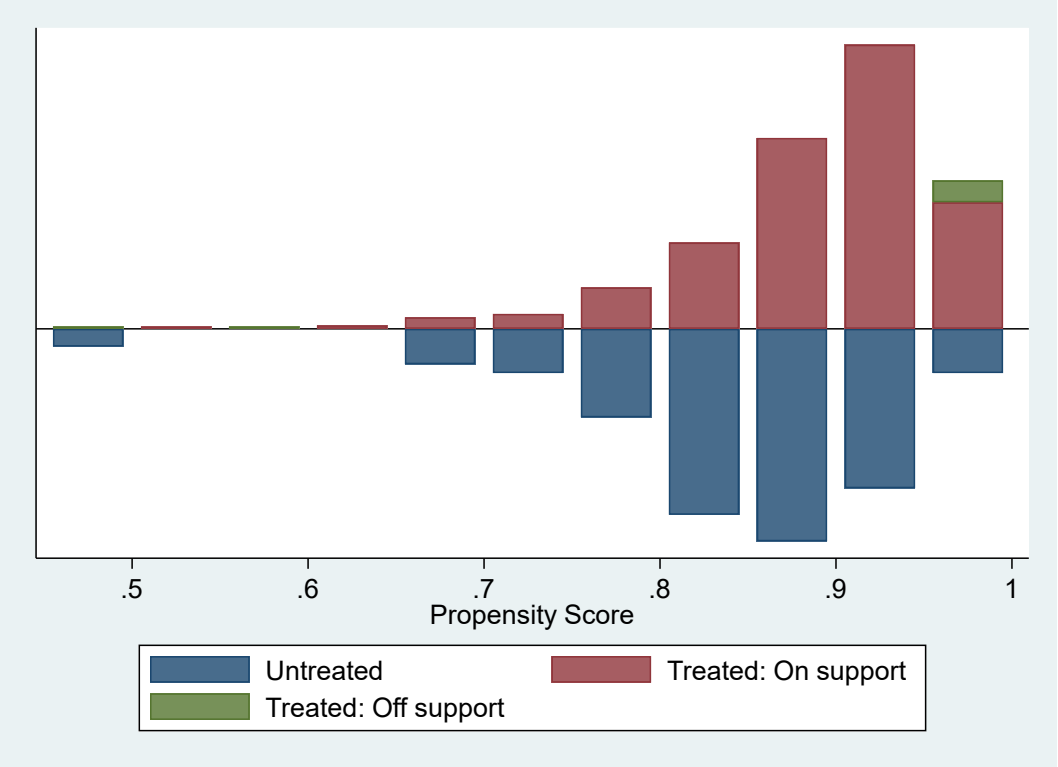
Variables	Unmatched characteristics					Matched characteristics				
	Mean		% Bias	T-Test		Mean		% Bias	T-Test	
	Treatment	Control		T Statistic	p>|T|	Treatment	Control		T Statistic	p>|T|
Distance of village to nearest bank (kilometre)	5.22	7.03	-39.3	-4.97	0.00	5.37	5.39	-0.6	-0.15	0.88
Distance of village to block headquarter (kilometre)	9.53	11.27	-23.8	-2.95	0.00	9.47	9.78	-4.2	-1.16	0.25
Distance of village to district headquarter (kilometre)	26.34	29.39	-14.7	-1.77	0.08	26.69	27.98	-6.2	-1.53	0.13
Soil type (loam=1)	0.17	0.12	13.1	1.48	0.14	0.16	0.17	-2.6	-0.60	0.55
Soil type (sandy=1)	0.06	0.04	10.9	1.19	0.23	0.05	0.05	2.3	0.56	0.58
Soil type (sandy loam=1)	0.46	0.34	25.8	3.00	0.00	0.46	0.42	8.1	1.95	0.05
Rainfed cultivation (yes)	0.41	0.56	-28.8	-3.43	0.00	0.42	0.46	-7.5	-1.84	0.07
Observations	1282	158				1220	158			

Source: Author's calculation

Notes: Matching is performed using a kernel matching procedure as described in the text. Matched characteristics are obtained in the common support region.

A potential issue here was small sample size, but it does seem to meet the overlap condition (Figure 3).

