Scientific Journal Warsaw University of Life Sciences – SGGW
Problems of World Agriculture volume 22(XXXVII), number 4, 2022: 35-46
DOI: 10.22630/PRS.2022.22.4.15

Michał Mrozek[1]
University of Szczecin – US, Poland

Indian Agriculture and Rural Economy in Terms of the COVID-19 Pandemic

Abstract. The aim of the paper is the analysis of the changes in Indian agriculture during the pandemic. The following research questions were put forward: What is the diversification of the Indian agriculture and rural economy in terms of COVID-19?; What is the percentage change in overall agricultural commodities production, in farm-gate prices for commodities in agriculture and the allied sector and in the availability of agri-inputs? The theoretical part of the paper depicted the following issues: India's role in global farming; rural economy issues, economic recovery, and the agricultural sector in terms of the COVID-19 pandemic. The studies that were conducted include: documentation, statistical, comparative, and dynamics analysis. The results showed that the Indian agriculture and rural economy in terms of COVID-19 had different tendencies. With businesses across all industries forced to shut down, the economy ground to a halt. Even while farming operations were spared during the lockdown's early stages, the agricultural value chain nonetheless experienced widespread disruptions. This was devastating to the rural Indian economy.

Key words: agriculture, rural economy, COVID-19, pandemic, India

JEL Classification: N50, O19, P32, Q10

Introduction

Since World War II, the COVID-19 pandemic is the largest worldwide humanitarian issue the world has faced. The virus spread rapidly, and the number of cases increased every day despite government efforts to contain it. In 2020, India acted immediately, instituting a proactive, countrywide 21-day shutdown, to flatten the curve and use the time to prepare and fully resource solutions. Globally, India's efforts to tackle the COVID-19 virus have been commended. However, the lockdown had an economic effect and rippled across all segments of society. The India shutdown caused by COVID-19 was a massive economic shock. It began throughout the nation on March 24, 2020, and is still ongoing with various limits. It halted the economy by mandating the shutdown of businesses in all sectors. Even though agricultural operations were spared from the lockdown, the agriculture value chain was severely disrupted in its early stages. This has had a significant negative impact on the rural Indian economy.

In broad portions of the nation, the coronavirus epidemic has sparked a major reverse migration from urban to rural regions. In addition to the obvious difficulties, a time of crisis may also provide numerous fresh opportunities. In the current coronavirus epidemic, the immediate issue was the restoration of supply chains for key goods and the alleviation of

[1] MSc; Department of Economics, Institute of Economics and Finance, Faculty of Economics, Finance and Management, University of Szczecin, Poland, Mickiewicza 64, 71-101 Szczecin;
e-mail: 2188@stud.usz.edu.pl; https://orcid.org/0000-0001-5647-3243

the situation of troubled migratory workers (International Trade Administration, 2022; IFAD, 2022).

In these tough times, the government has offered timely assistance to migrants via its various initiatives, particularly the Prime Minister Garib Kalyan Yojana and The Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA). While the majority of the obstacles posed by the epidemic have been effectively addressed, it is essential to take advantage of the possibilities the crisis presents. A few commodities, including pulses, wheat flour, milk, and vegetables, saw increases in wholesale and retail pricing as a result of disruptions in domestic supply chains brought on by restrictions on movement, transportation challenges, and reverse labour migration. Although three-quarters of customers observed price increases in vital goods, the buffer stock of food grains and harvest from previous harvests did not prove to be adequate. There are also countless instances of groups of farmers taking the effort to secure direct delivery of food to gated communities and societies, with items ranging from exotic avocados to typical fruits and vegetables. The complete logistical system is now operational, but it lacks depth and breadth. There is a need for an institutional jolt that builds on this competence and can produce several tiers of livelihoods (Intensive Agriculture, 2022; The Financial Times, 2022; TUM G&A, 2022; India water portal, 2022).

Research questions

The paper investigates the selected aspects of Indian agriculture and rural economy in terms of the COVID-19 pandemic. The fundamental aim of the paper is to analyse the changes in Indian agriculture during the pandemic.

The author presents the following research problems:

1. What is the diversification of the Indian agriculture and rural economy in terms of COVID-19?
2. What is the percentage change in several research aspects (overall agricultural production, magnitude of production in Agri & allied sector, in overall prices of agricultural commodities, in magnitude of farm-gate prices of commodities in agriculture & allied sectors and in the availability of Agri-Inputs)?

Materials and method

The theoretical part of the paper depicted such aspects as India's role in global farming; rural economy issues, economic recovery, and the agricultural sector in terms of the COVID-19 pandemic. The studies were carried out with documentation, statistical, comparative, and dynamic analysis. The paper was prepared based on print, digital, and electronic sources: reports, databases, books, textbooks, academic and trade journals, and scientific papers.

