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Invited Review Article

Age of pandemics toward agricultural and economic fall-off: COVID-19 and more

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Abstract

Pandemic spreads globally and typically follows a mortality pattern that targets mostly the oldest members of the population. Its' occurrence is unpredictable as nature, source, and treatment remain unknown initially. History transects those pandemics, be it smallpox, plague, malaria, cholera, yellow fever, influenza, tuberculosis, typhoid, typhus or in the recent past, diseases such as HIV/AIDS, H1N1 or COVID-19 had made people worst sufferers. All such pandemics directly resulted in a major humanitarian crisis and livelihood loss all over the world. The paper attempts to review all such concerns with a special reference to the agriculture, livestock, and fisheries sectors and highlight the effects of recent pandemics, i.e., COVID-19. As explored, the history of pandemics made it conspicuous that falls-off in the agriculture and allied sectors in terms of production, income, and consequent fall in GDP have been the common consequences across different countries or regions. The small or marginal farmers have been the worst sufferers. Further explorations state that different policy, organizational, infrastructural and individual measures are proven to effectively manage and mitigate such adverse effects of pandemics.

Key words: Agriculture, COVID-19, Fisheries, History, Livestock, Pandemics

Highlights

- Major pandemics across times resulted in a major humanitarian crisis and livelihood loss all over the world.
- History of pandemics confirmed the fall-off in Agriculture and allied sectors (livestock, dairy, fishery, etc.) in terms of production, income, and consequent fall in GDP across different countries or regions.
- The small or marginal farmers have been the worst sufferers in agriculture, livestock, fisheries, and dairy sectors.

INTRODUCTION

In the history of mankind, there have been countless life-threatening circumstances. Even though some were man-made and the rest were completely natural. Natural calamities such as pandemics or epidemics are considered as transcripts over the ages, explaining or interpreting history and predicting the future. Epidemics occur when an outbreak spreads to a wider geographical area. In contrast, a pandemic spread globally (Piret and Boivin, 2021). Throughout the history of mankind, many pandemics, be it smallpox, plague, malaria, cholera, yellow fever, influenza, tuberculosis, typhoid, typhus, or in more recent, diseases such as HIV/AIDS, H1N1 and COVID made people worst sufferers and brought devastating consequences in different ways (Samal, 2014). During hunting, animal-based foods trading, farming, wet markets, or the exotic pet trade, likelihood of cross-species transmission of pathogens significantly increased over the period (Bengis *et al*., 2004). Consequently, high mortality and widespread were observed. Pandemics typically follow a mortality pattern that targets mostly the old members of the population (Knight, 2021). Consequently, the workforces in every sector

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suffered from a skilled labour shortage, resulting in the declining trends in the growth of the economic and social sectors of any country. The problem occurs severely when it starts interrupting the production cycle in agriculture-allied sectors. The recent negative impact of COVID-19 has been intensified due to stringent lockdown, labour shortage, and other restrictions. According to the World Bank, "healthy, sustainable, and inclusive food systems" are the root of achieving global development goals (The World Bank, 2022). But, the emergence of epidemics and pandemics has left their indelible mark on the history of human civilization many times. Past studies on the effects of different pandemics/epidemics are mostly haphazard, and the unified major effects of those are hard to delineate with a special context to the agriculture and allied sectors. In this background, the present study looks at major pandemics that affected mankind and caused economic and livelihood disruptions across time, resulting in the agriculture allied sectors' (dairy, fishery, animal husbandry etc.) fall-off.

Methodology

The paper has been framed through reviews on the history of pandemics/epidemics. At the very outset, 101 related articles/papers/web sources and different secondary sources have been consolidated at par with the objectives of the study. Further, components such as name and details of pandemics/epidemics, origin, major effects, effects on agricultural, livestock, and allied, sectors, etc. were delineated and discussed. For maintaining the logical flow, a brief history of pandemics/epidemics has been presented in a format of timeline followed by brief details of each pandemic/epidemic. To make this paper much more comprehensive, the major effects of such pandemics/epidemics on agricultural livestock, and allied sectors, and consequent economic losses have been conspicuously discussed concerning previous studies. The study follows the 'Systematic Review' process wherein the following steps have been followed: "I. Framing questions for the review of the said context/subject area; II. Identifying relevant work/publication related to the context/subject area; III. Assessing the quality of those publications/research studies; IV. Summarizing the evidence out of those studies and finally, V. Interpreting the findings" (Okoli and Schabram, 2010; Snyder, 2019).

History of pandemics

The human race has been experiencing cataclysmic pandemics at periodic intervals since the inception of human civilizations (Huremovic, 2019). The prevalence of epidemics is as old as human history, and consequent diseases are as old as microorganisms (Kilic, 2020). Based on the natural environmental conditions, microorganisms (bacteria, viruses, fungi, algae, protozoa etc.) affect human life in various ways. The succeeding section discusses the major pandemics over the centuries (Fig. 1).

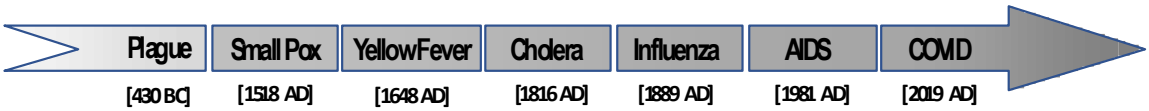

Fig. 1. Timeline of major epidemics/pandemics

Table 1. Calendar of plague throughout the world

Plague	Year of occurrence	Origin
The Athenian Plague	430 BC	Athens, Greece
The Antonine Plague	165-180 BC	Italian Peninsula
The Justinian Plague	541 AD	Egypt and Constantinople
The Black Death	1347 AD	Worldwide
19th Century Plague	1894	Hong Kong, China

Plague: Among the epidemics, the plague has a special place in history (Table 1). *Yersinia pestis*, a rodent-specific gram-negative cocco-bacillus that causes plague, is very often transmitted via rodents (Samal, 2014). This epidemic had led to numerous deaths from ancient times until the end of the 19th century. It is also referred to as *waba* or *ta'un* in the Islamic, while in the West; it is called as Black Death (Kilic, 2020). It was first documented (Athenian plague) during the Peloponnesian War (430-26 BC) between Sparta and Athens (Huremovic, 2019). But, the first epidemic was declared between 1347 and 1351 due to Black Death (Plague). An event in Europe was decimated which led to a proportionately greater death toll than any other epidemics to that point (Britannica, 2022).

