

Impact of Covid-19 on Agricultural Operations in India: An Overview

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Abstract:

As a result of Covid-19 distresses the economy and its impact on agriculture. This is complex and farmers have faced many problems, such as the unavailability of labour due to the lockdown and relocation of farmers to their locations and access to the market is difficult because transportation facilities were not available during the lockdown period and it is very difficult for farmers to repay loans in this period. Indian Council for Agricultural Research (ICAR) has been proposing agricultural reforms using technical innovation and attempting to safeguard farmers from losses. The goal of the research is to through a light on the structure of Indian agriculture and to give policy suggestions. It had been observed that, transportation stopped because of the lockdown making the farm economy go nowhere. The produce was unable to be transported to market, thereby disturbing the supply chain in the middle of the harvest period. Also, the non-availability of migrant laborers, seizing the harvest and post-harvest operations. The pandemic has made to several contests in procurement operations as well as agricultural operations in future the following new techniques such as mechanical soil ploughing, automatic irrigation system, advanced weather monitoring, app-based system, online knowledge and market conditions, advanced technologies can be leveraged . In order to help the farmers to find more effective ways to defend their crops from weeds, the farmers can use automation and robotics. A Blue River Technology-developed robot named See & Spray appears to have been industrialized to use computer vision to precisely spray weeds on cotton plants.. There are more advanced technologies using Artificial Intelligence (AI) and agricultural robotics to save water, sustain agro-ecology, rotate crops, and plant cover crops, alternating with manual labour that can keep farming activities going without hitch.

Keywords: Artificial Intelligence (AI), Agri-Robotics, ICAR, Covid-19, Growth Rate, Blue River Technology

I. Introduction

All available information suggests that Covid-19 has harmed the economy. Agriculture is greatly affects any segment of the agricultural value chain. It can have varying effects on different regions and agricultural workers. The problem in agriculture now is mostly due to a lack of available workers and an absence of business opportunities.

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Migrants are used in all types of roles in India's agriculture during the pandemic. There were 50 million migrant workers in India planning to return to their hometowns, who represent eleven percent of non-employed positions (ILO,2020). Most of people from the east end of the country,

who move to the west and north, work in agricultural settings. They are commonly used in various sectors like aquaculture, post-harvest, livestock, and construction. The current problems in agriculture mostly stem from a shortage of labour and trade. In the current conditions, increased mechanization has assisted with harvesting paddy commercial crops are highly reliant on immigrant workers. Due to the scarcity of migrant workers, farm wages have skyrocketed. Commodities such as vegetables and other commercial crops could be priced higher due to agricultural patterns that have been disrupted. The primary difficulty is dealing with debt to farmers and debt to gold loans.. Recent price drop means that farmers are under significant financial stress and thus, unable to repay their loans (FICCI,2019).

As a result, all states have greatly restricted trade and travel across their borders because of the "lockdown" the supply chain has got disturbed and agri-commodity prices have been skyrocketing. So, the problem was with the non-availability of labour at the farm which led to price rise post lockdown as the farmer let crops as it is or brunt . The study tries to explore the possible ways to mitigate the effects of the pandemic on the Indian agriculture. The first part of the study comprises of Introduction of the study and second part dedicated to review of literature, objectives and limitations of the study. Third base part gives a brief of structure and pattern of Indian agriculture, Reinvention of Agriculture under the pandemic and implication of advance technology and World Best Practices in Agriculture. Fourth part part offers conclusion of the study.

II. Literature Review

Study focused on an exploratory research methodology for the same ten scientific papers was reviewed and information was taken from different websites. No research has thoroughly assessed the full effect of the pandemic on Indian agriculture regarding change in the post-Covid-19 agricultural trend. So, this is one such effort to study what would be the change in Indian farmland in the midst of issues such as non-availability of workers, lack of availability of seeds and fertilizers, lack of crop Insurance and minimum price support.

S.Solomon et.al (2020) reiterated the effect of Covid-19 on the Indian sugar industry (society for sugar research & promotion 2020) This paper focuses on the impact of the sugar industry on stakeholders and their interconnected industries around the world and exports. It concluded that the government should emphasize the globalisation of manufacturing and other services with the proper use of resources.

