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COVID-19 Pandemic-Induced Disruptions and Implications for National Food Security and Farm Incomes: Farm-Level Evidence from Indian Punjab

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Abstract: By using the data from a primary survey of 1100 farm households from Indian Punjab, the present study examined the impact of COVID-19 pandemic-induced disruptions on food security and farm incomes. The paddy-wheat-based production system showed resilience to the challenges of the COVID-19 situation. Farmers adapted effectively to the changed equilibrium and there was no decline in food production, land lease activity or cropping patterns. The disruptions in agricultural machinery services and input supplies led to a rise in the rent of machinery and input prices. Agricultural wages also jumped due to scarcity of agricultural labour. The study highlights no imminent threat to food supplies from Punjab and hence to national food security. It showed that farmers may need some financial support to counter the effect of rising costs of farming. There is a need to enhance the resilience of various input and output markets in agriculture in the future.

Keywords: COVID-19 pandemic; Punjab agriculture; agricultural inputs and output; labour shortages; agricultural wages

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1. Introduction

The first wave of the COVID-19 pandemic caused colossal mayhem globally, with upward of 10 million infections and more than 5 million deaths worldwide. As a preventive measure, lockdowns of varying degrees were enforced globally to curtail its spread. Such restrictions and fear of the virus precipitated into economic spheres, manifesting in a global economic slowdown, compared by some to the magnitude of the 'Great Depression' [1]. As a result, the contraction of global GDP in 2020 was in the range of 3% to 7.5% [2–4]. Like other sectors of the global economy, agriculture experienced both demand- and supply-side shocks [5–7]. The pandemic had serious implications for food security in developing economies, where agriculture is the major source of livelihood for the rural poor [8–14]. The disruptions in the food supply chains have threatened food security in the short-run, and smallholder farmers and other vulnerable sections are likely to suffer more [15,16]. Although the situation may improve for those countries that are self-sufficient in food production and show less dependence on international food trade, the other countries depending on food imports may suffer [4,7,13,17–19]. The disruptions in supply chains caused farm-level crop losses and distressed sales with considerable income losses to farmers [20–24]. The restriction in movement forced by the lockdowns impacted the movement of seasonal migrant labour, causing severe labour shortages, a rise in wages and increase in the cost of food production [5,25–28]. The loss of remittances during the COVID-19 pandemic also caused a decline in farm investments and led to the fall of farm incomes [29]. Rising costs of production and supply chain disruptions caused

significant increases in food prices across the globe as compared to pre-COVID-19 price levels, although the increase varied across regions, crops and sub-sectors [30–34].

The stringent lockdown measures introduced in India coincided with the harvesting and marketing season of rabi crops and the resulting severe disruptions in the food and input supply chains led to considerable food losses at the farm and post-harvest levels [13,35,36]. The mass reverse-migration of labourers to their native states resulted in wage escalation [37]. The shortage of agricultural labour, inputs and machinery led to an increase in wages, input prices and rent of the machinery and ultimately a significant increase in production costs [38–41]. Also, marketing of produce was adversely affected [42] and led to distressed selling and depressed the prices received by the farmers in many parts of the country [40,43–46].

We consider the above range of evidence to examine the impact of the COVID-19 pandemic on access to machinery, inputs and agricultural labour, cost of production, farm profitability and food security with the help of a cross-section of data collected through primary surveys in Punjab, India. Punjab state is known as the food bowl of India, as it contributes around 38% of wheat and 21% of rice to the national food pool to ensure food security of the country [47,48]. Supply side shocks, rising costs and falling profitability have the potential to adversely affect long-term food supply to the national food pool. Falling profitability may also induce distress amongst farming households as their incomes are not diversified and farming contributes more than 90% of their total household income [49,50].