Smallpox: It is an infectious disease, which was primarily caused by Variola major and Variola minor variants, belong to the genus *Orthopoxvirus* (Babkin and Babkina, 2015). Alfred W. Crosby used the term "virgin soil epidemic" to describe smallpox.

Yellow fever: Yellow fever has a dreadful history of fatal diseases (Table 3). Early outbreaks of yellow fever had been reported in the Yucatan in 1648, with the virus and its vector both being imported from Africa during the slave trade era (Carter, 1931). *Aedes aegypti*, the mosquito (Monath and Vasconcelos, 2014) vector for the virus also shares the same epidemiology to Dengue, Zika and Chikungunya (Gubler, 2018). Before 1900, a large epidemic of yellow fever occurred when the virus was introduced to infected individuals or non-human primates like monkeys (CDS, 2019). Over time, the virus became native to Africa's tropical regions, Central America and South America (Staples *et al.*, 2008). Today, alone in Africa and Central and South America, there are around 47 countries where yellow fever is considered as endemic (Chen and Wilson, 2020). Also, in the "first New World pandemic", which is believed to be brought by someone, presumably from Spain to America (Kolbert, 2020). Major causalities were recorded in 1972 in Yugoslavia (Huremovic, 2019). Later on, this highly contagious illness spread over the modern world. Mostly among infants, the mortality rate was found to be higher by 30 percent compared to adults (Riedel, 2005). Later on, it was declared sterile in 1980 by the "World Health Organization (WHO)" after the last case of natural occurrence was diagnosed in October 1977 (WHO, 2022a). Table 2 depicts the aforesaid facts of smallpox.

Table 2. Calendar of smallpox throughout the world

Smallpox	Year of occurrence	Origin
Virgin soil epidemic	1518	Hispaniola
Colonial epidemic	1618	Massachusetts Bay
North American smallpox epidemic	1770	Pacific Northwest
Great Plains smallpox epidemic	1837	Steamboat on the Missouri River
Yugoslav smallpox	1972	Yugoslav, Europe

Table 3. Calendar of yellow fever pandemic throughout the world

Yellow Fever	Year of occurrence	Origin
Illness xekik	1648	Yucatan
Yellow fever outbreak	1685-90	Recife, Brazil
Yellow fever epidemic	1793	Philadelphia
Yellow Jack	1833 & 1853	New Orleans and Shreveport, Louisiana
Sylvan or jungle epizootic	2016	Minas Gerais state of Brazil

Cholera: Cholera, an acute and fatal water-borne disease, manifests in gastrointestinal tract, and the causative agent is gram-negative and coma-shaped bacteria, named *Vibrio cholerae* (Faruque *et al.*, 1998). A cholera toxin is released by bacteria, colonizing the small intestine, leading to massive and rapid loss of body fluids, hypovolemic shock, and death. Infection occurs through contaminated water consumed or utilized for food preparation (Cho *et al.*, 2010). Over the next century, five more major cholera pandemics spread from India to other continents (Faruque *et al.*, 1998). Although, the seventh cholera pandemic lasted the longest and spread across the largest geographic region (Hu *et al.*, 2016) where it started spreading from Indonesia in 1961 and reached the other parts of the world with no time (Mutreja *et al.*, 2011). By 1948, 98 percent of all cases started coming out from the Indian subcontinent, viz. India, Pakistan and Bangladesh. In 1970, the worst aspect of this pandemic was observed in some of the portions of all continents, except America (Table 4).

Influenza: Influenza or flu is an irresistible illness of mammals and birds, infected by the virus of the Orthomyxo viridae family (Table 5). The virus is an enveloped negative-sense virus containing single-stranded RNA (Wright and Webster, 2001). Since last 140 years, the world witnessed six major influenza pandemics, where 1918 one is considered as the most devastating (Klenk *et al.*, 2008). The actual time of its origin cannot be determined, but many historians believe that it could be during late 1510 (Morens *et al.*, 2010). Moreover, between 1889 and 1893, the occurrence of Russian flue is considered as the beginning of this influenza pandemic (Taubenberger *et al.*, 2007). After twenty five years, another flu namely 'Spanish flu (H1N1)' had been detected which was the genetic adaptation of the same avian infiuenza virus (Reid *et al.*, 2004). Moreover, the wide spread of H5N1 virus in Asia, Africa, Europe, and the Middle East highlighted the threat that avian influenza (H5N1) posed to human health and the necessity of its containment and elimination in animals (Morgan, 2006).

Table 4. Calendar of cholera pandemic throughout the world

Cholera	Year of occurrence	Origin
1st Cholera pandemic	1817-1826	Indian Subcontinent, China, Indonesia and Caspian Sea
2nd Cholera pandemic	1829-1851	Russia, Hungary, Germany, London, France, Canada, US, Pacific coast of North America
3rd Cholera pandemic	1852-1860	Mainly Russia
4th Cholera pandemic	1863-1875	Mainly in Europe and Africa
5th Cholera pandemic	1881-1896	Europe, America, Russia, Spain, Japan, Persia
6th Cholera pandemic	1899-1923	Russia
7th Cholera pandemic	1962-1966	Indonesia, Bangladesh, India, USSR

Table 5. Calendar of influenza pandemic throughout the world

Influenza	Year of Occurrence	Origin
Russian flu	1889-1890	Uzbekistan and other parts of North America
Spanish flu	1918-1919	Worldwide (all continents)
Asian flu	1957-1958	China and other parts of the world and US
Hong Kong flu	1968-1969	First case was detected in Hong Kong followed by other parts of world
H1N1	2009	Many parts of the globe

