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Agriculture and the Covid-19 Pandemic: An Analysis with Special Reference to India

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Abstract: This paper deals with the impact of Covid-19 on the agricultural sector. The analysis is organised at the global level, but it has a specific focus on India. First, it reviews the overall food supply situation in the world and India to assess the possibilities of food crises. The paper finds that while the food situation in April and May 2020 appeared comfortable, there were likely to be widespread food shortages in countries dependent on food imports if the pandemic was prolonged. This was particularly so if food exporting countries turned precautionary and restricted exports. In the case of many animal products, the paper finds that the drastic reduction in supplies created shortages in both the developed world and countries like India in April and May 2020. Secondly, it reviews the disruptions in food supply chains induced by the pandemic. International trade in agricultural goods shrank during the lockdown as imports fell and ports remained closed. Detailed data across more than 2000 markets in India are analysed to understand the fall in daily market arrivals for 16 crops between March 15 and May 31 over 2019 and 2020. The number of reporting markets fell in this period. Of the 16 crops analysed, it was only in paddy, lentil, tomato and banana that market arrivals in 2020 constituted more than 75 per cent of market arrivals in 2019. Thirdly, analysis of prices indicates that global price indices for food, dairy and meat fell in April and May 2020. For India, we do not find an across the board rise in either wholesale or retail prices of agricultural goods during the lockdown. The fall in wholesale price indices for cereals, vegetables, eggs and poultry chicken was indicative of low price realisation for the farmers. At the same time, the rise in urban CPI for cereals, vegetables, and egg, particularly in April 2020, was indicative of tightening supply chains in these commodities. Finally, the Covid-19 pandemic made the world recognise and appreciate the value of migrant labour. After the lockdown began, the mobility of migrant workers was severely restricted and large numbers of migrant workers returned home. Agriculture was acutely affected; farms across the world suffered from the impacts of labour shortages.

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This paper deals with the impact of the Covid-19 pandemic and the related lockdown on the agricultural sector. The analysis is informed by a global perspective, but has a specific focus on the Indian experience. It deals with the following questions. First, does the world have enough food to feed its people? Secondly, what were the types of supply chain disruptions in agriculture, and how did these disruptions affect the supply of agricultural goods? Thirdly, what were the trends in agricultural and food prices, at the wholesale and retail levels, during the lockdown? Finally, given that there were strong barriers to the movement of people, how did the absence of migrant workers affect agricultural operations? The broad reference period used is mid-March 2020 to end-May 2020.

1. The Context

The impact of the Covid-19 pandemic on the global economy has been profound. The global economy was slowing down prior to the pandemic, unemployment was rising, and inequality levels were high. Unemployment levels were rising. Debt was building up in every country. It was thus on a fragile global economy that the pandemic first arrived in February and March, 2020. As strict lockdowns were imposed, major economic activities came to a halt. This led to enormous uncertainties, not just with respect to immediate economic growth and the livelihoods of people, but also with respect to the very future of capitalist development in its present form.

A lockdown means that the production and supply of goods and services are disrupted, if not halted. Goods and services are not supplied in adequate quantities to meet existing demand. At the same time, as economic units are shut down, people lose jobs and wages. When lockdowns are in place, people do not venture out to purchase goods and services. Thus, as a result of reduced consumption, aggregate effective demand also falls. Recent crises in the global real economy were caused by either demand slowdowns or supply shocks or speculations in financial markets. The Covid-19 lockdown was unique in that *both* demand and supply fell. This was not a normal circumstance; rarely in history has such a convergence of demand and supply shocks occurred in all economies at the same time, and as a consequence of a non-economic, exogenous cause.

With reduced economic activity, most debt repayments stop. A prolonged lockdown could, thus, lead to a banking and financial crisis. Sectors dependent on exports face a fall in export demand and prices. In sectors dependent on imports of intermediate goods or raw material, imports and, consequently, production, stop. Remittances

fall, reducing foreign exchange reserves. The pandemic, thus, extends from being a health crisis into becoming a global economic crisis as well.[1]

That such a pandemic would adversely affect the agricultural sector is self-evident. To begin with, farmers face difficulties in every aspect of farming, from the purchase of inputs, sowing, and labour use, to harvesting, marketing, and processing. Problems of labour use are most acute in regions that depend on migrant labour. The disruption of supply chains leads to shrinking markets and falling output prices. With respect to consumer prices, even if farm gate prices fall, market arrangements and the disruption of supply chains can lead to a rise in retail prices. Consumers face the challenge of gaining access to adequate quantities of food at affordable prices. The absence of adequate quantities of food and rising retail food prices lead to a rise in hunger and malnourishment, particularly among the poor.

In the period immediately before the pandemic, farmers in different countries were suffering the impact of desert locusts (eastern Africa; Near East; Pakistan), fall armyworm (eastern Africa), African swine fever (China), drought (Indonesia), and floods (Somalia). In India, acute distress among the poor has been a feature of the agrarian sector for at least two decades. According to the Food and Agriculture Organisation (FAO), about 135 million people in the world were experiencing acute levels of food insecurity before the pandemic (FAO 2020a). In a post-Covid scenario, the World Food Programme (WFP) has estimated that the number of people facing acute food insecurity would rise from 135 million to 265 million (WFP 2020). The number of malnourished children is estimated to rise by 10 million.

2. Production And Stocks

Grains: Global Production and Stocks

Data from the FAO and United States Department of Agriculture (USDA) show that the world production of rice and wheat in 2019–20 was likely to be higher than in previous years (FAO 2020b; USDA 2020a). Total world production of rice and wheat is expected to be a record 1.27 billion tonnes in 2019–20 (see Figures 1 and 2). As on April 2, 2020, the global production of rice and wheat were estimated at 512 million tonnes and 763 million tonnes respectively. This was more than the global annual consumption of rice and wheat in 2019–20. Fresh harvests from multiple countries over the next few months are expected to further bolster the production figures.

[1] In fact, once the infections begin to spread, it becomes inevitable that economic activities are shut down in order to "break the chain" and "flatten the curve" (see Baldwin and di Mauro 2020). However, opinions differ as to whether the lockdown should be a blanket shutdown, or calibrated to ensure that livelihoods are protected. The scientific view has been that even if a lockdown is necessary, two aspects should be prioritised: one, the lockdown period should be used to expand testing and prepare for a spread of infections afterwards; and two, a universal economic support package should be implemented during the lockdown including provision of financial support, ensuring food security and continued functioning of essential sectors and activities.

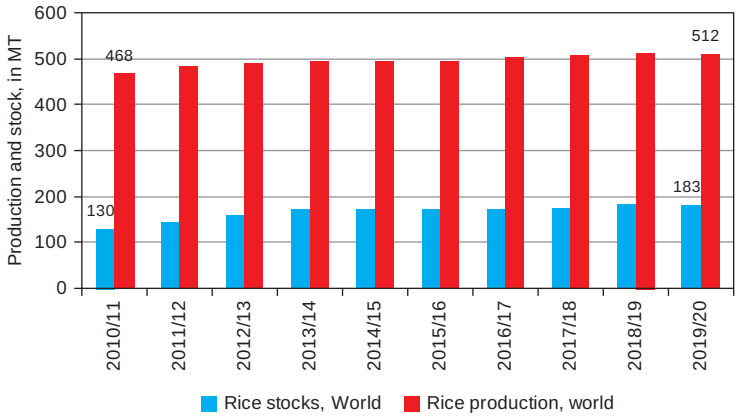

Figure 1 *World production and stock of rice, 2010–11 to 2019–20* in million tonne
Source: FAO-AMIS.

The world stocks of rice and wheat were also higher in 2019–20 as compared to 2018-19, at 456 million tonnes (Figures 1 and 2). As on May 7, 2020, rice stocks were estimated at 183 million tonnes and wheat stocks were estimated at 273 million tonnes. This translates into a stocks-to-use ratio (SUR), i.e., proportion of consumption available as stocks, of 35.2 per cent and 35.3 per cent respectively (Table 1). The SURs for cereals as a whole was 31.6 per cent. According to the FAO, these ratios were "comfortable."

In the beginning of April 2020, the global stocks of wheat were adequate to feed the world for about 4.7 months. Similarly, the global stocks of rice were adequate to feed the world for about 4.5 months. In countries acutely dependent on food grain imports, the space was more limited. Major importers of rice like Nigeria and Saudi

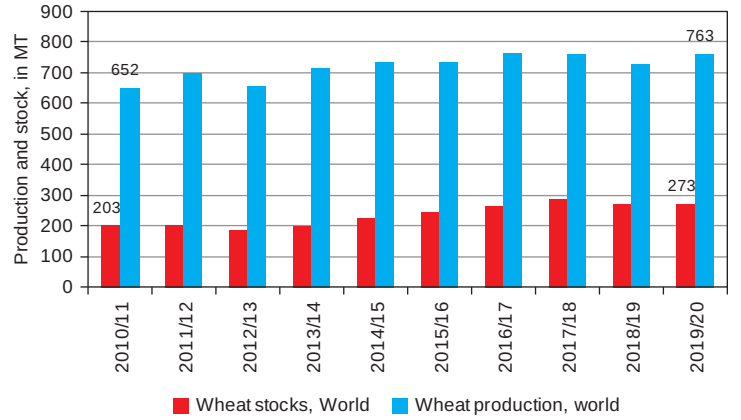

Figure 2 *World production and stock of wheat, 2010–11 to 2019–20* in million tonne
Source: FAO-AMIS.

Table 1 Stocks-to-use ratio (SUR) of rice, wheat, and cereals, world, 2010–11 to 2019–20

Year	SUR, rice	SUR, wheat	SUR, coarse cereals	SUR, cereals
2010-11	27.8	29.3	20.0	24.3
2011-12	30.9	29.9	20.9	25.6
2012-13	33.2	26.8	19.3	24.2
2013-14	34.6	28.3	23.1	26.8
2014-15	34.8	31.9	27.5	30.2
2015-16	34.2	33.0	27.8	30.5
2016-17	34.1	36.1	28.8	31.8
2017-18	34.5	38.3	29.6	32.9
2018-19	35.7	35.7	28.7	31.9
2019-20	35.2	35.3	28.6	31.6

Source: FAO-AMIS.

Arabia had about 1.5 months of consumption as stock. Others like Iraq, Brazil, Senegal, South Africa, Indonesia, and Malaysia had between 0.5 to 1.5 months of consumption as stock. In other words, if the major exporting countries restricted, or banned, trade, and if the lockdown was prolonged, then countries dependent on grain imports were likely to face food shortages.

World stocks are different from national stocks. National stocks are unequally distributed geographically. FAO data show that of the global wheat stock of 273 million tonnes in April 2020, China held about 45 per cent. The largest eight wheat exporters, together, held another 20 per cent of the global wheat stock. Of the global rice stock of 183 million tonnes in April 2020, China held 56 per cent and India held 18 per cent.

At the same time, major importers of rice and wheat, such as China, Egypt, the Philippines, Algeria and Morocco, announced plans to ramp up their stocks through fresh imports (Terazono, Saleh, and Reed 2020). However, global trade was expected to slow down with most exporters adopting a precautionary stance. In March and April 2020, 15 countries had actively binding export restrictions on food items (Debucquet 2020). Kazakhstan, a major wheat exporter, suspended its exports of wheat flour, buckwheat, and sunflower oil. Russia, the world's largest wheat exporter, suspended its exports of processed grains like rice, buckwheat, and oat flakes for 10 days in March 2020. It introduced a quota system to restrict exports of wheat and other grains. However, this self-imposed quota on grain exports applicable for the three months of April, May, and June 2020 was exhausted by April 26, 2020, itself. In effect, all Russian exports outside the Eurasian Economic Union were halted till July 1, 2020.

In rice, Vietnam is the world's third largest exporter contributing about 15 per cent to the world exports. It suspended its exports in March 2020 and limited its exports in

April 2020 to 500,000 tonnes. By end-April 2020, there was a partial lifting of the suspension. Full resumption of Vietnamese exports was to wait till the end of May 2020. Exports of rice from Thailand fell in April 2020. If India too banned rice exports, world trade in rice was expected to fall drastically.

The 15 export restrictions that were in place in March and April 2020 were less in number and quantum when compared to the export restrictions imposed during the global food crisis of 2007–08. Yet, the shocks were to be large for specific countries (for instance, for a country like Kyrgyzstan receives about 50 per cent of its calorie consumption from imports). Also, indications are that a prolonged lockdown may force more countries to impose export restrictions.

Grains: Production and Stocks in India

India's foodgrain output was projected to be at 292 million tonnes in 2019–20, up by 2.4 per cent from 2018–19. The stock of wheat and rice with the Food Corporation of India (FCI), as on March 1, 2020, was 77.6 million tonnes (Damodaran 2020). This stock was more than three times the specified minimum operational buffer-cum-strategic stock of 21.04 million tonnes required as on April 1. With the rabi wheat harvest in April and May 2020, the situation was expected to ease further. Similarly, for pulses, the National Agricultural Cooperative Marketing Federation of India (NAFED) was reported to have stocks of 2.25 million tonnes as on March 19, 2020. Between 2014–15 and 2018–19, NAFED made an unprecedented record procurement of 91.1 lakh tonnes of oilseeds and pulses (61.3 lakh tonnes of pulses and 30.3 lakh tonnes of oilseeds) under the Price Support Scheme, up by 1205 per cent from the 7 lakh tonnes procured between 2009–10 and 2013–14. Here again, the inflow of rabi pulses into the market in April and May, 2020, was expected to ease the situation further.

