



Review Article

Effect of COVID-19 Outbreaks' on the Livestock Industry

Abdul Kabir¹, Muhammad Rasheed², Hubdar Ali Kaleri⁵, Depeesh Kumar Bhuptani³, Mithan Kumar⁴, Raza Ali Mangi⁶, Abdul Wahid Solangi⁴, Sheva Dari¹, Saqib Kakar⁴, Panah Munir⁴, Ekra Akbar⁴ and Rameez Raja Kaleri^{4,5*}

¹Department of Veterinary Microbiology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, Pakistan; ²Animal Science Institute, PARC- National Agriculture Research Center Islamabad, Pakistan; ³Department of Meat Technology, Shaheed Benazir Bhutto University of Veterinary and Animal Sciences, Sakrand; ⁴Department of Animal Breeding and Genetics, Sindh Agriculture University, Tandojam; ⁵Livestock and Fisheries Department Government of Sindh; ⁶Department of Veterinary Anatomy and Histology, Shaheed Benazir Bhutto University of Veterinary and Animal Sciences, Sakrand.

Abstract | Pandemic of corona virus was started on the 11 March of 2020 year in Wuhan city of Peoples Republic of China by SARSCov 2 novel corona virus. In Covid 19 lockdown situations different types of industries got suffered and including livestock and poultry farming at high range. In the December of 2019, outbreak of corona virus started in China. The most common symptoms of this viral infection was observed and reported by the International Committee on the Taxonomy of Viruses SARS Cov 2. Main signs and symptoms of infections has been observed, tiredness, shortness in respiration, pain in chest area, dry cough, fever with difficulty in breathiness. Its genome sequence homology study also showed that the nucleotide sequence of human corona virus (SARS Cov-2 virus) is 87.5 percent to 96.3 percent identical to bat-borne corona viruses. Factory closures, IT parks, restaurants, shopping centers, and multiplexes are relatively easy to close during lockdowns, but agriculture and animal husbandry are more difficult to close; these industries will continue to produce. In order to manage our agriculture and livestock sectors in the best interests of both producers and consumers, we need an effective and quick action plan. The first step is to ensure that farm produce, livestock feed, and veterinary medication can circulate freely. Many critical services, for example, were not affected by the lockdown. Essential services such as food, feed, and agricultural inputs have been identified.

Received | August 05, 2021; **Accepted** | December 02, 2021; **Published** | November 26, 2022

***Correspondence** | Rameez Raja Kaleri, Department of Animal Breeding and Genetics, Sindh Agriculture University, Tandojam; **Email:** rameezkaleri@gmail.com

Citation | Kabir, A., Rasheed, M., Kaleri, H.A., Bhuptani, D.K., Kumar, M., Mangi, R.A., Solangi, A.W., Dari, S., Kakar, S., Munir, P., Akbar, E. and Kaleri, R.R., 2021. Effect of COVID-19 outbreaks on the livestock industry. *Journal of Innovative Sciences*, 8(2): 263-270.

DOI | <https://dx.doi.org/10.17582/journal.jis/2022/8.2.263.270>

Keywords | NCOVID-19, Outbreak, Lockdown periods, Livestock industry, Poultry farmers



Copyright: 2022 by the authors. Licensee ResearchersLinks Ltd, England, UK.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

The start of novel pandemic suddenly affected the world. During last century about 500 million

peoples were affected by influenza pandemic in 1918 and 17-50 million were killed (Jermy *et al.*, 2020). In 2009 swine flu pandemic affect 61 million people and 284000 peoples were killed. In this disease H1N1