Mahendra Dev et.al (2020) studied the Covid-19: Economic Impacts on India Health risks in rural locations are greater due to compactness in urban regions. But the illness can be spread to 70% of India's rural population. Many rural migrants have already returned. Due to Covid-19, farmers, agricultural workers, employees, and others operating in the food supply chains could be at risk of exposure. In addition to farm products, packaging material is a carrier of viruses. The social gap will be substantially less experienced in rural areas, which means cultivating and rural people need to be given protection.

Prangya et.al (2020) observed Despite the "Potential effect of Corona Virus on the agriculture sector," concerted initiatives by local and state governments, as well as examination institutions and increase administrations, could very well be defeated. Specific rules for horticultural operation should be developed to avoid the antagonistic impact of the Covid-19 flare-up and to keep the agribusiness segment untouched by the legislature. The value system should be considered and adjusted so that ranchers do not suffer any financial losses, and the cultivation network, as well as the workers, are covered from Corona infection.

Ritichatterjee (2020) discussed the Indian agriculture sector and its allied activities impact due to pandemic on the creation of food security in India, minimises undesirable effects and harms the

livelihoods of poor and marginalised people, focuses on providing quality seed to farms so that the season does not have an impact and there will be a proper distribution for farmers, the paper concluded that the government should take action to mobilise efforts to mitigate the effects on Covid-19.

Vikas Rawal et.al (2020) The impact of Covid-19 on the rural economy was investigated, and it was discovered that the Central Government lacks planning and readiness to deal with the Covid-19 pandemic. It has caused more problems for the Indian economy and the country's working people. It concluded that India was not prepared to face such hardships and crises in the economy, even though it knew the problems that other countries were facing.

Jill E. Hobbs (2020) studied for the COVID-19 pandemic, food supply networks, along with a shift in eating behaviors, took place. People began to rely more on food at home rather than food obtained outside. The impacts of demand-side shocks on food supply chains are considered, including rising consumer demand for essential products and an increased preference for homemade cuisine over restaurants. As a result, it's concluded that supply chain resilience is of a higher priority. In order to avoid potential losses, all tools should be maintained.

The study adopted exploratory research approach on the basis of literature based on published scholarly articles on the research topic, newspapers, magazines, internet sources etc.

Objectives

1. To assess the structure of Indian agriculture during Covid-19 and implications
2. To explore the Advance Expertise which can reduce the usage of labour in Agriculture
3. To find the ways which helps to achieve higher productivity using (AI), Agri-Robotics
4. To explore the Machine Vision for Pests and to carryout soil defects diagnosis using Technology
5. To offer policy suggestions

Limitations

1. The study is partial as it is based on the published sources to assess the productivity of agriculture in the pandemic .
2. The study is exploratory and theoretic, empirical study will give a border view of the research topic

III. Structure and pattern of Indian agriculture

Agriculture is the dominant occupation in the India, contributing to 58% of the country's economic output. Agriculture and its associated sectors, such as forestry and fisheries, are expected to add \$265.51 billion (in current dollars) in 2019. GVA growth in the agriculture and allied industries is expected to be 2.1 percent during the next two years. ([Krishi Jagran ,2020](#)).

In a study of 1,500 farmers in 200 districts across 12 states, 51% of farmers said their yields were lower this year as a result of the national lockdown compared to the previous year when they planted the same crop. about around 55% In order to sell their harvests, farmers were unable to market them, therefore they had to store them. The 6.7% of landless farmers, 19.9% of medium farmers, and 20.7% of big farmers were among the people who had entered the farming industry. This year, most farmers observed that harvesting expenses are higher than last year, and the most common explanations are a lack of manpower or machinery or an increase in machinery expenses. ([Shagun Kapil, Down to Earth, 2020](#))

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Source: Down to Earth, 2020

Growth in the Indian food business, notably in the food processing business, is helping to boost global food commerce. India's food and grocery market holds a 32% market share, while retail accounts for 70% of the revenue. Fourth in terms of production, consumption, export, and predicted growth, India's auto industry is among the country's most vital industries. GVA in industry and agriculture: 8.80–8.39% of overall GVA, 13% of India's total exports, and 6% of all industrial investment. (IBEF, 2020)