Figure 3: Common support region for PM-GKY beneficiary and non-beneficiary farmers



Source: Author's calculation

Note: We define PM-GKY beneficiaries as those who get benefit in April for the following schemes: PM-KISAN, PM-JDY, PM-UY, and PM-AVY. And non-PM-GKY beneficiaries as those who did not get the benefit of any of these schemes.

Table 4 presents the standardized difference of treatment (PM-GKY beneficiary) and control (non-PM-GKY beneficiary) for both raw and matched samples, respectively. The result reveals that the matching procedure reduces biases significantly.

Table 4: Unmatched and matched characteristics of farmers in the PMGKY program, treatment, and control groups

Variables	Unmatched characteristics					Matched characteristics				
	Mean		% Bias	T-Test		Mean		% Bias	T-Test	
	Treatment	Control		T Statistic	p>|T|	Treatment	Control		T Statistic	p>|T|
Gender (male=1)	0.92	0.93	-3.8	-0.33	0.74	0.93	0.90	11.3	1.88	0.06
Age (year)	43.3	43.5	-1.6	-0.14	0.89	43.4	44.4	-8.2	-1.47	0.14
Age squared (year)	2022	2032	-0.9	-0.08	0.94	2029	2122	-8.4	-1.45	0.15
Education (year)	6.05	7.17	-22.8	-2.08	0.04	6.13	6.35	-4.7	-0.86	0.39
Household size (#)	5.87	5.79	2.9	0.24	0.81	5.75	5.62	4.8	1.04	0.30
Religion (hindu=1)	0.93	0.97	-17	-1.34	0.18	0.94	0.94	-2.2	-0.37	0.71
Schedule caste and tribe (yes=1)	0.33	0.21	26	2.20	0.03	0.32	0.31	2.1	0.36	0.72
Below poverty line (yes)	0.27	0.20	16.3	1.40	0.16	0.27	0.23	9.0	1.62	0.11
Kisan credit card (yes=1)	0.42	0.51	-17.4	-1.55	0.12	0.42	0.48	-11.5	-2.09	0.04
Land size (hectare)	1.31	1.95	-26.6	-2.89	0.00	1.28	1.33	-2.2	-0.52	0.60
Primary source of income (cultivation=1)	0.74	0.76	-4.9	-0.43	0.67	0.75	0.81	-15.0	-2.86	0.00
Primary income source (livestock and other agriculture=1)	0.17	0.16	4	0.35	0.73	0.17	0.12	14.9	2.90	0.00
Primary source of income (non-agriculture=1)	0.08	0.08	2.2	0.19	0.85	0.08	0.07	3.4	0.64	0.52
Farm experience of the head of household (year)	20.25	20.78	-4.7	-0.43	0.67	20.19	20.47	-2.5	-0.45	0.66
Smart phone (yes=1)	0.18	0.27	-22.8	-2.16	0.03	0.18	0.19	-3.6	-0.71	0.48
Tractor ownership (yes=1)	0.22	0.30	-19.9	-1.85	0.06	0.21	0.24	-5.1	-0.97	0.33
Asset index (#)	-0.04	0.40	-30.2	-2.62	0.01	-0.03	0.20	-15.7	-2.81	0.01
Soil health card (yes=1)	0.09	0.12	-9.2	-0.86	0.39	0.10	0.11	-4.6	-0.87	0.38
Crop insured (yes=1)	0.40	0.48	-17.6	-1.58	0.11	0.40	0.45	-9.1	-1.66	0.10
Access to extension services (yes=1)	0.03	0.08	-21.1	-2.29	0.02	0.03	0.04	-7.3	-1.62	0.11
Social network of friends/neighbors/relatives	0.36	0.35	2	0.17	0.86	0.36	0.31	10.0	1.85	0.07
Distance of village to nearest input market (Km)	7.29	6.57	13.4	1.10	0.27	6.96	7.16	-3.6	-0.70	0.49