influenza virus was observed. However recent outbreak of SARS COVID-19 virus showed strong candidates for zoonotic pathogen conditions and spread over the world. Common human coronaviruses, according to the Centers for Disease Control and Prevention, mainly cause mild to moderate upper-respiratory tract diseases. Such as a common cold the majority of people become infected with one or more viruses at some time in their lives, they will encounter more of these viruses. It suggests that the human corona virus can be passed from animals to humans. COVID-19 is therefore classified as a Zoonotic illness. It is a highly contagious disease that spreads quickly from person to person/surface to surface via air droplets/fomites. The virus can spread up to 27 feet from an infected individual. It can endure anywhere from 2 hours to 9 days on various surfaces (paper, wood, glass, metals, plastic wares, etc.). However, there is no evidence that COVID-19 has spread from meat, eggs, milk, hide, or any other source. The meat, milk, and egg sectors were nevertheless severely harmed as a result of rumours. The price of chicken, in particular, exceeds the cost of production. Poultry farmers were forced to sell their products at a low price. There was complete lockdown during the COVID-19 epidemic. Everyone's movement was restricted in that circumstances. All of the manufacturing plants were shut down. For a limited time, only a few shops selling essentials like milk, veggies, medicine, and food grains were open. As a result, input raw material supply chains (animal feed, fodder) have been interrupted. Milk and meat sales have been declining. Farmers that raise poultry are in a desperate predicament. It has been reported number of COVID 19 people affected in many industries of different countries including Denmark, Brazil, Canada, Ireland, U.S, Spain, Australia and Germany (Van *et al.*, 2020). It has been reported this virus infected over 1500 workers in Europe continent in meat processing plant. It showed that major outbreak of virus at peaked after some weeks during the time when country was reopening (Connolly, 2020). It is reported that U.S was on the hardest hit country, where about 39000 positive cases were reported from 11th September in 417 meat processing plants in 40 states and about 184 deaths were reported in 27 states 50 plants. About 200 U.S department of Agriculture Food Safety Inspection Service (AFSIS) inspector reported positive with 4 deaths (Chadde, 2020).

1.1 The importance of the livestock industry

Before the COVID-19 pandemic particular livestock

and poultry production in industrial world was increasing and growing rapidly in the developing world by characterization of reduce the cost and increasing the production with intensive nature (Baba *et al.*, 2017). In this industry farms are less in number with larger number of animals and birds per holding nearly, environment control buildings, with large number of automatic with less number of staff (EPA, 2020). The production system is made to get maximum profit with all sort of chain from hatch to slaughter with full capacity. Such rapid effect of COVID-19 was a huge wave of panic for buying and seller public. Such products got decrease from the supermarket in early days were toilet rolls, sanitizers and disinfectants, milk, meat, egg, cheese pasta, yeast, rice and flour. It was also reported that prices of milk, meat and egg were also raised on the dairy shops during the lockdown (Etuah *et al.*, 2019).



Figure 1: The impact of COVID-19 on the dairy industry .

Pakistan is predicted to generate 42 billion liters of milk each year. Domestic animals contribute significantly to civilization and human existence all throughout the world, and they play an important part in agriculture. Livestock products are estimated to contribute for 30% of the entire worldwide value of food and agriculture, and roughly 19% of global food output (Shahid *et al.* (2012). Dietary animals contribute roughly 33% of the protein consumed in human diets worldwide, as well as roughly 16% of food energy (Martin (2001). Wool, skins, bones, and dung for fire are all valuable non-food goods. Animal manures contribute significantly to soil fertility and productivity, particularly in poor countries. In some communities, animals also supply significant power for cultivation and transportation, and they symbolize significant value, equity, and insurance globally.

Protein is an important component of animal feeding. It is essential for animal growth, body upkeep, reproduction, and the production of goods such as

milk, eggs, and wool. Approximately 11% of the total land mass is cultivated, 26% is permanent pastureland, and 31% is covered by forest. Protein can be obtained from plants and crops cultivated locally in traditional low-output farming methods. For commercial livestock and mixed farm profitability, higher output animal production is becoming increasingly crucial, and nutrition (especially protein) requirements have become considerably more demanding. High-performing animals require higher-quality feed, and with the exception of large-scale sheep and beef operations, imports of quality protein and energy in the form of compound or straight feeds are now the norm. Around 800 million tonnes of compound animal feed are produced annually around the world [IFIF \(2002\)](#).