Animal Products

Unlike cereals, the production and market arrivals of animal products is not a seasonal activity. Milk, butter, cheese, meat and eggs arrive in the market on a daily basis, and stocks are not an appropriate indicator to assess their market conditions. Further, many of these products like milk are perishable; for storage, they have to be converted to skimmed milk powder, which requires a factory. Yet, some comments may be made about the overall supply situation for these products.

Milk

The global market assessment in the sphere of milk and milk products was not unfavourable. On the one hand, the growth rate of milk production is increasing in the exporting regions such as New Zealand, Australia, and the European Union (EU). The Covid-19 pandemic is not expected to reduce the production of milk in these countries. On the other hand, the demand for milk has fallen. China is a major importer of milk in the world market. Chinese imports of milk were projected to fall

by 19 per cent in 2020 (Kemp 2020). After the Covid-19 pandemic began, trade slowed down as ports were closed and supply chains were disrupted. In the developed world, hotels, restaurants, and schools account for about half of the demand for milk and milk products.

As a result, the stocks of processed milk products like cheese and butter rose in most Western countries. In the United States, the total stock of butter was 310 million pounds as on March 31, 2020, which was 15 per cent higher than in March 2019 and the largest stock for any March after 1993.[2] Similarly, the total stock of cheese in cold storage warehouses was 1.4 billion pounds as on March 31, 2020. Reports suggest that many American farmers resorted to dumping of unsold milk or cutting down of production (USDA 2020b). According to Dairy Farmers of America, the country's largest dairy cooperative, the dumping of milk was to the extent of 3.7 million gallons per day. In the EU, about 50 per cent of cheese production is as fresh cheese, which is unsuitable for storage. The European Milk Board suggested the introduction of a voluntary volume reduction scheme for milk in the EU too.

In sum, globally, milk and milk products did not appear to be in short supply as far as production is concerned. However, demand drastically fell, supply chains remained disrupted and inventories were built up.

India was not different. India is largely self-sufficient in milk, and is not dependent on imports. In 2018–19, it produced about 187 million tonnes of milk. The production of milk usually falls in the summer months, but production and procurement continue to take place through cooperatives and private dairies. Only one-fourth of India's milk production is converted into milk products; the rest is sold as liquid milk. During the lockdown period, many regular consumers of milk like sweet shops, restaurants and hotels were closed down. The demand for milk is estimated to have fallen by 20-25 per cent during the lockdown (GoI 2020). As a result, milk sales declined, and the differential between milk procurement and sale widened by about 30 per cent at the national level.[3] Surplus milk, then, had to be converted to skimmed milk powder, but the capacities to convert could not be created or expanded overnight. Many milk dairies were forced to announce milk holidays.

Data on milk procurement by milk unions and federations in India is put together by the National Dairy Development Board (NDDB). NDDB data show that liquid milk procurement fell from 534.2 lakh litres per day (llpd) in the first two weeks of March 2020 to 508.3 llpd by the second week of April 2020 and 503.9 llpd by the last two weeks of May 2020 (see Figure 3). The sale of milk also declined from 386.9 llpd in the first half of March 2020 to 324.1 llpd in the second week of April 2020. Sales picked up moderately after mid-April 2020, and rose to 347.5 llpd by the last two

[2] See https://www.thebullvine.com/category/dairy-markets/.
[3] Interview with officials of the Ministry of Animal Husbandry and Dairy, Government of India, May 2020.

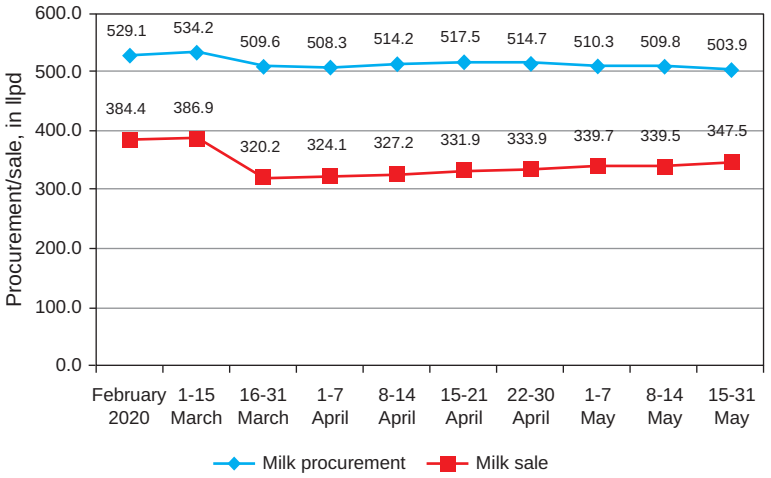

Figure 3 *Procurement and sale of liquid milk by dairy cooperatives, India* in lakh litres per day
Source: National Dairy Development Board.

weeks of May 2020. As a result, the gap between procurement and sale widened from 147.4 llpd in the first half of March 2020 to 186.9 llpd by the second week of April 2020, 170.3 llpd by the second week of May 2020 and 156.4 llpd by the last two weeks of May 2020. Most State governments attempted to increase capacities to convert surplus milk into skimmed milk powder and milk fat. NDDB data show that the closing stock of skimmed milk powder increased from 67,792 tonnes as on the March 15, 2020, to 134,995 tonnes as on April 30, 2020 and 158,624 tonnes as on May 31, 2020 (see also Rath 2020).

Our data are not in agreement with the claims of the government. According to the Union Finance Minister, a total of 1110 million litres of milk was "extra procured" from milk farmers of India during the lockdown period (GoI 2020). This was disingenuous, to say the least. Procurement actually fell by about 30 llpd during the lockdown. Even prior to the lockdown, the cooperatives were procuring more than the sales. After the lockdown, the difference between procurement and sales ("extra procured") widened not because procurement increased, but because sales fell at a faster rate than procurement. If we compare the first fortnight of March 2020 and the last fortnight of May 2020, procurement fell by 5.7 per cent while sales fell by 10.2 per cent.

Meat and Eggs: The Global Cases

Meat is not a perishable item in processed form, and can be stored for weeks. In countries like the USA, the situation was evolving on a weekly basis. In the second and third weeks of March 2020, there was panic buying of meat across the country, leading to a 70 to 100 per cent year-on-year rise in fresh grocery sales of beef, chicken, and pork (see Figure 4). Panic buying abated by the end of March 2020, but

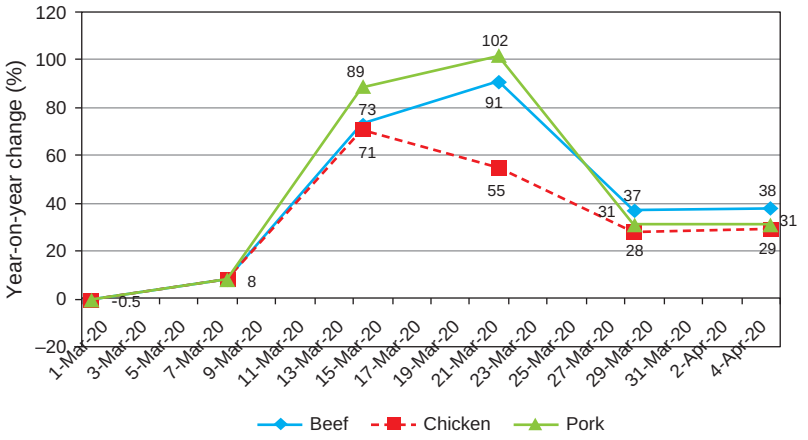

Figure 4 *Year-over-year change in fresh meat grocery sales, USA* in per cent
Source: Lusk, Mintert, and Langemeier (2020).

sales remained 29 to 38 per cent higher than during the corresponding weeks of March and April 2019. As meat plants remained functional, there was no fear of supplies drying up.

However, the situation changed by early-April 2020. A number of meat plants closed down due to the spread of infections, and at least 20 deaths among meat plant workers. Most large meat firms were affected by this shutdown: Cargill, Conagra, JBS USA, Smithfield Foods and Tyson Foods to name a few. Meat production in the USA is highly concentrated; about 50 plants are estimated to be organising more than 98 per cent of slaughtering and processing in the country (Corkery and Yaffe-Bellany 2020). As per another estimate, 15 pork plants slaughtered 59 per cent of all hogs in the country (Lusk, Mintert, and Langemeier 2020). By end-April 2020, about 4400 meatpacking workers working in 80 meat plants across 26 States of USA had tested positive for Covid-19 (Aronoff 2020). In mid-April 2020, about 16 per cent of the 3700 employees of the Sioux Falls plant of Smithfield Foods tested positive for Covid-19. Most dramatic was the full-page advertisements put out by Tyson Foods in newspapers. Their meat plant in Waterloo, Iowa was shut down after 200 workers tested positive for Covid-19. The company warned that:

> As pork, beef and chicken plants are being forced to close, even for short periods of time, millions of pounds of meat will disappear from the supply chain. As a result, there will be limited supply of our products available in grocery stores until we are able to reopen our facilities that are currently closed . . . .Millions of animals – chickens, pigs and cattle – will be depopulated because of the closure of our processing facilities. The food supply chain is breaking. . . . (Tyson 2020)

As a result of the meat plant closures, the weekly beef and pork production in the USA fell from about 1.15 billion pounds in mid-March 2020 to about 0.75 billion pounds in early-May 2020 (Langemeier and Mintert 2020). Similarly, the weekly poultry

production in the USA fell from about 1.2 billion pounds in mid-March 2020 to 1.05 billion pounds in April 2020; since then, it recovered to 1.15 billion pounds in early-May 2020 but remained lower than the figures in March 2020. According to another estimate in end-April 2020, there was a 25 per cent fall in the pork slaughter capacity and a 10 per cent fall in the beef slaughter capacity in USA (Gallagher and Kirkland 2020).

The broad assessment, thus, was that there could be a shortage of meat on the grocery shelves due to the closure of meat plants. Reports suggest that poor demand and broken supply chains led to overcrowding of pigs in many barns, forcing growers to euthanize thousands of hogs to adjust capacities (Jeffery and Newburger 2020). According to Kim Reynolds, the Governor of Iowa, about 700,000 pigs had to be euthanised in the USA every week (Polansek and Huffstutter 2020). These reports also speak of euthanising chicken in many layering plants to cut feed costs.

In the EU also, there was a fall in the demand for meat combined with supply disruptions. In Germany, as in the USA, a number of meat plants were closed down in Dissen, Coesfeld, and Bavaria due to workers testing positive on a mass scale (Young 2020). In end-April 2020, the farming bodies COPA and COGECA wrote a letter asking the European Commission to intervene, as:

> poultry meat . . . is piling up and freezers all over the EU are already full, waiting for the confinement measures to be over. This will cause an oversupply crisis from the moment restaurants, hotels and catering are open again, as consumers will not go twice as much to eat out of home as they did before the crisis. This will put tremendous pressure on price. (COPA and COGECA 2020)

The total demand for eggs is estimated to have risen across the world after the Covid-19 lockdowns began. The lockdown period coincided with the Easter week. In a normal year, the demand for eggs rises during Easter and declines afterwards. However, in 2020, the demand for cartoned shell eggs remained above normal in the American and European markets. The "shell egg demand index" for USA computed by the USDA was stable till March 15, 2020 (USDA, 2020c). But with large amounts of panic buying from the second week of March 2020, the index rose from close to zero to about 34 by the second week of April 2020. Surveys showed that American consumers were purchasing 44 per cent more eggs in the week ending March 14, 2020 than at the end of the corresponding week in 2019. Retailers were reportedly ordering six times the quantity of eggs to fulfil rising demand. The demand index softened after mid-April 2020, but remained at higher levels than in 2018 or 2019. So, the story of eggs in the USA is that of a sharply rising demand from mid-March till early-May 2020.

Meat and Eggs: The Indian Case

The case of India was different. India is the second largest exporter of beef in the world, after Brazil. It is the top supplier of beef to Malaysia and Indonesia, as well as the West

Asian region. It exports about 100,000 tonnes of buffalo meat every month, but exports in March 2020 were estimated to have fallen to 40,000 tonnes (Chu and Jadhav 2020). Another estimate placed exports in March 2020 at 65,000 tonnes (Sally 2020).

Sales fell domestically too. In the beginning of the Covid-19 pandemic, there were rumours that the consumption of meat led to Covid-19 infections. Though the government and associations of meat producers tried to highlight the unscientific basis for these rumours, there was a fall in the domestic consumption of meat. On the supply side, sufficient animals could not be transported from the source areas to large abattoirs. Many abattoirs closed down. In Mumbai's Deonar abattoir, the largest in Western India, about 250 water buffaloes and about 3000 sheep and goats were slaughtered on a daily basis. These animals used to arrive from neighbouring States like Rajasthan and Gujarat as well as other districts of Maharashtra. The transportation of these animals to Mumbai was adversely affected by lockdown restrictions. Finally, this abattoir closed down. As a result, meat traders in Mumbai reported a fall in sales to the tune of 50 per cent (Ganapatye 2020).