Table 6. Typology of major COVID pandemic variants throughout the world

Cornonavirus	Year of occurrence	Origin
SARS-CoV-2	2019	Wuhan, China
Delta variant (B.1.617.2)	2020	United Kingdom
Omicron variant	2021	South Africa

HIV/AIDS: The "Human Immunodeficiency Virus (HIV)/Acquired Immuno-Deficiency Syndrome (AIDS)" epidemic continues to spread over decades, across continents, and among the population, evoking new challenges with every generation and for every new group it infects (Huremovic, 2019). Globally, millions of households have been affected by this zoonotic disease (Sharp and Hahn, 2011). Infections with HIV are caused by mainly two types of the virus: HIV-1 and HIV-2, where HIV-1 is more virulent, easily transmitted, and accounts for 99 per cent of all HIV infections worldwide (Reeves and Doms, 2002). In 1986, it was found that an AIDS-causing virus had similarities in morphology, but was antigenically distinct (Clavel *et al.*, 1986). Reports say that HIV affected around 79.3 million people worldwide (prevalence rate-0.79%) and killed nearly half of the affected population i.e., around 36.3 million, since 1981 (Cohen *et al.*, 2008; WHO, 2022b), where the average number of deaths per year crosses a million worldwide (down from nearly two million in 2005).

COVID: The COVID-19 pandemic, which was reported first in Wuhan city of China, started spreading since December 2019 and immobilized the world by its health and economic shock (Siche, 2020). The "World Health Organization (WHO)" declared COVID-19 as a "public health emergency of international concern" and later on declared it as a "global emergency" on 30th January, 2020 (Sohrabi *et al.*, 2020; FAO, 2020). The disease, caused by the Coronavirus, was named as SARS-CoV-2 on 11th February 2020 (Deori and Konwar, 2020). This pandemic has rapid spread over 185 countries and regions, infecting millions of people with massive deaths (Pavan kumar *et al.*, 2021). As a result, many affected countries with specific conditions and resources had to adopt different containment measures, including travel restrictions and lockdowns, to control the spread of the highly contagious disease (Shrestha *et al.*, 2020). Table 6 shows different variants of Cornonavirus, causing COVID-19.

Effects of epidemics/pandemics on agriculture, livestock, and allied sectors

The threat posed by pandemics is not only serious for the population, but also for the economy of any nation, causing global instability (Table 7). During such a crisis, a severe impact on direct and indirect costs of agriculture-allied sectors' production may act as a long-term burden (Qiu *et al.*, 2017). As the global economy has grown, production, transport, and sale of products have needed to be trimmed of excess costs. Where, even a minor disruption in the availability of manpower, electricity, water, petroleum-based products and supply of food may bring many consequences, leading life to a halt (Osterholm, 2007). Disease and climate-related issues marked vulnerability to food supplies in many cases, causing numerous incidents of shock and depression in the producers' economy (Hamid and Mir, 2021) and that might be similar in COVID's context. However, the long-term cost (unpaid time off from work, lower-income adults, economic down-fall) is more severe. In the case of earning (agriculture-allied and non-agricultural sources) ones of many families those had died eventually putting their families under the burden of financial catastrophe (Qiu *et al.*, 2017). Such damages are nevertheless related to agricultural, livestock, and allied sectors of every nation, directly or indirectly.

Table 7. Major global economic losses by pandemics (*Sichone *et al.*, 2020; Gani and Leach, 2001; Liu and Rocklov, 2020; Smirnova *et al.*, 2020; Lee *et al.*, 2021; Chen *et al.*, 2022; ** LePan, 2020; Samal, 2014)

Pandemic/ Epidemic	Year of occurrence	Reproduction number of disease*	Death troll**	Economic and humanitarian loss
Plague	430 B.C.	1.7	> 450 million	• 15%-20% of wealth loss among the rich people of Europe (Alfani, 2021). • Daily wages increased by 40% in major European counties. • Rates on loans by goldsmiths rose from 8% to as much as 20% in England (Allentuck, 2020).
Smallpox	1518	3.5-6.0	>56 million	• It has been estimated that smallpox cost in the tune of more than $1 billion per year low-to-middle income countries (Ochmann and Roser, 2018). • More than $315 million cost was estimated while eradicating the pandemic (Nelson, 1999). • Approximately 85% of the global epidemic loss caused by India. Contextually, West Bengal, Bihar, and Orissa experienced this epidemic's outbreak (Swetha, 2019). • Over 15,000 people died in this epidemic, but most of the survived were ended up with disfigurement and blindness (Swetha, 2019).
Yellow fever	1648	1.35-11.0	100000 -150000	• According to some research, it was estimated that the epidemic had cost around $45 million on New Orleans to revive its economy (Patterson, 1992). • Also, many businesses in various counties vanished during the years of 1846-1850. • The Indian subcontinent is considered a region susceptible to yellow fever. The country is particularly vulnerable due to a number of factors, including the widespread distribution of *Aedes aegypti* mosquito species, favourable climatic conditions of more than 24°C temperature, and 60% relative humidity during the rainy season (Bhatia, 2020).

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Pandemic/ Epidemic	Year of occurrence	Reproduction number of disease*	Death troll**	Economic and humanitarian loss
Cholera	1816	1.7-2.6	>1 million	• Around $20.2 million out-of-pocket expenditures was estimated among 14 Asian counties. • Also, productivity loss was estimated for $985.7 million due to premature deaths (Mogasale *et al.*, 2020). • In African counties, a total of US$156.4 million loss was estimated during the year 2005 (Kirigia *et al.*, 2009). • In British-colonized India, this was thought to be the first significant epidemic of the 19th century, and it was called "perhaps the most terrible of them." The data collection in India started much later, most likely in the late 1860s, hence the overall estimation of mortality is not available (Swetha, 2019).
Influenza	1889	1.0-3.6	151700 -575400	• Reduced the per capita GDP by 6% and private food consumption by 8% in topical countries during 2008-2009 (Maas, 2020). • An, output drop of 7% on an average was estimated across the globe during 1918-1920 due to Spanish flu (De Santis and Van der Veken, 2020). • Retail grocery business was recorded to reduce by one-third (Garrett, 2007). • This was reported to have killed between 20 and 50 million people worldwide and was regarded as the worst. India was thought to be the focal point as this is reported to have killed between 20 and 50 million people worldwide and is regarded as the worst. India was thought to be the focal point as it was started to expand throughout the world (Swetha, 2019).
AIDS	1981 to present	0.92	25-35 million	• GDP growth rates in African counties reduced by 2-4% per year (Dixon *et al.*, 2001). • The average productivity losses per