2. Methodology

2.1. Research Framework

The study aimed at examining the impact of the COVID-19 pandemic on agricultural production, cost of food production, crop profitability, farm incomes and food security (Figure 1). We set the following hypotheses for the study:

- COVID-19 pandemic-induced disruptions and rising costs in agriculture may disrupt the land lease markets. The farmers may be reluctant to lease agricultural land with the possibility of reduction in area for major crops. It may ultimately reduce food production and have adverse long-term implications for national food security.
- COVID-19 pandemic may create a scarcity of agricultural machinery, agricultural labour and major inputs such as seed, fertilizers and pesticides/insecticides. It may cause a decline in crop productivity, with negative implications for farm incomes and food security.
- COVID-19 pandemic may also trigger food losses at the farm level as well as during the post-harvest operations. It may have negative implications for farm incomes and food security.
- Shortages of machinery, labour and agricultural inputs may lead to a rise in machinery rent, wages and input prices. Rising costs may reduce farm profits and incomes and may lead to economic distress among agricultural households.
- The impact of COVID-19 varied across different farm size categories.

We studied the changes in land lease activities, operational land, cropping pattern, crop productivity and crop marketing to examine the implications for future food supply and food security. In addition, we estimated the disruptions in machinery rental services, labour and input markets and their impact on access and the cost of crop farming. We used a 'before-and-after' approach to examine the impact of COVID-19 on various aspects of agriculture. As the pandemic had affected all the farmers in the entire region, we could not select a set of farming households in our sample who were not affected by the pandemic and could have acted as a control group for our study.

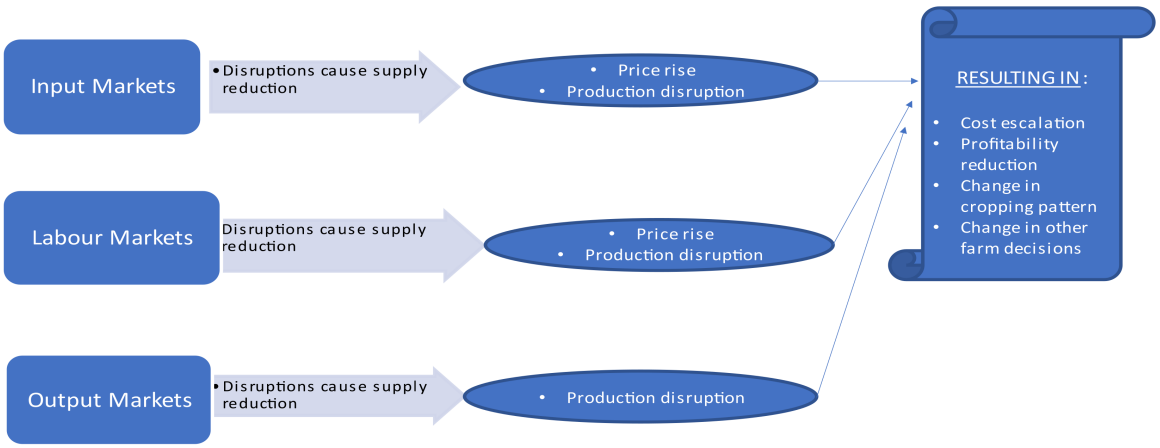

Figure 1. Research framework of the study.

