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Impact of the COVID-19 lockdown on agriculture in a rainfed region in India: Lessons for dealing with natural and economic shocks

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Abstract On March 25, 2020, India imposed a nationwide lockdown to curb COVID-19, affecting agricultural operations in northern Karnataka's rainfed districts. A survey of 1004 households revealed that 64% faced challenges accessing inputs, credit, and transport. In Bidar, 54% of respondents struggled with input supply disruptions, compared to 12% in Raichur. Additionally, 29% of respondents in Bidar and 33% in Raichur reported issues with timely credit access. These impacts varied by region, landholding, and social category. The study highlights the need for increased public agricultural expenditure, better technological tools, and strengthened supply chains and market access to mitigate such disruptions in the future.

Introduction

The COVID-19 pandemic and the measures undertaken to contain its spread have adversely impacted the global economy, with India being no exception. The nationwide complete/partial lockdowns[1] imposed in India between March 25, 2020 and May 31, 2020 ("Lockdown") in response to the COVID-19 pandemic had significant attendant economic costs and a cascading impact on all productive sectors of the economy, irrespective of whether or not they were

[1] The lockdown was meant to prevent the spread of infection from one person to other. Therefore, all commercial and private establishments were not operational, with the only exception being establishments engaged in essential activities. (https://www.mha.gov.in/sites/default/files/Guidelines_0.pdf)

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included in the ambit of "essential" sectors that were exempted from the stringent conditions of the lockdown (Kumar et al., 2021; NABARD, 2020). The lockdown led to widespread disruptions in the supply chain for agricultural inputs and produce (Ramakumar, 2020; Sharma et al., 2020; Varshney et al., 2021).

A significant portion of developing countries' population is involved in agricultural production as a principal economic activity (Singh et al., 2020). The agricultural sector contributes more than 20% to the gross domestic product (GDP) in developing countries of South Asia. In India, the agricultural sector contributes nearly one-sixth to the national income and employs nearly 50% of the workforce (Dev, 2015; NABARD, 2020). After the implementation of the lockdown on March 25, 2020, to contain the spread of COVID-19, most commercial and transport-related activities in rural and urban areas were closed or disrupted across the country. Measures such as border closure and quarantines led to disruption in the food supply chain and supply of inputs for rural and urban populations, and lowered purchasing capacities due to losses in incomes (Barman et al., 2021; Boughton et al., 2020; Ramakumar, 2020; Singh et al. 2020; Wang et al., 2020). On the other hand, in the agricultural sector, production processes were threatened due to shortages of agriculture inputs, credit and labour, leading to disruptions in *kharif* sowing, pre- and post-harvest processes, and access to markets (Goswami et al., 2021; Modak & Bhattacharya, 2021; Singh et al., 2020).

The impact of the lockdown varied across states and cropping systems in India. States such as Punjab and Haryana, mainly dependent on migrant labour for the agricultural workforce, witnessed a reduction of 9% and 21% in the yields of rice and wheat respectively, due to a delay in transplantation caused by shortage of labour output (Gupta, 2020; Kaur et al., 2011; Singh et al., 2020). Similarly, in 47% of districts studied by NABARD, agricultural production was adversely affected by the lockdown, while production increased in 19% of the districts (NABARD, 2020). The production of agricultural and allied sectors declined significantly during the lockdown period, especially in the poultry and fisheries sector (NABARD, 2020; Ramakumar, 2020). For the allied sectors, the leading cause of the reduction was a disruption in supply chains and a decline in demand. The NABARD study also revealed the impact of the lockdown on the availability and prices of agricultural inputs with 58% of districts adversely affected due to the non-availability of inputs, and cultivators in 54% districts showing an increase in prices of inputs in the same period (NABARD, 2020).

Most studies that evaluate the impact of the lockdown on the agricultural sector use secondary sources of data and/or present results of surveys conducted online or over telephonic conversations. The study by NABARD (2020) uses data collected from online surveys and presents an overall picture of the impact on cultivators without differentiation across social and economic categories of cultivators. Modak and Bhattacharya (2021) as well as Niyati and Vijayamba (2021) utilised telephonic surveys across 26 villages in India to assess the differential effects of the lockdown on agricultural production, employment and incomes, food consumption, and the public distribution system across classes of rural households. Given the wide variation in the impacts of the lockdown on various aspects of agricultural production across the country, in this study we focus on two districts (namely Bidar and Raichur) of the dry, rainfed Kalyana-Karnataka (KK) region (Figure 1).

This survey was part of a larger survey of 1004 households across the districts of Raichur and Bidar[2] using primary household field surveys administered in person between January and March 2021 before the second wave of the COVID-19 pandemic swept across India leading to another series of state-wide lockdowns in this region. The Kalyana-Karnataka (KK) region (previously known as the Hyderabad-Karnataka region) consists of six districts, viz., Ballari, Koppal, Raichur, Yadgir, Kalaburagi, and Bidar. The KK region has historically been characterised by higher levels of economic distress compared to other regions in the state of Karnataka (Benni & Chowdappa, 2017; Hanagodimath, 2014). In 2012, the KK region was also granted a special status as per Article 371J of the Constitution of India to facilitate accelerated development in the region. There is evidence of regular seasonal and long-term migration of marginal farmers and landless agricultural labourers either to neighbouring states or to the more developed and urbanised parts of the state (Doddamani, 2014; Shivanand, 2020).

The study, based on survey data, primarily aims to achieve the following objectives:

- To evaluate the impact of the lockdown on production processes in the agricultural sector in a predominantly rainfed region.
- To assess the variation in impacts across the two districts of Raichur and Bidar and explore reasons for the same.
- To analyse the differential impacts of the lockdown on different social and economic categories of cultivators and the respective differences in response strategies used by them to alleviate the impact of the same.

The first section of the paper provides an overview of the study region and the methodology used for the study, including details of the sampling strategy for the primary survey, key parameters analysed, and statistical tests performed for analysis. The subsequent section discusses the results and the differential nature of the impacts of the lockdown across regions and social and economic categories of farmers. The concluding section discusses some of the lessons learnt from the lockdown and potential ways to ensure better resilience to unexpected disruptions in the future.

Overview of the study region

About 14 million people (18% of the state's population) are engaged in agriculture in the state of Karnataka, of which 24% are cultivators and 26% are agricultural workers (details in Table 1) (PIB, 2020). Despite this overwhelming dependence on agriculture, it has received inadequate attention leading to the stagnation in the social and economic growth in the region. Additionally, both districts – Raichur and Bidar – have a literacy rate less than the state's average literacy rate of 75%. These two districts lie in the north-eastern dry

[2] These districts were selected based on the presence of Agromet Field Unit (AMFU) of India Meteorological Department (IMD), as this study carried out under a Ministry of Earth Science (MOES) project aimed at assessing the efficacy of extension services.

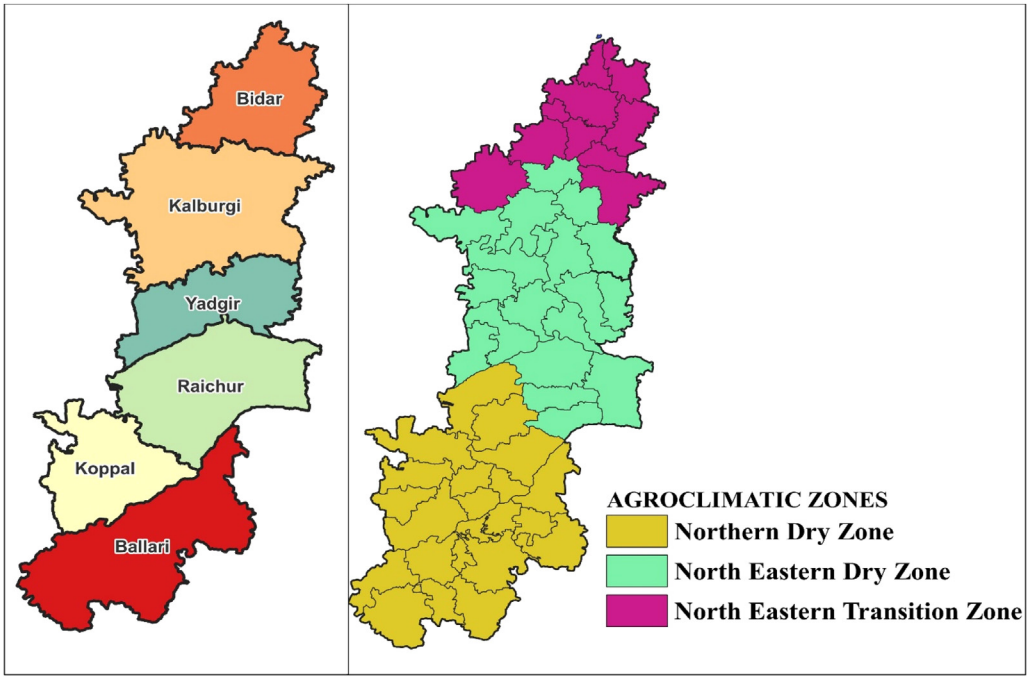

Figure 1 District boundaries and agrometeorological regions in the KK region.