India's Role in Global Farming

Agriculture and related industries have a vital role in the Indian economy. In terms of the general situation, it produces roughly one-sixth of India's national GDP and employs over fifty percent of the labour force. It is essential for guaranteeing the nation's food security and impacts the development of the secondary and tertiary sectors of the economy through its forward and backward connections. The success of the agriculture sector has a significant impact on accomplishments on many other fronts. Agricultural expansion decreases poverty both directly and indirectly by increasing agricultural earnings, creating jobs, and lowering food costs. In other words, a strong agricultural sector benefits the majority of India's economic sectors (Agribusiness Global, 2022; IDR, 2022).

India produces more than one-fifth of the world's rice and pulses. Similarly, it provides more than twenty percent of the world output of several horticultural crops, including okra, cauliflower, brinjal, banana, mango, and papaya (Bain & Company, 2022; IBEF, 2022; Krishnankutty et al., 2021).

Even though India is one of the greatest producers of some agricultural and horticultural items, the country's overall yield of its primary crops (except ground nuts) is lower than the average yield output seen around the world. In addition, the yield of these crops at the national level is far lower than the greatest yield that has been obtained in any other region of the globe. The COVID-19 epidemic has had a negative influence on the agricultural industry around the globe, and the agriculture sector in India is not an exception to this (Economic Research Service, 2022; FAO, 2022; Jakhotiya, 2021).

COVID-19: Rural Economy Issues, Economic Recovery, and Agricultural Sector

The COVID-19 epidemic has come at a time when the world and Indian economies were predicted to see a slowdown. As to the general information about the growth rate of the Indian economy, it should be said that it has slowed in recent quarters, with quarterly growth in Gross Value Added (GVA) falling from 7.63% in Q4 2017-18 to 3.04% in Q4 2019-20. In the financial year 2022 in the agriculture and allied sectors, the situation was better with growth at 18.08%. Estimates by the Government of India suggest that production in the eight major sectors of the economy dropped for the third consecutive month in May 2020, with output falling by 23.4%, compared with May 2019. The eight major sectors can be distinguished into: financial, real estate, and professional services (FRPS); agriculture and allied sectors (AAS); trade, hotels, transport, and communication (THTC); manufacturing (M); public administration, defence and other services (PADOS); construction (C); electricity, gas, water supply and other utilities (EGWSOU); mining and quarrying (MQ).

In terms of the distribution of gross value added across India in the financial year 2022, by sector it had the following percentages: FRPS: 20,9%; AAS: 18,8%; THTC: 16,9%; M: 15,4%; PADOS: 15,2%; C: 8%; EGWSOU: 2,3%; MQ: 2,3%. The majority of key industries, except fertilizers, have seen a decline in overall growth. The new Coronavirus (COVID-19) pandemic has brought the agricultural sector into sharp focus and increased its obligation to feed and employ thousands who may have lost their means of

subsistence. At a time when other sectors of the economy are said to be under severe strain, the agriculture industry continues to be optimistic and a source of economic support. All main kharif crops are anticipated to be seeded over a larger area than during the equivalent time last year. As the agriculture sector continues to be one of the few bright spots in the middle of this epidemic, there is a need to prioritize it now to guarantee a quick economic recovery for the nation (Earthworm, 2022; The Times of India, 2022; Kesar et al., 2021).

Analysis and Results of the Research

The survey study set out to determine how COVID-19 affected the following areas of rural life: the share of districts showing a change in overall agricultural production (in %); decrease in the magnitude of production in Agri & allied sector (in %); the share of districts showing a change in overall prices of Agricultural commodities (in %); decrease in the magnitude of farm-gate prices of commodities in agriculture & allied sector (in %); share of districts showing a change in the availability of Agri-Inputs (in %). The time scope of the survey was mainly 2020 (comparing data between 2020 and 2019), but some issues were broadened. The results of the research present significant modifications between the research variables in the given analysed areas.

The purpose of the survey was to determine if the lockdown, enforced because of the COVID-19 epidemic, had a positive, negative, or neutral effect on the many activities taking place in the farm and rural sectors. Responses were used to guide follow-up inquiries into the industry, with an eye on quantifying effect whenever feasible. 560 districts across 33 States, serviced by 401 District Development Managers (DDMs) of NABARD, were selected at random to collect data and comments. DDMs' opinions and insights are informed by their conversations with a wide range of people, including farmers, government officials, members of Self Help Groups (SHGs), Farmer Clubs, Farmer Producer Organizations, Microfinance Institutions, and Banks. The obtained data was analysed using common statistical methods.