The expectation in the market was that the fall in beef and mutton supply, particularly given the Easter and Ramadan seasons, would push consumers towards consuming more of chicken and eggs. In reality, however, the baseless rumours linking the consumption of non-vegetarian food with Covid-19 infections affected the consumption of chicken and eggs also.

Poultry producers in India were adversely affected at multiple levels: small growers in homesteads, layer nursery owners and broiler farms. As per one estimate, there are about 100,000 broiler farmers and about 35,000 layer nursery owners in India, who produce about 360 million broilers and 6400 million eggs on a monthly basis. Indian growers and firms largely sell live birds or fresh meat and eggs; their footprint in the frozen or chilled meat segment or dried egg segment is not significant. This increased the exposure of growers and firms to market shocks. Broiler birds, whose life span is about 30 to 40 days on an average, began to pile up in the farms and growers were forced to keep feeding them with purchased poultry feed. The supply of poultry feed itself was disrupted by the lockdown. Due to the poor availability of essential ingredients in their manufacture, like maize and soya meal, the prices of poultry feed had risen by 20 per cent even prior to the spread of Covid-19. As broiler birds grew in size as well as in numbers on a daily basis, and as the markets for their sale shrank, growers incurred major financial losses. Eggs also started to pile up in farms; their shelf life is not more than 15 days.

Faced with major losses, poultry growers decided to cull birds on a large scale. A report from Punjab in early March 2020 said that about 30 million birds were likely to face culling in the State (Mohan 2020). A report from Karnataka spoke of one farmer burying 6000 birds alive in one day (Anonymous 2020a). A report from Haryana described how one farmer buried 12,000 birds over 10 days, and another buried 6500

birds in one day (Rahar 2020). As per a report based on 14,000 women poultry producers in five States, eight lakh growing birds, two lakh day-old-chicks, and 10 lakh hatchlings and hatching eggs were destroyed in March and April 2020 (Tushir and Kanitkar 2020). These producers destroyed about 50,000 hatching eggs per day.

In mid-April 2020, it was estimated by the All India Poultry Breeders Association that the total loss for the poultry industry was likely to be Rs 250,000 million. According to the Poultry Federation of India, most poultry businesses in India were running at 30 to 35 per cent of their stocks in early-April 2020 (Singh 2020a). According to a note from ICRA, the poultry meat segment recorded a fall in revenue by 4 to 5 per cent between January and March 2020 (PTI 2020a). April figures were not available.

In sum, while the world appeared to have enough stocks of foodgrain, export restrictions are likely to reduce the availability for importing countries. If the lockdown proceeds beyond June 2020, the market is likely to tighten considerably. In the case of animal products, supply chain restrictions were acute in the developed world leading to significant losses for growers. In India, the food grain stock situation appeared comfortable. In the case of animal products, growers were under considerable stress given the breakdown of supply chains. The condition was most acute for poultry growers.

3. Disruptions in Supply Chains

Covid-19 crisis is marked by a simultaneous fall in both demand and supply. Each fall in demand (or supply) leads to a further fall in supply (or demand), leading to successive backward loops of demand and supply. Logistics personnel are familiar with the *supply bullwhip effect*, where a small change in demand at one end is extensively and disproportionately amplified as the signal is transmitted down the supply chain. As no supply chain is designed to take the load of excess demand for certain goods, and as demand for certain other goods declined or totally disappeared, the networks of markets across the world struggled to cope.

Decline in Trade Volumes

One illustration of the extent of disruptions in the supply chain could be had from the collapse of international trade in agriculture. In early-April 2020, the World Trade Organisation (WTO) estimated that global merchandise trade was likely to fall by 13 to 32 per cent in 2020 (WTO 2020a). According to UNCTAD, global trade in the first quarter of 2020 fell by 3 per cent. In the second quarter of 2020, global trade was expected to shrink by 26 per cent on a quarter-on-quarter basis. The WTO's goods barometer, an index based on the extent of world goods trade, fell from 95.5 in February 2020 to 87.6 in March 2020 (WTO 2020b). The fall was expected to be steeper in April 2020. Trade in agricultural goods declined sharply after the lockdowns took effect. The Baltic Dry Index (BDI), a benchmark indicator used to

assess costs of moving raw materials on ocean going vessels, fell sharply in April 2020 for grains and oilseeds (FAO 2020b). Another indicator used is the International Grains Council's (IGC) Grains and Oilseeds Freight Index or GOFI, which is a trade-weighted composite measure of ocean freight costs for grains and oilseeds. In April 2020, GOFI fell by 32 per cent y-o-y and by 19.7 per cent m-o-m to its lowest value in the last four years. The reasons for these declines were identified by the FAO in the "sliding bunker prices and slow demand for smaller carriers."

Movement of goods through ports was adversely affected because of a shortage of workers to load and unload, as well as poor availability of containers. Every container in the port has a specified time allotted to load, unload, transit and wait. Any disruption or delay disturbs the supply schedules globally and attracts demurrage charges. One reason for the piling up of containers in Indian ports during the lockdown was the inability of importers to pay the import detention charges (different from demurrage charges) to the global container shipping lines (Manoj 2020). In February and March 2020, as freight ships piled up in Chinese ports, the inadequacy of electrical plugging points for refrigerated containers emerged as a major bottleneck.

The case of goods transport within India would reveal another dimension of the complexity in export logistics chains. Consider a meat plant in western Uttar Pradesh, from where meat has to be loaded on to a ship located in the Jawaharlal Nehru Port Trust (JNPT) in Mumbai (Deloitte 2018). The packed meat is loaded on to a refrigerated truck, which is driven by road for between eight and ten hours to reach the cold storages at the Inland Container Depot (ICD) in Dadri near Delhi. This truck returns to the origin to bring another load. At the ICD Dadri, the goods are segregated, sorted, repacked and loaded on to reefer containers. These containers are then loaded on to freight rail, which takes them to JNPT in about four days. At the JNPT, they are loaded on to cargo vessels and the containers either return empty to Dadri or wait for an import consignment to arrive. Every link in the supply chain described above has to fall in place for it to function smoothly. Any break in the chain, due to the late arrival or return of a truck or the absence of workers to load the containers at any point, could leave the whole chain in disarray. Reports from different ports in India indicate that "tens of thousands" of containers were piled up in each port after the lockdown began (TNN 2020; Whelan 2020).

India's exports of merchandise goods fell sharply in March and April 2020; according to the RBI, this was "the worst slump in the last 30 years" (RBI 2020a). In April 2020, India's goods exports declined by 60.3 per cent. Data on the extent of decline of agricultural exports from India could not be obtained. However, reports indicate that the quantum of exports in March and April 2020 was minimal. According to the government, about 9700 phytosanitary certificates for exports were issued as on April 15, 2020. There was some export of sugar to Indonesia and Iran; some exports of basmati rice to various Asian and African buyers; export of about 50,000 tonnes of wheat by NAFED to Afghanistan; and export of about 40,000 tonnes of grains to

Lebanon under the government-to-government (G2G) arrangement (PTI 2020b). According to the tweets put out on various dates by the Agricultural and Processed Food Products Export Development Authority (APEDA), there were also exports of 223.4 tonnes of mango, banana, onion, musk melon, grapes and vegetables, and 600 tonnes of banana, to the West Asian region. These are small numbers relative to trade in a normal year.

If international trade in agricultural goods almost came to a halt, domestic trade networks were also affected by the lockdown. Within each country, transport restrictions affected the movement of goods from the farmer's fields to the nearest market; from wholesale markets to retail markets; from wholesale markets and aggregators to ports; and from retail markets to consumers. While essential goods were exempted from the lockdown on paper, the disruptions in supply and logistics on the ground remained acute. As accurate forecasting of demand became difficult, firms turned risk-averse and, due to the bullwhip effect, supplies shrank far more than was necessary.

An important indicator of the extent to which supply chains are broken is the extent of market arrivals. A case study of India's agricultural markets follows.

Market Arrivals: The Indian Case

The broken supply chains drastically reduced market arrivals of agricultural goods in India. I use data for 16 commodities from the database of the Centre for Monitoring Indian Economy (CMIE), which puts together data from 3289 markets across the country. These commodities are paddy, wheat, maize, barley, gram, pigeon pea (*arhar*), lentil (*masur*), potato, tomato, onion, cabbage, cauliflower, peas (*matar*), lady's finger, banana and mango. These crops represent all types of crop groups, such as cereals, pulses, fruits and vegetables, and crops that are specifically important for the rabi season.

The first point to make on market arrivals in India is that the number of markets that were functional declined significantly in March, April, and May 2020 compared to the corresponding months in 2019. The CMIE puts together data from AGMARKNET, a government website that provides data on market arrivals and prices from across the country. It has a count of markets that reported data on prices and arrivals during the lockdown. A market was considered closed in a month if it did not report data on prices or arrivals for even one day of the month. Defined thus, 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 (see Figure 5).[4] The number of

[4] In a study of seven commodities for the first 21 days of the lockdown after March 14, 2020, Rawal and Verma (2020) also note that there was a fall in the number of *mandis* in India that were functional for even one day. In the case of grains, the number of trading *mandis* fell from 449 to 123. In the case of perishables, the number of trading *mandis* fell from 325 to 100.

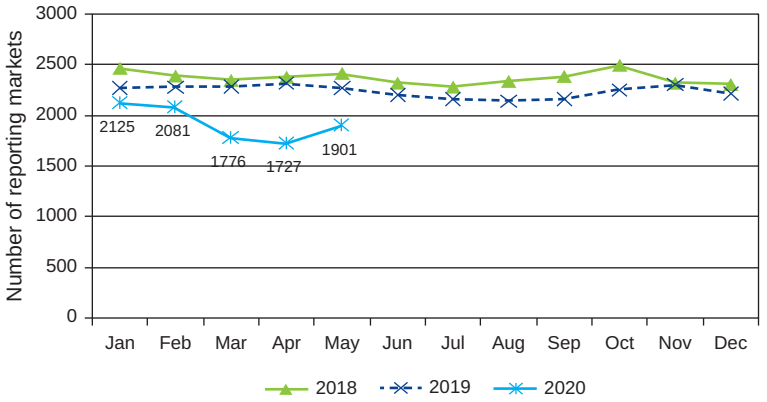

Figure 5 *Number of reporting agricultural markets at AGMARKNET, India, 2018, 2019, and 2020*
Source: CMIE.

reporting markets In April and May 2020, thus, were considerably lower than in April and May 2019.

In Figure 6, I have provided two sets of graphs for each of the 16 selected crops. The first panel, on the left side, represents *daily* market arrivals of each crop (in tonnes) at the national level between March 15 and May 31 for two years: 2019 and 2020. The second panel, on the right side, represents *cumulative* data on market arrivals of each crop, from March 15 to May 31 for two years: 2019 and 2020. Thus, 2019 is taken as a baseline year to estimate changes in arrivals in 2020. Table 2 provides data on the total arrivals between two dates: March 15 and May 15 for two years, 2019 and 2020.

For the period examined, market arrivals of all crops, except maize, were lower in 2020 than in 2019 both in the aggregate and for most days during the lockdown.[5] Other than maize, it was only in paddy, lentil, tomato and banana that market arrivals in 2020 constituted more than 75 per cent of market arrivals in 2019. In the case of wheat, potato, cauliflower, cabbage and lady's finger, market arrivals in 2020 were between 50 and 75 per cent of market arrivals in 2019. For the remaining crops, such as barley, gram, pigeon pea, onion, peas and mango, market arrivals in 2020 were less than half of the market arrivals in 2019.[6] In wheat, the most important rabi crop in India, only 56 per cent of the arrivals in 2019 were recorded in 2020. The lowest ratio was recorded for mango, where only 26 per cent of the market arrivals in 2019

[5] The reasons for high quantities of maize arrivals are not clear, but it could be due to the increase in production of maize in India in 2019-20. International Grain Council's estimates show that maize production in India may rise from 27.2 million tonnes in 2018-19 to 28.4 million tonnes in 2019-20 (See https://igc.int/en/default.aspx).
[6] It may be argued that higher procurement of pulses in 2020 may be a reason for lower market arrivals of crops like gram. Data till May 27, 2020, indicate that 7.3 lakh tonnes of gram were procured by the NAFED (PIB 2020d). Even if we add this quantity to the arrivals in 2020, the share of arrivals in 2020 relative to 2019 comes to only 68 per cent.