Table 1 Agricultural demographic details of Raichur and Bidar districts.

Districts	Proportion of cultivators (in no.)	Agricultural labourers (in no.)	Contribution of district agri-allied sector in GSDP (in %)	Literacy status (in %)
Raichur	2,06,680	3,28,491	3.2	59.6
Bidar	1,38,792	2,09,047	2.2	70.5

Source: E-Krishi, UAS, Banglore (2020).

and north-eastern transition agrometeorological zones, respectively (Figure 1) and receive average annual rainfall levels of 658 mm and 886 mm, respectively (E-Krishi, 2020).

Tables 2 and 3 provide an overview of the distribution of the surveyed households based on land ownership and social categories. The landholding size criteria utilised in the study is based on the Agricultural Census of 2015; households owning less than 1 hectare (ha) of land are classified as "marginal landholders"; "small landholders" own 1–2 ha of land; "semi-medium landholders" own 2–4 ha; "medium landholders" own 4–10 ha; and "large landholders" own more than 10 ha.

Table 2 Distribution of surveyed households by land ownership (percentage of total households).

Land class	Raichur	Bidar
Marginal landowners	45	39
Small landowners	31	43
Semi-medium landowners	18	16
Medium landowners	6	3
Large landowners	0.2	0

Notes: Only one large landowner was surveyed in Raichur. Villages surveyed in Bidar had a few absentee landowners who were not available during the field survey.

Table 3 Distribution of surveyed households by social category[31] (percentage of total households).

Social categories	Raichur	Bidar
Households belonging to Other Backward Classes (OBC)	47	52
Households belonging to Scheduled Castes	29	21
Households belonging to Scheduled Tribes	24	27

The distribution of land ownership for the sample used in this study roughly follows the distribution of land ownership in the overall population in the district.

Cropping pattern in the studied districts

Table 4 shows the major crops grown in the villages surveyed in the two districts. The cropping pattern in the villages is similar

Table 4 Major crops grown in the studied villages of Raichur and Bidar districts.

Districts	Major kharif crops	Major rabi crops
Raichur	Pigeon pea, paddy, pearl millet	Chickpea, jowar
Bidar	Pigeon pea, pearl millet, soyabean	Jowar, chickpea

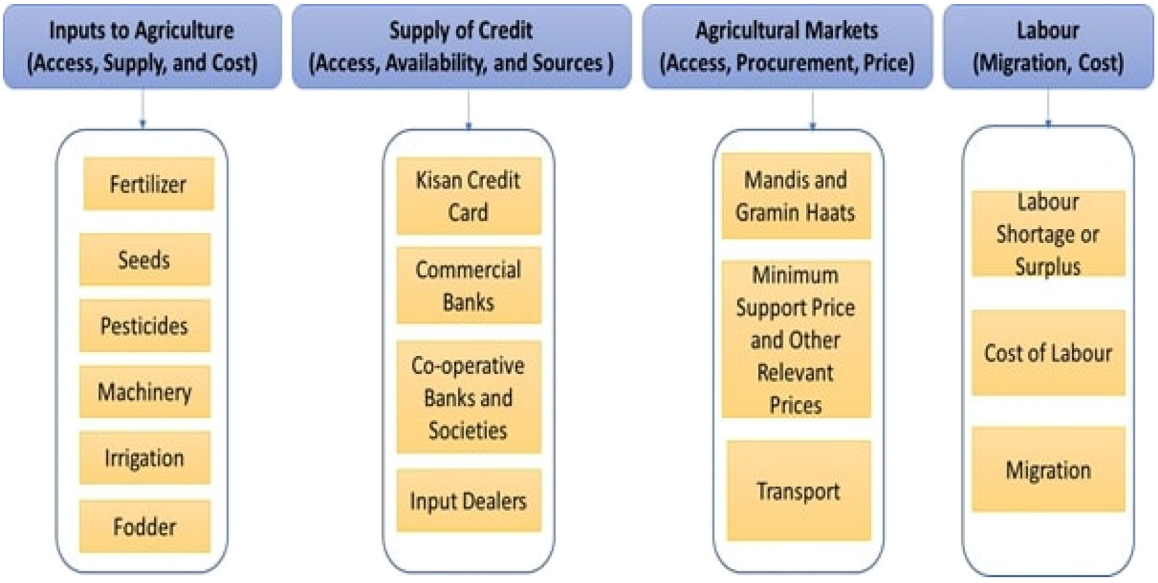

Figure 2 Key parameters in the assessment of impact of the lockdown on the agricultural sector in the KK region.

to the overall cropping pattern in the districts with a predominance of pulses and millets[4]. The major kharif crops cultivated in the two districts include pigeon pea and pearl millet, while chickpea and jowar are grown in the *rabi* season.

Methodology

The sample population for the primary field survey was selected based on the All-India Census of 2011. One village was selected from every block of the two districts. In Bidar, the fieldwork was conducted in the villages of Ilhal, Jalasangi, Kalwadi, Kaudgaon, and Khadarnagar. In Raichur, the fieldwork was conducted in Parampura, Karegudda, Mykaldoddi, Merchathal, and Kalamangi villages. A structured questionnaire was utilised wherein one thousand households were surveyed with a team of 10 enumerators. The list of cultivators was collected from the respective village gram panchayats and revenue officers. Using stratified random selection, the households to be surveyed were selected, with the strata being based on land size classes as per the Agricultural Census of 2015.

[3] There were no general category cultivators in the study area in both the districts.

[4] This study did not collect data on the impact of lockdown for individual crops but dealt with the impact of the lockdown on the overall agricultural production processes in the region.

The impacts of the lockdown have been examined across social categories and land size classes in the study region, based on four aspects - (i) access to agricultural inputs, (ii) credit supply for agriculture, i.e., loans from formal institutions such, as banks, cooperative societies, etc., (iii) access to agricultural markets, and (iv) the supply and availability of agricultural labour. Data were collected on various parameters that together provided information for each of the key areas of the lockdown's impact on agriculture in this region. The variables for which data were collected to assess the impacts across the four key aspects of agricultural supply chains are shown in Figure 2. Empirical data related to the impacts of the lockdown were collected for the period of March 2020 through December 2020.

We used non-parametric tests for hypotheses testing. The categorical variables which were tested included land-size class, social category, and the impacts faced by the cultivators across both the districts. An empirical investigation was conducted to determine the varied nature of the impact of the lockdown on cultivators differentiated across regions and by their landholding and social category. To achieve this, we utilised proportions tests and chi-square tests, which are appropriate for examining significant differences and statistical associations between variables. However, we emphasise that these methods do not establish causal relationships, as they are designed to identify patterns and potential associations rather than infer cause-and-effect relationships. The following statistical tests were performed:

Proportions test

The proportions test or the z-test for testing equality of proportions was undertaken to compare the proportions of cultivators across regions to evaluate whether they differ significantly. The null hypothesis (H0) for the test assumed that there were no differences between the proportion of cultivators experiencing the impact of the lockdown in Raichur and Bidar, thereby signifying that the impact of the lockdown was not differentiated across regions. The alternate hypothesis (H1) propounds that the proportion of cultivators experiencing the impact of the lockdown in Raichur and Bidar varies significantly, and the impact of the lockdown was differentiated across regions. The hypotheses were tested at a confidence level of 95%.

Chi-square test

We tested the statistical significance of differences between the observed and expected frequencies using the chi-square test. The chi-square test was used to assess the significance of the association between the size of the landholding and social category, with the impacts faced by the cultivators due to the pandemic. The null hypothesis (H_0) assumes independence between the categorical variables, while the alternate hypothesis (H_1) assumes that the two variables are dependent on each other.

To understand the differentiated impact of the lockdown on cultivators, it is necessary first to assess the existing social and economic conditions in the region as well as the availability of rural infrastructure and government support, which are important determinants of vulnerability. This study investigates the differential degrees of vulnerability based on the size of the landholdings and the social category to which the cultivators belong. The sections below provide an overview of the major findings including descriptive and empirical analysis of our survey data.

Results and discussion

Of the 1004 cultivators interviewed, 640 cultivators (64%) responded that they had encountered problems in accessing at least one of the key parameters during the lockdown (March 25, 2020 to May 31, 2020) including accessing inputs, credit, disruptions in transport services and agriculture markets. Figure 3 provides an overview of the overall impact of the lockdown in the study region separated by the four main themes that were considered for investigation during the survey. The responses of cultivators in Bidar and Raichur are given separately in the figure as the main problems faced by cultivators varied between the two districts.