2.2. Data Collection

The study aimed at identifying the impact of the COVID-19-induced lockdown on various indicators of interest (land holdings, inputs, machinery, labour, production, marketing, etc.) to at least 0.1 standard deviation at 5% level of significance and 90% power. We followed [51] for sample size determination and the required sample size for the study turned out to be 1051. Thus, we collected the primary data from 1100 farmers for this study (see Supplementary Materials). For collecting the cross-section data from the primary survey, a multistage random sampling technique was used with the district and village as the respective stages of sampling. At the first stage, 11 districts were randomly selected out of a total of 22 districts in Punjab (Figure 2). From each selected district, four medium-sized villages (population 1000–2500) were selected randomly. In cases where the villages were small in size, a nearby village was combined together into a village cluster for final sampling. In one district (Hoshiarpur), the villages were relatively small, and hence six villages were selected instead of four. A complete enumeration of all the farming households was done for each selected village/village cluster by using the latest voters' list published by the State Election Commission, and 25 farmers were randomly selected from each of them, making a total sample of 1100 farmers. The study sample represents different farm size categories to facilitate the testing of differential impacts of the COVID-19 pandemic. The farmers were classified on the basis of their operational land holdings into small farmers (<2 ha), medium farmers (2–6 ha) and large farmers (6 ha and above). Table 1 provides details of the distribution of the study sample (see also Supplementary Materials). The study examined various aspects of production and marketing of wheat, paddy and other major crops and compared the situation between the pre-pandemic and pandemic period. The pre-pandemic period referred to the period immediately preceding the COVID-19-induced lockdown, and the pandemic period referred to the period during the lockdown and immediately after that until the harvesting of kharif crop in 2020. More precisely, we compared rabi 2018 (pre-pandemic period) with rabi 2019 (pandemic period), as the lockdown started in March 2020, and kharif 2019 (pre-pandemic period) with kharif 2020 (pandemic period).

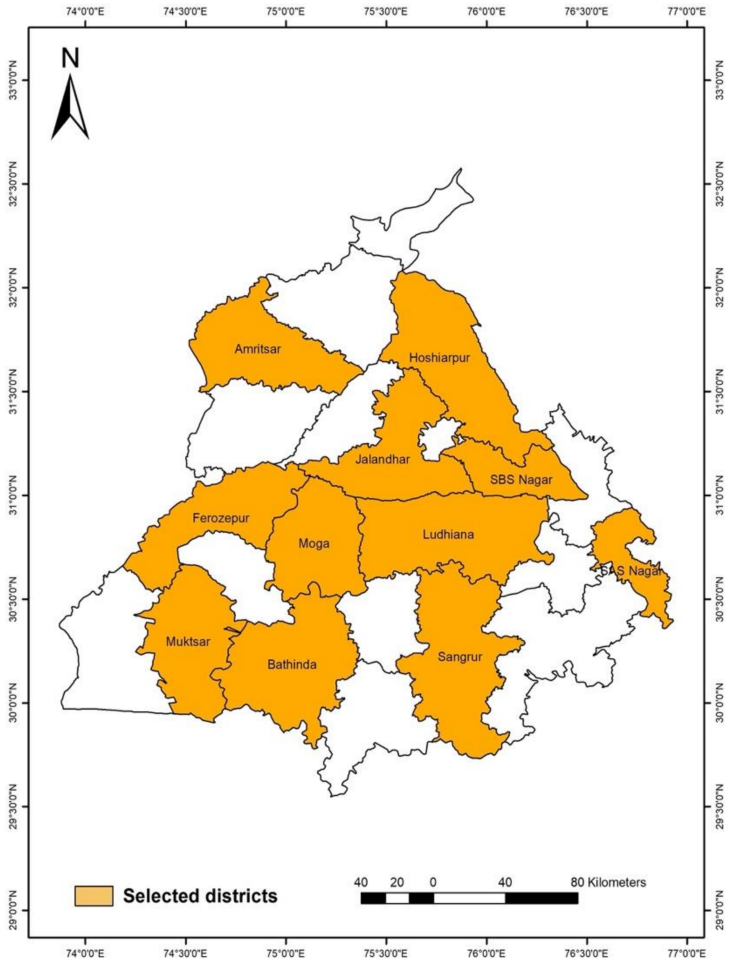

Figure 2. Map of selected districts for the study.

Table 1. Details and distribution of the study sample.