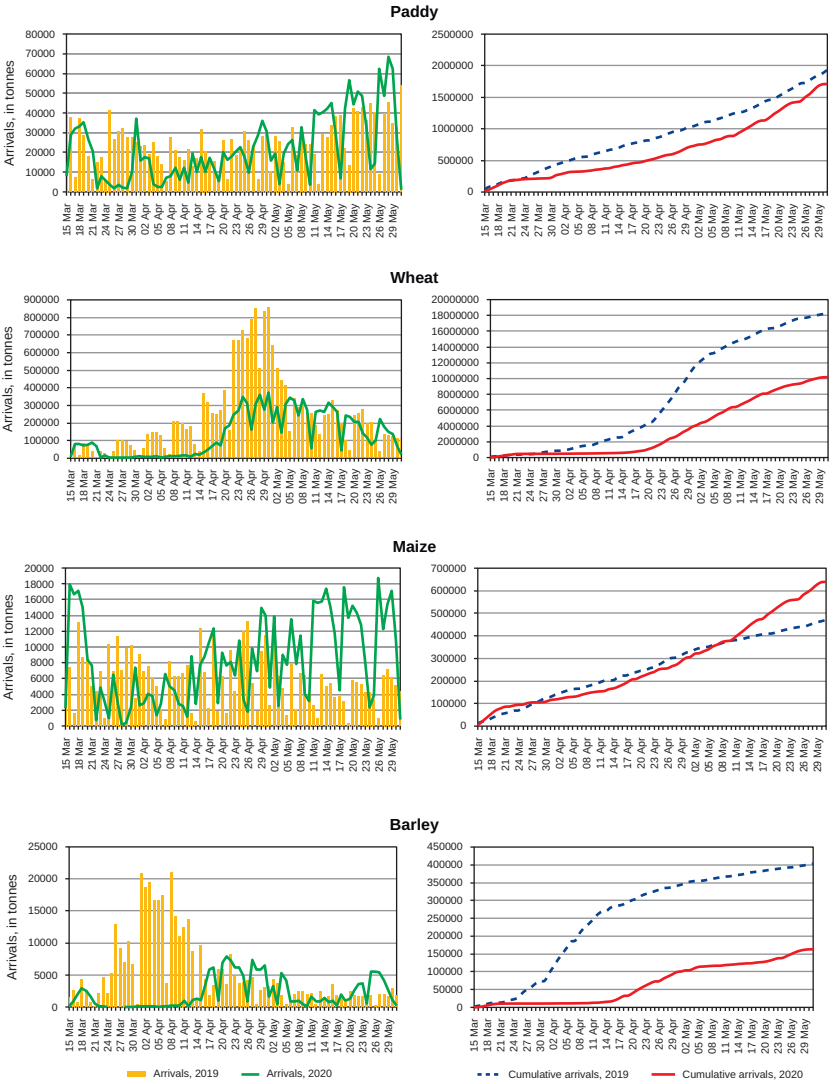

Figure 6 *Market arrivals of selected crops in India, March 15 to May 31, 2019 and 2020, daily and monthly*, in tonne
Source: CMIE commodities database.

were recorded in 2020. In crops like wheat, barley, gram, lentil, peas and mango, there was a long stretch of days in March 2020 when market arrivals were negligible.[7]

These numbers are at clear variance with the claims of the Government of India regarding the operation of agricultural markets. On April 23, 2020, the Ministry of Agriculture and Farmer's Welfare released a statement that claimed that out of the

[7] Rawal and Verma (2020) examined data on market arrivals for the first 21 days of the lockdown after March 15, 2020, and found a very sharp fall in market arrivals due, probably, to this phenomenon.

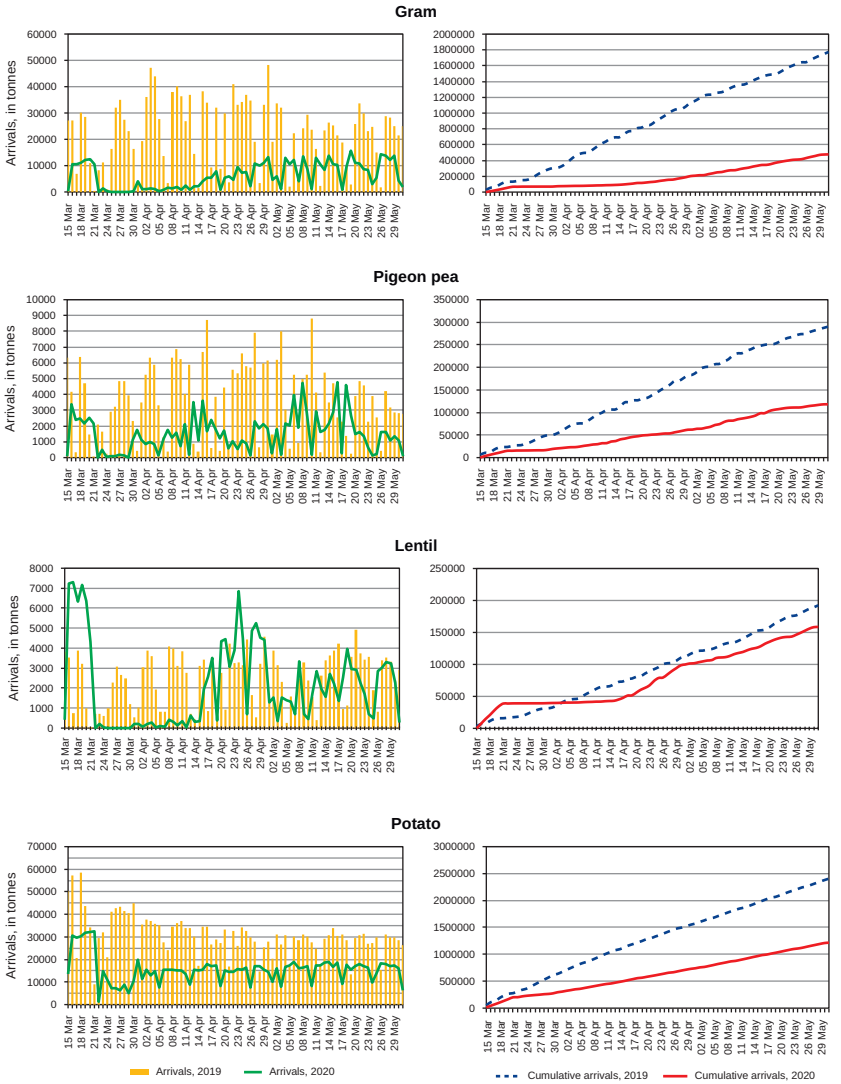

Figure 6 *Continued.*

2587 principal/main agricultural markets in the country, the number of functional markets rose from 1091 as on March 26, 2020, to 2069 as on April 21, 2020 (PIB 2020a). It noted that the arrivals of onion, potato and tomato increased by 622 per cent, 187 per cent and 210 per cent respectively between March 16, 2020 and April 21, 2020. These numbers and dates appear cherry-picked to suit the government's argument rather than convey the ground realities. As the data analysed in this paper show, there was a significant decline in the extent of market arrivals in 2020 compared to 2019. Of course, as Singh (2020b) pointed out, some commodities like

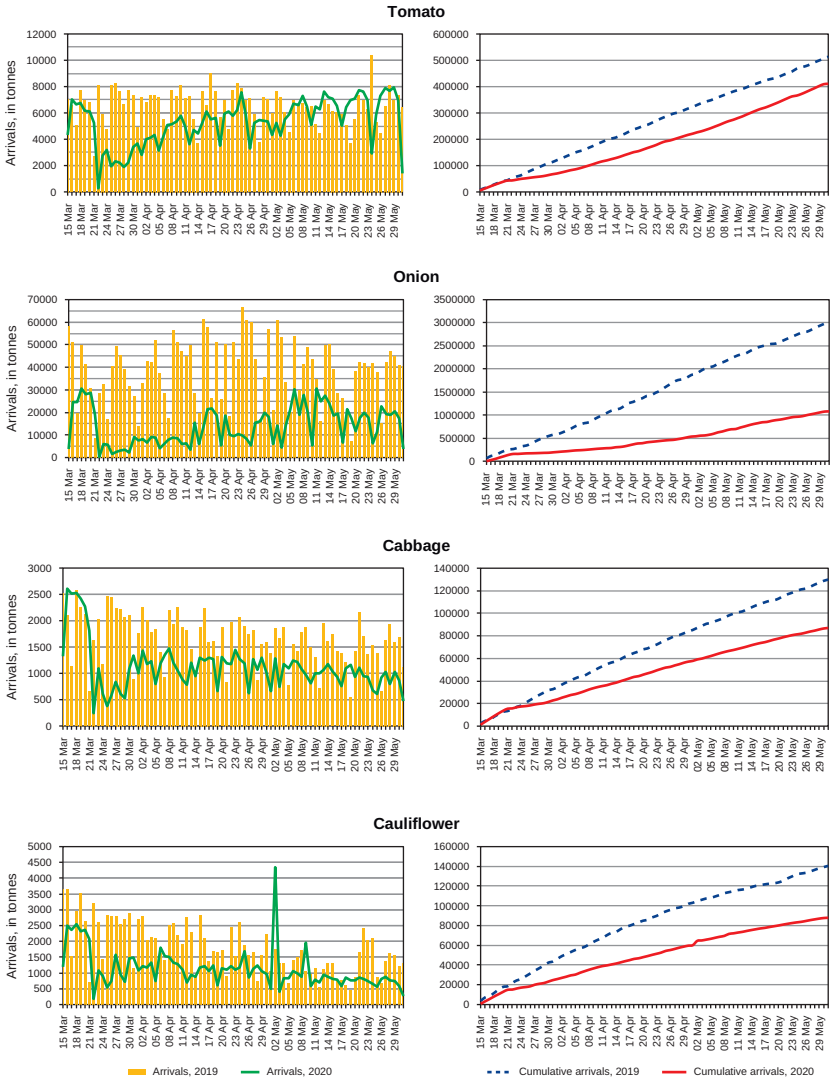

Figure 6 *Continued.*

wheat are not perishable and can be stored for a longer period by the farmers. But most other crops are perishable, especially fruit and vegetables. A major decline in arrivals of these crops most likely indicates permanent loss to farmers.

The sharp fall in market arrivals was the result of the breakdown of government procurement systems and private trade in the countryside. Government procurement systems were not operational in many regions. Even when the procurement centres were open, farmers struggled to bring their produce to the market yards due to poor availability of transport facilities and restrictions on

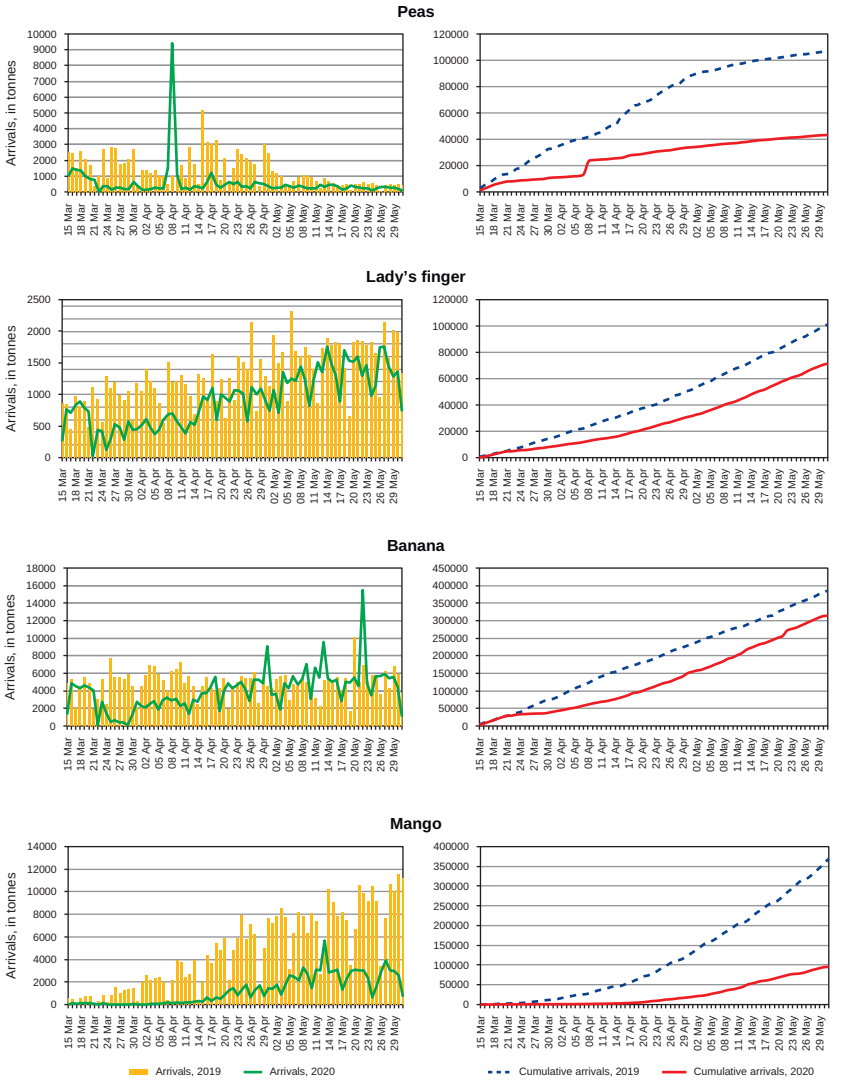

Figure 6 *Continued.*

movement of goods. Even where farmers were able to transport their produce to the market, they needed an invitation or appointment slip from the Mandi Board. The nature of these slips differed across north Indian States. In Haryana, not more than 100 farmers were given slips to enter the *mandi* premises on one day.

