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REVIEW ARTICLE

Pandemics and Ecological Animal Husbandry

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Abstract

The pandemics to which humanity has been subjected throughout history will also continue to exist in the future. There may be many reasons for the development of pandemics and threats to human and animal health. Whatever the reason, previous pandemics and also this current Covid-19 period revealed the importance of ecological agricultural production. The destruction of natural habitats, industrial agriculture, industrialization, and the decrease in biodiversity disrupt the ecological balance and create an environment for pandemic formation, endangering both human and animal health. This review is focusing on the importance of ecological animal husbandry in terms of both human and animal health and welfare, and especially understanding after the pandemics are part of our life.

Introduction

World Health Organization (WHO) claims that "A pandemic is the worldwide spread of a new disease" (WHO, 2020a). However, some confusion and contradictory situations have arisen from time to time in the use of the term "pandemic". While some claimed that a certain level of high contagiousness is sufficient to report a pandemic, others have argued that the severity of infection should also be taken into account (Morens *et al*., 2009). For an infection that has turned into a disease to become a pandemic; an epidemic that has not been exposed before must emerge, the disease factor must be transmitted to people, and cause a dangerous disease, and, the cause of the disease must be able to spread easily and continuously. The prevalence of a disease or condition that causes the death of a large number of people is not enough to be qualified as a pandemic, it must also be contagious (Aslan, 2020). Especially in the last 30 years, there has been an increase in communicable diseases, more than 70% of which are zoonotic (Wang and Crameri, 2014). Zoonotic diseases can be caused by viruses, bacteria, parasites, and mycetes. Sometimes, animals can seem healthy even if they carry factors that can infect people due to zoonotic disease. It is estimated that more than six out of every ten infectious diseases known to occur in humans can be spread by animals. Three out of every four new infectious diseases seen in humans are caused by animals (CDC, 2017). With the effects of globalization, the time taken for communicable diseases to spread throughout a regional area has become much shorter due to the increasing population, population density, and mobility. Globalization in trade, increasing population mobility, and international travel are the main human influence on the emergence, re-emergence and transmission of infectious diseases in the twenty-first century (Bickley *et al*., 2021). Lastly, according to WHO, Covid-19 emerged in China on December 31, 2019; in Thailand on January 13, 2020, in America on January 21, 2020, immediately after China, and then rapidly all over the world (Budak and Korkmaz, 2020). Countries closing their borders as a precaution to prevent the spreading of Covid-19 has shown the effect

of globalization on the epidemic diseases becoming a pandemic.

Among the major pandemics in world history (Table 1), the Plague of Justinian (causative agent Yersinia pestis, 541-542) which caused more than a quarter of the world's population (30-50 million people; The Black Plague (Black Death, 1347) caused the death of 30-60% of the European population (75-200 million people), Smallpox (poxvirus) which emerged in the fifteenth century killed tens of millions of people, and maintained its contagiousness until 1980 when WHO announced its eradication can be stated (Roos, 2020).

Covid-19

Due to this new coronavirus, which emerged in Wuhan, China at the end of 2019 and was classified as a pandemic by the WHO, over 455 million cases and 6 million deaths were detected until 15.03.2022 globally (WHO, 2022).

Over 60% of current and developing pathogens that affect people originate from animals and 75% of them are from wildlife, so human health, animal health, and ecosystem health must be considered together (WHO, 2018). The destruction of forest areas, the decrease in biodiversity, the excessive use of pesticides and chemical fertilizers due to industrial agriculture, intensive industrialization, and peoples lack of environmental awareness lead to the climate crisis (Aguirre, 2017). Main human threats to biodiversity are; overuse of species, habitat destruction, and the introduction of exotic species, all of which lead to ecosystem degradation that leads to changes in disease transmission patterns. Pathogen pollution, global toxicity, and global environmental changes due to climate increase the loss of biodiversity tremendously. Perhaps the most insidious factor out of these factors is climate change, which has a profound impact on all ecological processes, including some increased rise and drought in others. Increased coastal zone erosion with rising sea levels, increased tsunamis, hurricanes, and tropical storms, and the inability of many species to adapt to relatively rapid changes in climate regimes could potentially lead to mass extinctions (Aguirre, 2017). The pressure of human settlement and agriculture on natural ecosystems results in the expansion of ecotones where species from different habitats come together. This situation provides new

Table 1: Some of the major pandemics that have occurred over time (LePan, 2020; WHO, 2022).