Variables	Unmatched characteristics					Matched characteristics				
	Mean		% Bias	T-Test		Mean		% Bias	T-Test	
	Treatment	Control		T Statistic	p>|T|	Treatment	Control		T Statistic	p>|T|
Distance of village to nearest output market (Km)	9.56	9.79	-3.2	-0.31	0.76	9.17	9.16	0.2	0.04	0.97
Distance of village to nearest bank (Km)	4.92	6.02	-26.1	-2.35	0.02	4.98	5.08	-2.4	-0.46	0.65
Distance of village to block headquarter (Km)	9.75	10.64	-11.1	-1.07	0.28	9.47	9.43	0.4	0.09	0.93
Distance of village to district headquarter (Km)	25.19	27.27	-11.1	-0.96	0.34	25.32	26.17	-4.6	-0.86	0.39
Soil type (loam=1)	0.15	0.19	-10.8	-1.00	0.32	0.15	0.14	3.3	0.64	0.52
Soil type (sandy=1)	0.06	0.07	-2.5	-0.22	0.82	0.06	0.07	-2.4	-0.43	0.66
Soil type (sandy loam=1)	0.49	0.42	15.6	1.38	0.17	0.48	0.49	-1.2	-0.22	0.83
Rainfed cultivation (yes)	0.40	0.45	-9.7	-0.87	0.39	0.40	0.39	1.0	0.18	0.85
Observations	685	89				662	89			

Source: Author's calculation

Notes: Matching is performed using a kernel matching procedure as described in the text. Matched characteristics are obtained in the common support region.

5. Results and discussion

5.1. The Effectiveness of the PM-GKY

The PM-GKY appears to have been effective in reaching the beneficiaries in all three states (Table 5).[39] On an average, 89 percent of the eligible beneficiaries of the main component of PM-GKY (i.e., PM-KISAN) had reported to have received the INR 2,000 cash benefits. Of the three states, UP seems to have done the best in terms of reaching the most beneficiaries (94%) under PM-KISAN, followed by Rajasthan (88%) and Madhya Pradesh (83%). For the other three components (i.e., PM-JDY, PM-UY, and PM-AVY), the aggregate estimates for the three states are 93%, 94%, and 76% percent, respectively.

Only the women account holders of the beneficiary households are eligible for INR 500 transfer under PM-JDY and our estimates indicate that 78% of all households were eligible for this program of which 93% had received the Rs. 500 transfer. In the case of PM-UY, the results show that 63% of households were eligible to receive conditional cash transfer to buy an LPG cooking gas cylinder; of which 94% had received DBTs to obtain their allotted free-of-cost LPG cylinders. By state, the results reveal that the number of recipients is highest in Uttar Pradesh (95%), followed by Rajasthan (95%) and Madhya Pradesh (92%). In the case of PM-AVY, the results show that 98% of farmers were eligible to get free ration under this scheme; of which 76% had received the ration of rice, wheat, and pulses. By state, the result reveals that the number of recipients is highest in Uttar Pradesh (82%), followed by Rajasthan (80%) and Madhya Pradesh (62%).[40].

[39] Includes benefits from PM-KISAN, PM-JANDHAN, PM-UY and PM-AVY.
[40]Our results are comparable with PM-GKY allocation and actual distribution data as published by Ministry of Consumer Affairs and Public Distribution, Government of India.

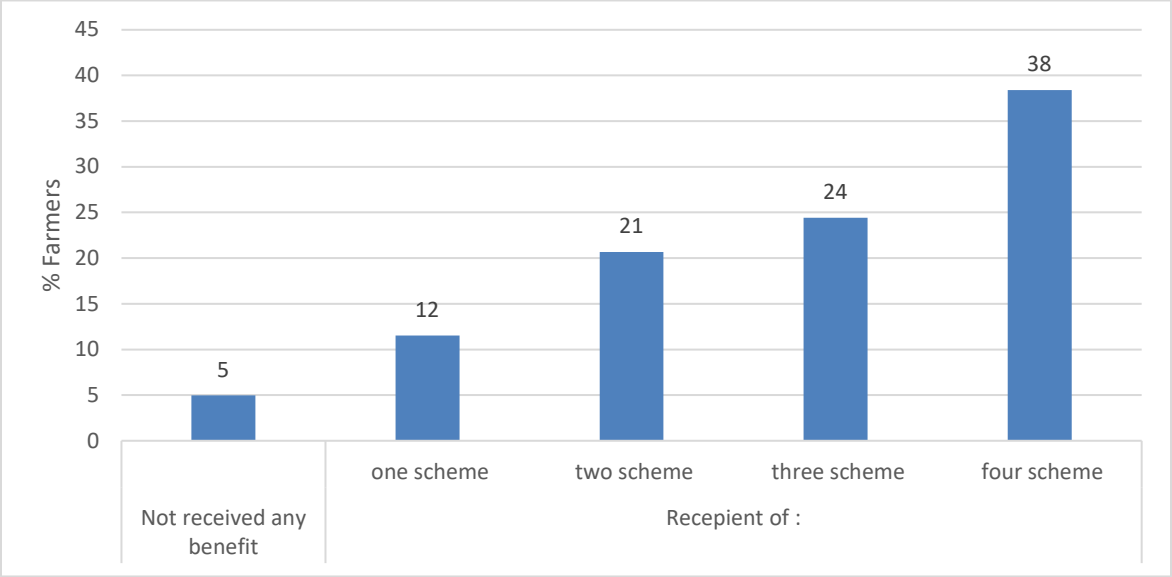
Table 5: Beneficiaries of PM-KISAN, PM-JDY, PM-UY and PM-AVY, by states, Northern India, 2020