Particular	Value
1. Sample size	1100
2. No. of districts	11
3. No. of villages	46
4. No. of small farmers (<2 ha)	311 (28.3%)
5. No. of medium farmers (2–6 ha)	454 (41.3%)
6. No. of large farmers (6 ha and above)	335 (30.4%)

2.3. Data Analysis

Impact evaluation studies typically follow a number of approaches, including: (i) before and after, (ii) with and without and (iii) difference in difference. The aim is to identify a proper control against which the change can be measured. The first approach uses the data from the same source before and after the intervention and the second approach compares the data of treated units with that of the untreated (control) units. While the former may unduly assign change due to other factors to the intervention itself, the latter may assume no change in the control group in the absence of intervention. The third approach addresses this limitation by using the differences in treated and untreated units over time and then comparing them [52].

In the present study, the second and the third approaches were not feasible, as all the farmers in Punjab were affected by the COVID-19 pandemic and no true control group was

available for comparison. We have thus used the first "before-and-after" approach and compared the data collected from the same set of farmers for the pre- and post-lockdown period. The statistical significance of the differences between pre- and post-lockdown period was estimated by using two different tests. For the data, where actual units of the variables were compared, paired *t*-tests were used for testing any change. The t-statistic is estimated using the following formula:

$$t = \frac{\sum d}{\sqrt{\frac{n(\sum d^2) - (\sum d)^2}{n-1}}}$$

where d is the difference in the change in value of the variable during the pandemic period and n is the sample size.

For the data on proportions (percentages), a McNemar test was used. The McNemar test involves only off-diagonal elements and despite being highly appropriate for analysing pre-post differences in dichotomous items, it is scarcely used, due to unfamiliarity [53]. It is a Chi-square test with one degree of freedom and is expressed by the following formula:

$$\chi^2 = \frac{\left(\left|n_{ij} - n_{ji}\right| - 1\right)^2}{\left(n_{ij} + n_{ji}\right)}$$

The test is applied to a 2 × 2 contingency table, where n_{ij} and n_{ji} are the numbers of misclassified items as per the methods i and j, respectively.

While the majority of the reviewed studies have examined the impact of the COVID-19 pandemic in a qualitative and descriptive manner, two [32,33] have used a *t*-test and chi-square test to examine the changes between the pre- and post-pandemic period.

3. Results

3.1. Operational Area, Land Lease and Cropping Pattern

The severe disruptions caused by the lockdown are less likely to affect the land ownership in such a short period, but we attempted to examine changes in land-leasing activity and cropping patterns, as these might be influenced by the short-term anticipations of the farmers on input and output markets in agriculture. We observed that there was a very small increase in the overall operational land (<1% increase) due to an increase in the leasing-in activity (2% increase) after the lockdown. There was no change in land ownership, as expected, and the leasing activities (both leasing-in and leasing-out) remained unchanged for the small and marginal farmers. However, the large farmers showed a slight increase (around 3%) in the leased-in and operational land (Table 2). The proportion of farmers engaged in leasing-in of land in the pre-pandemic period in Punjab was very high at almost 39%; and there was virtually no change in these numbers during the pandemic. As there was no adverse effect on lease markets, the increase in land rent ranged between Rs 18,106 to Rs 20,911 per ha (around >15% increase) during this period. During recent years, land rent has increased sharply, and it significantly affects the land lease activities in Punjab [54,55].

Table 2. The pattern of owned and operational land in Punjab during the pandemic period (hectares).

Particular	Small Farmers		Medium Farmers		Large Farmers		Overall	
	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period
Owned land	1.16	1.16	2.62	2.62	5.78	5.78	3.17	3.17
Leased-in land	0.08	0.07	0.77	0.77	4.88	5.02 ***	1.83	1.87 ***
Leased-out land	0.04	0.04	0.02	0.02	0.02	0.02	0.03	0.03
Operational land	1.20	1.18	3.37	3.37	10.64	10.78 ***	4.97	5.01 ***

Note: *** represents significant difference at 1% level between the values of pre- and post-lockdown period (based on paired *t*-test). In all other cases, there is no statistically significant difference.