Within the market, the amount of food grain that will be produced in the 2018-19 crop year is predicted to be 283.37 million tonnes. In 2019-20, India's government is shooting for a food grain output figure of 291.1 million tonnes. Total area seeded in India has been 95.35 million hectares as of November 2019. Second only to Brazil, India is the world's largest fruit producer. Projected production for horticultural crops is expected to reach a record 313.9 MMT in 2018-19 as stated in the third prediction. Milk output in the country rose 6.5% in 2018-19, reaching 187.7 million tonnes. Milk production will nearly double by 2025, reaching the impressive level of 53.5 million MT, as opposed to the current 53.2 million MT. In five years spanning from 2010 to 2019, India's overall agricultural exports climbed by 14.61% to reach \$38.54 billion. Agricultural exports for the 2019 fiscal year were \$22.69 billion in the financial year ending in November. (Economic Times, 2020)

In India, the organic food sector is expected to develop at a CAGR of 10% between 2016 and 2021, reaching a total market size of around Rs 75,000 crore (US\$10.73 billion) by 2025. Foreign Direct Investment (FDI) inflows have totaled over \$9.78 billion between April 2000 and December 2019, with roughly one-third of this total occurring in the food processing industry (DPIIT). (IBEF, 2020)

The company that manufactures the country's oldest and largest volume of fertilizer earned a million production and sales achievement in March of 2020. Eight-and-a-half-million-dollar investments in the manufacturing of ethanol were announced in India. In March 2018, Rajasthan's first mega-food park opened. The agri-food industry in India recognized \$1.66 billion in 558 deals between 2013 and 2017. (FDI MANAGER, 2020)

The government's plans to improve agricultural production are aimed at eradicating FMD and brucellosis in livestock: The program is set to begin in September 2019 with the implementation of the National Animal Disease Control Program (NADCP). The National Bank for Agriculture and Rural Development (NABARD) established a venture capital fund in May 2019 for investing in agricultural and rural start-ups, with a 700 crore rupees (US\$100 million) investment. According to the Ministry of Agriculture, the cost of executing the Pradhan Mantri Krishi Samman program is Rs. 1.50 crore (0.21 million) in Andaman and Nicobar during 2019-20. (IBEF, 2020).

Budget 2019-20 included a new fixed pension program, Pradhan Mantri Samman Nidhi Yojana, available to small and marginal farmers who are 60 or older. In order to increase agricultural

exports, the Indian government has established a Transport and Marketing Assistance (TMA) program that provides financial support for transportation and marketing. In December 2018, the Indian government implemented the Agriculture Export Policy, 2018. The agricultural exports of India are expected to reach \$60 billion in 2022 and \$100 billion in the subsequent years if the country has a sound trade policy. The Indian government has granted \$306.29 million to the Primary Agricultural Credit Society (PACS) for computerization, in order to make sure that cooperatives may make money from digital technology. ([Pib.gov.in,2020](#))

India has introduced a new AGRI-UDAAN initiative for the benefit of emerging businesses, with the intent of helping them establish and develop relationships with investors who want to aid their growth. The Indian government has created the Pradhan Mantri Krishi Sinchai Yojana (PMKSY) with an investment of US\$ 7.7 billion, which will provide a lasting drought solution. ([Sayantan Bera,livemint 2020](#)).

As a result of the Agro-Marine Processing and Growth of Agro-Processing Clusters (SAMPADA), the Indian government has decided to invest an additional US\$ 936.38 billion (approx. \$936.38 billion) into the food processing sector, and has set a goal of tripling the food processing capacity in the country from the current 10% of agricultural produce. India's government has given permission for 100% foreign direct investment (FDI) in food product promotion and food product e-commerce under the "automatic method." ([IIFL,2020](#)).

This year, India's sugar exports are estimated to reach five million tonnes (MT). Foreign Direct Investment (FDI) into India's food processing industry was \$628.24 million during the first half of 2018-2019. According to Indian Sugar Mill Association (ISMA), sugar production in India rose to 33.16 million tons in the 2018-19 sugar season and is predicted to drop to 26.85 million tons in the 2019-20 season (ISMA) ([Financial Express, 2020](#))

The eNAM was introduced in April of 2016 to connect the nation's existing APMCs to create a single nationwide market for agricultural products. More than 9.8 million farmers and 109,725 dealers have registered on the e-NAM platform. In India, 585 mandates were linked to another 415 mandates over the past two fiscal years. ([pib.gov.in,2020](#))