Further, procurement centres in many States refused to accept more than a specified quantity of produce per day. In April 2020, the maximum quantity of wheat that could be sold by a farmer in a *mandi* was as low as 80 kg per day in Madhya

Table 2 Total arrivals in the agricultural markets between March 15 and May 31, selected crops, India, 2019 and 2020 *in tonne and per cent*

Crop (1)	Total arrivals between March 15 and May 31, 2019 (in tonne) (2)	Total arrivals between March 15 and May 31, 2020 (in tonne) (3)	Arrivals in 2020 as per cent of arrivals in 2019 (%) (4)=(3/2)
Paddy	1,940,434	1,707,024	88.0
Wheat	18,315,110	10,186,771	55.6
Maize	470,034	638,122	135.8
Barley	402,966	161,802	40.2
Gram (*chana*)	1,775,383	476,704	26.9
Pigeon pea (*arhar*)	290,474	118,335	40.7
Lentil (*masur*)	191,725	158,967	82.9
Potato	2,400,594	1,210,066	50.4
Tomato	513,851	410,711	79.9
Onion	3,017,686	1,074,346	35.6
Cabbage	129,757	86,923	67.0
Cauliflower	140,924	88,270	62.6
Peas (*matar*)	107,057	43,472	40.6
Lady's finger	101,125	71,187	70.4
Banana	386,328	313,567	81.2
Mango	369,991	95,719	25.9

Source: Computed from the CMIE commodities database, June 1, 2020.

Pradesh.[8] In Punjab, the slips initially stated that only 50 quintals per day would be accepted, but were later revised to 70 quintals per day and even later to one tractor load. In Rajasthan, the maximum amount that the farmers could bring to the *mandi* was pre-determined by the government based on the land owned by the farmer as per the revenue records and assuming an average yield per hectare. Crops such as mustard and gram had absolute limits specified in the slips. In Haryana, the limits for mustard and gram were 25 quintals per day and 20 quintals per day respectively. As a result of these limits, many farmers were forced to take back the rest of their produce or sell it to middlemen outside the *mandis* at lower prices. In the case of perishables, many farmers did not harvest their produce to avoid the costs of harvesting. In some places, farmers were reported to be dumping their vegetables and fruits on the road (Narayanamoorthy and Alli 2020).

In many regions, *mandis* either closed down or were operational only for two or three days a week. In Mumbai and Pune, the largest APMC *mandis* were closed down completely in April 2020 after a few traders tested positive for Covid-19. They had not reopened in mid-May 2020.

[8] I am thankful to Ajay Jakhar for helpful discussions and information on this topic.

Many large private traders were not operational during the lockdown because of disruptions in truck services. According to one report, in early-April 2020, about 500,000 trucks were stuck in different highways of India as they could not cross state borders or were stopped by the police for technical reasons related to permissions (Lonkar 2020). As a result, trucks were in shortage. When trucks were available, truck drivers were not available as many had returned home before the lockdown. According to an internal analysis of the Government of India that I could access, districts in India that accounted for more than 50 per cent of truck drivers in India were also those districts with large Covid-19 outbreaks or clusters.

With supply chains in disarray, the union government attempted online procurement and trade. On April 13, 2020, it announced the expansion of National Agriculture Market (e-NAM), an online trading platform and linked 415 new *mandis* with the portal (PIB 2020b). On April 15, 2020, an All India Agri Transport Call Centre was launched. On April 17, 2020, the government launched a mobile app, named "Kisan Rath," to link farmers, traders and transporters (PIB 2020c). But, as our data till May 15, 2020 showed, none of these initiatives appears to have made a major impact on the ground; market arrivals remained considerably lower in 2020 than in 2019.

4. Trends In Prices

Globally, disruptions in the supply chains were accompanied by a fall in demand. Better-off consumers did resort to panic purchases and stockpiled food items in the early part of the lockdown in March 2020. At the same time, the loss of incomes and employment among the working class in the informal sector led to a fall in the demand for food items. Generalisations are difficult as there were shortages in certain areas for certain goods, and oversupply of certain other goods in certain other areas.

Global Prices

Trends in food prices, together with changes in market arrivals, can resolve some of the questions related to supply and demand. The FAO computes global monthly price indices for a selected set of commodity groups. Given a base of 2002–04=100, this index shows that global prices of food fell from January 2020 till May 2020 (Figure 7). Between February and May 2020, the index fell from 179.5 to 162.5, the lowest for any month after December 2018. This fall in global food prices conceals two diverging trends at the commodity level. On the one hand, the prices of rice and wheat "rose significantly" in April 2020 (FAO 2020c). According to the FAO, wheat prices rose by 2.5 per cent m-o-m and rice prices rose by 7.2 per cent m-o-m in April 2020. These were a result of the need of major importing countries to increase their buffer stocks and restrictions on exports placed by the major exporting countries. Rice prices continued to rise in May 2020, while wheat prices softened moderately. On the other hand, maize prices fell sharply in March, April, and May 2020. This

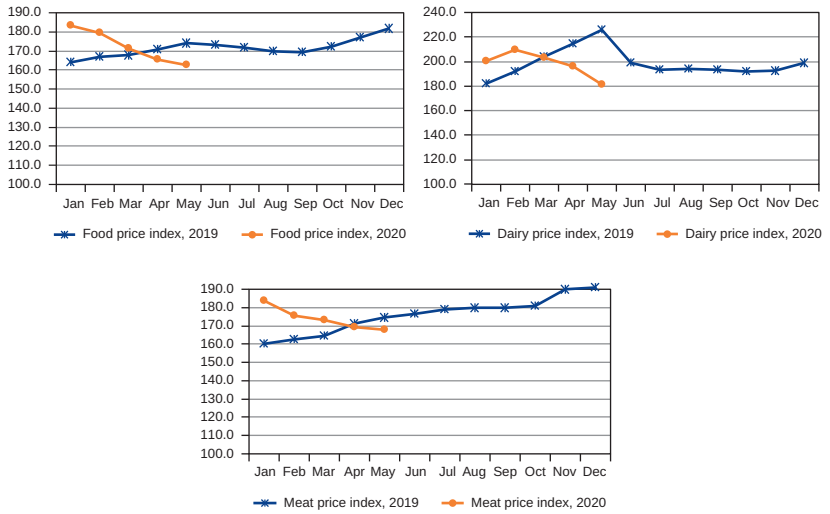

Figure 7. *FAO's world price indices for food, meat and dairy, January 2019 to May 2020*
Source: FAO.

was because of a fall in ethanol prices owing to a fall in demand for bio-fuels, and a fall in demand for animal feed.

Global meat and dairy price indices also fell by 3.6 per cent and 2.7 per cent, respectively, between March and April 2020. Between April and May 2020, dairy price indices fell by 7.3 per cent, while meat price indices fell by 0.8 per cent. In May 2020, dairy and meat price indices stood 19.6 per cent and 3.6 per cent below their levels in May 2019. Here again, there were stretches of rising and falling prices in the developed countries. USDA data show that prices of pork, chicken, beef and egg rose between the second and last week of March 2020 (Lusk, Langemeier, and Mintert 2020). In April 2020, the prices fell from peaks of late-March, except for egg where prices continued to rise till the first week of April 2020. The fall in prices of meat and milk imply that even though there were meat plant shutdowns, restaurant closures and disruptions in supply, the fall in demand might have outstripped decline in supply.

FAO's own analysis supports the conclusion that sharp downturns in demand may be the reason for the decline of food price indices in April 2020; it traces the April decline to "significant contractions in demand for many commodities" (FAO 2020d).

Prices in India

It is widely accepted that demand and supply of most agricultural commodities fell in India after the lockdown. However, there is less clarity over the relative weights of the demand and supply shocks.

Two studies that have analysed price movements in agriculture after the lockdown are by Rawal and Verma (2020) and Narayanan and Shah (2020). Rawal and Verma found significant volatility in *mandi* prices for seven commodities between March 15 and April 14, 2020. Apart from mustard and potato, they found no specific increasing trend in *mandi* prices. Narayanan and Shah (2020) analysed prices in *urban* food markets between mid-march and April 21, 2020. They used daily wholesale and retail price data for 22 commodities collected from 114 centres by the Ministry of Consumer Affairs, Food and Public Distribution, Government of India. They found that both wholesale prices and retail prices showed an upward trend for many commodities after March 24, 2020. They also found that the gap between wholesale and retail prices increased during the lockdown suggesting "increased transactions costs for retailers or greater retailer power to set prices." According to them, it might not be true that demand collapse overwhelmed supply shocks during the lockdown, and the rise in prices indicate such a possibility. Additionally, an internal analysis of the Reserve Bank of India (RBI), which looked at daily price data for 22 essential food items, suggested that food prices rose by 2.3 per cent till April 13, 2020 in a broad-based manner (RBI 2020b). A note from the Ministry of Finance states that retail prices of these 22 items rose by 4.2 per cent in April 2020 over March 2020 (Department of Economic Affairs 2020).

I have examined two sets of data on prices: official data on price indices and market data on prices of selected 16 commodities.

WPI and CPI

In India, monthly data on the wholesale price index (WPI) and the consumer price index (CPI) are available till April 2020. In Figure 8, I have provided a set of graphs that show movements in the WPI and CPI for specific commodities or related commodity groups from January 2019 till April 2020. I have chosen to use CPI for urban areas to better understand the impact on prices of supply chain disruptions. The conclusions are not straightforward, but may be summarised as follows.

The WPI showed a rising trend in March and April only for pulses, fruits, milk and beef. This is not surprising. NAFED increased the procurement of pulses, but was unable to distribute them effectively. Pulses had to be transferred from procuring States like Madhya Pradesh, Uttar Pradesh, Maharashtra and Rajasthan to mills and then from there to the States. But NAFED lacked an effective distribution mechanism. Fruit prices rose because of poor market arrivals of specific fruits like mango and apple. Milk prices rose because of the hike in milk prices by Rs 2 to 3 per litre by private dairies and lower levels of milk procurement. Beef prices rose, as the Easter and Ramadan seasons increased the demand even as supply remained poor. In pulses, fruits and milk, the CPI in urban areas also rose in April 2020.

In the case of cereals, the WPI fell even as the CPI rose. This may be indicative of disruptions in the supply chain in urban areas. Vegetables present a different

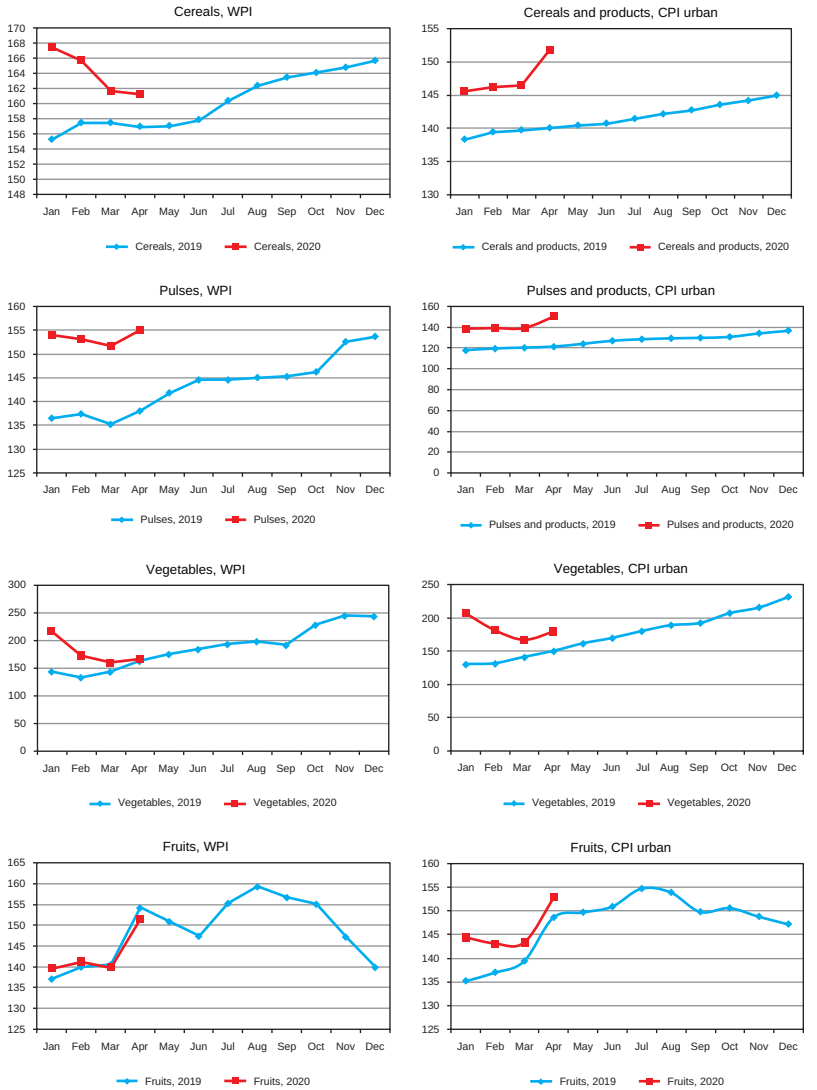

Figure 8 *Wholesale Price Index (WPI) and Consumer Price Index (CPI) in urban areas, selected items, India, January, 2019–April 2020, WPI base year 2011–12=100, CPI urban base year 2012=100*

Source: Ministry of Statistics and Programme Implementation and Ministry of Finance, Government of India.

picture. While WPI of vegetables remained more or less unchanged, the CPI for vegetables rose in April 2020. The case of vegetables was indicative of a major fall in market arrivals combined with supply disruptions. WPI for eggs and poultry chicken fell, even while CPI for eggs rose in April 2020.