Furthermore, the pandemic did not induce any major change in cropping patterns (Table 3). This scenario was apparent across all the farm-size categories. Paddy and wheat, which are the most reliable crops in terms of production and marketing, occupy around 85% of the total cropped area in the state. There was a very small but statistically significant decline in the area under wheat cultivation on medium and large farms. Such areas were shifted to vegetables on the medium farms and to minor crops on the large farms. The cropping pattern on small farms remained completely unaffected. The findings of no major change in the cropping pattern in Punjab are confirmed by the data released by the state department of agriculture [56]. In a nutshell, the COVID-19 pandemic did not affect the land-leasing activity and the cropping pattern in Punjab. The assured procurement, timely arrangements of machinery services and effective management of field operations (especially wheat harvesting and paddy transplantation) coaxed farmers into sticking to their traditional cropping pattern [41]. Minimal changes in the area under paddy and wheat crops during the COVID-19 pandemic period reflect no immediate adverse impact on food supply from Punjab to the national food pool.

Table 3. Changes in the cropping pattern in Punjab during the pandemic period (% of total cropped area).

Crop/Season	Small Farmers		Medium Farmers		Large Farmers		Overall	
	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period
	Kharif season							
Paddy	36.0	36.1	39.5	39.6	43.0	43.0	41.5	41.5
Basmati	1.7	1.7	2.2	2.2	2.1	2.0	2.1	2.0
Cotton	1.9	1.9	2.1	2.0	1.6	1.7	1.7	1.8
Maize	2.4	2.4	2.1	2.1	0.8	0.8	1.3	1.3
Sugarcane	-	-	0.5	0.5	1.5	1.5	1.2	1.2
Vegetables	-	-	-	-	0.1	0.1	-	-
Others	8.0	7.9	3.6	3.6	1.9	1.9	2.8	2.8
	Rabi season							
Wheat	42.8	42.5	45.6	45.1 **	43.4	42.6 ***	43.9	43.2 ***
Potato	-	-	0.4	0.5	3.6	3.8	2.5	2.6
Vegetables	-	-	0.1	0.3 **	-	-	-	0.1 **
Others	7.2	7.5	3.9	4.1	2.0	2.6 ***	3.0	3.5 ***
Total cropped area (ha)	2.28	2.34	6.70	6.71	20.96	1.25	9.82	9.92

Note: *** and ** represent significant difference at 1% and 5% levels, respectively, between the values of pre- and post-lockdown period (based on paired *t*-test). In all other cases, there is no statistically significant difference.

3.2. Disruptions in Machinery Services and Input Supply Chains

Almost all the field operations for paddy and wheat crops (except paddy transplantation) are entirely mechanised [57]. At the time of the lockdown, most of the harvesting machines were stuck in other states. These machines are normally transported to the states where harvesting commences in the agricultural lean season of Punjab and returned to Punjab when the harvesting season approaches in the state. Restriction in the movement of such machinery and disruptions in machinery services were likely to impact harvesting of wheat and other rabi crops. However, only about one-third of the farmers faced a shortage of harvesting machinery for wheat and only about one per cent for the other rabi crops (Table 4). Although the incidence of machinery shortage increased substantially immediately after the lockdown and caused a significant reduction in their availability, about two-thirds of the farmers could arrange the harvesters due to timely intervention from the state in ensuring that the harvesting machines stuck outside could reach Punjab in time. As the agricultural season progressed into kharif and machinery services still remained significantly affected, about 22% of the farmers faced machinery shortages for paddy crops and about 5% for other kharif crops. The machinery shortages for paddy

cultivation were experienced by those farmers who adopted direct seeding of rice during 2020. The majority of farmers were able to arrange machinery services for crop cultivation during the pandemic period, but machinery shortages led to an increase in the average rent of the machinery of around 11%.

Table 4. Percentage of farmers reporting problems in machinery services in Punjab during pandemic period.