Name	Time period	Type / Pre-human host	Death toll
Antonine Plague	165-180	Believed to be either smallpox or measles	5M
Japanese smallpox epidemic	735-737	Variola major virus	1M
Plague of Justinian	541-542	Yersinia pestis bacteria / Rats, fleas	30-50M
Black Death	1347-1351	Yersinia pestis bacteria / Rats, fleas	200M
New World Smallpox Outbreak	1520 – onwards	Variola major virus	56M
Great Plague of London	1665	Yersinia pestis bacteria / Rats, fleas	100.000
Italian plague	1629-1631	Yersinia pestis bacteria / Rats, fleas	1M
Cholera Pandemics 1-6	1817-1923	V. cholerae bacteria	1M+
Third Plague	1885	Yersinia pestis bacteria / Rats, fleas	12M (China and India)
Yellow Fever	Late 1800s	Virus / Mosquitoes	100.000-150.000 (U.S.)
Russian Flu	1889-1890	Believed to be H2N2 (avian origin)	1M
Spanish Flu	1918-1919	H1N1 virus / Pigs	40-50M
Asian Flu	1957-1958	H2N2 virus	1.1M
Hong Kong Flu	1968-1970	H3N2 virus	1M
HIV/AIDS	1981-present	Virus / Chimpanzees	25-35M
Swine Flu	2009-2010	H1N1 virus / Pigs	200.000
SARS	2002-2003	Coronavirus / Bats, Civets	770
Ebola	2014-2016	Ebolavirus / Wild animals	11.000
MERS	2015-Present	Coronavirus / Bats, camels	850
COVID-19	2019-Present	Coronavirus-Unknown (possibly pangolins)	6M (till March 15, 2022)

opportunities for pathogen spread, genetic diversification, and adaptation (Jones *et al.,* 2013). In The Global Climate in 2015-2019 report of the World Meteorology Organization (WMO), it was stated that the CO_2 emission resulting from the use of fossil fuels in the atmosphere has increased since 2015 and this rate of increase is 20% more than 2011-2015 period. Again, between the years 2015-2019, global warming increased by approximately 0.2 ^oC compared to the 2011-2015 period and reached 1.1 ^oC above the pre-industrial period (WMO, 2019). According to the report of the International Panel on Climate Change, it is stated that the climate crisis will grow even more if the temperature increase reaches 1.5 ^oC compared to the pre-industrial period (IPCC, 2020). Climate change is among the reasons for the emergence of zoonotic diseases, which have emerged especially after the 20th century and are likely to emerge in the coming years, threatening the whole world and turning into a pandemic. Curseu *et al.* (2009) stated that climate change and globalization can encourage the spread of avian flu and become a pandemic, and that global warming can change the migration patterns (routes) of birds as, consequently, the interaction between infected animals and humans. Wank and Crameri (2004) emphasized that climate change, habitat destruction, and modernization of agricultural practices, especially in developing countries, are the driving forces in the emergence of zoonotic diseases. These changes affect the interaction between pathogens and their hosts, between hosts and wild animals, and between livestock and people (Wank and Crameri, 2004). For instance; the reason for the higher levels of the spread of Tick-borne Encephalitis (TBE) virus in the Czech Republic has been linked to the effect of increased temperatures on the distribution of bird hosts from which the ticks were carrying this virus spread. The harsh winters due to climate change limit the movements of migratory ducks and cause them to gather in smaller areas, creating favorable conditions for H5N1 transmission in Europe (Fuller *et al.,* 2012). In addition to that, climate change may lead to the expansion of wetlands in eastern North America in parallel with the increase in precipitation and the congregation of more migratory ducks, which are the source of influenza (Fuller *et al.,* 2012). The emergence of West Nile Virus Outbreak, Rift Valey Fever, Dengue Fever, and O: 139 Cholera strain in new geographic regions is linked to El Nino release (Sachan and Singh, 2010). When biodiversity changes alter pathogen transmission dynamics, it is likely to spread to humans. The continuous emergence of Lyme disease in North America has been attributed to the decline of the red fox population, which has led to the abundance of small mammalian hosts of the pathogen (Baudron and Liégeois, 2020). In parts of Ghana, the eradication of lions and leopards has resulted in an increased abundance of baboons that come into contact with people at high risk of intestinal parasites (Baudron and Liégeois, 2020).