If we look at the WPI and CPI figures till April 2020, the price trends are different for different product groups; this was also noted by the Ministry of Finance (see MoF 2020,

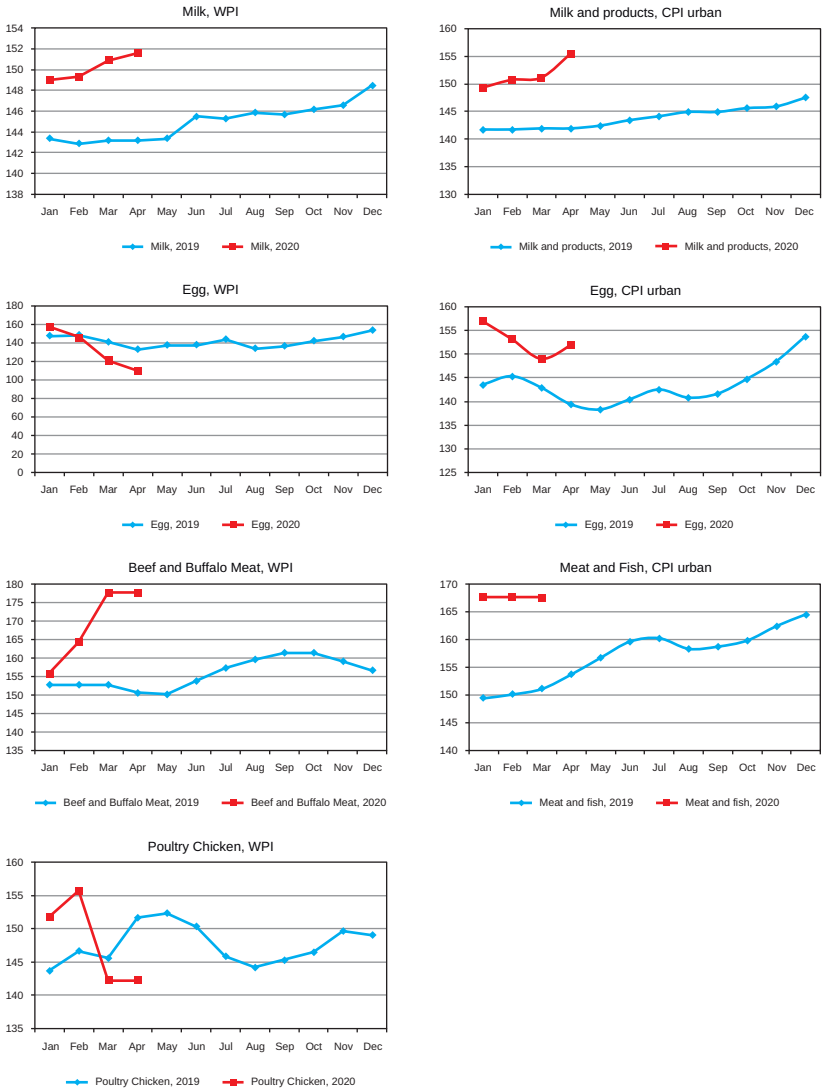

Figure 8 *Continued.*

p. 13). What we could say is that in many commodities, the urban CPI showed a rising trend in April 2020.

Market prices

To understand price variations better, I analysed data on daily market prices of 16 selected commodities from the commodities database of the CMIE for the period March 15 and May 31 of 2019 and 2020. The trends are shown in Figure 9.[9]

[9] These prices are more in the nature of wholesale prices.

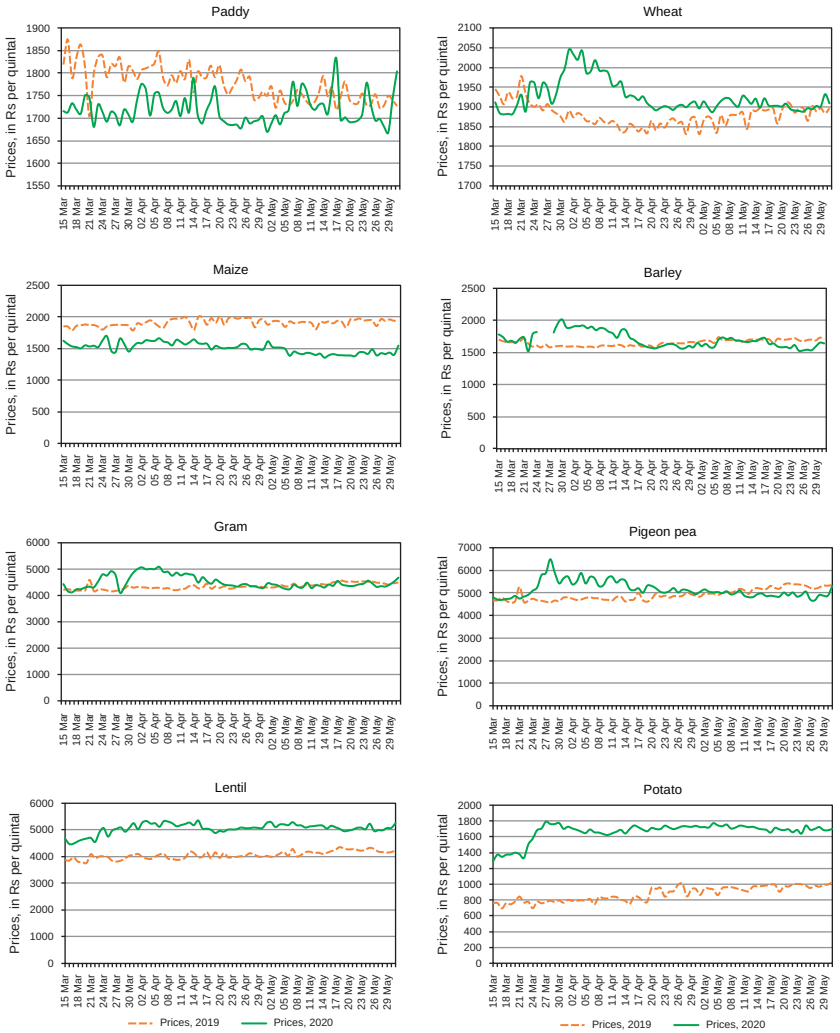

Figure 9. *Trends in daily market prices of selected commodities, India, March 15 to May 31, 2020*, in Rs per quintal
Source: CMIE, commodities database.

(a) Prices rose for wheat at the start of the lockdown, but fell afterwards to pre-lockdown levels. Prices of paddy fell towards the end of April 2020, but rose in the early part of May 2020 before falling again by mid-May 2020. The prices of pulses and maize were stable. The prices of perishable vegetables like tomato, onion, cabbage, cauliflower, and lady's finger, and cereals like barley, were falling through the lockdown. Potato prices rose early in the lockdown, but were stable thereafter. Turning to fruits, mango prices fell while banana prices were stable. In sum, a fall in prices was noted for most vegetables analysed as well as fruits like mango.

Figure 9. *Continued.*

(b) Changes in prices during the lockdown period were compared with the corresponding period in 2019. In the case of maize, barley, pulses, peas, potato and banana, the trends in prices in 2020 were largely in line with those in 2019. However, clear variations from 2019 were noticed in the case of paddy, wheat, most vegetables and fruits like mango.

What can we infer from the two sub-sections above? The fall in wholesale price indices for cereals, vegetables, eggs and poultry chicken was indicative of low price realisation for the farmers. In the case of cereals and vegetables, our analysis of average market prices from the CMIE database is in broad agreement with our analysis of the WPI numbers. At the same time, the rise in urban CPI for cereals, vegetables and egg,

particularly in April 2020, is indicative of tightening supply chains in these commodities. There is variance in our findings for pulses as between official price indices and market prices from CMIE. Data from CMIE show largely stable prices for pulses, but WPI and CPI for pulses rose in April 2020. Variance is also noted in fruits; market prices from the CMIE for banana and mango do not show a rise while both WPI and CPI for fruits show a clear rise.

We cannot hope to clinch the question of the relative importance of demand and supply using data on prices alone. Nevertheless, what our analysis does indicate is that demand slowdown was at least as important as supply shocks for many commodities, and may have been stronger than supply shocks in some commodities like vegetables. For certain commodities, such as pulses, it was possible that supply shocks may have been stronger than the demand slowdown. More detailed and disaggregated analysis is needed to understand this issue better. In this paper, we have analysed weighted average prices at the national level. Disaggregated analysis at the State and regional levels will allow us to understand price variations more meaningfully.

5. Labour Shortage During the Pandemic

The Covid-19 pandemic made the world recognise and appreciate the value of migrant labour. After the lockdown began, the mobility of migrant workers was severely restricted and large numbers of migrant workers returned home. Multiple sectors of the economy were affected by this phenomenon. The one sector most severely affected was agriculture; farms across the world suffered from the impact of labour shortages.

Migrant Labour: The Global Scene

The Covid-19 pandemic has shown the extent of dependence of developed country agriculture on cross-country migrant labour. In the USA, Canada, Europe and Australia, fears have heightened about how the absence of seasonal migrant inflows would disrupt cultivation during the summer months.

The USA is estimated to have about 2.5 million farm workers. Among these 2.5 million workers, more than half are immigrants with no work authorisation. In addition, more workers are annually brought into the country from South America, primarily Mexico, from March-April onwards. These workers come in on an H-2A temporary agricultural visa. Such H-2A visa workers constitute about 10 per cent of the total farm workers in the USA. Though President Donald Trump has viciously opposed migrant workers in his speeches, his own government had actually increased the number of H-2A visas from about 130,000 in 2016 to about 200,000 in 2019.

When the Covid-19 infections began to spread, the USA initially indicated that it would restrict the number of H-2A visas for 2020. Visa interviews were terminated.

Visas were issued only to those workers who were previously recipients of the visa. As a result, a large number of first-time applicants were turned away. However, in the last week of March 2020, these rules were relaxed (Wilson 2020). Even first-time applicants were allowed visas without an interview. President Trump himself stated that if this was not done "we're not going to have any farmers" (White House 2020).It is as yet unclear if this measure would resolve the stalemate. If the lockdown continues till June 2020, which is the peak season of labour demand, agricultural operations may be adversely affected. The total extent of shortfall of H-2A workers is estimated to be about 60,000. In Canada too, the shortage of farm workers is estimated at about 60,000.

Europe was estimated to have a shortage of one million farm workers, who usually migrate from North Africa and Eastern Europe. In early-April 2020, Norbert Lins, the Chair of the European Parliament's Committee on Agriculture, exhorted member countries to allow the safe passage of seasonal migrant workers. According to a news report, Lins

> called on the Agriculture Ministers and the European Commission to introduce 'laissez passer' [access passes] for seasonal workers to ensure the right to travel to seasonal workers using special busses or trains or even planes. (Nicolas 2020)

In France, it was estimated that about 200,000 agricultural workers would be needed over three months to compensate for the absence of migrant seasonal labour. The French Minister of Agriculture, Didier Guillaume, was quoted as saying: "I am calling on the men and women who are not working and locked indoors to join the great army of French agriculture," because "we need to produce to feed the French population" (Hansrod 2020). Germany was facing a shortage of about 300,000 seasonal workers who annually migrated to the country to harvest fruit and vegetables. The German government arranged special flights from Romania and Bulgaria to fly in migrant workers (McLaughlin 2020). In Poland, Ukrainian workers undertake much of the agricultural work; unions of Polish farmers requested their government to allow these workers to stay back in Poland.

In the United Kingdom (UK), the shortfall of seasonal workers was estimated to be 80,000. Farm unions in the UK demanded that the government grant them a £9.3 million support package in order to help pay for a "land army" of workers in fruit and vegetable production (Harvey 2020). Others demanded that the government encourage workers thrown out of other jobs to shift to seasonal agricultural labour on farms.

Migrant Labour: The Indian Scene

As in the West, farmers in India too faced the threat of labour shortage. The key driver of the labour shortage in India was the ill-planned announcement of the nationwide lockdown on March 24, 2020. This announcement set off a panic reaction among

millions of migrant workers across India, who began to return in thousands to the safety of their home States.

April is the month when India's rabi crops, especially wheat and pulses, are harvested. Farming in India is less mechanised than in the West, and harvest is a peak season of labour demand. Even when a farmer is using a mechanical harvester, three or four skilled labourers are needed to operate the harvesters and service the machines. In Punjab, Haryana and western Uttar Pradesh, migrant labourers from Bihar, Uttarakhand, and eastern Uttar Pradesh are regularly employed in large numbers. An assessment by the Punjab government in 2004 put the total number of migrant workers in the State's agricultural sector at about 700,000 (UNDP 2004).

There are permanent and short-term migrants in every village. Permanent migrants attach themselves to a landowner for a period, like one year, and return to their native village once a year for a few weeks. Short-term migrants travel to the destination state only during the peak season and return to their home State thereafter. In March and April 2020, many migrant workers either returned home or did not arrive due to the lockdown, fear of infections and the threats of police harassment. In many regions, farmers solicited the services of native village workers who had returned to the village from a nearby city or town due to the lockdown.