Respondents were also asked to rank the factors based on the severity of the experienced impact. The most severely affected aspect of the agricultural production process in Bidar, was the supply of inputs, including fertilisers, seeds, pesticides, and other machinery, as reported by the surveyed farmers. On the other hand, in Raichur, a majority of the cultivators (63%) reported that accessibility to agricultural credit was the biggest problem. Further disaggregation of village-wise data highlights that even within a district, different cultivators were differently vulnerable to various impacts based on their access to means of production and adaptive capacities.

Two notable points which emerge suggest that first the nature of the impacts faced by cultivators differs across regions subject to physical resource endowments, rural infrastructure, and the availability of government support. This point is also substantiated by Modak and Bhattacharya (2021) in their inter-regional study, where they claim that due to the presence of Agriculture Produce Market Committee (APMC) *mandis* and the implementation of Minimum Support Price (MSP) in Punjab, farmers have realised better prices and performed better than those in other states in terms of a reduced impact of the pandemic-induced lockdown. Second, even within regions, the vulnerability of the cultivators towards different impacts differs subject to their

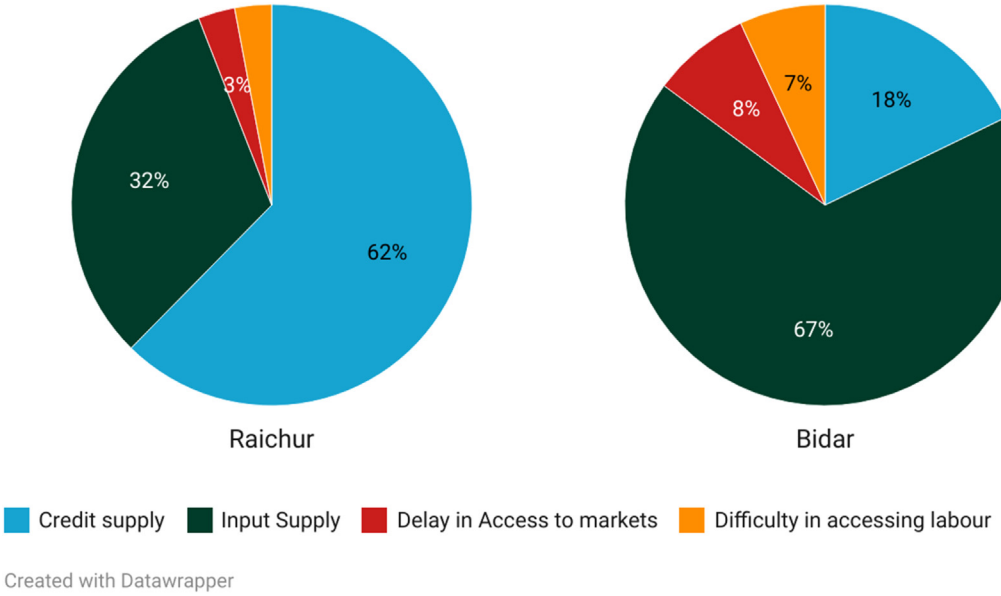

Figure 3 Percentage of cultivators affected by the COVID-19 lockdown in Bidar and Raichur districts (Values in % of cultivators who said that they were affected by the lockdown).

existing accessibility and ownership of means of production. Therefore, it becomes imperative to analyse the differential nature of these impacts faced by cultivators based on their varying vulnerabilities and adaptive capacities due to regional differences in the availability of infrastructure and existing structural inequalities.

Empirical analysis: Differential nature of the impacts of the lockdown

Tables 5 and 6 show the differences in proportions of the cultivators in both Bidar and Raichur. The tables demonstrate the statistically significant differences in the proportion of cultivators affected by the lockdown in Bidar and Raichur, especially in relation to the impact on credit and input supply. The results demonstrate that the proportion of cultivators across social categories differs for both Bidar and Raichur, thereby highlighting the regional disparities in the impacts of the lockdown, especially for impacts on credit and input supply. A more detailed analysis of each aspect of the impact of the lockdown is provided in the subsequent sections.

To further investigate the dependence between landholding, social category, and the nature of the impact of the lockdown, chi-square tests were conducted. Tables 7 and 8 summarise the assessment of the association between

Table 5 Results of the proportion test between size class of landholding and the impact of the lockdown.

Impact of lockdown	Cultivators across size classes of landholding who were affected by the lockdown (in %)							
	Marginal		Medium		Semi-medium		Small	
	Bidar (A)	Raichur (B)	Bidar (A)	Raichur (B)	Bidar (A)	Raichur (B)	Bidar (A)	Raichur (B)
Credit supply	27.0%	66.2% A	16.7%	62.5% a	11.1%	54.7% A	11.6%	62.8% A
Delay in access to markets	4.5%	2.0%	16.7%	0.0%[1]	11.1% b	1.9%	8.9% b	3.4%
Difficulty in getting labour	6.3%	2.7%	0.0%[1]	12.5%	4.4%	1.9%	8.0% b	2.8%
Input supply	62.2% B	29.1%	66.7%	25.0%	73.3% B	41.5%	71.4% B	31.0%

Notes:
Results are based on two-sided tests. For each significant pair, the key to the category with the smaller column proportion appears in the category with the larger column proportion.
Significance level for upper case letters (A, B, C): .05
Significance level for lower case letters (a, b, c): .1[2]
[1]This category is not used in comparisons because its column proportion is equal to zero or one.[2]Tests are adjusted for all pairwise comparisons within a row of each innermost sub-table using the Bonferroni correction.

Table 6 Proportions test between social category of cultivators and impacts faced.

Impact of lockdown	Cultivators across social categories who were affected by the lockdown (in %)					
	OBC		SC		ST	
	Bidar (A)	Raichur (B)	Bidar (A)	Raichur (B)	Bidar (A)	Raichur (B)
Credit supply	20.5%	62.9% A	9.4%	77.9% A	20.4%	53.7% A
Delay in access to markets	7.7% B	3.4%	7.8% b	1.5%	7.5% b	1.9%
Difficulty in getting labour	9.4% B	1.7%	7.8%	7.4%	2.2%	1.9%
Input supply	62.4% B	32.0%	75.0% B	13.2%	69.9% B	42.6%

Notes:
Results are based on two-sided tests. For each significant pair, the key to the category with the smaller column proportion appears in the category with the larger column proportion.
Significance level for upper case letters (A, B, C): .05
Significance level for lower case letters (a, b, c): .1[1]
Tests are adjusted for all pairwise comparisons within a row of each innermost sub table using the Bonferroni correction.

Table 7 Results of chi-square test between size of landholding of cultivators and the impacts faced by them due to the lockdown.

	Value	Degrees of freedom	Asymptotic significance (two-sided) (p-value)
Pearson chi-square	26.41[a]	12	.009**
Likelihood ratio	26.61	12	.009**

Notes:
[a]3 cells (15.0%) have expected count less than 5. The minimum expected count is 1.20.
**Significant at the level of 0.05.

Table 8 Results of chi-square test between social category of cultivators and the impacts faced by them due to the lockdown.

	Value	Degrees of freedom	Asymptotic significance (two-sided) (p-value)
Pearson chi-square	42.07[a]	8	.000**
Likelihood ratio	42.73	8	.000**

Notes:
[a]0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.06.
**Significant at the level of 0.05.

landholding and social category of cultivators with the impacts faced by them in the lockdown. There is a significant association between size of the landholding of the cultivators and the impacts faced by them during the lockdown (95% confidence). Table 8 shows similar results for social category signifying that the impacts of the lockdown are dependent on the social category to which the household belongs.

Cultivators across land-size classes and social categories undertook various measures to deal with the impacts of the lockdown based on their adaptive capacities. The coping mechanisms implemented by them were further dependent on their access to resources and existing vulnerabilities based on their social and economic status. The following section discusses the different coping strategies undertaken by cultivators to deal with the varied levels of impacts across the agricultural parameters being analysed.

Impact on agricultural inputs

Access to modern agricultural inputs is a prerequisite to increase farm production and productivity (Ganesan & Pushpavalli, 2017; McArthur & McCord, 2017). These inputs consist of improved seeds, fertilisers, pesticides, irrigation, machinery, and knowledge in the form of extension services. Farmers reported difficulties in procuring seeds, fertilisers, and pesticides due to increased costs of inputs and limited availability of stocks with input dealers during the lockdown.

Results of the proportion tests signify that across land-size classes (except medium landowners) and social categories, there existed statistically significant differences in proportions of cultivators facing an impact on access to inputs (95% confidence). In Raichur, the extent of impact on access to agricultural inputs is relatively less in comparison to Bidar and this holds true across different categories of farmers. The availability of a larger network of input supply dealers including wholesale dealers and retailers in Raichur may be responsible for this result.

62% of the marginal cultivators indicated difficulty in accessing inputs in Bidar, while 29% of the cultivators surveyed in Raichur district indicated such difficulties (Figure 4). A majority of the small and marginal landholders were disproportionately impacted due to the rise in input costs, while some of the semi-medium and medium landholders were able to cope by paying higher prices for accessing inputs and did not report it as a major problem. Figure 5 outlines the impact of the lockdown on the accessibility of agricultural inputs differentiated based on the social category to which a cultivator belongs. In terms of social category, the supply-chain of agricultural inputs is again seen to be more affected in Bidar in comparison to Raichur.