The Effect of Pandemic on Food Consumption

Food safety is defined as the state that all people have physical, social, and economic access to adequate, safe, and nutritious foods that meet their food needs and food preferences for a healthy life (FAO, 2009). The right to adequate food materialize when each individual, alone or with others, has physical, and economic access at all times to adequate food and means of supply (FAO, 2019a). The impact of pandemics on the change in food consumption habits, food safety, and the right to food has become more visible with the Covid-19 outbreak. In particular, the fact that people have to stay in their homes has changed their consumption habits and increased their anxiety about accessing healthy food (Janssen *et al*., 2021). During this pandemic, people started to take a stand against industrial agricultural products and foods. They seek ways to reach natural food, and the forgotten meals and foods inherited from the old generations have come to light again. During this period, consumers concerns about access to sufficient food and their demand for organic foods, which they consider safer in terms of nutrition and health, are increased. According to the Organic Product Performance Report published by the Organic Production Network (OPN) for the first quarter of 2020, it has been reported that consumers' buying behavior has changed in an unprecedented way with the impact of Covid-19 in the United States, and the dollar performance obtained from total organic products in March increased 22% compared to March last year and the dollar increase in January and February of this year was over 1.8% (Lutz and Long, 2020).

Taking animal protein every day regularly is vital for the antibodies, one of the body's defense mechanisms, to fulfill their functions and thus strengthen immunity. During the pandemic process, nutritionists emphasized the importance of the consumption of good quality animal products and the need to take protein regularly. It is accepted that the beneficial microorganisms found in animal products such as yogurt and kefir strengthen the immune system, the presence of antimicrobial properties of propolis, a bee product, and meat and dairy products obtained from naturally fed animals (pasture) are healthier and more nutritious. This idea has increased the demand for these kind of products (Kayan, 2021). Consumers' demand for organic certified chickens and eggs has increased in recent years due to the news about poultry being fed with genetically modified (GM) feeds. The continuity of these changes in diets will be inevitable, as diseases such as epidemics, cancer, abnormalities in the womb continue to increase with each passing year. More than 820 million people, in other words, one in nine people struggle with hunger, while more than 790

million people are estimated to be obese worldwide (FAO, 2019b).

While the pandemic process continues, the EU Commission's "From Farm to Fork" and "Biodiversity Strategy" reports were published in May 2020, which aim to fix food systems and turn them into fair, healthy, and environmentally friendly. Food systems cannot be resistant to crises such as the Covid-19 outbreak if they are not sustainable, according to the report. According to the decision of the Commission, pesticide use in EU countries will be reduced by 50% until 2030 and 25% of EU agricultural land will be allocated for ecological production (EC, 2020). In the United Nations Agroecology and Right to Food report, industrial production is stated to be largely dependent on fossil fuels and therefore not sustainable whereas ecological production is emphasized to be important to understand how nature works, to use the complementarity of plants and animals, to ensure a sustainable food production by protecting the food right of future generations, and to contribute to rural development (Schutter De, 2014).