States	No. of farmers (#)	PM-KISAN		PM-JDY		PM-UY		PM-AVY	
		Eligible Farmers (%)	Beneficiary (%)	Eligible Farmers (%)	Beneficiary (%)	Eligible Farmers (%)	Beneficiary (%)	Eligible Farmers (%)	Beneficiary (%)
Rajasthan	449	82	88	83	95	63	92	99	80
Madhya Pradesh	483	89	83	79	89	63	94	97	60
Uttar Pradesh	857	76	93	76	95	62	96	99	82
All states	1789	81	89	78	93	63	94	98	76

Source: Author's calculation.

Figure 4 presents key summary indicators for of the PM-GKY as whole. It shows 38% of the farm household had received benefits from all components of PM-GKY (PM-KISAN, PM-JDY, PM-UY, and PM-AVY); about 62% of them received benefits from at least three components of the package; about 83% of them received benefits from at least two components of the package. Overall, 95% of the farmers received benefits from at least one of the components on the PM-GKY scheme suggesting that the government institutions have been successful in transferring the benefits of this package. It is also clear that the Direct Benefit Transfer (DBT) schemes have been more efficient in reaching beneficiaries compared to the in-kind support schemes.

Figure 4: Percentage of beneficiaries by the number of schemes



Source: ICAR-IFPRI Survey 2020

5.2. Impact of PM-KISAN

The estimates of PM-KISAN's impacts on the procurement of agricultural inputs for the 2020 Kharif season are presented in Table 6 Panel-A, for both entire sample and the sample of small and marginal farmers.[41] For the entire sample, results show a positive and significant impact of the PM-KISAN scheme on the procurement of agricultural inputs. In terms of magnitude, the recipients of PM-KISAN benefits about 16 percentage points more likely to purchase the agricultural inputs and 14% more likely to purchase seeds for the 2020 Kharif season. However, the program does not seem to have statistically significant impacts on the purchase of fertilizers and pesticides, implying that the results for increased agricultural input procurement might be driven primarily by the increased purchase of modern seed. To explore it further, we examine whether the impact story changes if we consider the other components of PM-GKY in the next section.

The results presented in Table 6 Panel-A relied heavily on the assumption of conditional independence. It is possible that the results are not robust in the presence of hidden bias. Although we have used a wide range of covariates in conducting matching, it is still possible that results are not robust. To assess the problem of hidden bias, we conduct Rosenbaum bounds sensitivity analysis for all cases to determine - whether results are strong or insensitive to the bias that triples the odds of access to PM-GKY. The magnitude of hidden bias that makes the findings spurious should be higher than 1.9.[42] This means that the results remain the same for unobservable characteristics that may increase the likelihood of receiving PM-GKY by about 1.9 times compared to the control group. Therefore, we conclude that the results are insensitive to the problem of hidden bias.

[41] We are not able to conduct the analysis of medium and large farmers because of less sample size.
[42] See Table 6 Panel-A.