During the time frame of the online survey (April 29th, 2020 - May 4th, 2020), the government mandated a strict lockdown. The movement of people and vehicles was strictly prohibited, except for those involved in providing life-sustaining services. It is important to note that only districts with NABARD officials present were able to contribute to the online survey; this is because the lockdown severely restricted the movement of people and vehicles. The DDMs' answers are grounded on their observations from the field and the results of discussions with a wide range of rural-based stakeholders. Consequently, the results should be evaluated and used with this caveat in mind. The share of districts showing a change in overall agricultural production (in %) is depicted in Figure 1. What is the district's sample mean? It is the percentage calculated from all districts in India.

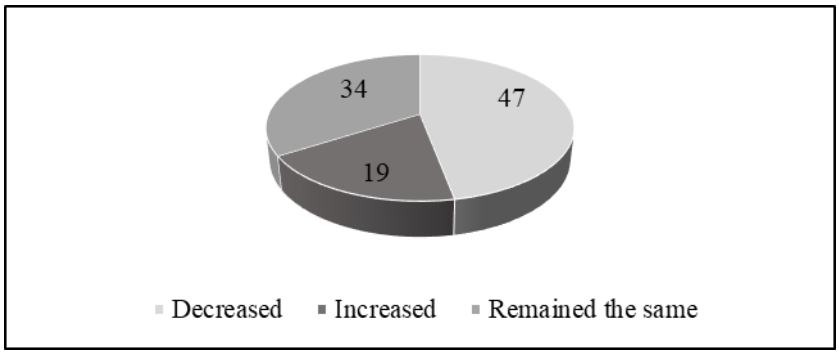

Fig. 1. Share of districts showing the change in overall agricultural production (in %)
Source: Author's own elaboration based on NABARD (2022) data.

In 47% of the sample districts, the effect of the nationwide lockdown imposed due to COVID-19 on the overall output levels in the agricultural and allied sectors has been considerable, with overall production levels in the agricultural and allied sectors falling. 19% of districts have also reported a rise in the total level of output in the sector. However, 34% of districts have shown no change in the level of production in the agricultural and allied sectors (Figure 1.). Several factors have contributed to the decrease in agricultural operations, including a shortage of available labour and machinery, the requirement for social separation, and limits on the free movement of persons and machines (Euronews, 2022; Parveen et al., 2020).

All subsectors have shown a decrease in production magnitude, with poultry exhibiting the greatest decrease of 19.6%, followed by fisheries with a 13.6% decrease in output. Crop output has been the least affected, down by 2.7%. The decrease in the magnitude of production in the Agri & allied sector (in %) is illustrated in Figure 2. What is the production in Agri & allied sector (in %)? It is a percentage change calculated from the magnitude of production in particular areas of the Agri & allied sector in India.

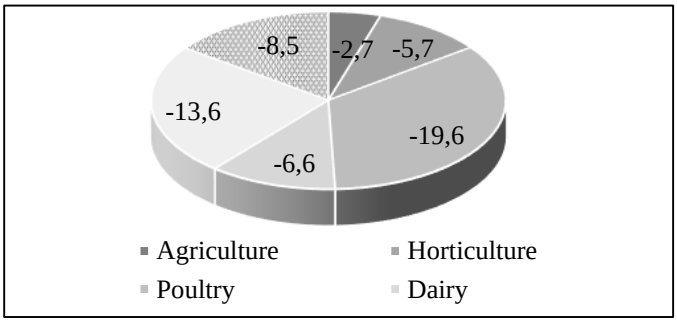

Fig. 2. Decrease in the magnitude of production in the Agri & allied sector (in %)
Source: Author's own elaboration based on NABARD (2022) data.

Output in the allied sector had decreased dramatically, particularly in the poultry sector (-19.6%), followed by fisheries (-13.6%), sheep/goat/pig (-8.5%), dairy (-6.6%), and horticulture (-5.7%) (Figure 2.) (Forests News, 2022; Behura and Dash, 2020). The pandemic's breakout has had the greatest impact on the poultry and allied industries, with demand plummeting as a result of widespread concerns in the aftermath of COVID-19 that animal products were carriers of the Coronavirus and may be a source of illness. As a consequence, demand for goods from the poultry, fishery, and sheep/goat/pig (S/G/P) sectors fell dramatically during the April 2020 lockdown period. As a result, the production cycles in these associated industries were harmed. In the dairy industry, demand for milk was somewhat unaffected, but demand for processed dairy products like sweets, khoya, paneer, cream, and so on was negatively impacted owing to demand interruptions created by the lockdown. Hotel, restaurant, sweet shop, parlour, and street vendor closures, in particular, reduced demand for processed dairy products. As a result of decreased demand, dairy producers were not receiving remunerative rates for their milk, resulting in a decline in milk output. According to feedback from the field, dairy producers lowered the dosages of green and dry fodder, feed, and other nutrients given to their animals, resulting in a decrease in milk capacity. All of these variables contributed to a 6% drop in dairy output throughout the country within one month of the lockdown (Investindia, 2022; Chathukulam and Tharamangalam, 2021).