First of all, the decision of countries to restrict foreign trade in some product groups with the coronavirus epidemic has further increased the importance of meeting food needs domestically. The disruptions caused by the Covid-19 crisis have exposed many of the vulnerabilities of today's food systems. Restrictions and market closures imposed in this process have led to workers' vulnerability across the food system, with access to safe and nutritious food at affordable prices. Those dealing with high-value, labor-intensive and perishable products (fruit, vegetables, fish, meat, and dairy products) required for good nutrition were disproportionately affected by this process. The Covid-19 outbreak has also highlighted the vulnerabilities in countries dependent on imports of food and agricultural inputs, creating a new perspective for shorter value and supply chain creation to increase market flexibility and reduce producer losses. Today's food systems fall short of the 2030 Agenda for Sustainable Development. While poverty and hunger are settled, obesity and related health problems and economic costs are constantly increasing. Food systems contribute significantly to increasing greenhouse gas emissions and constitute an important driving force for biodiversity loss. On the other hand, it is significantly affected by climate change (FAO, 2020a). During the pandemic period, countries have made intensive efforts to prevent a possible food crisis. Local administrations either gave the vacant lands they had to the producers or planted them with their own means for the needy. After this period, it is clear that issues such as food safety, sustainable agriculture, biodiversity, and access to healthy food will often come to the fore due to such epidemics. Because of this reason, an ecological transformation will be inevitable in both crop and animal production. According to the report named Guiding The Transition To Sustainable Food And Agricultural Systems of the United Nations Food and Agriculture Organization (FAO), agroecology; simultaneously applied to food design and management and agricultural systems; It is an approach integrated with ecological and social concepts and principles. In addition to this, taking into account the social situation needed for a sustainable and fair food system; It is a system that seeks to optimize the interaction between plants, animals, humans, and the environment (FAO, 2018).

The Effect of Pandemic on Livestock Sector

In this epidemic period, the governments' taking measures such as travel, trade, and curfew caused some difficulties in the supply of agricultural inputs and especially in the marketing of products with short durability, such as animal products**.** The increase in the prices of imported agricultural inputs (fertilizer, medicine, feed, etc.) due to the import-export imbalances that occurred during the pandemic period and the increase in exchange rates caused the farmers engaged in both herbal and animal production to enter the bottleneck. China is the most important producer and consumer of phosphate, sulfur, and sulfuric acid (Seleiman *et al.,* 2020). The Covid-19 outbreak that occurred in China affected the fertilizer industry by disrupting both the fertilizer and fertilizer raw material movement. For some countries that are synthetic fertilizer importers, producers have been advised to add biological and organic fertilizers in addition to synthetic fertilizers (Seleiman *et al.,* 2020). In the production of forage plants, which are one of the main inputs of animal husbandry, both raw materials and synthetic fertilizers, medicines, et cetera used in production. Countries that import inputs have been the countries most affected by the pandemic process. It is a critical decision for the livestock sector that America and Brazil, which are the most important soy and corn exporters due to Covid-19, want to use these products for domestic consumption instead of exporting in large quantities (Seleiman *et al.,* 2020). Supply chain disruption due to the pandemic further delayed the feed supply. Again, disruption of the global trade flow due to restrictions in Brazil, the world's largest soy exporter, has reduced soy supply to feed mills. For these reasons, the increase in input prices will cause an increase in the prices of animal products. Import restrictions will greatly affect Africa and developing countries that require imported inputs to sustain production, or whose meat and milk consumption is dependent on imports. For instance; In Iran, since 80% of the feed inputs of the poultry farms are dependent on imports and because of the sanctions that the enterprises cannot access corn and soybean pulp, the chicks have been killed. Similarly, in countries where access to animal markets, slaughterhouses, and markets is restricted, producers will be exposed to higher production costs and product loss because they

have to keep their livestock or shed their milk (FAO, 2020b).