The International Food Policy Research Institute's (IFPRI) IMPACT food model predicts that meat demand would rise by 58 percent between 1995 and 2020. Over this time period, demand for poultry meat could rise by 85 percent, beef by 50 percent, and pig meat by 45 percent. According to IFPRI, the developing world will account for 97.5 percent of population growth between now and 2020, accounting for 84 percent of global society. In the developing world, income development, urbanization, changes in lifestyles and food choices, as well as continued population increase, might quadruple meat demand by 2020. This forecast may not be realized during the COVID-19 pandemic. Technology advancements, regulatory requirements and institutional constraints, environmental concerns, globalization effects, competitiveness, and political involvement are some of the other drivers of change in the agrifood business. All of these elements will have an impact on the so-called "livestock revolution," to a greater or lesser extent.

By the help of (CGIAR) Research program on policies of institution and market (PIM) (USAID) United States Agency for International Development (BMGF) Bill and Melinda Gates Foundation, IFPRI is jointly working with local partner as well government of different countries to find out the economic loss as well as cost of such loss due to Covid 19 in multiple developing countries to know the public investment and policies of their relief and recovery during the 2020 to 2022. Main aim of this authority is to recognize vulnerable population groups, such as men and poor women which are on

major risk of poverty, diet and food security.

Following studies are underway by the IFPRI COVID-19 carried out by government and demand with support of USAID and BMGF.

- To make communication among the local partner and Government of Covid 19 affected countries with AGRA Alliance for the Green Revolution in Africa BMGF and its supporting country staff and USAID Agency.
- To increase the level of work in various other countries which are under observation for Covid 19 affect
- To apply the Broaden analysis to provide relief and recovery work with better policies on Covid 29 affected areas.
- To maintain a task for knowing the level of danger and risk such food insecurity, climatic change, world market uncertainty ([EPA, 2020](#); [IFPRI, 2020](#)).

As the corona virus crisis takes an unprecedented toll on the region's service sector and main export destinations, the IMF's Asia and Pacific Department predicts that Asia's economic growth will come to a halt in 2020 for the first time in 60 years. Policymakers must provide targeted assistance to homes and businesses that have been disproportionately affected by travel bans, social distancing regulations, and other pandemic-fighting measures. The world economy is going through a period of great uncertainty and difficulty. There is no exception in the Asia-Pacific area. The corona virus will have a huge, all-encompassing, and unprecedented influence on the region. This isn't the time to go about your business as normal. Asian countries must employ all policy instruments available to them [Corona \(2020\)](#).

1.2 Effect on dairy sector

The GDP growth percentage of Pakistan during the year 2019 to 2020 was estimated 3.2% prior to Covid 29 pandemic and share of agriculture was 2.9%. Out break of corona virus and other hand, slowed several channels of Pakistan's economy; as a result, the provisional GDP growth for 2019–2020 has been recalculated at -0.4%, with agriculture as the sole sector exhibiting positive growth at 2.7 percent [PBS \(2017\)](#). Punjab is the most populous province in Pakistan, accounting for about half of the country's agricultural output. The province produces more than 80% of the country's wheat and cotton, almost two-

thirds of the country's sugarcane, and around half of the country's maize, while its horticulture output accounts for 67 percent of the country's total [GOP \(2018\)](#).

India is one of the fastest-growing global leaders of livestock product producers over the last decade and is currently the fourth largest in volume terms. The animal husbandry, dairy and fisheries ministry of Govt. of India has been kept for regular vigil on the stock of situation. The minister of Food and Agriculture are linked to recognized the decrease in consumption demand of milk, meat even these are major food accessories. It has been reported that from the start of lockdown consumption of such food items have been decrease at large level due to many supply problems in market. During initial period of lockdown majority of peoples refused to buy meat as different types of rumors were spread in the market regarding the presence of corona virus in meat and it could be spread through this. Whereas Ministry of food and Agriculture has displayed on media such as TV, Newspaper, and other programs that chicken is safe and there is no evidence for covid 19 presences in Chicken egg, meat. Indian Minister of Dairy, Fisheries and Animal Husbandry Giriraj Singh submitted a report in Assembly about the loss of Covid 19 in livestock and Poultry industry. Government started to collect the data of affected industries including Fisheries, milk, meat and poultry for knowing the estimation of economic loss in this industry ([Kumar, 2020](#)). Government was also taking serious to low consumption of milk because most of the milk was transported from small scale farmers brought milk for sweat shops and bakery and these shops were closed. This was major problem facing by farmers deal remaining milk which got serious loss to small scale dairy farming in lockdown situation.