Agriculture capacity expanded by 4% CAGR over 2014-17, increasing its loading capacity to 131.8 million tonnes. In FY 20, coffee exports amounted to 286.95 million tonnes (April-September 19). 10,000 clusters will be supported between 2014-18 as part of the Pradhan Mantri Krishi Vikas Yojana (PMKVY) ([PMKVY, 2017](#))

India's goal of tripling farm revenue by 2022 is expected to be achieved. Better financing in agricultural structures such as irrigation, warehousing, and cold storage will lead to greater stability in the agricultural industry in India in the years ahead. However, as GM crop use grows, Indian farmers' production will increase. Because scientists have focused on developing early-maturing pulse varieties, it is expected that India will become self-sufficient in pulses in the near future. By 2022, India's agri-exports are expected to surpass the USD 60 billion target. ([Priscilla Jebaraj-The Hindu, 2020](#))

Because of this, the country's plague has had a significant impact on the agricultural sector, most notably on rabbit crops, leaving agriculture operations unable to employ people, bottlenecking supply, and having an adverse effect on market prices (even if only a few state governments provide).

3.1. REINVENTING INDIAN AGRICULTURE DURING PANDEMIC

The use of technology helps to face the pandemic situation. Even when social distancing in practise is possible with the proper use of technology, agriculture helps to achieve smooth and proper productivity. Technology as provided power to single individual to manage instead of using

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crowds, this prevents big gathering where it is common in agricultural production (NASSCOM,2020)

Why Technology in Covid-19 (Pandemic) supports agriculture

1.Ploughing Mechanical Soil: There are many machines on the market, 10 people can work, machines such as tractors, field cultivators, seeders and planters, etc. For farmers requirements several machines are also available for rent so they can take and increase productivity and decrease coast.



Source: toptillers.com

2. Mechanical Irrigation System: The plants drive never grow or survive without proper irrigation facility, it's with foods and fabrics. Now with the use of expertise it is very easy to irrigate without humans, earlier many peoples would be involved.

Technology like pipeline system connected to nozel & sensors, if we click it works inevitably.

Drip irrigation is a forms of micro-irrigation system that provide water to drip slowly to the roots of plants from above the soil surface or buried below the surface where it is needed, potentially saving water and nutrients. The aim is to get water into the root zone quickly and reduce evaporation which saves lot of water.



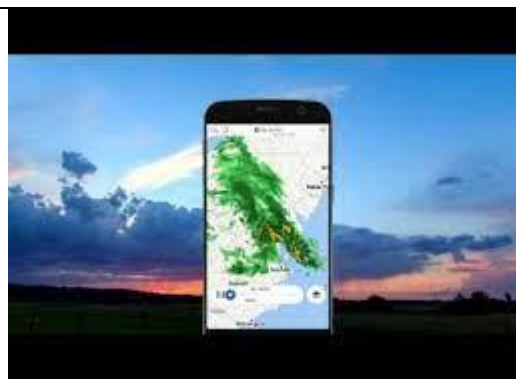
Source:devmesh.intel.com



Source:indiamart.com

3. Advanced Weather Tracking: It is essential to know weather conditions or else you can end up destroying it, so there is no need to see the sky all the time, farmers can get to know if it's going to rain or sunny with the use of technology.

Ex: Dark Sky, Flowx, Radar Scope



Source:prnewswire.com

4. Inventory Framework based on App: For farmers, handling inventories is hard. There are many items to keep track of fertilisers, chemicals, etc., but farmers can get to know it with the inventory system so that no seed or instrument needs to be damaged.



Source: codecanyon.net

5. Knowledge Online & Conditions of the Market for Agri-Products: It is easy to forecast or know the market price with the apps, so that farmers can get the right price for their crops and it is also the easiest and safest way in Covid-19.



Source:agivation.com

3.2.2. Agricultural Activities Progress

Farmers face many difficulties in growing production and selling more crops, unproductive soils, diseases of plants, pests and droughts, and lack of access to improved seeds or fertilisers and pesticides, and the lack of a stable market and restricted availability of pricing information is a major challenge.