Operational Holding	Rabi Season				Kharif Season			
	Wheat		Other Crops		Paddy and Basmati		Other Crops	
	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period
Small farmers	13.5	34.7 ***	-	-	9.7	29.3 ***	-	4.8 ***
Medium farmers	5.1	31.5 ***	-	0.4	2.2	18.5 ***	-	4.6 ***
Large farmers	2.7	31.6 ***	1.8	3.3	0.6	20.9 ***	-	6.3 ***
Overall	6.7	32.5 ***	0.5	1.2	3.8	22.3 ***	-	5.2 ***

Note: *** represents significant difference at 1% level between the percentage values of pre- and post-lockdown period (based on McNemar test). In all other cases, there is no statistically significant difference.

Besides machinery services, input supply chains were also disrupted due to the lockdown, reducing access to seeds, fertilizers, agro-chemicals, etc. During the pandemic period, the proportion of farmers who had problems accessing the inputs increased from 1.4 to 5% during the rabi season and from 2.1 to 21.9% during the kharif season. A much higher increase in the proportion during the kharif season is because the kharif season was about to begin when the lockdown restrictions were imposed in Punjab, whereas the rabi season was almost over (Table 5). As a result, 3.5% of the farmers in rabi and 21.1% during kharif had to pay higher prices to ensure the availability of inputs for their crops. The issue of access to inputs and higher prices increased severely with increased farm size. In summary, machinery and input supply chains were disrupted, leading to higher rent and prices. Despite this, the majority of the farmers could effectively manage their crop production during the pandemic period.

Table 5. Percentage of farmers reporting disruptions in input supply chains in Punjab during the pandemic period.

Operational Holding	Rabi Season				Kharif Season			
	Poor Access to Inputs		Higher Prices for Inputs		Poor Access to Inputs		Higher Prices for Inputs	
	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period
Small farmers	-	0.3	-	-	1.3	18.3 ***	-	16.4 ***
Medium farmers	0.7	2.4 ***	0.4	1.3	3.3	21.8 ***	0.2	20.9 ***
Large farmers	3.6	12.8 ***	1.8	9.8 ***	1.2	25.4 ***	0.6	25.7 ***
Overall	1.4	5.0 ***	0.7	3.5 ***	2.1	21.9 ***	0.3	21.1 ***

Note: *** represents significant difference at 1% level between the percentage values of pre- and post-lockdown period (based on McNemar test). In all other cases, there is no statistically significant difference.

3.3. Disruptions in Agricultural Labour Markets

There were unprecedented disruptions in agricultural labour markets after the COVID-19-induced lockdown in early 2020. The fears of COVID-19 and subsequent lockdown witnessed a large-scale return of the migrant workers from Punjab to their native states. The lockdown also hurt the possibilities of return of migrant agricultural workers for the transplantation of paddy, as it requires almost 50 million days of labour [41,58,59]. However, shutdown of the industry rendered the rural non-agricultural workers unemployed, and some of them sought employment in agriculture as a survival strategy. A recent study highlighted that local workers filled the major supply deficit of migrant agricultural workers. Although there was a significant wage hike in agriculture, it was still less than

what it could have been without shifting local non-agricultural workers to agriculture [39]. While less than 3% of the farmers in the rabi season and less than 1% in the kharif season faced labour shortages before the pandemic, these proportions soared to almost 50% farmers in the rabi season and more than 70% in the kharif season during the pandemic (Table 6). The proportion of farmers facing a labour shortage increased with the operational holding category due to higher demand for labour on such holdings. The labour shortages were aggravated during the kharif season as paddy (the dominant kharif crop) requires considerably more labour for transplantation than any other crop in the cropping pattern. In response to the severe labour shortages, the wage rate increased by 30% during the rabi season (from Rs 344/day to 448/day). However, the wages increased by 49% for paddy transplantation (from Rs 7229/ha to Rs 10790/ha). Due to the shortage of migrant workers, the farmers also resorted to the use of local wage workers. We estimate that compared to about 82% of the paddy area being transplanted by migrant workers in the pre-pandemic year, only 46% area was transplanted by the migrant workers in Punjab after the pandemic hit the nation. The farmers also resorted to the adoption of direct seeding of rice to overcome the labour shortages, but its effect might have been minimal, as only 5% of the paddy area was brought under this practice. Clearly, there were widespread labour shortages during the pandemic due to the return of the migrant workers to their native states and the inability to return during peak agricultural operations such as wheat harvesting and paddy transplantation. Despite more local workers being available in the agriculture sector, the shortages could not be mitigated and led to a substantial increase in agricultural wages [41,60].

