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Review on Emerging Infectious Diseases and Their Impact in Livestock Productions

Adane Mota Japaro*

Head of livestock and fisheries resource, Ethiopia

***Corresponding author**

Adane Mota, Head of livestock and fisheries resource , Oofa District, Wolaita soddo, SNNPRs , Ethiopia Tel: +251921003550; Email: adanedvm18@gmail.com

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Abstract

The increase of land converted to agricultural production and livestock grazing is expected to cause a surge in human livestock, human–wild animal and livestock wild animal contact rates and increases emergence of infectious diseases. Emerging infectious disease, are new in its occurrence, have increasing incidences or spreading to new geographical areas. Emerging infectious diseases include COVID-19, Ebola, Middle East Respiratory Syndrome coronavirus (MERS-CoV) and highly pathogenic avian inflenza among others. The emerging infectous diseases having zoonotic importance, diseases cause impact in livestock production. Diseases raises from interaction between wild animal, human and domestic animals this is due to increased human population and increased agricultural cultivation land. Diseases cause closing of national boundries and marketing for animal and animal products. In animal production, farmers fatted his beef ox send to market and sell at low price due to low demand on meat caused by emerging disease outbreak and farmer take animal back to mix animal to herd. In addition, diseases affected economy of disease affected area which depended on wild animal meat as source of house hold income and protein sources. Therefore, the objective of this paper is to review emerging infectious diseases and their impact in livestock production

ABBREVIATIONS

EID: Emerging infectious diseases ; **MERS-CoV**: Middle East Respiratory Syndrome coronavirus; **SARS-CoV**: Severe Acute Respiratory Syndrome Coronavirus ; **HPAI**: Highly Pathogenic Avian Influenza; **FAO**: Food and Agricultural Organizations; **WHO**: World Health Organizations; **OIE**: The Office International des Epizooties; **EVD**: Ebola Virus Disease; **IGAD**: International Government Authority on Development; **APHA**: Animal and Plant Health Agency ; **GSO**: General Statistics Office; **US**: United States; **FAO-WFP**: Food and Agricultural Organizations - World Food Program; **FEWS NET**: Famine Early Warning System Network ; **OHRECA**: One Health Research, Education and Outreach Centre in Africa

INTRODUCTION

Feeding 11 billion people and the associated increase of land converted to agricultural production and livestock grazing is expected to cause a surge in human livestock, human–wild animal and livestock wild animal contact rates, increasing the likelihood of 'spillover' events, which are defined as pathogen transmission from a reservoir host population to a novel host population [1-3]

Infectious diseases are emerging at an unprecedented rate with significant impacts on global economies and public health and environmental conditions that give rise to disease emergence. The socialare thus of particular interest, as are management approaches that might reduce the risk of emergence or re-emergence [4]. Emerging infectious diseases (EIDs) include infections that are new, have increasing incidence or are spreading to new geographical areas. Examples of these diseases include COVID-19, Ebola, Middle East Respiratory Syndrome coronavirus (MERS-CoV) and highly pathogenic avian inflenza among others [5].

Recently, two outbreaks of coronaviruses have been recorded with devastating effects, these being the Middle East respiratory syndrome coronavirus (MERS)-CoV and severe acute respiratory syndrome coronavirus (SARS)-CoV [6]. These coronaviruses can also infect several animal species. For example, SARS-CoV-1 which cause Severe Acute Respiratory Syndrome (SARS) outbreak in 2003, was also closely related to other coronaviruses isolated from bats and can infected civet cats and then humans, while the virus causing the Middle East Respiratory Syndrome (MERS-CoV) is found in dromedary camels, and has continued to infect humans since 2012 [7].

SARS-CoV-1, the cause of the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003, was also closely related to other coronaviruses isolated from bats. These close genetic relations of SARS-CoV-1, SARSCoV-2 and other coronaviruses, suggest that they all have their ecological origin in bat populations [7].

The occurrence of COVID-19 leads to the sudden closure of livestock markets in March and April left commercially-oriented

livestock producers with market-ready animals and no buyers [8] and shown how the epidemics can threaten peoples' lives and livelihoods worldwide [5].