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Pandemic/ Epidemic	Year of occurrence	Reproduction number of disease*	Death troll**	Economic and humanitarian loss
				month were measured to be 5.05 days/ person in Nepal (Poudel *et al.*, 2017). ● The first HIV infections in India were found in Chennai among female sex workers in 1986. The current national prevalence was roughly 0.26%, compared to a global average of 0.20% (Paranjape, 2016).
COVID	2019	2.5	>6.2 million	● Global GDP drop during 2020 was estimated at around 4.5%, and economic growth reduced to almost US$2.96 of its economic output (Szmigiera, 2022). ● Largest-ever single-day loss in the global stock market was also recorded as almost 3,000 points (Statista Research Department, 2022). ● Indian economy primarily depends on agriculture, and COVID-19 indirectly impacted production, storage, marketing, farm income, as well as GDP (Das, 2020). ● India's real GDP depleted to its bottom in over six years during the 4th Quarter of 2019-20 (Hussain, 2021). ● As per Govt. reports, India's growth rate went down to 3.1% due to COVID-19 (Hussain, 2021).

The widespread agrarian crisis, which was roiling Europe since the late 13th century, was brought on by a number of factors (Dyer, 2003). Numerous causes led to the broad agrarian crises that had been shaking Europe since the late 13th century (Dyer, 2003). The massive loss of population brought on by the Black Death most likely hastened the drop in Crop Production in many regions (Yeloff and Geel, 2007), the probable reasons being disruptions in farming labour-force. The disease is thought to have wiped out Europe's first farming population (Callaway, 2018). Grazing pressure was greatly reduced as a result of a fall in the number of grazing animals and a shortage of farmers caused by the Black Death. The unused pasture had experienced vegetation succession by the late 14th century, which increased the cover of woody tree species, primarily "Betula" and "Corylus" (Hall, 2003). Researchers also uncovered *Yersinia pestis*, a 4900-year-old strain of bacterium genomes, causing plague from a Neolithic burial site in Sweden. Researchers' findings suggested that the disease might have spread over Europe sooner than previously thought (Callaway, 2018). A smallpox outbreak

that afflicted Sierra Leone's northern region from 1915 to 1919 significantly disrupted trade, agricultural output, and human migration (Rashid, 2011). The government's removal of enslaved and peasant labour from the protectorate for construction and military service had an impact on rural welfare, livestock rearing, and agricultural activity. It caused a severe labour shortage in rural areas (Rashid, 2011). In 1995, the virus spread through vectors to non-immunized people in West African nations, primarily young Peul people who were exposed to it during agricultural activities and functioned as viremic hosts in the epidemic cycle (Thonnon *et al*., 1998). Due to the significant increase in disease outbreaks in 1867, the cotton market declined. People living close to the Mississippi Bay were drowning in debt and unable to pay back the loan (Nuwer, 2015). Men employed in forestry or clearing land for agriculture were primarily impacted by the virus in South America, where it was spread in sparsely populated forested areas (Monath, 2001).

A significant contributor to the rapid spread of cholera in middle-eastern counties was the watering of crops with wastewater. As a result, Israel's agricultural exports to Europe were all but devastated by the Jerusalem cholera outbreak in 1970 (Bartone, 2011). The business leader pointed out hurdles after the prohibition of agricultural imports in Peru, as a result, $40 and $50 million worth of fish and agricultural exports, respectively were estimated to be affected (Khol, 1991). The cholera epidemic in Virginia resulted in significant losses in turkey poultry production, the cost of medicines to treat affected flocks, retarded growth and loss of eggs in hatching flocks. The potential profit-cost loss for the Virginia turkey industry was estimated to be $500,000 in 1967 (Moyer, 2019).

During the US influenza pandemic, egg production dropped by 0.8 billion dozen while exports dropped by 0.2 billion dozen below the expected baseline. As a result, the cost of a dozen eggs climbed by 19%. (Brown *et al*., 2007). Before 2009, a flu pandemic was predicted in the UK, France, Belgium, and the Netherlands, which recorded modest losses in agricultural exports, with the exception of the Netherlands (Keogh-Brown *et al*., 2010). The United States' avian influenza outbreak caused a decline in the poultry meat and egg industries of 602 million to 853 million dollars, respectively. In the first four quarters, consumers of poultry meat lost $900 million in consumer surplus, which was a decrease of 10.7%. (Paarlberg *et al*., 2007). Following the H5N1 avian influenza, Vietnam's poultry production dropped by 15%, resulting in a 0.1% GDP loss in terms of economic output (Brahmbhatt, 2005).

HIV/AIDS has multiple impacts on agriculture and the livelihoods of rural households which were gradually realized (Slater and Wiggins, 2005). According to the FAO, 7 million agricultural workers died from AIDS in the 25 worst-affected African nations since 1985, and 16 million more could be happened in the next 20 years (Villarreal, 2006). Recent research by the FAO and UNAIDS indicates that AIDS is mostly to blame for the agricultural output decline of small farmers in some regions of Zimbabwe, which may have reached 50% during the past five years (FAO, 2002). HIV/AIDS had a particularly negative impact on smallholder agriculture, but it is also having an increasingly negative influence on commercial agriculture, especially in sub-Saharan Africa. It resulted in the loss of agricultural knowledge, expertise, and experience, an issue that is especially crucial for training institutions but received little attention so far (Topouzis, 2000). The impact of HIV/AIDS on subsistence agriculture due to increased morbidity and mortality in Swaziland also manifested the balance of labour available to households and farms. In such households, there was a reduction in cultivation of up to 34.2 percent (Mushala, 2004).