Dairy industry in India has faced approximately 25-30% reduction in the overall demand of dairy products in first 1 month after the lockdown, that is, since March 25, 2020 [Shashidhar \(2020\)](#). In many rural areas milk cooperatives are not established yet. It has led to distressed sale of milk by villagers and hence reduction in milk price was reported up to 50% level [Bilawal et al. \(2020\)](#). It was also necessary for farmers to provide proper fodder and to know the proper places and sources of animal fodder regularly due to closing of market.

1.3 Effect of COVID-19 on livestock production

The lockdown had a significant impact on livestock

production, particularly piggery, horses, ponies, camels, goats, sheep, and the meat export business. Limited market access, a lack of marketing, and a disruption in the marketing channel cost animal keepers a lot of money. The export of buffalo meat was halted due to restricted movement during the lockdown, which had a significant impact on the country's economy. The anticipated annual revenue from buffalo meat exports is Rs. 25,000 crores [Corona \(2020\)](#). Sales and prices have been reduced due to the disruption of the logistical channel and a decline in demand. For example, pig prices in the United States have decreased by nearly 27% in just over a week. Farmers are forced to hold their stock longer or dump milk due to limited access to markets and slaughterhouses/processing factories, resulting in higher production costs or animal overgrowth, and hence decreased demand and profitability [FAO \(2020\)](#).

Various countries including Pakistan, China, United States of America and India have two different supply chains such as supply of green vegetable stores and 2nd supply of food industry. However, the gap between the shelves not showed the lack of things but present of commodities in the forms in un well manner in supermarket show its increased the price and demand. As during the pandemic all schools and restaurant were closed and demand of dairy products reduced about 12 to 15% (16) leading to milk surplus and dumping. All the egg demand was increased in whereas the liquid egg demand was reduced up to 30% in market due to closures and cancellations of plants ([Gibbens, 2020](#)).



Figure 2: Livestock sector suffer in lockdown.

1.4 Effect on poultry sector

The poultry business has been struck hard in several parts of the country due to rumors that the new corona virus can be transferred to humans through chicken consumption, causing prices to plummet. In

the market, poultry farmers were sold on 20 rupees one bird, whereas its total productions cost was more than 80 rupees. It has been reported about nearly 2 crore poultry farming engaged in this business got seriously affected during this lockdown situation. The people were refusing the buy meat, fish, egg as well as other food items, hence reduction in demand got decreased in the prices about 70 percent. Right now chicken has been sold 100 to 150 per bird before this pandemic it was 180 to 200 per kg prior to the Covid-19 pandemic [Sardana \(2020\)](#).

During initial period of Covid 19 outbreak government has been taken serious safety measures to prevent its spread in multiple areas these restrictions seriously affected the poultry production system and different developing countries of the world ([Hossain *et al.*, 2020](#); [FAO, 2021](#)). Due to lockdown in world Agriculture as well as livestock industry was seriously affected due to stoppage and decrease in the transportation of items from producer to consumer ([Hafiz and Attia, 2020](#)). It has been reported that Covid 19 crises affected on various industries including poultry food, chick transportation that was a big challenge from small scale farmers. It is real fact that this virus affected poultry and livestock supply chain danger to highly worse for livelihood ([Deeh *et al.*, 2020](#)).