During the pandemic process, countries whose economy depends on the livestock sector had significant economic losses regarding food safety. Likewise, while the increase in avian influenza incidence in 2005-2006 decreased the demand for poultry, it directed consumers to other livestock products. It is emphasized that the Covid-19 period and other pandemics that will emerge from now on may adversely affect animal production and those whose livelihood is animal production. The impact of the livestock supply chain from the pandemic process may limit access to the market, especially by nomadic livestock producers (FAO, 2020c). Many livestock markets have been closed at the west of Africa, bovine and ovine prices have dropped by more than half, and this situation has forced migrant livestock breeders to quit animal husbandry en masse (FAO, 2020b). Disruptions in the tourism sector due to closures of restaurants, other places of mass consumption, and travel restrictions are likely to adversely affect the supply chain of animal products (Seleiman *et al.,* 2020; UNCTAD, 2020).

Ecological Animal Husbandry

Organic animal husbandry is a system that encourages the use of organic and biodegradable inputs in the ecosystem in animal feeding, animal health, animal housing, and reproductive systems (Chander *et al.,* 2011).

The use of too many chemicals in agricultural research caused some problems in plant and animal breeding with the rise of the petrochemical industry in the early 1900s. Agrochemicals, veterinary medicines, antibiotics, and improved feeds can reduce production costs and increase food supply in various livestock systems around the world. However, nowadays, quality-conscious consumers are looking for healthy foods that are environmentally safe and do not leave chemical residues, together with product traceability and produced via organic methods including high animal welfare. Livestock has always played a key role in organic production systems. Between 1920 and 1950, the typical organic farms of Great Britain, Europe, and North America combined the breeding of livestock, forage crops, and food production. This system met all the needs of a farmer, while the waste obtained from livestock was used as fertilizer in crop production, crop production residues were used as feed in animal husbandry (Wolde and Tamir, 2016).

Businesses in organic agriculture are based on a self-feeding and closed production system that enables animal, plant, human, and food interaction (Figure 1). Organic agriculture aims to ensure sustainability in agriculture by protecting the health of humans and other living creatures to the maximum without polluting the environment, soil, water resources, air, and agricultural products. Among the main principles of organic agriculture in the production for this purpose are production in harmony with nature, appropriate crop rotation application, and the application of a closed system agriculture model. The closed system agriculture model is defined as a type of agriculture in which the resources of the enterprise are used and the enterprise can be as self-sufficient as possible. Especially in this