Table 6. Percentage of farmers facing labour shortages in Punjab during the pandemic period.

Operational Holding	Rabi Season		Kharif Season	
	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period
Small farmers	5.2	48.2 ***	1.3	62.4 ***
Medium farmers	2.0	46.9 ***	0.4	72.3 ***
Large farmers	2.1	54.9 ***	-	82.7 ***
Overall	2.9	49.7 ***	0.5	72.6 ***

Note: *** represents significant difference at 1% level between the percentage values of pre- and post-lockdown period (based on McNemar test).

3.4. Disruptions in Agricultural Product Markets

The pandemic-induced lockdown caused severe restrictions on population movement and crippled the transportation of agricultural and other commodities. The physical distancing norms posed a tough challenge on effective procurement of wheat, more than 13 million tonnes of which (of the total production of 18 million tonnes) was expected to arrive in the market within a short period. To avoid crowding in the markets and ensure hassle-free procurement, the state government introduced a token/e-pass system known as the Arhtiya-Kisan e-pass [61]. Under this system, the passes were generated online by *arhtiyas* (commission agents) through software. These passes specified the date of bringing the produce to the market by the farmer. These passes were then provided to the farmers. Each pass allowed only one trolley (open wagon) loaded with produce to be brought to the mandi. One part of the pass was then retained by the farmer and the other by the mandi board official. The farmer could then go back to the mandi for additional/surplus stock on another day, as per the pass. Though the procurement spread over an extended period in 2020, it was effective, as highlighted in Table 7. There was almost no adverse effect on the production of wheat and the produce sold in the markets due to the pandemic. However, owing to the token system introduced in the markets, only about 2/3 of the produce was brought to the market immediately after the harvest. In contrast, the entire produce had been brought directly to the market for sale before the COVID-19 pandemic. The rest of

the produce was stored temporarily at home for a few days (about 3.4 days) per the token availability and compliance with the COVID-19 restrictions. The changed procurement norms during the pandemic period caused a significant decline in the immediate sale of the produce and increased the temporary storage of produce at home for a relatively longer duration. More than 90% of the farmers arranged tokens before reaching the market to sell their produce. An effective procurement strategy by the state government ensured that all the farmers could sell their produce at MSP, as only about 1% of the farmers reported selling their produce below MSP (almost the same as in the pre-pandemic period).

Table 7. Changes in procurement of wheat in Punjab during the pandemic period.

Particulars	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period	Pre-Pandemic Period	Pandemic Period
Average wheat production (Qtl)	52.1	51.9 *	149.1	150.9	452.7	448.1	214.1	213.3
Wheat stored at home (Qtl)	12.0	12.7	17.2	18.3 *	26.8	25.7	18.6	18.9
Wheat sold in the market (Qtl)	40.1	39.2 **	131.9	132.6	425.9	422.4	195.5	194.4
Wheat taken directly to the market (Qtl)	39.9 (99.5%)	31.5 *** (80.4%)	131.2 (99.5%)	100.5 *** (75.8%)	419.7 (98.5%)	267.0 *** (63.2%)	193.2 (98.9%)	131.7 *** (67.7%)
Wheat stored at home before taking to the market (Qtl)	0.2 (0.5%)	7.6 *** (19.6%)	0.7 (0.5%)	32.1 *** (24.2%)	6.2 (1.5%)	155.4 *** (36.8%)	2.2 (1.1%)	62.7 *** (32.3%)
Average number of days wheat before sale in the market	0.1	1.9 ***	0.1	2.8 ***	0.1	5.6 ***	0.1	3.4 ***
Distance from market (Km)	5.2	5.2	5.3	5.3	5.5	5.5	5.3	5.4
Farmers receiving price lower than MSP (%)@	1.0	1.3	1.3	1.3	0.9	1.2	1.1	0.4
Farmers receiving token before taking wheat to the mandis (%)@	-	93.0 ***	-	94.9 ***	-	96.7 ***	-	93.0 ***