In many northern States, labour shortage forced farmers to delay or stagger harvests that led to economic losses. In the rice mills in some southern States, the shortage of migrant workers resulted in the inability of mills to procure adequate quantities of paddy from the farmers. Labour shortages were also experienced in milk processing plants, cold storage units and warehouses. According to the officials of the milk cooperative AMUL, most milk processing plants in the country were operating with half the regular labour force (Pandya 2020).

Conditions of Work

Across the globe and in India, migrant agricultural workers face extremely poor conditions at the workplace. They face multiple occupational and health hazards. They are brought to the workplace in crowded jeeps, trucks or buses. In Romania, when Eurowings announced special flights in March 2020 for migrant workers to fly to Baden, Berlin and Düsseldorf, labour contractors bussed more than 2000 workers to the Cluj airport raising panic and serious fears of Covid-19 infections (Anonymous 2020b). At the destination of work, migrant farm workers are provided with poor housing facilities; they are sometimes even housed in unventilated shipping containers and their settlements are mostly overcrowded with many workers forced to share a single room (Wiltz 2020). They are not provided with hygienic toilet facilities (Schwartz 2016). Levels of sanitation are poor. A report from the tobacco fields of North Carolina puts it thus:

> After long, hot days in the fields, many tobacco farm workers return to labour camps that are deplorable, cramped and uncomfortable, and that pose many hazards and health risks, including sleeping on bare bunks or mouldy mattresses on the floor, poor ventilation, leaky roofs, hazardous wiring, poorly maintained plumbing and showers, poor ventilation, infestations of flies, mosquitoes, and other bugs, and inadequate facilities for washing clothes contaminated by pesticides and tobacco residue. (Oxfam America 2011)

Migrant farm workers are also deprived of basic forms of social protection cover. In the USA, about half of the migrant workers do not have health insurance. Even at the height of Covid-19 infections, protective gear or face masks were not made available to the migrant farm workers.

In India, too, migrant workers are regularly transported across villages and towns in overcrowded jeeps and trucks. Most migrant workers are denied minimum wages. They cannot access the local public food distribution system. Except in Kerala, they do not enjoy any concrete welfare fund and pension cover. They have poor access to television or internet so as to gain awareness about the spread of Covid-19 and measures to be taken to reduce the spread of infection.

Migrant workers everywhere also regularly face hostility and discrimination at the destination. Dominant sections in the local population treat migrants as outsiders, and regularly humiliate them with racist or casteist overtones. Most petty thefts at the destination lead to finger-pointing at the migrant workers, branding them as potential criminals. They are relegated to the periphery of the village, geographically and socially. With the onset of Covid-19, migrants were also stigmatised as carriers of infections and this exacerbated the extent of socioeconomic exclusion they face in villages.

Migrant farm workers everywhere present a special case. They are inevitable for the production process in rural areas. Without them, rural production will collapse in many regions. Yet, they are poorly paid, treated with disdain and denied multiple human rights. It remains to be seen if the continued flow of migrant farm workers across the globe, with little focus on their safety and security, will be followed by, or associated with, any serious health hazard.

6. Conclusions

The Covid-19 pandemic has pushed the world economy into a recession. The direct and indirect effects of the pandemic are likely to persist for more than two years. This paper was an attempt to describe and analyse the impact of Covid-19 lockdown on the agricultural sector. While we reviewed the global situation, we placed special emphasis on developments in India.[10] We looked at four specific themes: production

[10] Admittedly, this paper has not been able to do justice to developments in all developing countries outside India, such as Brazil, South Africa or China. Global analysis is limited to developments in the world as an aggregate, or to developed country markets like USA and EU.

and stock of food; supply chains; prices; and migrant work. Our broad assessment is as follows.

As of April 2020, the world had food stocks that were about one-third of global annual consumption. The FAO considers this a satisfactory amount. However, world stocks are different from national stocks. If the major holders of global stocks decided to restrict exports, and if the lockdown is prolonged, countries dependent on rice imports are likely to suffer. India, has adequate stocks of cereals and pulses to feed its population through the period of lockdown. However, the challenge in India, historically, has not been production but internal distribution. As the experience during the lockdown has shown, millions of people in India suffered from reduced food consumption and hunger, as the potential of the internal food rationing network remained poorly utilised.

The situation was different with respect to animal products, which are produced and marketed on a daily basis. In the developed countries, the closure of a number of meat plants shrank the supplies of meat. Meat shelves in grocery shops were running empty in April and May 2020. In the case of milk, there was a major fall in demand combined with the disruption of supply networks. In India, milk demand fell by 20 to 30 per cent during the lockdown; the procurement of milk by the cooperatives also fell. In the case of meat, the bottlenecks in transporting animals led to closure of abattoirs. Poultry growers faced the largest losses in the animal sector; the demand for eggs and chicken fell sharply leading to major economic losses in this sector. Across the world and in India, culling of millions of birds was resorted to cut losses among poultry growers.

A key feature of the lockdown was the total breakdown of supply chains, global and Indian. Global exports of agricultural goods declined. Sowing, harvesting and marketing of crops were in crisis. In India, there were (a) disruptions in the procurement of foodgrain by government agencies; (b) disruptions in the collection of harvests from farms by traders; (c) shortage of workers to harvest the rabi crops; (d) shortage of truck drivers; (e) blockades in the transport of commodities; (f) limited operations of APMC *mandis*; and (g) shutdowns in the retail markets. Our case study of Indian markets showed that compared to the period between March 15 and May 31, 2019, market arrivals of crops during the corresponding period in 2020 were significantly lower. In an important crop like wheat, the arrivals during the two-and-a-half month period in 2020 were only 47 per cent of the corresponding arrivals in 2019.

Prices received by farmers fell as a result of the supply disruption and fall in demand. The decline was marked in certain foodgrain like wheat, perishables like vegetables and fruit, eggs and poultry chicken. The trends in retail prices was markedly different across crops and when compared to wholesale prices. Retail prices rose for certain food items, possibly due to disruptions in the supply chain, while they remained stable for certain other food items. Data till May 15, 2020, do not indicate an across

the board rise in retail prices of food items. At the same time, prices alone do not provide adequate information on the relative importance of supply shocks and demand shocks. More disaggregated studies are needed in this respect. Vulnerable sections of the population find their access to food shrunk with rises in food prices. Rising food prices could imply higher costs of food for the consumers even as they need not necessarily mean better prices for farmers.

Migrant farm workers, despite their critical presence, have always faced oppressive systems of labour control, poor working and living conditions and been denied access to social security systems. The Covid-19 pandemic opened the eyes of the world to the importance of migrant workers in rural production systems. Migrant workers as a category were, even if temporarily, made visible by their absence. This was true for both developed and developing countries. Farmers reeled under the impact of labour shortage, as agricultural operations suffered and costs of labour rose. Ports, logistics systems and truck transport systems also suffered due to the absence of migrant workers.

Agriculture deserves a new deal in a post-Covid world. The pandemic highlighted major gaps in the way agricultural policy has been conducted over many decades. It forcefully brought back the importance of self-reliance in food production and the pitfalls of free trade regimes. In the developed world, the perils of corporate-led, profit-minded, large-scale and multi-national agri-business have been highlighted as a product of unbridled capitalist expansion in agriculture, which needs reform. In the developing world, where small farmers have not been uprooted yet by large-scale agri-business or corporate farms, the challenges are related to questions of agrarian transition and the role of the state in agricultural policy. Post-lockdown, these concerns need to be forcefully brought to the policy table. Such a prospect is contingent on whether the political economy of policy making becomes conducive. To be sure, it is a tall order to expect that orthodoxies in economic theory would give way easily to a more heterodox understanding of our economy and society. At the other end of the lockdown, this is a struggle that remains to be fought.

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References

Anonymous (2020a), "Karnataka Poultry Farmer Buries Alive 6,000 Chickens in Mass Grave as Coronavirus Impacts Sale," *News18.com*, March 11, available at https://www.news18.com/news/buzz/karnataka-poultry-farmer-buries-6000-chickens-alive-in-mass-grave-as-coronavirus-impacts-sale-2533167.html, viewed on May 22, 2020.

Anonymous (2020b), "Destination Germany: Desperate to Leave Romania, Farm Workers Besiege Airports," *Emerging Europe*, April 10, available at https://emerging-europe.com/news/destination-germany-desperate-to-leave-romania-farm-workers-besiege-airports/, viewed on May 22, 2020.

Aronoff, Kate (2020), "Give Me Meat and Give Them Death," *The New Republic*, April 30, available at https://newrepublic.com/article/157501/give-meat-give-death, viewed on May 22, 2020.

Baldwin, Richard, and di Mauro, Beatrice Weder (eds.) (2020), *Mitigating the COVID Economic Crisis: Act Fast and Do Whatever It Takes*, CEPR Press, London, available at https://voxeu.org/content/mitigating-covid-economic-crisis-act-fast-and-do-whatever-it-takes, viewed on May 22, 2020.

Chu, Mei Mei, and Jadhav, Rajendra (2020), "India's Coronavirus Lockdown Curbs Buffalo Meat Exports, Hitting Ramadan Supplies," *Reuters*, May 3, available at https://in.reuters.com/article/health-coronavirus-asia-beef/indias-coronavirus-lockdown-curbs-buffalo-meat-exports-hitting-ramadan-supplies-idINKBN22F01N, viewed on May 22, 2020.

COPA and COGECA (2020), "Press Statement," April 29, available at https://copa-cogeca.eu/Download.ashx?ID=3766911&fmt=pdf, viewed on May 22, 2020.

Corkery, Michael, and Yaffe-Bellany, David (2020), "The Food Chain's Weakest Link: Slaughterhouses," *The New York Times*, April 18, available at https://www.nytimes.com/2020/04/18/business/coronavirus-meat-slaughterhouses.html, viewed on May 22, 2020.

Damodaran, Harish (2020), "21-day Lockdown: Is India Prepared to Meet the Supply Requirements of Foodstuffs?" *Indian Express*, March 25, available at https://indianexpress.com/article/explained/coronavirus-india-lockdown-food-supply-chain-6330203/, viewed on May 22, 2020.

Debucquet, David Laborde (2020), "COVID-19 Food Trade Policy Tracker," International Food Policy Research Institute (IFPRI), Washington, available at https://www.ifpri.org/project/covid-19-food-trade-policy-tracker, viewed on May 22, 2020.

Deloitte (2018), "LEADS: Logistics Ease Across Different States," Department of Commerce and Industry, Government of India, January.

Department of Economic Affairs (2020), "Macroeconomic Report," Economic Division, Government of India, New Delhi, May.

Food and Agriculture Organisation (FAO) (2020a), "FAO needs $350 Million to Avert Rising Hunger as Countries Reel From COVID-19 Pandemic's Impact," Food and Agriculture Organisation, Rome, May 18, available at http://www.fao.org/news/story/en/item/1276081/icode/, viewed on May 22, 2020.

Food and Agriculture Organisation (FAO) (2020b), "AMIS Market Monitor," no. 78, Food and Agriculture Organisation, Rome, May, available at www.amis-outlook.org/fileadmin/user_upload/amis/docs/Market_monitor/AMIS_Market_Monitor_current.pdf, viewed on May 22, 2020.

Food and Agriculture Organisation (FAO) (2020c), "Global Food Commodity Prices Drop Further in April," Food and Agriculture Organisation, Rome, May 7, available at http://www.fao.org/news/story/en/item/1273914/icode/, viewed on May 22, 2020.

Food and Agriculture Organisation (FAO) (2020d), "Global Food Commodity Prices Drop Further in April," Food and Agriculture Organisation, Rome, May 7, available at http://www.fao.org/news/story/en/item/1273914/icode/, viewed on May 22, 2020.

Gallagher, Dianne and Kirkland, Pamela (2020), "Meat Processing Plants Across the US are Closing due to the Pandemic. Will Consumers Feel The Impact?" *CNN Business*, April 27, available at https://edition.cnn.com/2020/04/26/business/meat-processing-plants-coronavirus/index.html, viewed on May 22, 2020.

Ganapatye, Shruti (2020), "Mutton Prices Skyrocket to Rs 900 per kg," *Mumbai Mirror*, May 1, available at https://mumbaimirror.indiatimes.com/coronavirus/news/mutton-prices-skyrocket-to-rs-900-per-kg/articleshow/75479482.cms, viewed on May 22, 2020.

Government of India (GoI)(2020), "Atmanirbhar India: Part 3, Agriculture," Power Point Presentation made by Finance Minister, Government of India, New Delhi, May 15.

Hansrod, Zeenat (2020), "Covid-19: French Minister Urges Jobless to Help Farmers 'so We may All Eat'," March 25, available at http://www.rfi.fr/en/france/20200325-coronavirus-covid19-food-agriculture-france, viewed on May 22, 2020.

Harvey, Fiona (2020), "Farmers Call for 'Land Army' to Sustain UK Food Production During Coronavirus Crisis," *The Guardian*, March 20, available at https://www.theguardian.com/environment/2020/mar/20/farmers-call-for-land-army-to-sustain-uk-food-production-during-coronavirus-crisis, viewed on May 22, 2020.