The World Organisation for Animal Health report [9], which mentions that "The endemic situation of HPAI in Egypt is affecting not only the commercial flocks but also rural households through most of the governorates". Animal product chains have been diversely affected by the Ebola Virus Disease outbreak. The commercial poultry sector has suffered from its dependence on imported feed, unlike fish and pork production. Reopening of borders should be organized for feed and animal trade [10]. However, there is no the reviewed title on emerging infection diseases that initiated to review this paper. Therefore the objectives of the paper is emerging infectious diseases and their impact in livestock production

LITERATURE REVIEW

Emerging infectious diseases

Highly pathogenic avian influenza: The OIE *Terrestrial Animal Health Code* (*Terrestrial Code*) defines "avian influenza" as an infection of **poultry** caused by any influenza A virus with high pathogenicity (HPAI), and by H5 and H7 subtypes with low pathogenicity (H5/H7 LPAI). Influenza A is caused by specified viruses that are members of the family Orthomyxoviridae and placed in the genus influenza virus A. There are three influenza genera – A, B and C; only influenza A viruses are known to infect birds [11].

Avian influenza was first reported in its highly pathogenic form (HPAI) in poultry in a small farm in Scotland, UK, in 1959 [12]. HPAI caused by the current H5N1 virus was first reported in Southeast Asia in late 2003, although the virus is now considered to have emerged as early as 1996, when it was first identified in geese in Guangdong Province in southern China. It then caused disease in the Hong Kong Special Administrative Region, where poultry and humans were affected in 1997, poultry only in 2001 and early 2002 and poultry and captive wild birds in 2002– 2003. From 2003 onwards, the disease spread widely, initially through East and Southeast Asia in 2003–2004 and then into Mongolia, southern Russia, the Middle East and to Europe, Africa and South Asia in 2005–2006, with outbreaks recurring in various countries in 2007. To date, 60 countries have reported outbreaks of HPAI H5N1 in domestic poultry, wild birds or both [13].

The spread of highly pathogenic H5N1 avian influenza throughout Asia, Africa and Europe has led to an increase in the number of laboratories performing diagnostics for this pathogen. Highly pathogenicity avian influenza (HPAI) viruses, in general, are a serious threat to birds and mortality is often 100% in susceptible chickens. In addition, the agents can also pose a serious zoonotic threat, with over 50% mortality reported in humans infected with H5N1 HPAI virus [14].

Middle East respiratory syndrome coronavirus

Middle East respiratory syndrome coronavirus (MERS-CoV) is a zoonotic respiratory infection that is endemic in dromedary camels (Camelus dromedarius) and causes asymptomatic or mild-to-severe illness in the human population [15]. (MERS) coronavirus (MERS-CoV) first emerged in 2012 in Saudi Arabia and is currently a worldwide concern [16]. Since 2012, when the first human case of MERS-CoV was detected in Saudi Arabia, there have been 2494 confirmed human cases and 858 deaths reported from 27 countries, including the Middle East, Southeast Asia, Europe, North America and North Africa [17-18].

Although during most reported outbreaks the virus is mainly transmitted by human-to-human contact, infection through contact with dromedary camels (*Camelus dromedaries*) plays a major role in the primary cases. In the Middle East and some countries from East Africa where MERS is endemic, high prevalence of MERS-CoV specific antibodies in dromedaries has been reported [19]. The supporting evidence that camels as the primary reservoir includes isolation of the virus, the high prevalence of MERS-CoV antibodies in camel sera from many countries in the Middle East, Africa and Asia, and the ability to be experimentally infected with the virus [15].

Other than camels the pigs can be infected with MERS-CoV and other members of the family Suidae could be susceptible to the virus, such as common warthogs (*Phacochoerus africanus*), bushpigs (*Potamochoeruslarvatus*), and wild boars (*Sus scrofa scrofa*). Indeed, these animals are commonly found in the Greater Horn of Africa or the Middle East, sharing territories and water sources with dromedaries [20]. Moreover, the surveillance in Saudi Arabia demonstrated that MERS-CoV strains isolated from humans were also detected in the upper respiratory tract of dromedaries of several geographic origins, indicating that the virus did not require mutations to jump between species [21].