Note: Figures in the brackets are the percentages to total produce sold in the market. ***, ** and * represent significant difference at 1%, 5% and 10% levels, respectively, between the values of pre- and post-lockdown period (based on paired *t*-test). In all other cases, there is no statistically significant difference. For @, the McNemar test was used to test the statistical significance of pre- and post-lockdown difference in proportions.

Despite the effective functioning of the token system and satisfactory procurement, about 25% of the farmers were satisfied with the token system, and only about 11% of the farmers wanted it to continue for the paddy crop (Table 8). This may be due to the farmers' additional transportation and storage costs due to the token system. However, after removing the lockdown restrictions and owing to farmer aversion, the token system was not introduced during paddy procurement, and operations reverted to the earlier marketing system.

Table 8. Farmers' responses on marketing of paddy during the pandemic period.

Particulars	% Response
Satisfied with the token system in wheat	24.7
Preference for token system for forthcoming paddy procurement	11.2

4. Conclusions, Implications and the Way Ahead

In this section, we provide brief conclusions, their implications for food security and farmers' incomes and the way ahead to address the challenges of COVID-19 for Punjab agriculture.

4.1. Conclusions

The agriculture sector in Punjab showed resilience to the challenges of the COVID-19 pandemic and the land lease markets and cropping pattern remained unaffected despite serious supply- and demand-side disruptions. The study reveals that despite the disruptions in input availability, machinery services and agricultural labour availability, food production and productivity did not decline. This situation reflects the fact that states such as Punjab are a stable source of food supply for the national food pool even during the worst situations of the national and global economy. As the public procurement system for wheat and paddy crops in Punjab is well established and serves the farmers well, they quickly and adequately adapted to the changes made in procurement in the form of a token system and temporary storage of some part of the produce at home before marketing.

The disruptions in agricultural machinery services, input supply chains and agricultural labour availability adversely affected all the farmers, though medium to large farmers were relatively more affected due to their relatively higher demand. The demand–supply gap has led to an increase in the rent for machinery, prices of inputs and wages for agricultural labour. As a result, the cost of food production has increased at the farm level. As support prices for food crops are not increasing at the same pace, the COVID-19 pandemic will reduce crop profitability and farm incomes.

4.2. Implications

Our study reveals no threat to food production in one of the most important agricultural states, Punjab. As Punjab is the major contributor to the national food pool, there is no imminent threat to the future food supply, food stocks of the country and to national food security. The COVID-19 pandemic, however, has raised the cost of food production and reduced the profitability of farming due to disruption in input supply chains and scarcity of labour. As agricultural households in Punjab derive more than 90% of their income from agriculture and related activities, any squeeze in profitability will lead to distress in farming and may also have adverse effects on future investments in farming by the farmers. It may ultimately lead to further slowdown in the agriculture sector in Punjab.

4.3. Way Ahead

The Covid-19-induced lockdown produced no imminent threat to food security in India and food supplies are expected to remain stable during the ongoing pandemic, but the farming sector will require further strengthening through productive investments in input supply chains, machinery services and facilitating inter-state mobility of migrant labourers for agricultural work in the country. Some financial support to farmers to neutralise the rising costs of production will check the deepening distress in the sector. There is need to strengthen the agricultural supply chains, especially machinery services and input supplies, to check further price increases.

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