Availability of infrastructure for accessing agricultural inputs in Raichur and Bidar

The Karnataka government licenses dealers and firms to provide agricultural inputs, mainly seeds, fertiliser, and pesticides. Only licensed dealers are allowed to provide these inputs (Department of Cooperation, GOK, 2013). Wholesale dealers functioning at the state level provide the approved inputs to dealers at the district level who then distribute these to retailers in the region for which licenses are provided. From field observation, it has been seen that subsidised seeds are also offered through government agencies such as the *Raitha Samparka Kendra (RSK)*, although most cultivators are still dependent on private dealers for seed supply. Table 9 indicates the number of active dealers in Bidar and Raichur based on the type of input supply. The number of licensed input dealers is significantly higher in Raichur than in Bidar. This difference between the number of licensed dealers in Raichur and Bidar points to one of the potential reasons for the difference in the responses of

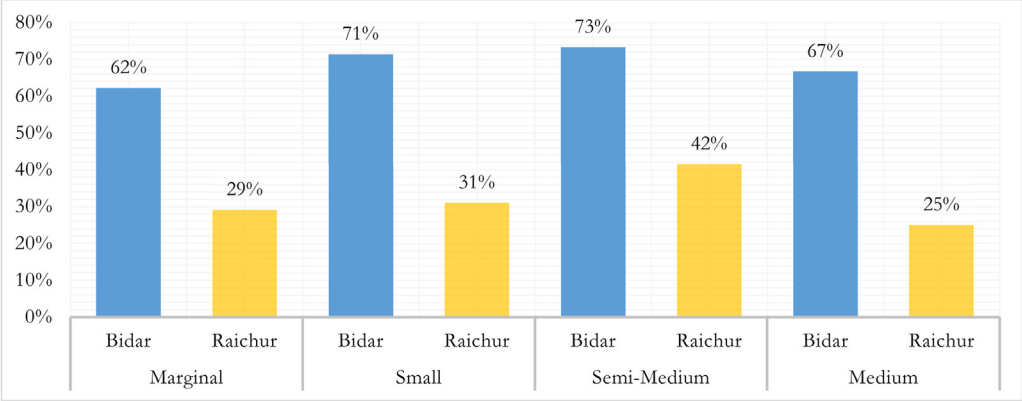

Figure 4 Percentage of cultivators affected by lack of access to agricultural inputs in Bidar and Raichur districts (by size of landholding).

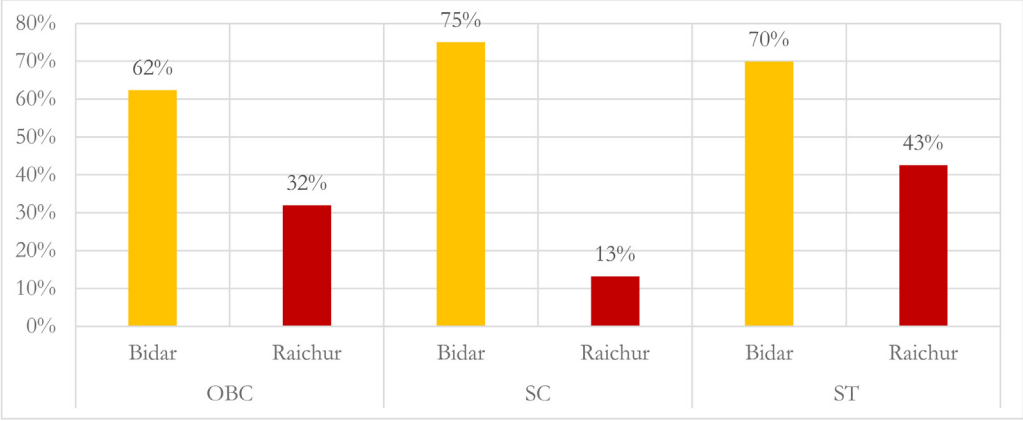

Figure 5 Percentage of cultivators affected by lack of access to agricultural inputs in Bidar and Raichur districts (by social category).

Table 9 Licensed fertiliser dealers in Bidar and Raichur districts.

		Bidar	Raichur
Fertilisers	Wholesale dealers	35	226
	Retailers	313	802
	Point of sale (PoS) devices[1]	359	690
Seeds	Wholesale dealers	33	235
Pesticides and insecticides	Wholesale dealers	4	4

Sources: Krishi Marata Vahini and Government of Karnataka (2021).
[1]A point of sale (POS) device is a machine installed in the fertiliser shops. Sale of all subsidised fertilisers to farmers/buyers is made through point of sale (POS) devices installed at each retailer shop and the beneficiaries are identified through Aadhaar Card, KCC, Voter Identity Card, etc. *Source:* https://fert.nic.in/dbt.

farmers in both these districts with respect to the main impact of the COVID-19 lockdown.

Other studies have also demonstrated that the restrictions due to the lockdown(s) in developing countries disrupted the outflow of these agricultural products, which hindered the production of necessary inputs, disturbed the production cycle, and undermined the production capacity (Mingzhe & Zhong, 2020; Ceballos et al., 2021). This disruption in the input supply chain impacted the farming community across India, as the availability of seeds, fertilisers, pesticides, and fodder declined by 9% to 11% (Thornton & FICCI, 2020; Bhargava, 2020). The prices of these inputs also increased in the range of 10% to 12% in India (Modak & Bhattacharya, 2021; Thornton & FICCI, 2020). The increased prices of agricultural inputs have led to a higher cost of cultivation for farmers in India (Modak & Bhattacharya 2021; NABARD, 2020). Small and marginal cultivators and those not represented by Farmer Producer Organisations (FPO) in remote areas of the country faced delays in seed supply due to constricted logistics and the non-availability of transport

facilities. Additionally, the seed industry witnessed a 15-20% drop, while the fertiliser sector saw record sales during the lockdown period in India (Thornton & FICCI, 2020).

Coping strategies for dealing with disruptions in input supply

Impacts on the disruptions in supply chains and reduced availability of inputs during the lockdown affected marginal and small landholders disproportionately, while medium landholders felt these problems to a lesser extent in our study area. These problems are due to the closure of input dealerships and higher input prices due to limited stocks. 16% of marginal landholders and 26% of small landholders in Bidar reported that they had to face immense difficulties and delays in getting inputs, while in Raichur the supply-chains of inputs were not impacted that severely (Figure 6). In Bidar district, 5% of marginal landholders resorted to sowing home-produced seeds instead of buying new seeds, while none of the landholders surveyed in Raichur district reported this during the survey. A few marginal and small landholders in Bidar and Raichur could not deal with the hiked prices, forcing them to postpone kharif cultivation leading to losses in productivity and incomes. However, none of the semi-medium and medium landholders reported having experienced difficulties in procuring agricultural inputs due to increased prices.

Across social categories of cultivators, the accessibility of agricultural inputs was hindered more severely in Bidar in comparison to Raichur. In Bidar district, 25% of SC cultivators, 22% of ST cultivators, and 16% of OBC cultivators experienced difficulties and delays in accessing inputs, while in Raichur district, only 2% of the SC cultivators were affected (Figure 7). Overall, the ST cultivators also experienced difficulties in paying higher prices for the agricultural inputs. In both districts, only 2–4% of cultivators reported sowing home-grown seeds to avoid paying the hiked prices for procured seeds, while 1% of the cultivators surveyed (across all social categories) delayed kharif cultivation in 2020.

Impact on credit supply

According to the National Sample Survey Organisation's (NSSO) situation assessment survey, 50% of agricultural households in India are indebted (NSSO, 2020). This situation has deteriorated further among cultivators due to the pandemic (Shukla & Arora, 2020). Cultivators have struggled to raise capital to prepare for the kharif-2020 sowing season, which has added to the current debt crisis. Due to the closure of formal sources of credit, including rural and commercial banks, cooperative societies as well as prevalent informal sources (input dealers, traders), landholders in Bidar and Raichur reported reduced accessibility to agricultural credit.