Equipment, feeding systems, manual feeders, water systems, drinker heating systems, and ventilators for the poultry industry have all seen a significant drop in sales in recent weeks. At any given moment, there are an estimated 80 million live poultry, including broilers and layers, giving meat and eggs to consumers. Poultry and dairy farmers, as well as those who grow maize, soybean, mustard, peanut, cotton, and other coarse grains used in livestock feed, benefit from these birds and animals [Kumar \(2020\)](#).

Top poultry producers in the country reported that chicken and egg sales had dropped by half in the last few weeks, owing to rumors linking them to the Corona virus illness. The rumors have resulted in a 50% decline in consumption to 35-40 million birds each week, as well as a 70% drop in costs. During this time, the chicken business has decreased by 10% to 11%. In the branded chicken business, a reduction in sales of 30-40 percent has been noticed. In the previous four to five weeks, the unorganized chicken business has lost 10-11 percent of its earnings. Not

only businesses, but also farmers, have suffered losses in recent weeks as a result of the corona virus concern, which has resulted in a decline in chicken consumption in the country [Covid 19 \(2020\)](#).

Lockdown has disrupted the supply chain at many levels, including hatcheries, feed mills, poultry farms, and retail outlets, due to restrictions on vehicle movement. Furthermore, chicken consumption in India is estimated to be around 1.5 lakh tonnes per week in value terms, worth Rs 1,100 crore, with approximately one crore day old chicks placed per week at the national level. In terms of employment, the chicken sector in India employs over 4 crore people. Though the poultry industry rebounded somewhat once they clarified that eating chickens was safe, he claimed that complications connected to the inter-state movement of eggs and hens in various regions of the country damaged the industry. The poultry business, according to the Association, employs over 10 lakh farmers and directly contributes Rs 1.3 lakh crore to the country's GDP. More than one crore maize and soya agriculture farmers gain directly from the sector. Poultry farming employs nearly five crore Indians directly and indirectly through poultry production, trading, feed manufacturing, agriculture crops, logistics, exports, and other activities. The poultry sector suffered a cumulative loss of Rs 22,500 crores in the first two-and-a-half months of this year [Weizhen \(2020\)](#).



Figure 3: Coronavirus impact on poultry.

1.5 Post COVID-19, livestock production in Asia

Prior to the COVID-19 epidemic, China's pig industries were suffering from African Swine Fever, which had wiped out the country's hog population and sent pork prices soaring in the previous year. China's poultry producers are in severe straits as a result of the corona virus outbreak, which follows the country's pork problem. Millions of chickens may perish in the next days due to a lack of critical feed. According to analysts and Chinese

state media, the shutdowns in China's provinces have impacted supply chains, with transportation restrictions preventing much-needed animal feed such as soybean meal from reaching chicken farms.

In order to identify the demand of medium, small, micro enterprises and operational conditions observed during the pandemic, a survey was conducted with the name of ESIEC Enterprise Survey for Innovation and Entrepreneurship of China. This survey was conducted through online interview by cell phone and land line telephonic system regarding status of Agriculture sector past 3 years. In this survey it was observed that major problem was observed that farmers were facing difficulties to adopt latest technology and proper policies.

In this survey it was reported that number of citizen were not registered as enterprises and they were working on household at small level farming. Due to this project team could not reach directly to agriculture farmers which are mainly affected. Whereas other different types of business related to agriculture sector such as pollination services, livestock farms, animal and poultry nutrition mils, mechanization tractor and other machines as well as fertilizer and pesticide dealers reported that during February 24.6% of agriculture business got loss and stopped its production. Hence this Covid seriously affected the agriculture sector or world.

In the project team analysis major problem faced by agriculture enterprises was disruption of logistics particularly supply problem and reduction in the raw material. The livestock farmers stress level was recorded 35.98% in logistic disruption list. The major problem for agricultural and non agriculture enterprises as well as service sector was 35.6%, 19.7% and 18.9%, respectively, (Xiabo, 2020, IFPRI).

The livestock industry will be severely harmed as a result of this. Even if a nearby plant reopens, deliveries will take longer than usual due to logistical issues such as manpower shortages, road closures, and road inspections. Farmers in Hubei, the virus's epicenter, are already in a "extremely distressed" condition.