5.3. Impact of PM-GKY

The analysis of this section is motivated by the concept of fungibility of program benefits. In theory, the fungibility of assets is examined in the context of behavioral and conventional life-cycle models.[43] Levin (1998) shows that the spending is more sensitive to income and liquid assets as compared to assets such as house. In the context of the present study, where three of the four schemes under PM-GKY are DBTs and the fourth one is IKS for free ration, it is likely that farmers may divert the resources of non-agricultural schemes for leverage the productive investment. Empirical studies on the fungibility in microfinance for Bangladesh and India also suggests that formal agricultural credit was diverted for unintended purposes such as meeting household consumption expenditure, illness, and repayment of informal loans.[44]

While the main component intended to support agriculture was PM-KISAN, it is likely the farmers had used transfer from other components of PM-GKY, especially given benefits were given in a package.[45] Furthermore, since there was time lag in the marketing of farmers rabi produce due to lockdown, most farmers were facing severe credit constraints during the months of April and May 2020. To test if the PM-GKY package had an impact, we carry out the analysis for the entire sample as well as for the sample of small and marginal farmers. Results of our analysis on the entire sample, presented in Table 6 Panel-B, which shows that the PM-GKY has had statistically significant impacts on the procurement of agricultural inputs for the 2020 Kharif season.

In terms of magnitude, the result shows that PM-GKY beneficiaries are 17 percentage points more likely to purchase modern agricultural inputs. In case of seeds, the results reveal that

[43] Thaler (1990).
[44] See, for example, Mahajan and Ramola (1996) and Sharma and Zeller (1997).
[45] This evident in microfinance literature. For details, see Husain and Thapa (2016).

PMGKY beneficiaries are about 14 percentage points more likely to purchase the seeds for the 2020 Kharif season immediately after receiving the assistance. Note the magnitude of the impact of PMGKY on the procurement of agricultural inputs and seeds is significantly higher than PM-KISAN. This finding is consistent with the theory of fungibility and earlier empirical studies. For instance, De Brauw and Hoddinott (2011) demonstrated for Mexico's PROGRESA program that missing any component of the conditional cash transfer could reduce the likelihood of program impacts. For the PM-GKY, the explanation is simple: the farmers could afford to shift the benefits from other programs to purchasing agricultural inputs.

For small and marginal farmers, the result shows that PM-GKY beneficiaries are about 16 percentage points more likely to purchase the agricultural inputs; 13 percentage points more likely to purchase modern seeds, and about 3 percentage points more likely to purchase chemical fertilizer and pesticides for the 2020 Kharif season. Importantly, all estimates are statistically significant, suggesting that the PM-GKY alleviated the credit constraints of smallholders and enabled them to purchase all the modern inputs. To check for the robustness, we tested for the overall bias reduction after matching. Our estimates of Rosenbaum's bounds show that the extent of hidden bias that makes the findings spurious should be greater than 1.7. This means that the results remain the same for unobservable characteristics that may increase the likelihood of receiving PM-GKY by about 1.7 times compared to the control group.[46] Here, we conclude that the results are insensitive to the problem of hidden bias within this range.

[46] See Table 6 Panel-B.

Table 6: Impact estimates of PM-KISAN and PM-GKY on the procurement of agricultural inputs, farmers in Rajasthan, Madhya Pradesh, and Uttar Pradesh

Panel A: Impact of PM-KISAN						
	All farmer			Small and marginal farmer		
	Agricultural inputs	Seed	Fertilizer and Pesticides	Agricultural inputs	Seed	Fertilizer and Pesticides
Kernel matching						
ATT	0.158***	0.137***	0.022	0.133**	0.125***	0.009
	(0.031)	(0.029)	(0.011)	(0.042)	(0.037)	(0.021)
Rbounds	(1-2.6)	(1-2.8)	(1-3)	(1-1.9)	(1-2.2)	(1-3)
Nearest neighbor (n=5)						
ATT	0.163***	0.143***	0.020	0.096	0.100**	-0.003
	(0.031)	(0.028)	(0.013)	(0.056)	(0.050)	(0.031)
Rbounds	(1-2.6)	(1-2.8)	(1-3)	(1-1.9)	(1-2.2)	(1-3)
Obs.	1440	1440	1440	1163	1163	1163
Panel B: Impact of PM-GKY						
	All farmer			Small and marginal farmer		
	Agricultural inputs	Seed	Fertilizer and Pesticides	Agricultural inputs	Seed	Fertilizer and Pesticides
Kernel matching						
ATT	0.173**	0.136**	0.037***	0.164***	0.129**	0.034***
	(0.058)	(0.058)	(0.011)	(0.045)	(0.045)	(0.009)
Rbounds	(1-2.5)	(1-2.6)	(1-3)	(1-1.9)	(1-1.7)	(1-3)
Nearest neighbor (n=5)						
ATT	0.194***	0.157**	0.038***	0.153**	0.121**	0.033***
	(0.048)	(0.048)	(0.011)	(0.058)	(0.058)	(0.009)
Rbounds	(1-2.5)	(1-2.6)	(1-3)	(1-1.7)	(1-1.7)	(1-3)
Obs.	776	776	776	624	624	624