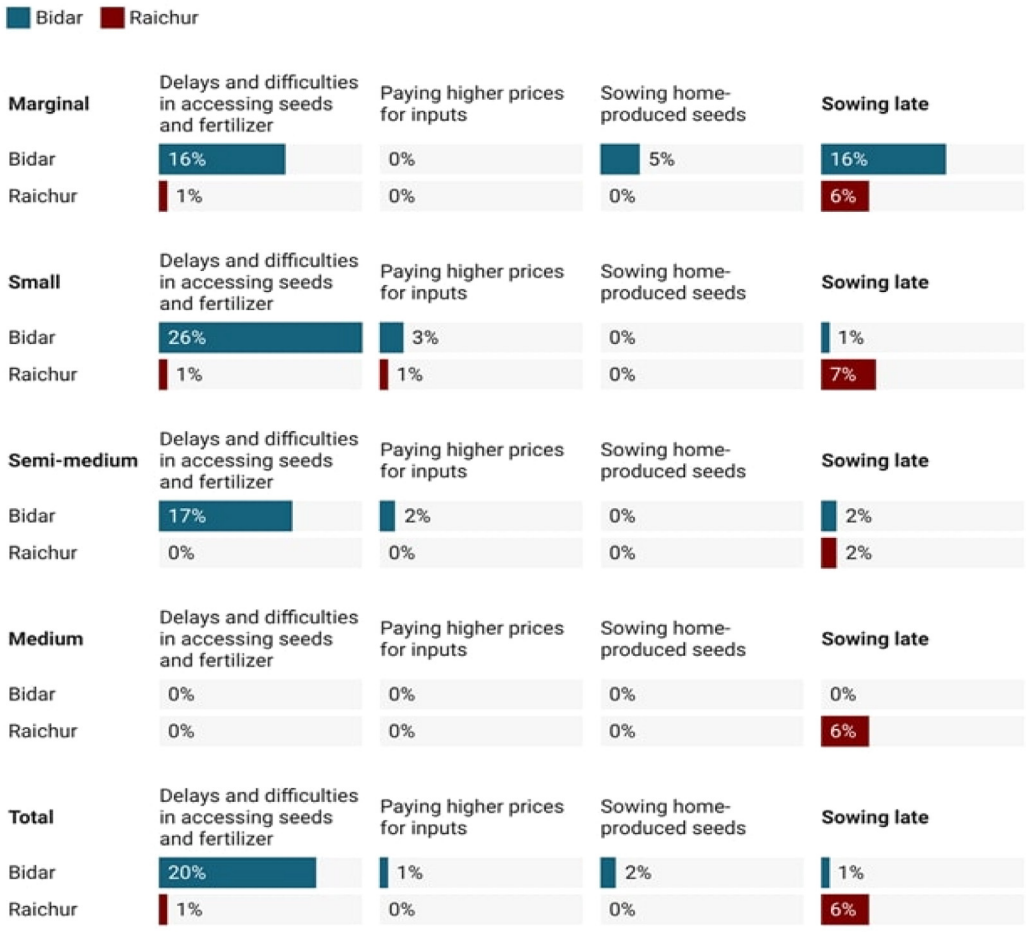

Figure 6 Cultivators affected by disruptions in input supply across size classes of landholding (in %).

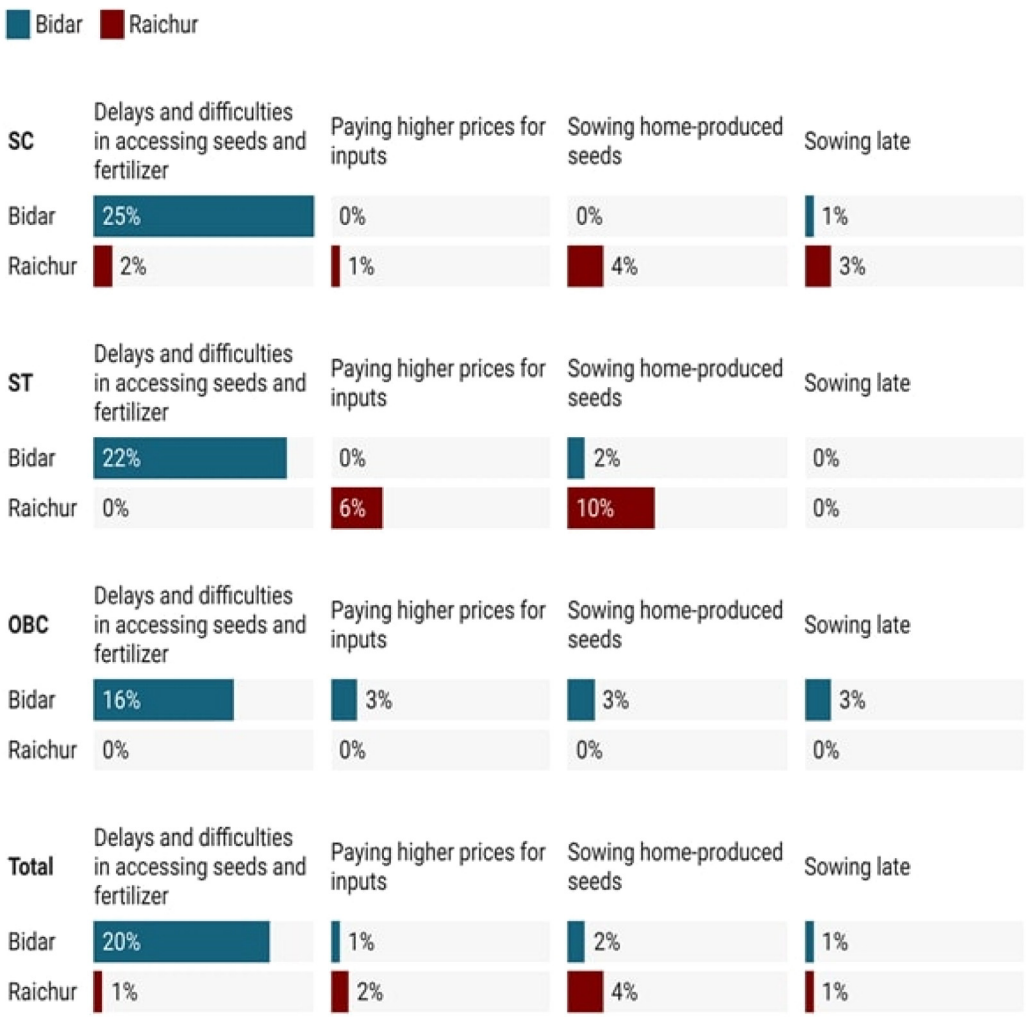

Figure 7 Cultivators affected by disruptions in input supplies across social categories (in %).

27% and 66% of marginal landholders in Bidar and Raichur, respectively, faced problems in accessing formal or informal credit. Fewer numbers of small and semi-medium landholders were affected in Bidar in comparison to Raichur. The differences in the percentage of landholders impacted across size classes of landholding were more pronounced in Bidar, while in Raichur the burden of impacts was more evenly distributed (Figure 8). Similarly, in Raichur, a higher

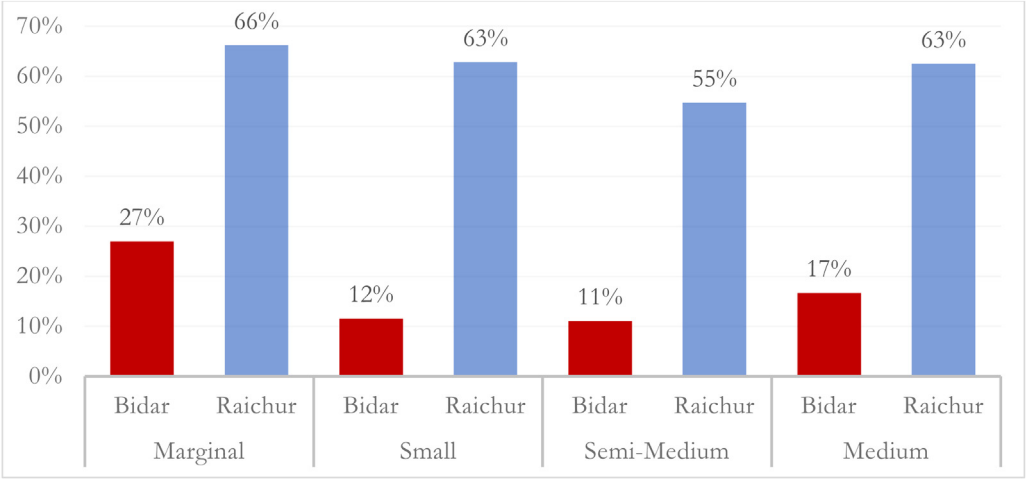

Figure 8 Percentage of cultivators affected by lack of access to credit in Bidar and Raichur districts (by size of landholding).