Fresh fruits, vegetables, fish, and dairy goods suffered losses as a result of COVID-19. These losses were brought about by governments' limits on travel and social interaction, lost labour, and a decline in demand as a result of businesses like hotels and restaurants closing (Cortignani *et al*., 2020; Harris *et al*., 2020). Scholars have

identified a number of hazards that could prevent the economic development of the agriculture and fishing industries. These risks include pandemics linked to food export and import, business failures, income losses, unemployment, poverty and inequality, among others (Ahmed *et al*., 2020; Barichello, 2020; Martin, 2020; Nicola *et al*., 2020; Debnath, 2021). According to various projections, COVID-19 was expected to reduce China's agricultural growth rate by 0.4% to 2.0% in 2020. (Zhang *et al*., 2020) and India's agriculture and related sectors witnessed the growth of 3.4% from 2020 to 21 despite a -7.2% fall in the country's total economic growth during that time. Major food commodities like pulses, wheat flour, and milk in India experienced a 1-5% increase in wholesale and retail prices in a week and an increase of 114-117% in a month amid lockdown (Cariappa *et al*., 2020). The grape industry faced losses of Rs. 1000 crores as the harvest would continue for a few weeks, and also, the main buyers were far away from the orchard (Saha and Bhattacharya, 2020). India reported a daily loss of 224 crores from its marine sector during the COVID-19 outbreak (Kumar, 2021). Also, a severe impact on fish export was noticed (Alam *et al.*, 2022).

To mitigate the effects of COVID on the farming sector, a suitable policy for the farmers may be devised to minimize the risk of price fluctuations, and Minimum Support Price (MSP) may be ensured. Involvement of FPOs and FPCs for proper management of the produces may be ensured, especially in developing countries like India. Adoption of secondary farming practices as well as alternative crops in critical situations may be one of the beneficial options in this regard. Further, providing access to adequate storage facility for avoiding distress selling of farm produces and imparting training and motivational programmes for the farming communities can facilitate the purpose (Debnath, 2021).

Conclusion

The onset of any epidemic/pandemic is unpredictable. Still, the world had shown its resilience many a time with a hard fight back. Ever since the beginning of any pandemic, the worst sufferers had been the small or marginal farmers engaged in agriculture, livestock, fisheries, and dairy sectors (Narayanan and Saha, 2020) and reports also showed the sufferings of urban people and migratory labourers. This paper revealed that the history of major pandemics/epidemics led the world towards major depression in agricultural and allied sectors in terms of production and global economic losses, huge humanitarian crises etc. In this regard, COVID-19 pandemic is no exception. Alike other pandemics, the COVID-19 induced prolonged lockdown and resulted in closed state borders, unavailability of labourers, and public dependence on commodities with a longer shelf-life contributing to remarkable losses in every sectors including agricultural, livestock, and allied sectors (Saha and Bhattacharya, 2020). Indian economy primarily depends on agriculture, and COVID-19 indirectly impacted the production, storage, marketing, farm income, as well as GDP of India (Das, 2020). India's GDP dropped to its bottom in over six years during the fourth quarter of 2019-20. According to the Govt. reports, the economic growth rate of India was gone down to 3.1% due to COVID-19 (Hussain, 2021). History of pandemics tells us that when any pandemic hits, including COVID, there is a fall-off in agriculture, livestock, and allied sectors in terms of production and income, leading to the global economic crisis.

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Author's contribution: RD: Consolidation of reviews, writing and data visualization; AG: Conceptualizing, writing and critically revising the manuscript; RC: Consolidation of reviews; BL: Revising and editing the manuscript; PRP: Critically revising the manuscript.

REFERENCES

Ahmed F, Ahmed N, Pissarides C and Stiglitz J, 2020. Why inequality could spread COVID-19. Lancet, 5(5): 240, doi: 10.1016/S2468-2667(20)30085-2

Alam GM, Sarker MNI, Gatto M, Bhandari H and Naziri D, 2022. Impacts of COVID-19 on the fisheries and aquaculture sector in developing countries and ways forward. Sustainability, 14(3): 1071, doi: 10.3390/su14031071

Alfani G, 2021. Economic inequality in preindustrial times: Europe and beyond. J Econ Lit, 59(1): 3-44, doi: 10.1257/jel.20191449

Allentuck A, 2020. How past plagues have affected economies. Available in https://www.investmentexecutive.com/news/research-and-markets/how-past-plagues-have-affected-economies/ [Accessed on 20 June, 2022]

Babkin IV and Babkina IN, 2015. The origin of the variola virus. Viruses, 7(3): 1100-1112, doi: 10.3390/v7031100

Barichello R, 2020. The COVID-19 pandemic: anticipating its effects on Canada's agricultural trade. Can J Agric Econ, 68(2): 219-224, doi: 10.1111/cjag.12244

Bartone CR, 2011. From fear of cholera to full wastewater treatment in two decades in Santiago, Chile. Environmental Engineering Consultant World Bank Water Days, Agricultural Water Management Session, Washington DC, USA, pp 1-23

Bengis RG, Leighton FA, Fischer JR, Artois M and Morner T, 2004. The role of wildlife in emerging and re-emerging zoonoses. Rev Sci Tech, 23(2): 497-511

Bhatia V, Palepu S, Parida SP, Singh AK and Sahoo SS, 2020. Yellow fever vaccination: how much do travellers from Eastern India know? Hum Vaccines Immunother, 16(9): 2151-2155, doi; 10.1080/21645515.2020.1757988

Brahmbhatt M, 2005. Avian and human pandemic influenza-economic and social impacts, World Bank, Washington, DC

Britannica, 2022. Black Death Pandemic, Medieval Europe. Available in https://www.britannica.com/event/Black-Death [Accessed on 21 June, 2022]

Brown S, Madison D, Goodwin HL and Clark FD, 2007. The potential effects on United States agriculture of an avian influenza outbreak. J Agric Appl Econ, 39(2): 335-343, doi: 10.1017/S1074070800023038