The concerns became visible in the change in state-level production volume and the majority of states have seen a fall in agricultural productivity. Agriculture productivity has decreased significantly in states such as Chhattisgarh (13%) and Himachal Pradesh (15%). Some large agricultural states, such as Telangana (23% increase), Punjab (5% increase), Rajasthan (4.4% increase), and Gujarat (6.7% increase), have shown an increase in agricultural production, which may be attributed to the fact that rabi season witnessed bumper crop production and harvesting was completed in many states before the outbreak and lockdown (Gatesfoundation, 2022). The poultry industry was the most severely affected in all states (excluding Arunachal Pradesh, where output was estimated to have increased by 25%), with production decreasing significantly. Production levels fell the most sharply in Haryana (37.2%), Madhya Pradesh (34.2%), and Uttar Pradesh (31.9%). The drop in chicken production levels might be directly attributable to decreasing demand for poultry products as a result of widespread concern that the COVID-19 virus could spread via poultry birds.

After agricultural production, the dairy industry was one of the least impacted industries during the lockdown, since the demand for dairy products was largely consistent and the supply chain was not significantly disrupted. At the level of India as a whole, dairy output decreased by 6.6%, although this reduction was of a comparable extent across the majority of important states. The States of West Bengal (-11.9%), Jharkhand (-13%), and Chhattisgarh (-11.5%) recorded the greatest decrease in the dairy industry production, mostly owing to a fall in demand for milk products since most restaurants and confectionery stores stayed closed during April 2020 (Business-Standard, 2022; World Economic Forum, 2022).

The effect on farm-gate prices in agriculture and related sectors is another important aspect. The development of the pandemic and the ensuing government lockdown had a substantial influence on the farm-gate pricing of goods in the agricultural and associated sectors. The lack of transit, the closure of rural haats/markets, and the closing of stores, which resulted from the shutdown of key economic sectors, led to a decline in prices

throughout many parts of the nation, which was primarily caused by the closure of major economic sectors. Below is presented the share of districts showing the change in overall prices of agricultural commodities (in %) (Figure 3.). What is the district's sample mean? It is the mean percentage calculated from all districts in India. 54% of districts reported a decrease in the overall prices of goods in the agricultural and allied sectors, while 23% of districts recorded an increase. This might be linked to supply chain disruptions in several regions of the nation. In 23% of areas, prices stayed unchanged (Figure 3.) (UTKARSHAGRO, 2022).

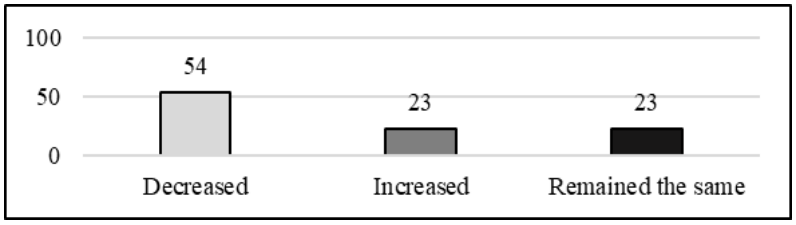

Fig. 3. Share of districts showing the change in overall prices of agricultural commodities (in %)

Source: Author's own elaboration based on NABARD (2022) data.

According to reports, farm-gate prices in India have decreased across all subsectors. The sector where prices fell the most was the chicken industry, where they fell by as much as 17.8%. This was followed by a 7.6% decline in the price of horticultural products, mostly owing to their perishability and reduced demand. The agricultural (2.2%) and swine/sheep/goat (2.9%) industries had the smallest price declines. Additionally, the dairy and fisheries industries saw a minor fall of 5.6% and 4.8%, respectively (Figure 4.). The reduction in pricing might be ascribed to a decrease in demand for these items and a disturbance in the delivery of agricultural products to the markets as result of a prohibition on vehicle mobility (JAKARTA GLOBE, 2022). What is the magnitude of farm-gate prices of commodities in the agriculture & allied sector? It is showing the percentage change in the magnitude of farm-gate prices of commodities in the agriculture & allied sector.