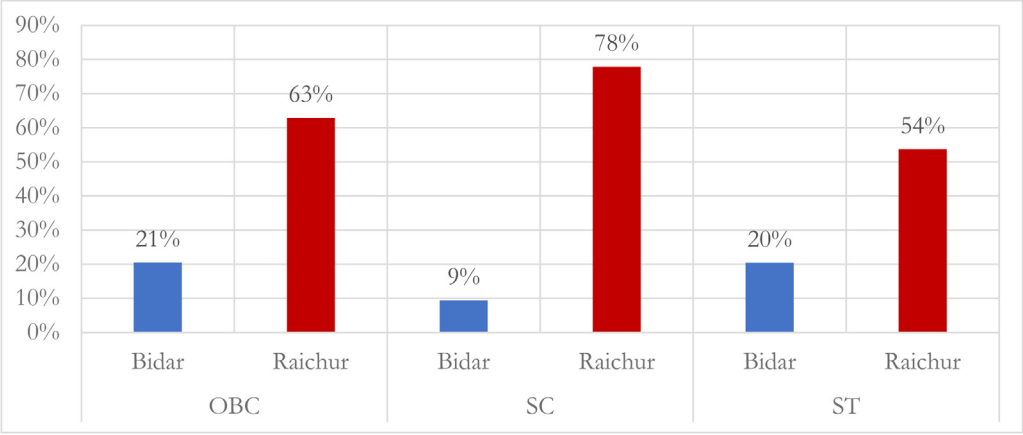

Figure 9 Percentage of cultivators affected by lack of access to credit in Bidar and Raichur (by social category).

share of cultivators belonging to all social categories reported being affected (35%) due to lack of access to agricultural credit in comparison to Raichur (Figure 9). These results are statistically significant at 95% confidence levels.

Other studies have also highlighted the fact that the access to institutional credit for farmers varies across the land-size classes with only 40% of small and marginal farmers (who form 86% of total cultivators) being able to access formal credit sources (Kak, 2020; MOAFW, 2019). Indebtedness and lack of access to institutional credit make the farmers resort to informal moneylenders for credit support. Modak and Bhattacharya (2021) describe instances of farmers being denied formal loans such as kisan credit card loans due to the inability of cultivators in repaying previous loans taken during the lockdown. The burden of repaying existing MFI (micro finance institution) loans and non-banking financial company loans has forced cultivators to mortgage their limited assets due to a deficiency in earnings and employment due to the lockdown (Niyati & Vijayamba, 2021). Owing to the rising costs of cultivation and reduction in farm incomes, it was observed that the respondents of the study resorted to taking loans to tide over their difficulties during the lockdown (NABARD, 2020).

The reasons for the differential nature of this impact may be connected to the sources of informal credit in the village, or to the location of the specific village surveyed. The following section provides an overview of the sources of formal and informal credit available in the two districts, although the authors may not have enough evidence to conclusively ascertain the reasons for the differential impacts observed.

Indebtedness and non-institutional credit supply

Agricultural households were compelled to take loans from various sources to manage losses incurred due to reduced incomes and increased costs of cultivation. It was observed that 43% of landholders impacted by the lockdown in both the districts were indebted. 75% of the loans in Bidar and 92% in Raichur were from institutional sources of credit including commercial banks, cooperative banks, and microfinance institutions. Of the 640 cultivators impacted by the lockdown, 7% of the cultivators reported difficulties in accessing institutional credit and had to avail loans from non-institutional sources such as friends, neighbours, and rich peasants in the village. In Bidar, 13% of the marginal and small landholders availed credit at very high interest rates ranging from 1% to 6% per month from non-institutional sources.

On the contrary, medium landholders were able to deal with the impacts better and could manage the additional expenses from their own private capital, while 1% of farmers from this category who had to take loans could access institutional credit. The distribution of debtors by social category in Bidar shows that more than 40% of the SC and OBC households that were affected could access loans from institutional sources, while only 19% of the affected ST households availed institutional loans. A similar trend was observed in Raichur, where the accessibility of institutional credit was less available for marginal and small landholders as well as SC and ST cultivators, whereas all the medium landholders were able to access loans from commercial and cooperative banks.

Impact on access to markets

The collection and aggregation of crop produce, and its formal procurement are essential activities in the agriculture market. The cultivators in Bidar and Raichur are largely dependent on the APMC and sub-APMC markets in the region. Apart from APMC markets however, cultivators also sell to private traders (Krishi Marata Vahini & Government of Karnataka, 2021))[5]. More cultivators reported being affected due to lack of access to agricultural markets during the lockdown in Raichur as compared to Bidar (Figure 10). Results of proportion tests show that statistically significant differences (at the significance level of 10%) existed between the proportions of small and semi-medium cultivators facing an impact due to reduced accessibility of markets in Bidar and Raichur, while the difference in impact on marginal and medium cultivators in Bidar and Raichur was not significant. Similarly, there existed a difference in proportion of cultivators affected in Bidar and Raichur across social categories, but at significance level of 10% (Figure 11).

Based on the qualitative responses received from the interviewees, it was concluded that even though there existed a greater network of private traders in Raichur, their

[5] All the major crops cultivated in the study villages (demonstrated in Table 4) are covered the jurisdiction of the APMC.

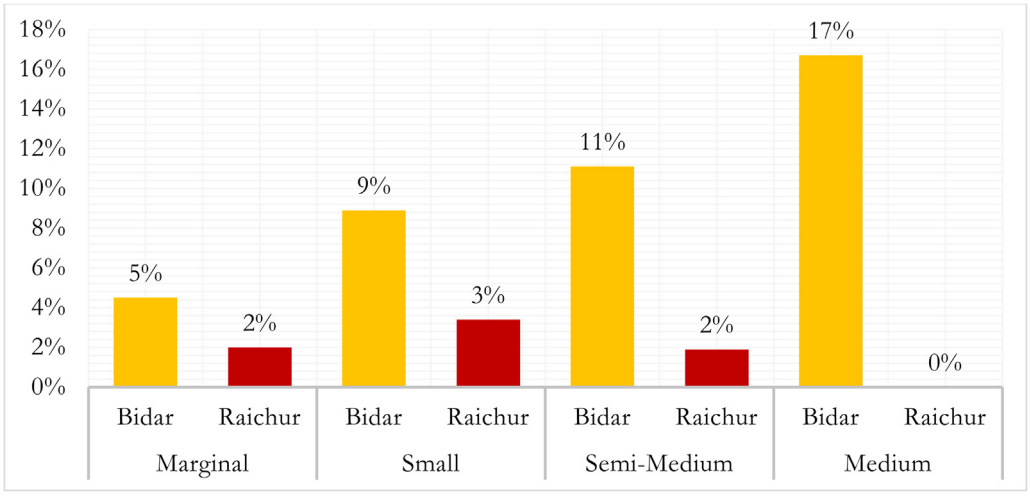

Figure 10 Percentage of cultivators affected by lack of access to market infrastructure in the Bidar and Raichur districts (by size of landholding).

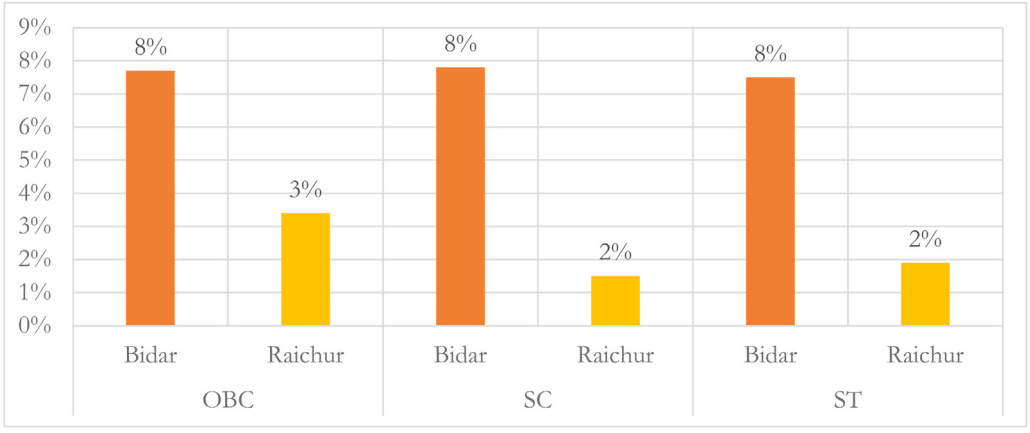

Figure 11 Percentage of cultivators affected by lack of access to market infrastructure in Bidar and Raichur (by social category).

availability and affordability remained a concern during the lockdown period. Private traders in Raichur, were either not operational, or the farmers reported several difficulties in accessing transportation to reach the private procurement centres. The impact of the disruption in markets was also dependent on the prevalent cropping patterns of the region, with the prices of major crops dependent on the APMC, such as paddy, getting affected more so than other crops. Since paddy was majorly grown in Raichur, the cultivators felt a greater impact due to the closure of APMC and sub-APMC markets in comparison to Bidar. Additionally, Raichur also had a higher percentage of horticulture crops and perishable items under cultivation, which were more severely impacted due to the lack of cold storage facilities and inoperative markets.