Farmers can adapt new technological developments, such as low-cost solar-powered water pumps, to give farmers better access to market information as well as new information technologies, and they can also move agricultural knowledge across regions through radio, television, internet and mobile phones. (Union of Concerned Scientists, 2020)

The following are said to be the advanced practices:-

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The conservation of good soil	soil conservation is about cultivation practices that sustain the field's productivity, saving soil quality and keeping it fertile
Water Saving, Water Saving Management	Strategies to conserve fresh water involve implementing all policies, plans, and activities aimed at sustainably managing the natural resource of fresh water, as well as safeguarding the hydrosphere.
Agroecology	Agroecological principles can be used to manage farms, prevent harm and increase productivity and profitability.
Rotating crops and crop diversity	practices including intercropping, increase soil fertility by growing mixed crops in the same region.
Planting cover crops	This entails planting clover or hairy vetch in the off-season to protect and avoid soil erosion and nutrients and to suppress weeds.
Tillage reduction or elimination	It includes planting seeds into undisturbed soil, reducing soil erosion and improving the health of the soil.
Applying integrated management of pests (IPM)	Mechanical and biological management requires the control of pests, which minimises the use of chemical products.
Integrating crops and livestock	Small crop & animal production integration can be more efficient ,productive and profitable.
Adopting forestry activities for Agriculture	It is a new initiative to provide shelter for the conservation of plants, animals and water supplies by combining shrubs and trees in farms

3.3. World Agricultural Best Practices using Artificial Intelligence & Robotics

The agricultural industry and artificial intelligence are industries in which companies develop and deploy autonomous robots to carry out more advanced agricultural operations such as harvesting crops in a quicker and more efficient manner than is possible with human labor. Agricultural robot-powered farms Many agriculture companies are using advanced computer imaging and deep learning algorithms for crop and soil health monitoring. Computer models that utilize machine learning techniques are now being improved to manage and predict changes in the weather's effect on crop yields, for example, variations in the weather.

3.3.1. Robotics in Agriculture

Technology from Blue River-Weed Management

Weed control is of the utmost importance to farmers, and herbicide resistance will become more of a problem. According to estimates, hundreds of herbicide-resistant weeds have been observed. Farmers have started embracing automation and robotics to assist them preserve their crops from weeds using methods that are more efficient. See & Spray, which is purported to employ computer vision to detect and accurately spray weeds on cotton plants, is a product of Blue River Technology. To prevent herbicide resistance, make sure to use herbicides precisely. CROO Robotics Automation is growing as a means to address difficulties in the labour market. A projected 6% reduction in agricultural jobs is forecast between 2014 and 2024.

harvesting Strawberry producers now have a help robot to do the harvesting and packing of their harvests. Losses in farm labor income are estimated at \$millions due to a labor shortage. bale The CROO Robotics robot boasts that it can harvest 8 acres of crops in a single day, and in the process replace up to 30 human workers.. (Daniel Faggella, 2020)

3.3.2.Monitoring Crop and Soil Health

PEAT-Machine Vision for Pests / Soil Defects Diagnosis

The practice of deforestation and soil degradation threatens food security and has a detrimental impact on the economy. USDA estimates that annual soil erosion costs the U.S. \$44 billion. The Berlin-based agricultural tech company, PEAT, has developed a new deep learning system, Plantix, that not only helps in detecting faults and nutrient shortages in soil, but also helps producers make informed decisions on seed blends. Computational algorithms that identify plant pest, disease, and soil defect patterns are developed through study. Photographs captured using the user's smartphone camera are used to discover any faults in the image recognition software.. (T Gomiero,2016)

Drones have been used in Japan for spraying crops since the 1980s. The agricultural drone market is expected to reach \$480 million by 2027. AI and aerial technology are widely used in modern business practices to track crop health. (Fortune Business Insights, 2020)

Drone technology is being used in estates by Sky Squirrel Technologies Inc. Their goal is to help farmers produce more and save money in the process. In the field, users can predetermine the course of the drone before it launches and utilize computer vision to capture pictures that will be analyzed after deployment. The data is stored on a USB drive when it is connected to a computer after completing the voyage, after which it can be uploaded to a cloud drive. In order to produce a complete report on the health of the vineyard, specifically the state of grapevine leaves, Sky Squirrel uses algorithms to integrate and analyze the acquired images and data. In order to know the health of the plant and its fruit, it is often a good proxy to learn about the health of the grapevine leaves. Where Technologies employs machine learning algorithms to predict weather, examine crop sustainability, and discover disease and insect presence on farms in Colorado. (Daniel Faggella, 2020)