Hubei, China's sixth largest poultry production province, with approximately 348 million birds. Hubei, which is also a major egg producer, slaughters over 500 million birds per year. Given an epidemic

of H5N1 bird flu in Hunan, the outlook for China's poultry could be significantly harmed. Following the epidemic, almost 17,000 birds had to be culled.

Conclusion and Recommendations

It is very easy to shut down industries, IT parks, hotels, shopping malls, and multiplexes during lockdowns, but agriculture and animal husbandry are more difficult to shut down; these sectors will continue to produce. You can't shut down the dairy and poultry facilities in a matter of days. It is the obligation of the government to ensure that farmers are able to keep their livestock alive and market the crop that has been harvested or will be harvested during the lockdown time. In order to manage our agriculture and livestock sectors in the best interests of both producers and consumers, we need an effective and quick action plan. The first step is to ensure that farm produce, livestock feed, and veterinary medication can circulate freely. Many critical services, for example, were not affected by the lockdown. Essential services such as food, feed, and agricultural inputs have been identified.

Novelty Statement

This article contains enough knowledge about recent crises raised in the World's Livestock Industry due to Covid 19 virus effect and how they should be maintained in future with proper planning. Particular we have discussed with detailed that how Asia and Pakistan can get rid from recent crises of Covid 19.

Author's Contribution

Conceived & Designed the Experiment: A Kabir, M Rasheed & RR Kaleri.

Performed Experiment: Collected the Data: A Kabir, H Kaleri, M Ali & DK Bhptani.

Analyzed the data: M Kumar, RA Mangi, AW Solangi & S Dari.

Wrote paper: S Kakar, P Munir & Akbar.

Conflict of interest

The authors have declared no conflict of interest.

References

- Baba, I.A., Banday, M.T., Khan, A.A., Khan, H.M., and Nighat, M., 2017. Traditional methods of carcass disposal: A review. *J. Dairy Vet. Anim.*