Jeffery, Adam, and Newburger, Emma (2020), "Wasted Milk, Euthanised Livestock: Photos Show How Coronavirus has Devastated US Agriculture," *CNBC*, May 2, available at https://www.cnbc.com/2020/05/02/coronavirus-devastates-agriculture-dumped-milk-euthanized-livestock.html, viewed on May 22, 2020.

Kemp, Daniel (2020), "Dairy Markets Facing Coronavirus 'Hangover' in 2020," *AgriInvestor*, March 19, available at https://www.agriinvestor.com/dairy-markets-facing-coronavirus-hangover-in-2020/, viewed on May 22, 2020.

Langemeier, Michael, and Mintert, James (2020), "Ag Outlook Webinar," Centre for Commercial Agriculture, Purdue University, May 15, available at https://ag.purdue.edu/commercialag/home/resource/2020/05/corn-and-soybean-outlook-webinar/, viewed on May 22, 2020.

Lonkar, Pramiti (2020), "Supply Chain Faces Disruption with over 5 Lakh Trucks Stranded at State Borders," *MoneyControl.com*, April 2, available at https://www.moneycontrol.com/news/india/coronavirus-pandemic-supply-chain-faces-disruption-with-over-5-lakh-trucks-stranded-at-state-borders-5103041.html, viewed on May 22, 2020.

Lusk, Jayson, Langemeier, Michael, and Mintert, James (2020), "COVID-19's Impacts on U.S. Food and Agriculture," Webinar, April 15, Centre for Commercial Agriculture, Purdue University, available at https://ag.purdue.edu/commercialag/home/resource/2020/04/covid-19s-impacts-on-u-s-food-and-agriculture-webinar/, viewed on May 22, 2020.

Manoj, P. (2020), "Scrap Order on Waiver of Detention Charges: Container Carriers Tell Government," *The Hindu Business Line*, April 30, available at https://www.thehindubusinessline.com/economy/logistics/scrap-order-on-waiver-of-detention-charges-container-carriers-tells-government/article31470232.ece, viewed on May 22, 2020.

McLaughlin, Daniel (2020), "Germany Lifts Ban on Foreign Workers to Salvage Harvest," *The Irish Times*, April 10, available at https://www.irishtimes.com/news/world/europe/germany-lifts-ban-on-foreign-workers-to-salvage-harvest-1.4226277, viewed on May 22, 2020.

Mohan, Vibhor (2020), "3 Crore Birds Face Culling in Punjab," *The Times of India*, March 28, available at https://timesofindia.indiatimes.com/city/chandigarh/3-crore-birds-face-culling-in-punjab/articleshow/74859968.cms, viewed on May 22, 2020.

Narayanan, Sudha, and Saha, Shree (2020), "Urban Food Markets and the Lockdown in India," WP-2020-017, Indira Gandhi Institute of Development Research, Mumbai, April.

Nicolas, Elena Sanchez (2020), "Coronavirus Threat to EU Farm Seasonal Workers," *EU Observer*, March 26, available at https://euobserver.com/coronavirus/147890, viewed on May 22, 2020.

Oxfam America (2011), "A state of Fear: Human Rights Abuses in North Carolina's Tobacco Industry," Oxfam America and Farm Labour Organising Committee, Boston, available at http://www.floc.com/wordpress/wp-content/uploads/2013/11/Oxfam-A-state-of-fear-full-report-final.pdf, viewed on May 22, 2020.

Pandya, Jay (2020), "First 15-20% Panic Rise, Then 30% Fall; Overall 10-12% Dip: Amul Chief Sodhi on Milk Sales," *Republicworld.com*, March 30, available at https://www.republicworld.com/india-news/general-news/no-need-to-panic-everyone-will-get-supplies-of-our-products-amul.html, viewed on May 22, 2020.

Press Information Bureau (PIB) (2020a), "Functional Agricultural Markets Almost Double since Beginning of Lockdown," Ministry of Agriculture and Farmers' Welfare, Government of India, April 23, available at https://pib.gov.in/PressReleasePage.aspx?PRID=1617594, viewed on May 22, 2020.

Press Information Bureau (PIB)(2020b), "200 New Mandis from 7 States Integrated with the e-NAM Platform for Marketing of Agricultural Produce," Ministry of Agriculture and Farmers' Welfare, Government of India, May 1, available at https://pib.gov.in/PressReleseDetailm.aspx?PRID=1620050, viewed on May 22, 2020.

Press Information Bureau (PIB)(2020c), "'Kisan Rath' Mobile App Turns Big Hit Within a Week of Its Launch," Ministry of Agriculture and Farmers' Welfare, Government of India, April 24, available at https://pib.gov.in/PressReleasePage.aspx?PRID=1617919, viewed on May 22, 2020.

Press Information Bureau (PIB)(2020d), "1.78 Lakh MT Pulses Distributed to 13.4 Crore Beneficiaries in States/UTs under PM-GKY," Ministry of Agriculture and Farmers' Welfare, Government of India, May 27, available at https://pib.gov.in/PressReleseDetailm.aspx?PRID=1627218, viewed on June 1, 2020.

Polansek, Tom, and Huffstutter, P. J. (2020), "Piglets Aborted, Chickens Gassed as Pandemic Slams Meat Sector," *Reuters*, April 28, available at https://www.reuters.com/article/us-health-coronavirus-livestock-insight/piglets-aborted-chickens-gassed-as-pandemic-slams-meat-sector-idUSKCN2292YS, viewed on May 22, 2020.

PTI (2020a), "Poultry Meat Sector to Witness 4 to 5 Per Cent Fall in Q4 Revenue: ICRA," *The New Indian Express*, April 25, available at https://www.newindianexpress.com/business/2020/apr/25/poultry-meat-sector-to-witness-4-to-5-per-cent-fall-in-q4-revenue-icra-2135114.html, viewed on May 22, 2020.

PTI (2020b), "Indian Begins Export of Major Farm Items Amid COVID-19 Lockdown: Government," *The Economic Times*, April 15, available at https://economictimes.indiatimes.com/news/economy/foreign-trade/indian-begins-export-of-major-farm-items-amid-covid-19-lockdown-government/articleshow/75163423.cms, viewed on May 22, 2020.

Rahar, Sunil (2020), "Lockdown-Hit Haryana Poultry Farmers Bury Starving Birds Alive," *Hindustan Times*, March 30, available at https://www.hindustantimes.com/india-news/lockdown-hit-haryana-poultry-farmers-bury-starving-birds-alive/story-gWPCZBceESiMGTniPm6smK.html, viewed on May 22, 2020.

Rath, Dilip (2020), "A new White Revolution: How COVID-19 Could Benefit the Dairy Industry", *Financial Express*, April 29, available at https://www.financialexpress.com/opinion/a-new-white-revolution-how-covid-19-could-benefit-the-dairy-industry/1942634/, viewed on May 22, 2020.

Rawal, Vikas and Verma, Ankur (2020), "Agricultural Supply Chains During the COVID-19 Lockdown: A Study of Market Arrivals of Seven Key Food Commodities in India", SSER Monograph 20/1, Society for Social and Economic Research, New Delhi.

Reserve Bank of India (RBI) (2020a), "Governor's Statement", Reserve Bank of India, Mumbai, May 22, available at https://www.rbi.org.in/Scripts/bs_viewcontent.aspx?Id=3859, viewed on May 22, 2020.

Reserve Bank of India (RBI) (2020b), "Governor's Statement," Reserve Bank of India, Mumbai, April 17, available at https://www.rbi.org.in/Scripts/bs_viewcontent.aspx?Id=3853, viewed on May 22, 2020.

Sally, Madhvi (2020), "Orders Flow in for Meat and Cotton Yarn Exporters," *The Economic Times*, April 18, available at https://economictimes.indiatimes.com/news/economy/foreign-trade/orders-flow-in-for-meat-and-cotton-yarn-exporters/articleshow/75217881.cms?from=mdr, viewed on May 22, 2020.

Schwartz, Jeremy (2016), "Unlivable: How Texas Fails Farm Workers," *My Statesman*, March 17, available at http://specials.mystatesman.com/farmworker-housing/, viewed on May 22, 2020.

Singh, Shikha (2020a), "India Lockdown: Corn Prices Drop as COVID-19 Takes Toll on Domestic Demand," S&P Global, April 8, available at https://www.spglobal.com/platts/en/market-insights/latest-news/agriculture/040820-india-lockdown-corn-prices-drop-as-covid-19-takes-toll-on-domestic-demand, viewed on May 22, 2020.

Singh, Sukhpal (2020b), "Making Markets Work for Farmers During and After the Lockdown," *The India Forum*, May 5, available at https://www.theindiaforum.in/article/making-markets-work-farmers-during-and-after-lockdown, viewed on May 22, 2020.

Terazono, Emiko, Saleh, Heba and Reed, John (2020), "Countries Follow Consumers in Stockpiling Food", *Financial Times*, April 5, available at https://www.ft.com/content/5c8cbc60-aec0-4f3d-b0e2-a5e44f0c6f74, viewed on May 22, 2020.

TNN (2020), "Containers Pile Up at Dry Port as Bizmen Struggle with Shipping Line Charges," *Times of India*, May 6, available at https://m-timesofindia-com.cdn.ampproject.org/c/s/m.timesofindia.com/city/ludhiana/containers-pile-up-at-dry-port-as-bizmen-struggle-with-shipping-line-charges/amp_articleshow/75565408.cms, viewed on May 22, 2020.

Tushir, Deepak, and Kanitkar, Ajit (2020), "Misconceptions about COVID-19 Result in Poultry Value Chain Erosion – II," *Village Square*, May 4, available at https://www.villagesquare.in/2020/05/04/misconceptions-about-covid-19-result-in-poultry-value-chain-erosion-ii/, viewed on May 22, 2020.

Tyson, John (2020), "Feeding the Nation and Keeping Our Team Members Healthy," April 26, available at https://thefeed.blog/2020/04/26/feeding-the-nation-and-keeping-our-employees-healthy/, viewed on May 22, 2020.

United Nations Development Programme (UNDP) (2004), *Punjab Human Development Report 2004*, United Nations Development Programme, New Delhi, available at http://hdr.undp.org/en/content/punjab-human-development-report-2004, viewed on May 22 2020.

United States Department of Agriculture (USDA) (2020a), "World Agricultural Supply and Demand Estimates," WASDE 599, Economic Research Service, United States Department of Agriculture, April 9, available at https://www.usda.gov/oce/commodity/wasde/wasde0420.pdf, viewed on May 22, 2020.

United States Department of Agriculture (USDA) (2020b), "Dairy Market News," vol. 87, Report 20, Economic Research Service, United States Department of Agriculture, May 11–14, available at https://www.ams.usda.gov/mnreports/dywweeklyreport.pdf, viewed on May 22, 2020.

United States Department of Agriculture (USDA) (2020c), "Egg Markets Overview," Economic Research Service, United States Department of Agriculture, May 1.

World Food Programme (WFP) (2020), "Covid-19 Will Almost Double People in Acute Hunger by End of 2020," World Food Programme, April 16, available at https://insight.wfp.org/covid-19-will-almost-double-people-in-acute-hunger-by-end-of-2020-59df0c4a8072, viewed on May 20, 2020.

Whelan, Sam (2020), "Uncleared Import Boxes Clogging India's Ports Being Used as 'Free Warehousing'," *The Loadstar*, April 24, available at https://theloadstar.com/uncleared-import-boxes-clogging-indias-ports-being-used-as-free-warehousing/, viewed on May 22, 2020.

White House (2020), "Remarks by President Trump, Vice President Pence, and Members of the Coronavirus Task Force in Press Briefing," April 1, available at https://www.whitehouse.gov/briefings-statements/remarks-president-trump-vice-president-pence-members-coronavirus-task-force-press-briefing-16/, viewed on May 22, 2020.

Wilson, David L. (2020), "Trump Welcomes More Guest Workers Amid Crisis While Rejecting Asylum Seekers," *Truth Out*, April 11, available at https://truthout.org/articles/trump-welcomes-more-guest-workers-amid-crisis-while-rejecting-asylum-seekers/, viewed on May 22, 2020.

Wiltz, Teresa (2020), "States Struggle to Provide Housing for Migrant Farmworkers," *Pew*, May 2, available at https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2016/05/02/struggle-to-provide-housing-for-migrant-farmworkers, viewed on May 22, 2020.

World Trade Organisation (WTO) (2020a), "Trade Set to Plunge as Covid-19 Pandemic Upends Global Economy," World Trade Organisation, Geneva, April 8, available at https://www.wto.org/english/news_e/pres20_e/pr855_e.htm, viewed on May 22, 2020.

World Trade Organisation (WTO) (2020b), "WTO Goods Barometer Flashes Red as Covid-19 Disrupts World Trade," World Trade Organisation, Geneva, May 20, available at https://www.wto.org/english/news_e/news20_e/wtoi_19may20_e.htm, viewed on May 22, 2020.

Young, Holly (2020), "'Exploitative Conditions': Germany to Reform Meat Industry After Spate of Covid-19 Cases," *The Guardian*, May 22, available at https://www.theguardian.com/environment/2020/may/22/exploitative-conditions-germany-to-reform-meat-industry-after-spate-of-covid-19-cases, viewed on May 22, 2020.