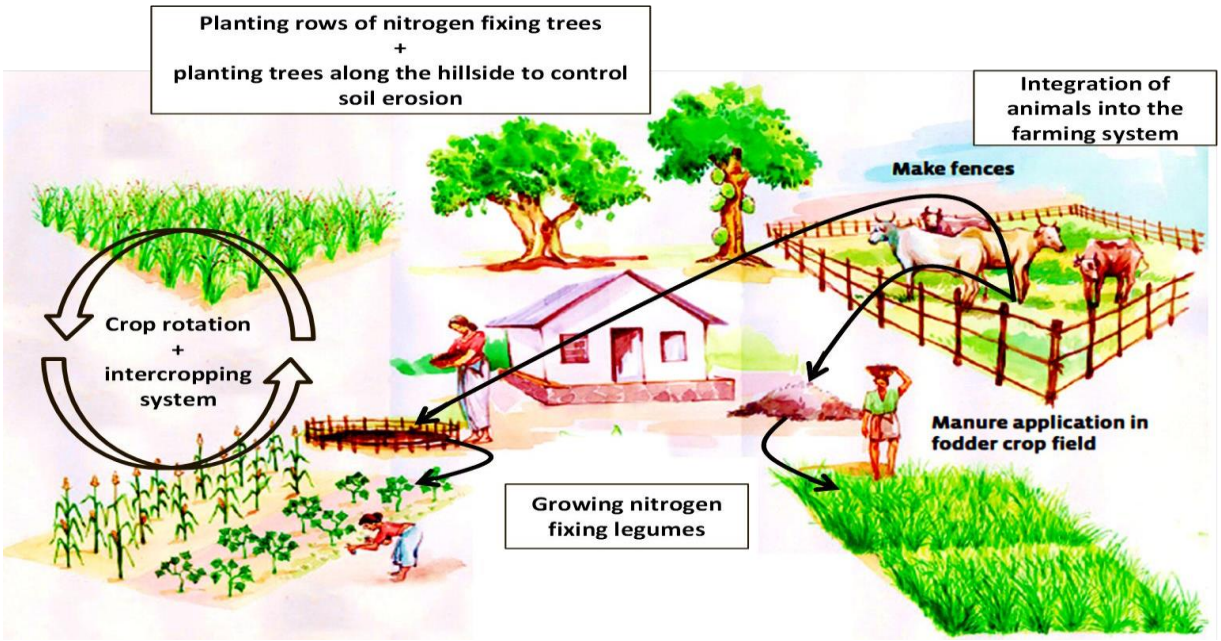

Figure 1: Some Organic Farming Methods (FAO, 2015).

system where plant production and animal husbandry are combined, it is important to evaluate the products produced in the enterprise as animal feed and to use animal wastes obtained from animals as organic fertilizers in plant production, in terms of providing the cycle in production (Duman *et al.,* 2009). Organic or ecological animal husbandry is a closed system production model that takes care of human health, animal health and welfare, encourages alternative livestock production systems, such as silvapastoral systems that less encourage outbreaks. It is also a model that is environmentally friendly, compatible with nature, chemically synthesized veterinary medicinal products, antibiotics and inputs obtained from genetically modified organisms are not used, all kinds of waste are evaluated as re-inputs and inputs are within the enterprise as much as possible (Altieri and Nicholls, 2020). Animal manure, which is seen as waste in most conventional livestock enterprises, contributes to the formation of a new product in organic livestock enterprises. Organic livestock farming is pasture-based and still does not allow antibiotics used as feed additives in some countries. In a study conducted to compare organic and traditional raw milk quality in the Netherlands, the conjugated linoleic acid (CLA) and omega 3 fatty acids levels of organic milk were found to be significantly higher (Bloksma *et al.,* 2008). Butler *et al.* (2008) compared the difference between fatty acid and antioxidant profiles of milk from traditional and organic systems in England and Denmark, and found that milk from organic farms had higher concentrations of nutritionally desirable fatty acids, conjugated linoleic acid, α-linolenic, α-tocopherol, and carotenoids. In addition, the impact of reproduction technologies such as superovulation, Multiple Ovulation and Embryo Transfer (MOET) or OPU-IVP-ET on welfare and integrity has already been discussed. It is accepted that reproduction techniques should be natural (Nauta *et al.,* 2001). According to the International Federation of Organic Agriculture Movements (IFOAM) standards, while artificial insemination is allowed, embryo transfer, genetic manipulation and hormonal synchronisation are not permitted (FAO, 2021).

According to the joint data of Research Institute of Organic Agriculture (FIBL) and International Federation of Organic Agriculture Movements (IFOAM), organic agriculture activities carried out with 2.8 million producers on 71.5 million hectares of land in 186 countries in 2018 reached 96.7 million Euros in the global market. The countries with the largest organic market in 2018 are the USA (40.6 billion Euros), Germany (10.9 billion Euros), and France (9.1 billion Euros). The highest amount of money spent on organic products in 2018 was in Denmark and Switzerland with 312 Euros per capita, and later in Sweden with 231 Euros (FIBL and IFOAM, 2020).