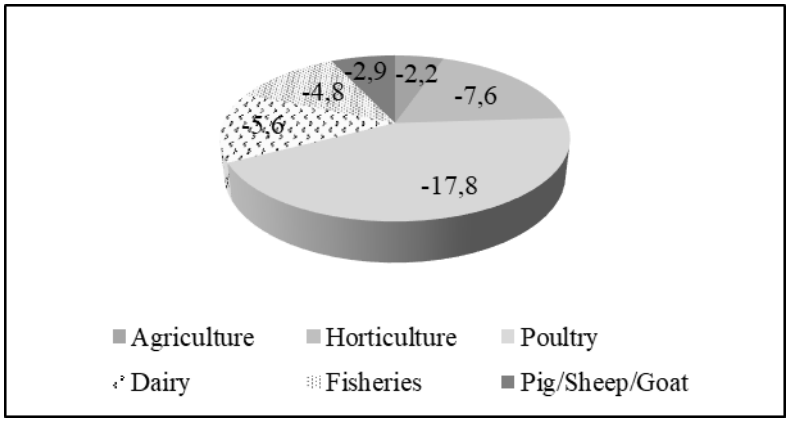

Fig. 4. Decrease in the magnitude of farm-gate prices of commodities in agriculture & allied sector (in %)

Source: Author's own elaboration based on NABARD (2022) data.

Regarding agriculture, the influence of COVID-19 on the pricing of the agriculture sector at the state level has been rather variable. Several Indian states, including Arunachal Pradesh (15%), Mizoram (13.6%), Himachal Pradesh (8%), and Jammu & Kashmir (7%), have reported a rise in agricultural commodity prices. In contrast, states like Karnataka (15%), Telangana (11.7%), and West Bengal (9.7%) have recorded a fall in agricultural commodity prices. Relating to horticulture, the influence of COVID-19 on the pricing of goods is inconsistent. Some states, including Arunachal Pradesh (15%), Kerala (13%), and Mizoram (10.7%), have recorded a rise in horticultural commodity prices. In contrast, states such as Karnataka (23%), Tamil Nadu (15.8%), Telangana (15%), and Madhya Pradesh (13.3%) have recorded a fall in the price of horticultural products. The cost of horticultural items decreased by 7.6% over the whole of India. Referring to poultry, prices have fallen significantly in most states throughout the nation. Haryana (37.2%), Madhya Pradesh (34.2%), Bihar (31.9%), and Punjab (28.2%) have recorded the greatest drop in chicken prices (Muthukumar and Salini, 2021).

In the context of dairy, prices in the industry as a whole went down by 5.6%. The prices of dairy products went up in the smaller states of Arunachal Pradesh (25%), Mizoram (7.5%), and Meghalaya (6.7%). Prices went down in the larger states of West Bengal (13.8%), Uttarakhand (15.0%), Jharkhand (14.2%), and Chhattisgarh (11.9%) (Department of Economics and Statistics Kerala, 2022). Pig/Sheep/Goat prices had a modest overall fall of 2.9% throughout India. The states with the greatest reduction in costs were Haryana (21%), Madhya Pradesh (18.6%), Himachal Pradesh (15%), and Punjab (14.4%), whereas Nagaland (25%), Kerala (16.1%), Tamil Nadu (10.6%), and Telangana (10%) had the largest rise in prices. In the context of the effect of COVID-19 on the availability of agricultural inputs during the lockdown period, it was observed that 58% of the sample districts indicated a drop in the overall availability of agri-inputs, 38% of the total districts polled reported no change in the availability of agri-inputs, and just 4% of the districts reported an increase in the availability of agri-inputs (Figure 5.) (Mckinsey, 2022). What is the district's sample mean? It is the mean percentage calculated from all districts in India.

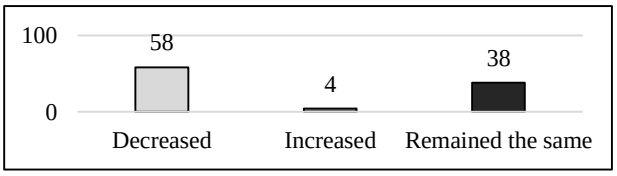

Fig. 5. Share of districts showing the change in the availability of Agri-Inputs (in %)

Source: Author's own elaboration based on NABARD (2022) data.

The overall availability of agricultural inputs in India has been reported to have decreased across all subsectors. The availability of fertilizers fell the most (11.2%), followed by fodder/cattle feed (10.8%) and rental agricultural equipment (10.6%). Pesticide availability (9.8%) and seed availability (9.1%) have also decreased significantly. The causes for the drop in input availability were supply disruptions caused by limits on vehicle travel, the closure of stores and marketplaces, and so on (Outlookindia, 2022; Harris et al., 2020).