Source: Author's calculation

Notes: Out outcome variable '*Agricultural Inputs'* takes value 1 if farmers procured the inputs such as fertilizers and pesticides or seeds in the month of April-May 2020 for the Kharif season 2020. The outcome variable '*Fertilizers and pesticides'* takes value 1 if farmers procured the fertilizers and pesticides in the month of April-May 2020 for the Kharif season 2020. The outcome variable '*Seeds'* takes value 1 if farmers procured the seeds in the month of April-May 2020 for the Kharif season 2020. In Panel-A, the treatment group is defined as those farmers who received the benefit of PM-KISAN in the month of April 2020 and control group as those eligible farmers who did not received the benefit of the program. In Panel-B, the treatment group is defined as those farmers who receive the benefit in April 2020 for the following schemes: PM-KISAN, PM-JDY, PM-UY the PM-AVY. The Control group is defined as those farmers who did not get the benefit of any of these schemes. Propensity score matching is performed using a kernel matching procedure, as described in the text. Small and marginal farmers are defined as those who own less than 2 hectares of land. Rosenbaum bounds (Rbounds) are estimated to determine the ranges between 1 to 3 on which the results are insensitive to the hidden bias. Analytical standard errors in the parenthesis.

***Significant at 1%. **Significant at 5%.

Moreover, we tested for the overall bias reduction after matching. The results, shown in Table 7, suggest that there was indeed a significant reduction in bias. Statistics on pseudo R^2 indicate that the explanatory power of the regression is improved significantly after matching. Thus, we can conclude that the matching quality is overall good.

Table 7: Indicators of matching quality, farmers in Rajasthan, Madhya Pradesh, and Uttar Pradesh

	Pseudo R^2	LR chi^2	p>chi^2	Mean bias	Median bias
PM-KISAN beneficiaries Vs. Eligible non-PM-KISAN beneficiaries					
Unmatched	0.082	81.58	0	13	9.5
Matched	0.011	36.92	0.252	4.2	3.1
PM-GKY beneficiaries Vs. non-PM-GKY beneficiaries					
Unmatched	0.074	40.68	0.114	12.5	11.1
Matched	0.031	56.95	0.003	6	4.7

Source: Author's calculation

Appendix Table A2 presents the results for bias-corrected matching estimator (Abadie and Imbens (2011) and the kernel matching estimates using reduced probit specification. Our results on the impact of PM-KISAN follows a similar pattern irrespective of the methods used to estimate impact on the procurement of agricultural inputs. In the case of PM-GKY, the result also follows similar patterns. Thus, we can conclude that the results presented in the paper are robust.

6. Summary and Implications

The COVID-19 pandemic has hit Indian economy hard. Following national lockdown in March 2020, major economic sectors came to a halt, joblessness skyrocketed, and it became evident that the nation's economy was heading for an unprecedented contraction. During the second quarter of 2020, the economy shrank by almost 24%, which was by far the worst since the country started publishing quarterly data. Amid this massive economic slowdown, somewhat surprisingly, the agriculture sector experienced a 3.5% growth during the same period. This paper has examined whether the package of public transfers program, announced immediately after the lockdown, had helped farmers deal with the shock and make investments in modern inputs. The analysis is based on a unique phone survey, conducted by IFPRI and ICAR, on a previously interviewed farm household in three northern states of India.