COVID-19: The first human cases of COVID-19, the disease caused by the novel coronavirus causing COVID-19, subsequently named SARS-CoV-2 were first reported by officials in Wuhan City, China, in December 2019 [22]. There are seven coronaviruses strain (229E, NL63, OC43, HKU1, MERSCoV, SARS-CoV) that infect humans have been identified since the 1960s [6]. They are known as coronaviruses (CoV) because they belong to the ribonucleic acid (RNA) family of viruses that often have a characteristic crown (corona) of protein spikes around its lipid envelope [23].

The most likely ecological reservoirs for SARS-CoV-2 are bats, but it is believed that the virus jumped the species barrier to humans from another intermediate animal host. This intermediate animal host could be a domestic food animal, a wild animal, or a domesticated wild animal which has not yet been identified [24].

The coronaviruses are very stable in a frozen state which can survival for up to two years at -20°C and viruses can persist on different surfaces for up to a few days depending on a combination of parameters such as temperature, humidity and light but, they are thermolabile, which means that they are susceptible to normal cooking temperatures (70°C). Therefore, the consumption of raw or undercooked animal products can lead to harbor the viruses which are handled with uncare [22]. Coronaviruses spill over, infecting humans and animals, while causing a range of effects including respiratory, gastrointestinal, hepatic and neurologic diseases among humans and animals alike [25,26].

Ebola: Ebola hemorrhagic fever is a fierce and extremely rapid killing viral disease which passes to other humans *via* blood and other body fluids, and causes death in 50-90% of clinically diagnosed cases.It leads to rapid onset of symptoms (initially high temperature, shivering, and aches). It advances to gastric problems and rashes on appropriately the third day, resulting to throat lesions by the eight day. This is often accompanied by spontaneous bleeding and renal failure, and then to extreme lethargy and hallucinations and usually death within two weeks [27-28].

On 21 January 2015, the Ebola virus disease (EVD) outbreak in West Africa had led to over 21 600 reported cases, including more than 8 600 deaths. Sierra Leone is the worst affected country with 10 300 cases (compared with 8 400 cases and 2 800 cases respectively in Liberia and Guinea, the two other worst affected countries in the region) but has reported fewer deaths than Liberia [29].

Emerging infectious diseases impact in livestock production

Impact of HPAI in livestock production: The impact of HPAI on poor and very poor livelihoods whose livehood depend on poultry raising is very high; chickens are small, hardy and durable providers of protein that are easy to care for in conjunction with other activities. Since the HPAI outbreak, generating extra income has been a challenge for rural households, particularly those headed by women, whose employment opportunities are limited. Alternative strategies have had to be taken, such as sending children to work and reducing meat and other food consumption, all of which compromise children's welfare and well-being [30].

HPAI, like other highly contagious animal diseases, affects animal production via three main pathways [31].

- First, disease causes direct losses to producers and other actors connected to the production and marketing of poultry through morbidity and mortality and the private costs associated with ex-ante risk mitigation (e.g. investment in animal housing) and/or ex-post coping measures during periods of downtime1 (e.g. bridging loans if the enterprise carries significant borrowings) and the need to reinvest in replacement birds.
- Second, animal diseases that are 'notifiable' can have severe impacts through government intervention, which carries a cost borne by the public at large and affects producers (and associated up- and downstream actors), irrespective of the disease status of their flocks. These costs include public investment in animal health infrastructure and epidemic preparedness.
- Third, disease impacts arise through market reactions, which can be particularly severe on the demand-side in the case of diseases that are associated with a public health risk. Analogous to disease control measures affecting producers even if their flocks have not contracted HPAI, market reactions can occur, irrespective of whether or not avian influenza has actually occurred in the country.

Direct and immediate impacts of HPAI outbreaks in poultry flocks result from the loss of the current value of birds, which die or are culled, and from foregone income from poultry raising during the ensuring interruption of production (downtime). Large numbers of poultry have died from HPAI or been culled to control the disease since it spread widely from 2004 onwards. In Thailand, 63.8 million birds were culled from the onset of HPAI outbreaks in 2004 until 2006 [32], whereas for Vietnam the figure amounts to around 50 million birds [33]. For Indonesia, Hartono [34] reports that 17.1 million poultry (15 million layers, 2 million parent stock and 0.1 million broilers) died or were culled between July 2003 and January 2004, before the official announcement of HPAI by the government. In Nigeria, 0.9 million birds died or were culled in commercially-oriented farms by mid-June 2006 [35].