In terms of the state-level impact on agri-input availability, although there was an overall drop in the availability of agricultural inputs at the national level, there were slight variances among states. Seed availability was negatively affected in all states (excluding Arunachal Pradesh, where seed availability increased by 2.8%). The biggest reduction in seed availability was documented in Nagaland (27.5%), Jharkhand (16.7%), West Bengal (15%), Bihar (14.7%), and Tamil Nadu (12.5%). As to fertilizers, the lockdown enforced as a result of the COVID-19 epidemic had a substantial effect on the supply of fertilizers. Except for Uttarakhand and Arunachal Pradesh, the availability of fertilizers declined in every state. States such as Nagaland (35%), Jharkhand (20.8%), Punjab (20%), Andhra Pradesh (18.8%), and West Bengal (18.8%) recorded the greatest decrease in fertilizer availability. In terms of pesticides, the availability decreased significantly in all states except Uttarakhand (Reserve Bank of Australia, 2022; Jaacks et al., 2021). Nagaland (35%), Andhra Pradesh (20.6%), Manipur (20%), and West Bengal (18.1%) reported the biggest decline in pesticide availability.

Concerning rental agricultural machinery, due to constraints on the movement of persons and materials, the availability of Rental Agricultural Machinery has decreased throughout all states in the nation. Nagaland (45%), Jharkhand (18.6%), Assam (17%), and Gujarat (17%) reported the greatest decrease in the availability of Rental Agricultural Machinery. In regards to fodder/cattle feed, supply has also decreased throughout all states in the nation as a result of the COVID-19 outbreak. Manipur (19.7%), West Bengal (19.7%), Bihar (17.6%), and Jharkhand (16.1%) were among the states reporting the biggest reduction in fodder/cattle feed availability (Statista, 2022; Ceballos et al., 2020; Darnhofer, 2020).

Conclusions

The agricultural and related industries took a significant hit from COVID-19 and the subsequent shutdown on a nationwide scale. However, related industries including poultry, fisheries, and the pig/goat/sheep sector saw a severe drop in demand owing to incorrect rumours regarding the means of spreading the virus, resulting in decreased output and falling farm- gate prices. Rabi crops were the least impacted since harvesting was almost complete. Nonetheless, it was predicted that the closure of stores and marketplaces would lead to a rise in the price of agricultural supplies. While banks were not directly affected by the lockdown, fundamental banking services such as loans, deposits, and recoveries were severely limited in most of the sample areas throughout the nation. The bright spot, meanwhile, was an uptick in digital banking activity across the board in sample districts. Microfinance and micro, small, and medium-sized enterprises (MSME) were hit the hardest, with disruptions occurring in over 80% of the sample districts. This had a devastating effect on the unorganized sector, which is responsible for the vast majority of rural employment. Also, all Farmers Producer Organisation (FPO) and Finance Companies (FC) operations came to a standstill. These rural organizations, such as SHGs, took advantage of the crisis by making face masks, personal protective equipment, and sanitizers, therefore aiding the community and providing financial security for its members. In addition, in some of the districts, FPOs worked closely with local government to give fruit, vegetable, and dry rations to the poor, providing a much-needed helping hand to the community. SHGs and Farmer Clubs (FCs) are two examples of rural organizations that

helped spread information about the spread of COVID-19 and how to protect against it across rural communities.

Literature

Behura, S., Dash, D. (2020). Highway or Byway: Corona Virus Effect in Agriculture. *Biot. Res. Today*, 2, 523-525.

Ceballos, F., Kannan, S., Kramer, B. (2020). Impacts of a national lockdown on smallholder farmers' income and food security: Empirical evidence from two states in India. *World Dev.*, 136, DOI: 10.1016/j.worlddev.2020.105069.

Chathukulam, J., Tharamangalam, J. (2021). The Kerala model in the time of COVID-19: Rethinking state, society, and democracy. *World Dev.*, 137, DOI: 10.1016/j.worlddev.2020.105207.

Darnhofer, I. (2020). Farm resilience in the face of the unexpected: Lessons from the COVID-19 pandemic. *Agric. Hum. Values*, 37, 605-606, DOI: 10.1007/s10460-020-10053-5.

Department of Economics and Statistics Kerala (2021). Gross Domestic Product of Kerala and India, Department of Economics and Statistics Kerala: Thiruvananthapuram, India.

Harris, J., Depenbusch, L., Pal, A.A., Nair, R.M., Ramasamy, S. (2020). Food system disruption: Initial livelihood and dietary effects of COVID-19 on vegetable producers in India. *Food Security*, 12, 841-851, DOI: 10.1007/s12571-020-01064-5.