The results show that the transfer package (PMKGY), consisting of four main components, was successful in reaching the intended beneficiaries on time. Overall, 95% of the smallholders received supports from at least one of the four main components of PMGKY scheme. Direct cash transfers (i.e., PM-KISAN and PM-JDY) have performed better than the food transfer scheme (i.e., PM-UY and PM-AVY). On an average, 89 percent of the eligible beneficiaries of the main component of the PM-GKY (i.e., PM-KISAN) had reported to have received full amount of cash benefits, with variations across states ranging from 83 percent in Madhya Pradesh to 94% in Uttar Pradesh. Of relevance is the other direct benefit transfer program specifically designed for poor women—that is, PM-JDY—where 92 percent of the eligible beneficiaries reported to have received INR500 cash transfers. In case of PM-UY, the results show that of the 63 % eligible households, 94% received the transfers of cooking gas.

The econometric analyses of the impact of PM-GKY also offer some important insights in terms of investments in modern inputs both for entire sample and for the sample of small and

marginal farmers. In case of entire sample, our results show that the PMGKY beneficiaries are 23% more likely to purchase modern agricultural inputs compared to the control group. For the small and marginal farmers, the program beneficiaries are about 21 percent likely to purchase agricultural inputs; 17 percent more likely to purchase modern seeds, and about 4% more likely to purchase chemical fertilizer and pesticides for the 2020 Kharif season. Importantly, all estimates are statistically significant and passes a host of robustness checks. A key insight from this analysis is the fungibility of benefits—that is, ability to mitigate liquidity constraints through multiple components of PM-GKY.

The results from our analysis are impressive for any public transfer programs let alone the challenges of executing them during an unprecedented lockdown. This success, we would like to argue, is the testament to India's investments on direct benefit transfer infrastructure in recent years and safety nets infrastructure over decades.

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Online Appendix

Table A1: Crop profile of farmers in Rajasthan, Madhya Pradesh, and Uttar Pradesh

Rajasthan		Madhya Pradesh		Uttar Pradesh	
Crops	% cropped area	Crops	% cropped area	Crops	% cropped area
Pearl millet (K)	16	Soybean (K)	27	Wheat (R)	39
Wheat (R)	12	Wheat (R)	26	Rice (K)	23
Mustard (R)	10	Gram (R)	9	Pearl millet (K)	4
Soybean (K)	5	Rice (K)	8	Maize (K)	3
Gram (R)	4	Maize (K)	4	Potato (R)	2
Other crops	53	Other crops	26	Other crops	29

Source: Land Use Statistics, 2016-17, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.
Note: 'K' denotes Kharif crop. 'R' means Rabi crop.

Table A2 : Robustness of Impact estimates of PM-KISAN and PM-GKY on the procurement of agricultural inputs, farmers in Rajasthan, Madhya Pradesh, and Uttar Pradesh

Panel A : Impact of PM-KISAN						
	All farmer			Small and marginal farmer		
	Agricultural inputs	Seed	Fertilizer and Pesticides	Agricultural inputs	Seed	Fertilizer and Pesticides
Bias-corrected ATT (kernel based matching)	0.144*** (0.028)	0.119*** (0.029)	0.025** (0.010)	0.121*** (0.031)	0.121*** (0.033)	0.001 (0.018)
ATT (kernel matching using reduced probit model)	0.162*** (0.026)	0.144*** (0.022)	0.018 (0.014)	0.119** (0.045)	0.107** (0.042)	0.012 (0.017)
No. of Observation	1440	1440	1440	1163	1163	1163
Panel B : Impact of PM-GKY						
	All farmer			Small and marginal farmer		
	Agricultural inputs	Seed	Fertilizer and Pesticides	Agricultural inputs	Seed	Fertilizer and Pesticides
Bias-corrected ATT	0.165*** (0.035)	0.124*** (0.034)	0.041*** (0.010)	0.070* (0.041)	0.033 (0.040)	0.037*** (0.009)
ATT (kernel matching using reduced probit model)	0.178*** (0.046)	0.142** (0.045)	0.036*** (0.010)	0.147** (0.046)	0.122** (0.044)	0.026* (0.013)
No. of Observation	776	776	776	624	624	624

Source: Author's calculation

Note : Analytical standard errors in the parenthesis. ***Significant at 1%. **Significant at 5%. *Significant at 10%.

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