In Australia, 97% of the 35.69 million hectare organic production areas, which continues to grow its organic lands in 2018, are large pastures used for feeding cattle. In terms of organic production, Australia is followed by Argentina with 3.63 million hectares and China with 3.14 million hectares. Organic pasture areas worldwide increased by 2.9% in 2018, accounting for more than two-thirds (48.2 million hectares) of the total organic farmland. Current statistics show that organic pastures constitute 34% of organic agricultural lands, 27% of organic arable lands, and 18% of organic permanent products. The organic livestock sector is developing rapidly in European countries. Organic livestock farming in many countries started with beef, lamb, and milk production. According to 2018 data, 4.85 million cattle, 5.9 million sheep, 1.4 million pigs, and 56.5 million poultry are organically grown in Europe. Between 2009 and 2018, the biggest increase (128%) was in poultry due to high egg demand. Growth in organic livestock in this decade was 88% in beef and dairy cattle, 69% in sheep, and 105% in pigs (FIBL and IFOAM, 2020). Top three in organic cattle breeding are Germany (771.320), France (751.382), and Austria (421.324), while Greece (1.299.677), France (1.132.809), and the United Kingdom (826.598) are in organic sheep farming and Germany (178.200), Denmark (488.886) and France (317.925) are in organic pig farming. Organic cow milk production in EU countries has almost doubled since 2007 to meet the growing demand for milk and dairy products. According to the 2018 data, there are 5.113 cattle, 1.25 million poultry, 10.475 sheep-goats, and 51.272 beehives in Turkey (FIBL and IFOAM, 2020).

According to USDA PSD data, the use of corn and soy for feed purposes in conventional livestock breeding was 36-38% and 20-21% in the USA between 2016/17 and 2018/19, while the use of organic corn and soy was 52-62% and 77-86%, respectively (MERCARIS, 2020). The share of all animals in organic production remains inadequate compared to some crop production groups due to the insufficient organic feed obtained from local sources and the difficulties in obtaining traceable certified feed imports (FIBL and IFOAM, 2020).

The Importance of Ecological Animal Husbandry in Pandemics

The experienced process in the Covid-19 pandemic has revealed how closely linked human, animal, and ecological health is (Altieri and Nicholls, 2020). Human behavioral changes are caused by population growth, economic and technological development, and associated agricultural expansion; It creates new and more intense interactions between humans, animals, and wildlife. While meeting the food requirements of the increasing global population, there is a need for sustainable agricultural food systems that protect human health, biodiversity, and the environment and minimize the risk of emerging diseases (Jones *et al.,* 2013).

Many countries engaged in industrial animal husbandry import genetically modified soy or soy feed for animal feeding purposes. While herbicides used in industrial soybean production enter the digestive systems of animals, causing a decrease in beneficial bacteria (Jespersen, 2017), this may cause animals to be exposed to more diseases. In a study that compared chickens fed with traditional and the organic feed, it was found that although the chickens fed with organic feed came from behind in weight gain, caught chickens fed with traditional feed, and chickens fed with organic feed showed an improved immune reactivity (Huber, 2012). Organic livestock farming's not allowing the use of antibiotics is important for both human and animal health. According to the WHO, the use of antibiotics in livestock reduces the effectiveness of antibiotic treatment applied to humans (WHO, 2015). According to the European Medicines Agency's Sales of veterinary antimicrobial agents in 30 European countries 2016 report, for 1 kg of biomass (mg / PCU), the countries that used the most veterinary antimicrobial agents from 30 European countries between 2010 and 2016 were Cyprus (453.4 mg), Spain (362.5 mg) and Italy (294.8 mg) (EMA, 2016). In industrial livestock, antimicrobials are often used for growth promotion, disease prevention, and treatment, which promote the evolution of antimicrobial resistance in zoonotic pathogens (FAO, 2019a). The fact that organic animal husbandry promotes biodiversity and allows animals to roam freely provides low concentrations of zoonotic pathogens in these herds. While avian flu was of high intensity in conventional farms, it has been shown that there was low mortality and difficulty in spreading in small farms called backyard poultry and in flocks with diversity among poultry (GRAIN, 2006).

Organic animal husbandry demands for animals be provided with living conditions and opportunities suitable for their physiology, natural behavior, and well-being (Vaarst and Alrøe, 2012). In organic livestock farming, the movement of animals in wider areas and the low density of animals falling in a certain area prevents the animals from being stressed and reduces the risk of diseases. Animal welfare has also become a marketing argument for organic produce, and in some countries, consumers think that organic farming products as more 'animal friendly' than traditional products (Lund and Algers, 2003).