Jaacks, L.M., Veluguri, D., Serupally, R., Roy, A., Prabhakaran, P., Ramanjaneyulu, G. (2021). Impact of the COVID-19 pandemic on agricultural production, livelihoods, and food security in India: Baseline results of a phone survey. *Food Security*, 13, 1323-1339, DOI: 10.1007/s12571-021-01164-w.

Jain, P., Baghla, K., Aditya, R. (2020). Effect of corona/COVID-19 on the agricultural sector in India. *The Pharma Innovation Journal*, 9(5), 41-45.

Kangogo, D., Dentoni, D., Bijman, J. (2020). Determinants of farm resilience to climate change: The role of farmer entrepreneurship and value chain collaborations. *Sustainability*, 12, 868, DOI: 10.3390/su12030868.

Karki, S.K., Jena, R., Grote, U. (2016). Fair Trade Certification and Livelihoods: A Panel Data Analysis of Coffee-Growing Households in India. Agric. *Resour. Econ. Rev.*, 45, 436-458, DOI: 10.1017/age.2016.3.

Kesar, S., Abraham, R., Lahoti, R., Nath, P., Basole, A. (2021). Pandemic, informality, and vulnerability Impact of COVID-19 on livelihoods in India. *Can. J. Dev. Stud.*, 42, 145-164, DOI: 10.1080/02255189.2021.1890003.

Krishnankutty, J., Blakeney, M., Raju, R.K., Siddique, K.H.M. (2021). Sustainability of Traditional Rice Cultivation in Kerala, India-A Socio-Economic Analysis. *Sustainability*, 13, 980, DOI: 10.3390/su13020980.

Kumar, A., Padhee, A.K., Kumar, S. (2020). How Indian agriculture should change after COVID-19. *Food Security*, 12, 837-840, DOI: 10.1007/s12571-020-01063-6.

Kumar, P., Singh, S.S., Pandey, A.K., Singh, R.K., Srivastava, P.K., Kumar, M., Dubey, S.K., Sah, U., Nandan, R., Singh, S.K., et al. (2021). Multi-Level impacts of the COVID-19 lockdown on agricultural systems in India: The case of Uttar Pradesh. *Agric. Syst.*, 187, DOI: 10.1016/j.agsy.2020.103027.

Meuwissen, M.P.M., Feindt, P.H., Spiegel, A., Termeer, C.J.A.M., Mathijs, E., de Mey, Y., Finger, R., Balmann, A., Wauters, E., Urquhart, J., et al. (2019). A framework to assess the resilience of farming systems. *Agric. Syst.*, 176, DOI: 10.1016/j.agsy.2019.102656.

Muthukumar, P., Salini, R. (2021). Impact of COVID-19 on production and productivity of Kerala agriculture sector. *IJISET-Int. J. Innov. Sci. Eng. Technol.*, 8, 155-162.

Norvy, P., Elsa, M.J., Sheena-Rajan, P. A. (2020). Revisit to COVID-19 Challenges and Responses: A Case Study of Kerala. *Space Cult. India*, 8, 47-61, DOI: 10.20896/saci.v8i2.1061.

Padhee, A.K., Pingali, P. (2020). Lessons from a pandemic to repurpose India's agricultural policy. *Nat. India*, 1-9.

Internet sources

Agribusiness Global, How Agtech Is Reshaping the Farming Landscape in India, https://www.agribusinessglobal.com/agtech/how-agtech-is-reshaping-the-farming-landscape-in-india/, (access: 05.12.2022).

Bain & Company, Indian Farming's Next Big Moment: Farming as a Service, https://www.bain.com/contentassets/cb61f701eb1b4923bb41a8a70f04a290/report_indian_farmings_next_big_moment_farming_as_a_service.pdf, (access: 03.12.2022).

Business-Standard, India: An agricultural powerhouse of the world, https://www.business-standard.com/article/b2b-connect/india-an-agricultural-powerhouse-of-the-world-116051800253_1.html, (access: 06.12.2022).

Earthworm, Earthworm's campaign to help tackle environmental challenges in India, https://www.earthworm.org/news-stories/change-the-climate-india?gclid=CjwKCAiAkfucBhBBEiwAFjbkr0i2Bc17_9nvNUiBIYF8z_QSoJOUG169Xn_-9aaOlXbavWo6M-DfFBoCiM8QAvD_BwE, (access: 04.12.2022).

Economic Research Service, U.S. Department of Agriculture, https://www.ers.usda.gov/topics/international-markets-u-s-trade/countries-regions/india/, (access: 10.12.2022).

Euronews, Farmers in India are fighting climate change and desertification using nature, https://www.euronews.com/green/2022/11/12/farmers-in-india-are-fighting-climate-change-and-desertification-using-natural-agriculture, (access: 30.12.2022).