AColorado-based firm that applies satellite-related machine learning algorithms to predict weather, study crop sustainability, and detect the presence of diseases and pests on farms has launched a product called Where-Weather Predictions. Future technology such as artificial intelligence and robotics could make it more efficient and require fewer workers in India's agriculture industry. More research and development funding should be allocated to AI and robotics projects such that the government has developed as many supply chain management initiatives as the AGRI-UDDAN programme in the annual budget (AGRI UDAAN is a Food & Agribusiness Accelerator organized by a-IDEA, Technology Business Incubator of NAARM,

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supported by Dept. of Science & Technology, Government of India)



Source: <https://aidea.naarm.org.in/agri-udaan/>

3.3.3. Food and Agribusiness Accelerator 3.0

AGRI UDAAN is an NAARM-assisted Food & Agribusiness Accelerator prepared in advance by a-IDEA, a non-profit, technology-focused business incubator. The agreement was extended by the Science & Technology Department, India's government Through intensive mentoring, industry networking, and investor diving, the Plan focuses on stimulating food and agribusiness entrepreneurs at the scale-up stage.

AGRI UDAAN is a single platform for early-stage agricultural sector innovators, entrepreneurs, and startups to showcase their ideas and services and to access critical insights from mentors, incubators, research institutions, agriculture industry investors, and other organizations.



Source: <https://aidea.naarm.org.in/agri-udaan/>

Indian IT firm Cisco has announced that they have chosen 25 agri-tech businesses, together with the government, out of 844 agri-tech startup entries in the Cisco Agri Challenge. It's intended to mobilize agricultural start-ups to search for answers that have the potential to benefit 10 million people.. (Times of India-25th March 2021)

Thus, the harvest was slowed significantly, causing damage to the agricultural sector. Since peak harvest, produce could not make it to the mandis, disrupting the supply chain. Additionally, harvests and post-harvest operations are hampered by a shortage of labor. There have been numerous challenges associated with the acquisition of dairy products like milk, milk products, eggs, and so on due to the pandemic. (Hima Bindhu, Grain Mart 2020). The above-mentioned technologies would be useful during the pandemic where the availability of labour is less.

IV. Conclusion

The Covid-19 Pandemic obstructed every sector of the global economy, so the Indian economy was already in a slump, with the manufacturing and automobile sectors taking the brunt of the

damage. Global Rating Agencies like Standard & Poor's and Moody's have all lowered India's economic growth, while the World Bank and the IMF have also done so. Despite the fact that the agricultural sector has shown signs of life. Due to a lack of labor, the situation has again worsened even further, especially in agriculture. Hence, by leveraging the Technology would be the right option for sustain growth in Agriculture.

The present study attempted to explore the effect of Covid-19 on India 's agricultural operators in the face of labour and finance scarcity, lack of government support such as minimum support price, cold storage facilities, marketing facilities Crop Insurance, Crop loss Compensation etc., Even if provided in few states it is not suffice. A brief review of the literature confirms that labour non-availability contributes to higher prices of essential commodities.

The appearance of AI-powered technology is increasing production and resolving industry issues, such as determining agricultural production, monitoring soil health, and evaluating herbicide resistance. Agricultural robots are implemented in this industry with the express purpose of using AI to be widely accepted. In dairy farming, numerous milking robots are currently in use as evidence of widespread adoption.. From \$1.9 billion to \$8 billion in twenty-three years, this business is predicted to increase. This may very well happen in the next three to five years, as agricultural robots are being designed to carry out increasingly diversified sets of activities.

Agricultural finance is one more issue in which Reserve Bank of India (RBI) has provided the 3-month moratorium guidelines for banks' gold mortgage and crop loans. The government's assistance and stimulus package need time for the agriculture sector to recover from the crisis. The Government can increase the lending for its flagship programme Pradhan Mantri Kisan Samman Nidhi and Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). In this background, the current government's agenda of doubling farmer incomes by increasing productivity and cutting costs, as well as diversification toward high-value agriculture, may be a welcome departure. Despite opposition parties and farmer's associations' protests, the government has passed three critical bills through Parliament.

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