Callaway E, 2018. Plague linked to the mysterious decline of Europe's first farmers. Nature, doi: 10.1038/d41586-018-07673-7

Cariappa AGA, Acharya KK, Adhav CA, Sendhil R and Ramasundaram P, 2020. COVID-19 Induced Lockdown Effects on Agricultural Commodity Prices and Consumer Behaviour in India - Implications for Food Loss and Waste Management. SSRN, doi: 10.2139/ssrn.3680634

Carter HR, 1931. Yellow Fever. An Epidemiological and Historical Study of Its Place of Origin. The Williams & Wilkins Co, Baltimore Md, pp 18-22

CDS, 2019, Transmission of Yellow Fever Virus. Centers for Disease Control and Prevention. Available in https://bit.ly/3ub8KIy [Accessed on 21 June, 2022]

Chen LH and Wilson ME, 2020. Yellow fever control: current epidemiology and vaccination strategies. Trop Dis Travel Med Vacc, 6(1): 1-10, doi: 10.1186/s40794-020-0101-0

Chen YH, Farnham PG, Hicks KA and Sansom SL, 2022. Estimating the HIV effective reproduction number in the United States and evaluating HIV elimination strategies. J Public Health Manag Pract, 28(2): 152-161, doi: 10.1097/PHH.0000000000001397

Cho YJ, Yi H, Lee JH, Kim DW and Chun J, 2010. Genomic evolution of *Vibrio cholerae*. Curr Opin Microbiol, 13(5): 646-651, doi: 10.1016/j.mib.2010.08.007

Clavel F, Guetard D, Brun-Vézinet F, Chamaret S and Rey MA, 1986. Isolation of a new human retrovirus from West African patients with AIDS. Science, 233(4761): 343-346, doi: 10.1126/science.2425430

Cohen MS, Hellmann N, Levy JA, DeCock K and Lange J, 2008. The spread, treatment, and prevention of HIV-1: evolution of a global pandemic. J Clin Invest, 118(4): 1244-54, doi: 10.1172/JCI34706

Cortignani R, Carulli G and Dono G, 2020. COVID-19 and labour in agriculture: economic and productive impacts in an agricultural area of the Mediterranean. Italian J Agron, 15(2): 172-181, doi: 10.4081/ija.2020.1653

Das G, 2020. Impact of COVID-19 in agricultural system, value chain, and food security. Agric Ext J, 4(2): 67-70

De Santis R and Van-der VW, 2020. Economic expected losses and downside risks due to the Spanish Flu. VoxEU-CEPR Policy Portal

Debnath R, 2021. A Study on Effects of COVID-19 on Fish Farmers' Livelihood in Tripura. Master's Thesis. Department of Fisheries Extension, Economics and Statistics, College of Fisheries, Central Agricultural University (Imphal),

Lembucherra (Unpublished)

Deori U and Konwar G, 2020. Impact of COVID-19 in North Eastern States of India. Int J Health Sci Res, 10(6): 213-217

Dixon S, McDonald S and Roberts J, 2001. AIDS and economic growth in Africa: A panel data analysis. J Int Dev,13(4): 411-426, doi: 10.1002/jid.795

Dyer C, 2003. Making a Living in the Middle Ages: the People of Britain 850-1520. Yale University Press, New Haven, doi: 10.12987/9780300167078

FAO, 2002. The impact of HIV/AIDS on food security in Africa. Available in https://www.fao.org/3/Y6059e/Y6059e.htm [Accessed on 5 August, 2022]

FAO, 2020. How is COVID-19 affecting the fisheries and aquaculture food systems. Available in https://www.fao.org/3/ca8637en/ca8637en.pdf [Accessed on 5 August, 2022]

Faruque SM, Albert MJ and Mekalanos JJ, 1998. Epidemiology, genetics, and ecology of toxigenic *Vibrio cholerae*. Microbiol Mol Biol Rev, 62(4): 1301-1314, doi: 10.1128/MMBR.62.4.1301-1314.1998

Gani R and Leach S, 2001. Transmission potential of smallpox in contemporary populations. Nature, 414(6865): 748-751, doi: 10.1038/414748a

Garrett TA, 2007. Economic effects of the 1918 influenza pandemic. Federal Reserve Bank of St. Louis, pp 26

Gubler DJ, 2018. Pandemic yellow fever: A potential threat to global health via travellers. J Travel Med, 25(1): 1-2, doi: 10.1093/jtm/tay097

Hall VA, 2003. Vegetation history of mid- to western Ireland in the 2nd millennium AD; fresh evidence from tephra-dated palynological investigations. Veg Hist Archaeobot, 12(1): 7-17, doi: 10.1007/s00334-003-0002-y

Hamid S and Mir MY, 2021. Global agri-food sector: challenges and opportunities in COVID-19 pandemic. Front Sociol, 6(647337): 1-11, doi: 10.3389/fsoc.2021.647337

Harris J, Lutz D, Arshad AH, Ramakrishnan MN and Srinivasan R, 2020. Food system disruption: initial livelihood and dietary effects of COVID-19 on vegetable producers in India. Food Secur, 12(4): 841-851, doi: 10.1007/s12571-020-01064-5

Hu D, Liu B, Feng L, Ding P and Guo X, 2016. Origins of the current seventh cholera pandemic. Proc Natl Acad Sci USA, 113(48): 7730-7739, doi: 10.1073/pnas.1608732113

Huremovic D, 2019. Psychiatry of Pandemics: A Mental Health Response to Infection Outbreak. Springer Int Publish, pp 185, doi: 10.1007/978-3-030-15346-5

Hussain SA, 2021. Impact of COVID-19 on Indian economy. Int J Econom Growth Environ Issues, 9(4): 4-8, doi: 10.2139/ssrn.3843496

Keogh-Brown MR, Smith RD, Edmunds JW and Beutels P, 2010. The macroeconomic impact of pandemic influenza: estimates from models of the United Kingdom, France, Belgium and The Netherlands. Eur J Health Econ, 11: 543-554, doi: 10.1007/s10198-009-0210-1

Khol B, 1991. Peru: Update on Cholera Epidemic and Economic Impact. Univ New Mexico, Digit Reposit, pp 1-3