- Res., 5: 21–27. <https://doi.org/10.15406/jdvar.2017.05.00128>
- Biswal, J., Vijayalakshmy, K., and Rahman, H., 2020. Impact of COVID-19 and associated lockdown on livestock and poultry sectors in India. *Vet. World*, 13(9): 1928. <https://doi.org/10.14202/vetworld.2020.1928-1933>
- Chadde, S., 2020. Tracking COVID-19's impact on meatpacking workers and industry. 2020. Available online at: <https://investigatemedwest.org/2020/04/16/tracking-covid-19s-impact-on-meatpacking-workers-and-industry/> (accessed September 16, 2020).
- Connolly, K., 2020. Meat plant must be held to account for Covid-19 outbreak, says German Minister. Available online at: <https://www.theguardian.com/world/2020/jun/22/meat-plant-must-be-held-to-account-covid-19-outbreakgermany> (accessed July 15, 2020).
- Corona virus, 2020. Chicken prices fall, poultry industry affected. IANS.
- Covid19, 2020. With projected losses of Rs 22,500 crore, Indian poultry sector seeks Centre's intervention. Press Trust of India. Hyderabad.
- Deeh, P.B.D., Kayri, V., Orhan, C., and Sahin, K.m 2020. Status of novel coronavirus disease 2019 (COVID-19) and animal production. *Front. Vet. Sci.* 7: 586919. <https://doi.org/10.3389/fvets.2020.586919>
- Environmental Protection Agency (EPA). 2020. Carcass management of non-diseased animals in response to the coronavirus outbreak (COVID-19). Available online at: <https://www.epa.gov/agriculture/carcassmanagement-non-diseased-animals-response-coronavirus-outbreakcovid-19>.
- Etuah, S., Ohene-Yankyera, K., Liu, Z., Mensah, J.O., and Lan, J., 2019. Determinants of cost inefficiency in poultry production: Evidence from small-scale broiler farms in the Ashanti region of Ghana. *Trop. Anim. Health Prod.* 52: 1–11. <https://doi.org/10.1007/s11250-019-02115-6>
- FAO, 2020. Mitigating the impacts of COVID-19 on the livestock sector. Corona virus pandemic to bring Asia's 2020 growth to halt for 1st time in 60 years.
- FAO, 2021. Impacts of COVID-19 on food security and nutrition: Developing effective policy responses to address the hunger and malnutrition pandemic. Available online: <http://www.fao.org/agroecology/database/detail/en/c/1310872/> (accessed on 3 March 2021).
- Gibbens, S., 2020. These 5 foods show how coronavirus has disrupted supply chains. Available online at: <https://www.nationalgeographic.com/science/2020/05/covid-19-disrupts-complex-food-chains-beef-milk-eggsproduce/> (accessed July 15, 2020).
- Government of Punjab, 2018. Punjab Agriculture Policy 2018. Lahore. <http://www.agripunjab.gov.pk/system/files/Punjab%20Agriculture%20Policy.pdf.2020>. RISE PUNJAB Responsive Investment for Social Protection and Economic Stimulus: Punjab's Post COVID-19 Public Investment Strategy. Lahore. https://pnd.punjab.gov.pk/system/files/RISE%20Punjab_Covid-19-Final.pdf#overlay-context=downloads.
- Hafez, H.M., and Attia, Y.A., 2020. Challenges to the poultry industry: Current perspectives and strategic future after the COVID-19 outbreak. *Front. Vet. Sci.*, 7: 516. <https://doi.org/10.3389/fvets.2020.00516>
- Hossain, M.F., Hasana, S., Mamun, A.A., Uddin, M.S., Wahed, M.I.I., Sarker, S., Behl, T., Ullah, I., Begum, Y., and Bulbul, I.J., 2020. COVID-19 outbreak: Pathogenesis, current therapies, and potentials for future management. *Front. Pharmacol.*, 11: 563478. <https://doi.org/10.3389/fphar.2020.563478>
- IFIF, 2002. Roger gilbert personal communication.
- Jeremy, N., Marchant-Forde and Laura, A., and Boyle. 2020. COVID-19 effects on livestock production: A one welfare issue. *Front. Vet. Sci.*, 7: 585787. <https://doi.org/10.3389/fvets.2020.585787>
- Kumar, A., 2020. Lockdown effect: Low consumption of milk, poultry worries ministry. *Econ. Times Bureau*,
- Kumar, P.K., and Sally, M., 2020. Corona virus rumours hit sales of egg, chicken. *Econ. Times Bureau*,
- Martin, A.M., 2001. The future of the world food system. *Outlook Agric.*, 30(1): 11-19. <https://doi.org/10.5367/000000001101293409>
- Pakistan Bureau of Statistics (PBS). 2017. Population census, 2017. Islamabad. Labour force survey of Pakistan 2017–18. Islamabad. 2020. National Accounts 2019-20 Tables. Islamabad.

- Sardana, V., 2020. Amid lockdown, we need action plan to manage our agriculture, livestock sectors. The Indian Express.
- Shahid, H., Shafique, O., and Shokat, A., 2012. Dairy industry of Pakistan. *Eur. J. Bus. Manage.*, 4(18): 1-4.
- Shashidhar, A., 2020. Coronavirus impact: Dairy industry faces 30% dip in demand. Business Today.
- Van der Zee, B., Levitt, T., and McSweeney, E., 2020. Chaotic and crazy: Meat plants around the world struggle with virus outbreaks. Available online at: <https://www.theguardian.com/environment/2020/may/11/chaotic-andcrazy-meat-plants-around-the-world-struggle-with-virus-outbreaks> (accessed July 15, 2020).
- Weizhen, T., 2020. Hundreds of millions of chickens at risk of being wiped out with much of China locked down. Indian News Paper-15-3-2021.
- Xiabo, Z., 2020. Senior researcher presented report 26th July, 2020, The International Food Policy Research Institute's (IFPRI).