Other studies have also described the varied impact of market disruption across crops in Karnataka. The cultivators and merchants dealing with fruits, vegetables, and other perishable goods were hit the hardest in wholesale and retail markets due to the limited time available to dispose the produce during lockdown and lack of adequate cold storage facilities (The Hindu, 2021). The impact on wholesale prices and quantities traded in agricultural markets for non-perishable (rice and wheat) and perishable commodities (fruits and vegetables, such as onion and tomato) varied during lockdown (Varshney et al., 2020). The study conducted by NABARD has shown that 74% of districts with mandis and 87% of districts with rural *haats* were impacted during the lockdown (NABARD, 2020). The number of reporting agricultural markets in India fell from 2081 in February 2020 to 1776 in March 2020, 1727 in April 2020, and 1901 in May 2020 for eight commodities (paddy, wheat, maize, barley, gram, lentil, peas, and mango) (Ramakumar, 2020). As highlighted in prior research, (Ramakumar, 2020; Rawal & Verma, 2020), there was a severe collapse of government procurement systems and private trade across states during the lockdown. Even where the procurement centres were operational, inadequate availability of transportation and prevalent travel restrictions impeded cultivators from bringing their produce to the marketplaces.

Inaccessibility of agricultural markets and fall in output prices

In response to the impact on agricultural markets, cultivators across size classes and social categories resorted to different coping mechanisms to contend with the reduced accessibility to the APMCs and other agricultural markets

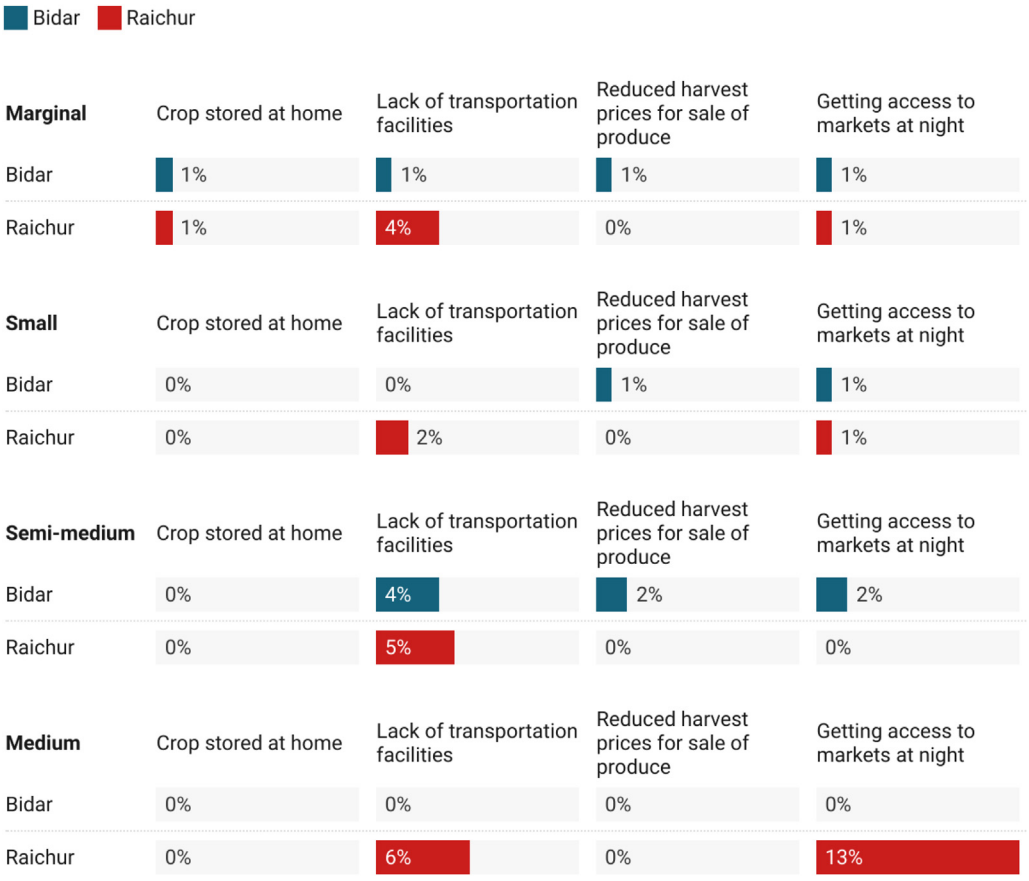

Figure 12 Coping strategies employed for dealing with disruptions in agricultural markets across size classes of landholding.

during the lockdown (Figures 12 and 13). Marginal and small landholders in Raichur faced immense difficulties in securing transportation facilities to transfer their produce to mandis and private traders and had to endure increased transportation costs. None of the medium landholders reported any difficulties in bearing the additional costs of transportation in both the districts. In Raichur district, 12% of the medium landholders accessed the agricultural

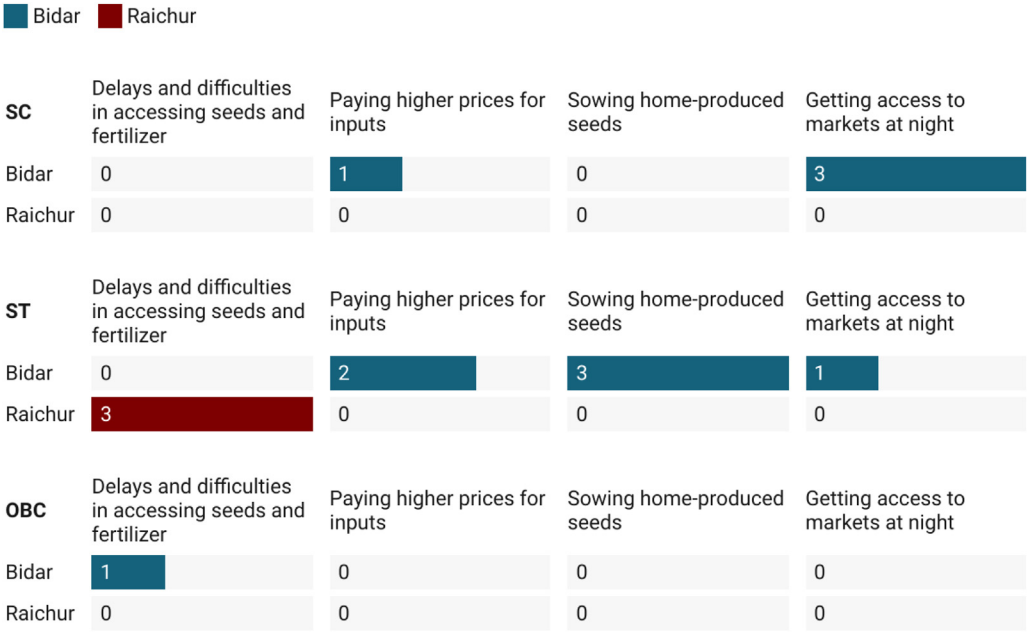

Figure 13 Coping strategies employed for dealing with disruptions in agricultural markets across social categories of cultivators.

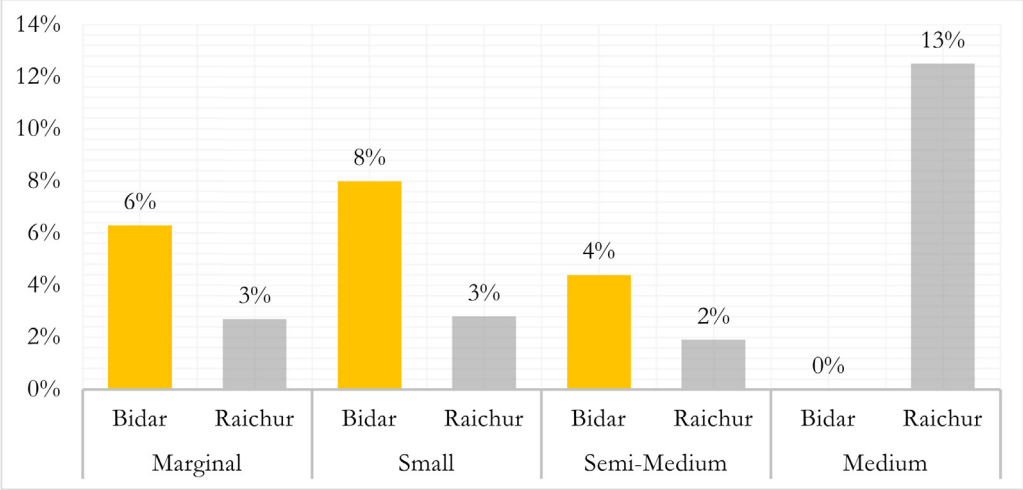

Figure 14 Percentage of cultivators affected by lack of access to labour in Bidar and Raichur (by size of landholding).

markets at night. These farmers had access to private transportation facilities and the financial means to afford higher transportation costs at night. Marginal landholders who were unable to bear costs of transportation, were forced to store their produce at home until accessibility of markets improved post lockdown, leading to economic losses. Comparably, across social categories, SC and ST cultivators faced a disproportionate burden of the impacts, while none of the OBC cultivators who were impacted, reported difficulties in dealing with the effects of the lockdown. Even when SC and ST cultivators managed to sell their produce in agricultural markets, they realised lower output prices as they were not able to negotiate fair prices for produce, leading to losses in incomes.