It is also important for countries' food safety that organic systems are self-feeding systems. Because organic livestock farming is either slightly dependent or not dependent on feed crops (soy, corn and etc.) used in industrial animal husbandry and imported by many countries. Controlled grazing of animals on the pasture not only allows pastures to be maintained and regenerated but also maximizes soil fertility, animal welfare, and quality animal food production (Escribano, 2018). Due to foreign trade restrictions, especially during the Covid-19 pandemic, countries and international organizations have started to focus more on food safety, self-sufficiency, and sustainable food production systems. These issues will be constantly on the agenda during and after this process (Gülçubuk, 2020).

In recent years, especially in parallel with the increase in environmental and health awareness, the demand for organic products has increased in EU countries, the USA, and other developed countries. In a study conducted in the USA, it was investigated why consumers prefer organic products. According to this study, 66% of consumers think that organic products are healthy and more nutritious, 38% taste better, 26% have positive effects on the environment, and 30% think that there is no hormone or drug residue in terms of food safety (Durak Kılıçaslan, 2015).

According to a report prepared in the UK, the coronavirus pandemic has increased the demand for organic and sustainable foods. According to the report, there was a 25-30% increase in the sales of online natural food retailers during the pandemic process (Ecovia Intelligence, 2020) . While existing customers from physical retailers were shopping more, so did customers consuming new organic products. During the Covid-19 period, consumers' awareness of nutrition and health increased and they bought more organic food to strengthen their immunity. The report states that the demand for organic foods will continue after the fear of the pandemic has passed. For example, the BSE crisis in 2000 increased the demand for organic meat products in Europe and sales remained high in the following years. Similarly, emerging SARS in China (and Asia) led to an increase in demand for organic food. The melamine scandal in 2008 increased the demand for organic baby food in China, and within a few years, the Chinese organic baby food market has become the largest in the world. Organic foods were first introduced on a large scale in the early 1990s, and global organic product sales exceeded USD 50 billion in 2008 and USD 100 billion in 2018. As the Covid-19 pandemic changes the way we shop and eat, the organic food market is estimated to exceed USD 150 billion in the next 5 years (Ecovia Intelligence, 2020).

The Covid-19 pandemic has led to the need to focus on many current issues such as antimicrobial resistance, zoonotic diseases, climate change, food fraud, and the digitalization of food systems, each of which has potentially significant consequences for food security. In the same way, the importance of protecting environmental resources and biodiversity as a natural buffer against diseases has shed light on the significant level of habitat degradation associated with land-use changes (FAO, 2020a). Ecological animal husbandry will become more important and necessary in the future in terms of solving problems such as human health, animal health and welfare, environment, climate, biodiversity, food security of generations, and food safety in general.

Conclusion

It is clear that pandemics that existed in the past and today will be inevitable in the future. The destruction of natural habitats, industrial agriculture, industrialization, and the decrease in biodiversity disrupt the ecological balance and create an environment for pandemic formation, endangering both human and animal health. This period revealed the importance of agricultural production, especially ecological production, and the desire of people living in cities to purchase agricultural products without intermediaries from producers, support small family businesses and settle in rural areas and produce their own food increased. In other words, the awareness of consumers about food has increased. With projects such as "Waste-Free Kitchen" and "Save Food, Protect Your Dining Table", the consumers have become more conscious.

Ecological animal husbandry transformation is a solution proposal to these problems that are likely to exist in the future and even increase their severity. It is clear that ecological animal husbandry is important in terms of both human and animal health and welfare to prevent pandemics by reducing the pressure on the ecological balance, and its importance will be understood more in the next 20 years. In countries that are dependent on imported inputs in animal production, the Covid-19 period has shown that domestic production is necessary for food safety, industrial feed production will not be sustainable for animal feeding, there is need to improve pastures with agroecological models, and a closed agricultural system model that is not dependent on external sources is important.

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Author contributions

All authors contributed equally to the study.

Conflict of Interest

The author declare no conflicts of interest.

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