Food and Agriculture Organization of the United Nations (FAO), FAO in India, https://www.fao.org/india/fao-in-india/india-at-a-glance/en/, (access: 21.12.2022).

Forests News, Beyond the Green Revolution: Clearing a new path for Indian agriculture, https://forestsnews.cifor.org/76536/beyond-the-green-revolution-clearing-a-new-path-for-indian-agriculture?fnl=, (access: 27.12.2022).

Gates Foundation, Agricultural development, https://www.gatesfoundation.org/our-work/places/india/agricultural-development, (access: 25.12.2022).

India Brand Equity Foundation (IBEF), Agriculture in India: Information About Indian Agriculture & Its Importance, https://www.ibef.org/industry/agriculture-india, (access: 31.12.2022).

India Development Review (IDR), What's next for agriculture in India? https://idronline.org/whats-next-for-agriculture-in-india/?gclid=CjwKCAiAkfucBhBBEiwAFjbkr9vIeN5Ftdbp3iIUfTz7M6r1Ir86SJx8BZB0ikHI7l7V-LQvhjJpwBoCJa0QAvD_BwE, (access: 28.12.2022).

India water portal, Agriculture, https://www.indiawaterportal.org/topics/agriculture, (access: 01.12.2022).

International Fund for Agricultural Development (IFAD), India, https://www.ifad.org/en/web/operations/w/country/india, (access: 03.12.2022).

International Trade Administration, Food and Agriculture Value Chain, https://www.trade.gov/country-commercial-guides/india-food-and-agriculture-value-chain, (access: 06.12.2022).

Intensive Agriculture, https://agricoop.nic.in/sites/default/files/Intensive%20Agriculture%20April%20-%20June%2C%202022%20issue%20%281%29_repaired_0.pdf, (access: 09.12.2022).

Investindia, Industry Scenario, https://www.investindia.gov.in/sector/agriculture-forestry, (access: 11.12.2022).

JAKARTA GLOBE, Will India Become a Leading Agricultural Power? https://jakartaglobe.id/opinion/will-india-become-a-leading-agricultural-power/, (access: 27.12.2022).

Mckinsey, How digital innovation is transforming agriculture: Lessons from India, https://www.mckinsey.com/industries/agriculture/our-insights/how-digital-innovation-is-transforming-agriculture-lessons-from-india, (access: 18.12.2022).

National Bank for Agriculture and Rural Development NABARD, Publications, https://www.nabard.org/Publication.aspx?cid=50&id=24, (access: 29.11.2022).

Outlookindia, Are Indian Farmers Ready To Explore International Markets?, https://www.outlookindia.com/website/story/india-news-are-indian-farmers-ready-to-explore-international-markets/343762, (access: 16.12.2022).

Reserve Bank of Australia, Economic Development and Agriculture in India, https://www.rba.gov.au/publications/bulletin/2011/jun/3.html, (access: 18.12.2022).

Statista, Agriculture in India - statistics & facts, https://www.statista.com/topics/4868/agricultural-sector-in-india/#topicOverview, (access: 31.12.2022).

The Financial Times, India's rice farmers find themselves on the front line of the water crisis, https://www.ft.com/content/92408b4c-f46d-4daf-bc5f-0308bb9ea61b, (access: 29.12.2022).

The Food and Land Use Coalition, Food and land use context in India, https://www.foodandlandusecoalition.org/country/india/, (access: 27.12.2022).

The Times of India. Covid Deaths in India: India's Covid Toll in 2nd Wave Tops 2.5 Lakh, 1 Lakh More Deaths Than in 1st Wave, https://timesofindia.indiatimes.com/india/covid-toll-in-second-wave-tops-2-5-lakh/articleshow/84393269.cms (access: 31.12.2022).

TUM Global and Alumni Office (TUM G&A), The impact of agricultural technology on the future of farming in India, https://www.international.tum.de/en/global/mumbai/insights/future-of-farming/, (access: 20.12.2022).

UTKARSHAGRO, Our Incredible India- A Global Agricultural Powerhouse, https://utkarshagro.com/india-a-global-agricultural-powerhouse/, (access: 25.12.2022).

World Economic Forum, How vertical farms could boost food production in India, https://www.weforum.org/agenda/2022/10/how-vertical-farms-increase-food-production-india/, (access: 28.12.2022).

For citation:

Mrozek M. (2022). Indian Agriculture and Rural Economy in Terms of the COVID-19 Pandemic. *Problems of World Agriculture*, 22(4), 35-46; DOI: 10.22630/PRS.2022.22.4.15