Impact on access to labour

Accessing agricultural labour can be a bigger problem for farm households that rely on hired wage labour. However, for some crops, such as paddy for example, where labour intensive operations are required during transplanting and harvesting, even small and marginal households depend on shared labour or hire wage labour. This is a probable reason for a larger proportion of farmers in Raichur, which has a higher proportion of cultivation of labour-intensive crops, reporting labour shortages during the lockdown.

Results of proportion tests demonstrate that the only statistically significant difference in proportion existed between small cultivators in Raichur and Bidar who were affected due to reduced accessibility of labour. About 6% of the small and marginal landowners reported facing labour shortages, while 13% of the medium landowners in Raichur reported labour shortages during this period (Figure 14). In contrast, the proportion of small and marginal farmers who reported facing labour shortages in Bidar was 14%. None of the medium landholders in Bidar reported facing labour shortages. In both the districts, semi-medium and medium landholders were able to cope with the impacts of increasing costs of labour, while marginal and small landholders were compelled to rely on using a higher proportion of family labour for agricultural operations. Across social category, it was observed that a significant difference only existed between the proportions of OBC cultivators (at the significance level of 10%) facing labour shortages in Raichur and Bidar, while for SC and ST cultivators, the difference in proportions was not statistically significant (Figure 15).

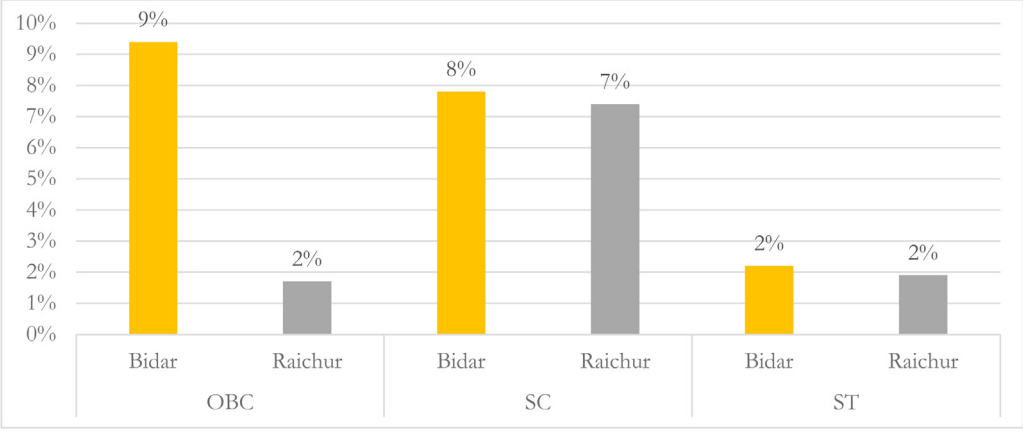

Figure 15 Percentage of cultivators affected by lack of access to labour in Bidar and Raichur (by social category).

Other studies have also commented about labour shortages during the lockdown causing disruptions in the rabi harvest and kharif sowing operations in the country and also disrupting the food supply chains in many states (Vasudeva & Jebaraj, 2020). In Karnataka, the impact of the labour shortage varied across the irrigated and non-irrigated regions as the irrigated paddy belt of north Karnataka (Raichur, Koppal, Gangavathi, and Ballari) with a delayed rabi harvest and kharif sowing in the region (Srivatsa, 2020).

Deployment of family labour

In the case of agricultural labour too, medium landholders with access to finance and resources reported having managed the higher labour costs without much trouble. In Bidar district, 8% of marginal landholders and 10% of small landholders reported having to deploy a higher proportion of family labour than usual for intensive cropping operations. Across social categories, a higher number of SC and ST cultivators in comparison to OBC cultivators in both the districts reported having to rely on family labour during the pandemic.

The descriptive and empirical analyses mentioned above outline the dependence between the size of landholding as well as the social category of the cultivators with the impacts faced by them due to the lockdown. The empirical analysis also highlights the differential regional impact of the lockdown across the different aspects of the agricultural production process which were assessed.

Conclusions

In this paper, we studied the impact of the pandemic-induced nationwide lockdown between March 25, 2020 and May 31, 2020, on four specific parameters: supply of agricultural inputs, agricultural credit, agricultural markets, and availability of labour. This study is based on primary survey data collected from cultivators and aims to provide a descriptive understanding of the differentiated impact of the lockdown. The study was based on a survey of 1004 household across 10 villages in two districts of northern Karnataka. This region is largely rainfed and lies in the north-east transition and north-eastern dry agro-climatic zone. We studied the nature and severity of the impacts reported by agricultural households and the methods they employed to cope with the same. Given the cross-sectional nature of the data, this study does not establish causal relationships but instead attempts to derive an understanding of the observation's statistical associations between key factors. Future research should employ causal inference techniques or longitudinal data collection to explore further, the long-term effects of such disruptions on agricultural livelihoods.

The study highlights the large regional disparities in the kind of impacts that were faced by farmers. Results from our empirical analysis confirm the differentiated regional impact of the lockdown across geographies. It also underlines the fact that the vulnerability of agricultural households is highly correlated to structural inequalities, availability and investment in rural infrastructure, provision of governmental support, and access to credit. The adaptive capacities of cultivators are also differentiated by class and social category, with poorer cultivators having lesser capability to handle the economic consequences of the lockdown.

While the nature of the measures to control the pandemic was unprecedented in many ways, it is possible to draw parallels with disruptions of shorter durations and smaller geographical scales that have occurred more frequently in recent times. For example, high impact regional events such as floods and long droughts may create similar disruptions in access to agricultural input supplies, markets, and labour (Altieri & Nicholls, 2020). On the other hand, economic slowdown or policy decisions such as demonetisation may impact access to credit supply (Murthy et al., 2019). Assessment of vulnerability in historically backward regions, such as the Kalyana Karnataka region studied here, is therefore critical to prevent severe distress in farm households. In Karnataka, volatile market pricing structure for the horticulture crops which was not able to cover the cost of cultivation aggregated during the pandemic.

The study presented in this paper highlights the importance of the presence of a good network of licensed input dealers in all regions. Lack of timely access to inputs can lead to delayed sowing and economic losses disproportionately impacting marginal farmers and those belonging to socially marginalised communities. State governments must invest in ensuring a minimum density of licensed input dealers in every block and ensure that these dealers comply with relevant guidelines related to stock availability.

Access to input supply is also determined by access to credit. There is a long-standing problem of access to institutional credit in India and much has been said even in normal times about indebtedness of small and marginal farmers in India (Sidhu & Gill, 2006). The study shows that economic shocks can exacerbate this problem leading to severe distress in farm households. Given the experience of the pandemic, it is necessary for state governments to envision the creation of more reliable instruments of institutionalised credit that will be available to farmers of all social and economic categories even when physical infrastructure may be inaccessible. Kisan credit cards must be provided to all households, and cooperative and public sector banks must be encouraged to have ground personnel to help farmers use these instruments to access credit.

Ensuring reliable and affordable access to markets and ease of transportation to the same is also an important element in increasing resilience to natural or economic shocks. Presence of government mandis within a reasonable distance in every block is therefore very essential. E-trading is a good option, especially in times of crisis. The central government has initiated the expansion of National Agriculture Market (e-NAM), an online trading platform linking 415 new mandis, as well as launched a mobile app, named *Kisan Rath*, to link farmers, traders, and transporters (Ramakumar, 2020). However, a concerted effort is required to build the capacities of farmers to be able to access this option and also ensure that fair trade is ensured under such schemes. There is a need to develop digital infrastructure and provide training for cultivators under the ambit of agricultural extension services, to facilitate their access to these digital marketing platforms.

The problem of labour is much more difficult. The study shows that small and marginal farmers depend quite significantly on family labour and in times of crisis the use of

family labour is intensified. This can potentially impact other aspects of economic and social well-being such as schooling for children and women's health among others. The need to appropriately estimate the monetary value of family labour and ensure that support prices for farm produce can account for this is therefore essential.

The pandemic compounded the impact of major shortcomings in the agricultural sector, especially in terms of the failure of the marketing system, deficient supply-chains, inadequate market prices, and rising levels of indebtedness amongst cultivators. This becomes more important in the case of rainfed areas which are already plagued by low yields, lack of infrastructure, and low levels of farm incomes. It exposes the need for increased public expenditure on agriculture, technological advancements, higher levels of mechanisation, and improvements in the status of supply-chains and markets to augment productivity.

Ethical consent note

We obtained ethical clearance for this study to ensure the protection of the human subjects involved. Respondents voluntarily participated in the surveys, with no coercion involved, indicating their consent to be part of the research. The information gathered from the surveys will be used solely for non-commercial and academic purposes, maintaining the privacy and confidentiality of the respondents. The authors diligently informed the participants about the confidentiality and anonymity of their responses, safeguarding their rights and ensuring their trust in the research process. This study adheres to ethical guidelines, prioritising the well-being and rights of the surveyed individuals.

Acknowledgements

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