Kilic O, 2020. Pandemics throughout history and their effects on society life. Reflections on the Pandemic, pp 13, doi: 10.53478/TUBA.2020.073

Kirigia JM, Sambo LG, Yokouide A, Soumbey-Alley E and Muthuri LK, 2009. Economic burden of cholera in the WHO African region. BMC Int Health Hum Rights, 9(1): 1-14, doi: 10.1186/1472-698X-9-8

Klenk HD, Matrosovich M and Stech J, 2008. Avian influenza: molecular mechanisms of pathogenesis and host range. In: Animal Virus: Molecular Biology, Caister Academic Press, UK, pp 253-301

Knight R, 2021. How pandemics affect societies. Texas A&M Today. Available in https://today.tamu.edu/2021/01/28/how-pandemics-affect-societies/ [Accessed on 22 July, 2022]

Kolbert E, 2020. Pandemics and the shape of human history. The New York, Available in https://www.newyorker.com/magazine/2020/04/06/pandemics-and-the-shape-of-human-history [Accessed on 22 July, 2022]

Kumar S, 2021. Covid-19 inflicts a daily loss of Rs. 224 crore to India's fishery sector. The Hindu (online), Available in https://www.thehindubusinessline.com/economy/agri-business/covid-19-causes-a-daily-loss-of-224-crore-to-indias-fishery-sector/article31388582.ece [Accessed on 22 July, 2022]

Lee Y, Lee DH, Kwon HD, Kim C and Lee J, 2021. Estimation of the reproduction number of influenza A (H1N1) in South Korea using heterogeneous models. BMC Infect Dis, 21(1): 1-11, doi: 10.1186/s12879-021-06121-8

LePan N, 2020. Visualizing the history of pandemics. Available in https://www.visualcapitalist.com/history-of-pandemics-deadliest/ [Accessed on 22 July, 2022]

Liu Y and Rocklöv J, 2020. What is the reproductive number of yellow fever? J Travel Med, 27(7): 1-2,

doi: 10.1093/jtm/taaa156
Maas S, 2020. Social and economic impacts of the 1918 influenza epidemic. NBER, Available in https://bit.ly/3yv2Gxg [Accessed on 22 July, 2022]
Martin P, 2020. COVID-19 and California farm labor. California Agric, 74(2): 67-68, doi: 10.3733/ca.2020a0017
Mogasale V, Mogasale VV and Hsiao A, 2020. Economic burden of cholera in Asia. Vaccine, 38(1): 160-166, doi: 10.1016/j.vaccine.2019.09.099
Monath TP and Vasconcelos PF, 2014. Yellow fever. J Clin Virol, 64: 160-173, doi: 10.1016/j.jcv.2014.08.030
Monath TP, 2001. Yellow fever: An update. Lancet Infect Dis, 1(1): 11-20, doi: 10.1016/S1473-3099(01)00016-0
Morens DM, Taubenberger JK, Folkers GK and Fauci AS, 2010. Pandemic inûuenza's 500th anniversary. Clin Infect Dis, 51(12): 1442-1444, doi: 10.1086/657429
Morgan A, 2006. Avian influenza: An agricultural perspective. J Infect Dis, 194 (S2): 139-146, doi: 10.1086/507561
Moyer DD, 2019. The Virginia cholera control program. Available in https://bit.ly/3AelAd4 [Accessed on 20 May, 2022]
Mushala HM, 2004. Impact of HIV/AIDS on subsistence agriculture in Swaziland: some policy implications. The quest for peace in Africa: transformations, democracy and public policy, pp 367-378
Mutreja A, Kim DW, Thomson NR, Connor TR and Lee JH, 2011. Evidence for several waves of global transmission in the seventh cholera pandemic. Nature, 477: 462-465, doi: 10.1038/nature10392
Narayanan S and Saha S, 2020. More reform than relief: Indian agriculture and the pandemic. Indian J Labour Econ, 63(1): 105-111, doi: 10.1007/s41027-020-00264-z
Nelson AM, 1999. The cost of disease eradication: smallpox and bovine tuberculosis. Ann New York Acad Sci, 894(1): 83-91, doi: 10.1111/j.1749-6632.1999.tb08048.x
Nicola M, Alsafi Z, Sohrabi C, Kerwan A and Al-Jabir A, 2020. The socio-economic implications of the coronavirus pandemic (COVID-19): A review. Int J Surg, 78: 185-193, doi: 10.1016/j.ijsu.2020.04.018
Nuwer DS, 2015. Mississippi in the 1870s. Plague Among the Magnolias: the 1878 Yellow Fever Epidemic in Mississippi. University of Alabama Press, pp 206
Ochmann S and Roser M, 2018. Smallpox. Available in https://ourworldindata.org/smallpox [Accessed on 5 July 2022]
Okoli C and Schabram K, 2010. A guide to conducting a systematic literature review of information systems research. Sprouts, 10(6): 1-51
Osterholm MT, 2007. Unprepared for a pandemic. Foreign Aff, 86: 47
Paarlberg PL, Seitzinger AH and Lee JG, 2007. Economic impacts of regionalization of a highly pathogenic avian influenza outbreak in the United States. J Agri Appl Econ, 39(2): 325-333, doi: 10.1017/S1074070800023026
Paranjape RS and Challacombe SJ, 2016. HIV/AIDS in India: An overview of the Indian epidemic. Oral Dis, 22(51): 10-14, doi: 10.1111/odi.12457
Patterson KD, 1992. Yellow fever epidemics and mortality in the United States, 1693-1905. Soc Sci Med, 34(8): 855-865, doi: 10.1016/0277-9536(92)90255-O
Pavan KST, Lahiri B and Alvarado R, 2021. Estimation of trends in Covid-19 infections and deaths across WHO regions and India: multiple change point analysis approach. Spat Stat, 49: 100538, doi: 10.1016/j.spasta.2021.100538
Piret J and Boivin G, 2021. Pandemics throughout history. Front Microbiol, 11: 631736, doi: 10.3389/fmicb.2020.631736
Poudel AN, Newlands D and Simkhada P, 2017. The economic burden of HIV/AIDS on individuals and households in Nepal: A quantitative study. BMC Health Serv Res, 17(1): 1-13, doi: 10.1186/s12913-017-1976-y
Qiu W, Rutherford S, Mao A and Chu C, 2017. The pandemic and its impacts. Health Cul Soc, 9: 1-11, doi: 10.5195/hcs.2017.221
Rashid I, 2011. Epidemics and resistance in colonial Sierra Leone during the First World War. Canad J Afr Stud, 45(3): 415-439, doi: 10.1080/00083968.2011.10541064
Reeves JD and Doms RW, 2002. Human immunodeficiency virus type 2. J Gen Virol, 83(6): 1253-1265, doi: 10.1099/0022-1317-83-6-1253
Reid AH, Taubenberger JK and Fanning TG, 2004. Evidence of an absence: The genetic origins of the 1918 pandemic inûuenza virus. Nat Rev Microbiol, 2: 909-914, doi: 10.1038/nrmicro1027
Riedel S, 2005. Edward Jenner and the history of smallpox and vaccination. Proceedings, 18(1): 21-25, doi: 10.1080/08998280.2005.11928028
Saha T and Bhattacharya S, 2020. Consequence of lockdown amid COVID-19 pandemic on Indian agriculture. Food Sci Reports, 1(SI): 47-50