In Egypt, an estimated 36 million poultry have died or been culled as a result of HPAI (Office of the Prime Minister). The impact was particularly severe in the Governorates of Kayloubia, Sharkia, Giza and Ismaelia in terms of average bird losses per rural person [36]. In Bangladesh, between February 2007, when HPAI appeared, and June 2008, 1.6 million chickens were culled and further 277 000 died in a total of 287 outbreaks. In addition, nearly 2.2 million eggs were destroyed on affected properties [37]. One of the few reports from China states that when HPAI occurred in Anhui Province in June 2004, 145 000 poultry were infected and 9 million birds were culled [38].

One component of the 'cost of HPAI' found in a number of reports is that of direct bird losses, estimated as the product of the number of birds that died or were culled and the average value of a bird. However, widely different average values are at times assumed. In Nigeria, for example, the estimated farm value of the 0.9 million birds lost was US $4.82 million (Naira 617.4 million) [39], i.e. an average value of more than US $5 was assumed per bird, whereas for Indonesia, Rushton *et al*. [40] estimated the national losses from 16.2 million poultry died or culled at US $16.2–32.4 million, based on a value range of US $1–2 per bird, subject to its weight or being broiler or layer. Although certainly there is a wide range of values individual birds can have, e.g. grand-parent stock will be much more valuable than broilers, such widely differing 'average' bird values across assessments are surprising. It also appears that many reports use market values of finished birds when calculating the cost of stock losses, when actually many, if not the majority, of birds that die or are culled are pre-market age.

Different estimates of HPAI-related 'losses' can also be found for similar periods within the same country. For Vietnam, direct losses from culled birds, lost production, costs of culling and disinfection in 2004 were estimated by the Government of Vietnam to amount to about US $205 million (VND 3226 billion) [41]. An estimate by the World Bank [42] for the same period arrived at a national loss of US $120 million, i.e. 60% of the government estimate. Inaccuracies in disease impact assessments stemming from variable methodological approaches and differing valuations are compounded by major information deficits.

Depending on incentives or disincentives for disease reporting such as compensation or culling, the real incidence and impact of HPAI may be under- or over-reported. Thus, for Bangladesh, it is likely that losses in the commercial layer and breeding units have been underreported and that backyard systems have not

reported disease either through a lack of information or because of problems of receiving compensation [37]. Exaggeration of HPAI losses or attribution of poultry deaths from other disease to HPAI are said to have occurred in some countries where compensation funds of the central government are disbursed by local authorities (anonymous, personal communication).

Impact of COVID-19 in livestock production: The impact of the COVID-19 pandemic in camel sector was impacted by five main ways: 1) through infection and disease of the owners or staff in camel farms leading to disorders in the manpower management, 2) through the difficulties in the local and international distribution network of camel products due to the restriction of movements, especially during the time of confinement, 3) through changes in the consumers' behavior toward the unexpected health crisis, 4) through the cancelation of touristic or sport event linked to camel breeding, and 5) through national and international travel restriction of professionals, service personals, scientists etc [43].

Due to the occurrence of COVID-19 and closure of market the livestock producers with additional herding animals could integrate finished animals into the larger herd for future sale, but specialized producers with no other herd holdings were forced to either sell finished animals at a lower than anticipated price, or keep them and incur additional expenses for care, including labor and fees for fodder, mineral supplements, water and water delivery. Similarly, the occurrence of COVID-19 in one country result in direct and indirect impact in livestock production that can be explain as follows [8]:

- The outbreak of a trans-boundary or zoonotic disease occurred have, result in the market closures for example, the reduced supply of livestock has resulted in higher meat prices for end consumers. This is why the impact of COVID-19 on livestock market systems is unique: the pandemic radically reduced market demand for meat and milk. The consumption of meat and milk often decrease when retail prices increase or when household incomes decrease or become less reliable. The sudden loss of income for thousands of urban residents, coupled with the closure of bars, restaurants, institutions and street-food vendors, gutted demand for meat and milk in urban and peri-urban communities.
- For much of the region, the emergence of COVID-19 corresponded with the rain, a time when livestock keepers limit livestock sales to maximize milk production and animal and herd growth. Instead, they engage in alternative livelihoods, such as milk trading, agricultural labor or trade in local materials. Market closures and movement restrictions related to COVID-19, as well as fear of contracting the disease, have limited households' ability to earn income from these alternative sources. Livestock-keeping households lost an estimated 20-40 percent of their income between March and May. To cope, they are limiting their expenditures, using savings or taking credit when possible.