Samal J, 2014. A historical exploration of pandemics of some selected diseases in the world. Int J Health Sci Res, 4(2): 165-169

Sharp PM and Hahn BH, 2011. Origins of HIV and the AIDS pandemic. Cold Spring Harb Perspect Med, 1(1): a006841, doi; 10.1101/cshperspect.a006841

Shrestha AM, Shrestha UB, Sharma R, Bhattarai S and Tran HNT, 2020. Lockdown caused by COVID-19 pandemic reduces air pollution in cities worldwide. doi: 10.31223/osf.io/edt4j

Siche R, 2020. What is the impact of COVID-19 disease on agriculture? Sci Agropecu, 11(1): 3-6, doi: 10.17268/sci.agropecu.2020.01.00

Sichone J, Simuunza MC, Hang'ombe BM and Kikonko M, 2020. Estimating the basic reproduction number for the 2015 bubonic plague outbreak in Nyimba district of Eastern Zambia. PLoS Negl Trop Dis, 14(11): e0008811, doi: 10.1371/journal.pntd.0008811

Slater R and Wiggins SL, 2005. Responding to HIV/AIDS in agriculture and related activities. Natural Resource Perspectives, 98, Overseas Development Institute, London. Available in https://www.files.ethz.ch/isn/91774/NRP98.pdf [Accessed on August 3, 2022]

Smirnova A, Sterrett N, Mujica OJ, Munayco C and Suarez L, 2020. Spatial dynamics and the basic reproduction number of the 1991-1997 Cholera epidemics in Peru. PLoS Negl Trop Dis, 14(7): e0008045, doi: 10.1371/journal.pntd.0008045

Snyder H, 2019. Literature review as a research methodology: An overview and guidelines. J Bus Res, 104: 333-339, doi: 10.1016/j.jbusres.2019.07.039

Sohrabi C, Alsafi Z, O'neill N, Khan M and Kerwan A, 2020. World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). Int J Surg, 76: 71-76, doi: 10.1016/j.ijsu.2020.02.034

Staples JE and Monath TP, 2008. Yellow fever: 100 years of discovery. JAMA, 300 (8): 960-962, doi: 10.1001/jama.300.8.960

Statista Research Department, 2022. Largest one-day point losses of the Dow Jones Industrial Average Index from 1897 to June 2020. Available in https://www.statista.com/statistics/274327/largest-single-day-losses-of-the-dow-jones-index/ [Accessed on August 3, 2022]

Swetha G, Eashwar VMA and Gopalakrishnan S, 2019. Epidemics and pandemics in india throughout history: A review article. Indian J Pub Health Res Dev, 10(8): 1570-1576

Szmigiera M, 2022. Impact of the coronavirus pandemic on the global economy - Statistics & Facts. Available in https://bit.ly/3QUTtVX [Accessed on August 3, 2022]

Taubenberger JK, Morens DM and Fauci AS, 2007. The next inûuenza pandemic: can it be predicted? JAMA, 297(18): 2025-2027, doi: 10.1001/jama.297.18.2025

The World Bank, 2022. Agriculture and Food. Available in https://www.worldbank.org/en/topic/agriculture/overview#1 [Accedded on August 3, 2022]

Thonnon J, Fontenille D, Tall A, Diallo M, Renaudineau Y *et al*., 1998. Re-emergence of yellow fever in Senegal in 1995. Am J Trop Med Hyg, 59(1): 108-114, doi: 10.4269/ajtmh.1998.59.108

Topouzis D, 2000. The impact of HIV on agriculture and rural development: implications for training institutions. FDA, pp 92-103

Villarreal M, 2006. HIV/AIDS: A threat to the viability of the societies it attacks. Kybernetes, 35(1-2): 195-208, doi: 10.1108/03684920610640317

WHO, 2022a. Smallpox. Available in shorturl.at/jqsF2 [Accessed on 20 July, 2022]

WHO, 2022b. The Global Health Observatory. Available in https://bit.ly/3I01Nj6 [Accessed on 20 July, 2022]

Wright PW and Webster RG, 2001. "Orthomyxoviruses," in Fields Virology. Lippincott Williams & Wilkins. 4th edn., Philadelphia, pp 1533-1579

Yeloff D and Geel BV, 2007. Abandonment of farmland and vegetation succession following the Eurasian plague pandemic of AD 1347-52. J Biogeograph, 34(4): 575-582, doi: 10.1111/j.1365-2699.2006.01674.x

Zhang S, Wang S, Yuan L, Liu X and Gong B, 2020. The impact of epidemics on agricultural production and forecast of COVID-19. China Agric Econom Rev, 12(3): 409-425, doi: 10.1108/CAER-04-2020-0055

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