In addition, cumulative UK milk production for 2020/21 now stands at 7,616.12m litres. This is 35.54m litres lower than at the end of September 2019. In spite of many milk contracts offering a slight increase in prices recovering from the falls during the start of the Covid pandemic, the UK average milk price for September 2020 is estimated at 28.72pence per litre (ppl). This is 0.49ppl lower than the average price received during September 2019 [44]. In March 2020, governments across the Horn of Africa established mitigation measures to prevent the spread of COVID-19. Initial measures included suspending international flights, closing international borders and limiting gatherings of large groups of people. Closure of international borders along with suspension of night-time travel has resulted in bottlenecks and delays in the movement of goods including animal health inputs, raw ingredients for animal feed (maize, soya, imported supplements), and live animals; resulting in higher operating costs for traders and increased prices for retailers and processors [45].

Impact of Ebola in livestock production: The Ebola outbreak caused decreased food availability, accessibility, affordability, due to low or virtually lack of processing and preservation, marketing, financing, and storage and food protection undertakings. Moreever, the effect of outbreak decreased in food storage and protection within the quarantine communities [28]. In addition, the farm yield low, food storage and perseveration is impossible, as food itself is not available. This is due to the fact that most of the farmers abandoned their farms and crops at the mercy of pests for destruction. Where farmers abandon farms or are prevented from attending to their farms as a result of quarantine or restriction of their movement, there would be nothing for storage or preservation. The implication of this is food insecurity in the community leading to increased malnutrition and poverty [46].

Different factors have contributed to decreased demand for some animal products, such as fear of animal products originating from affected areas, the evacuation of managerial and supervisory personnel from the mining sector, and more broadly, consumers' lower purchasing power. Decreased purchasing power probably contributed to keep animal product prices low in affected areas [47]. In urban areas, increases in prices were recorded (up by 40 percent for fih in Sierra Leone urban markets [48].

Since the Ebola outbreak, Sierra Leone, Liberia, and Guinea have all experienced disruptions of economic activities acros s sectors. The largest economic effects of the crisis are not necessarily the direct costs, but those resulting from behavior changes driven by fear that caused lower demand for goods and services and consequently lower levels of domestic income and employment. In Liberia, households maintained access to their typical sources of food although the level of access was reduced for some sources of food, including in-kind payment, bush meat, and market purchase [49].

Bans on bushmeat did not lead to a major increase in demand for other animal products, even in Liberia where bushmeat consumption is usually high in rural areas. Bushmeat consumption may have been replaced by the consumption of small livestock (poultry, pigs, small ruminants) and this has consequently led to farm decapitalization. If confimed, animal restocking should be targeted to help households recover from the EVD epidemic [49].

Causes for emergence of infectious disease

As with many other types of human-wildlife conflict, their emergence often involves dynamic interactions among populations of wildlife, livestock and people within environments that rapidly change due to human activities, especially: Human population growth and urbanization, which encroaches into wildlife habitats, drive animal species into marginal environments, and result in direct competition for limited resources and land. Expansions and intensification of economic activities (such as husbandry, agriculture, fishing, infrastructure development, mining and logging) increase human-wildlife interactions [50]:

- Wild species continue to be an important source of food, income and cultural identity for millions of indigenous and rural people, particularly in tropical and subtropical regions. The survey of nearly 8 000 rural households in 24 countries across Africa, Latin America and Asia has found that 39 percent of households harvested wild meat, and almost all consumed it. Wild meat thus represents the main source of vital protein, fat and micronutrients – as well as a key element in diet and income diversification for millions of rural people across the tropics and subtropics. Dependence on wild meat increases with poverty, including in places and at times when other food supply chains fail, making wild meat the sole or primary source of protein and income available, for instance during economic hardship, civil unrest or drought.
- The level of exposure is a key element in the probability of contracting zoonotic diseases both in the natural environment where hunting occurs and in markets that provide wild meat to urban populations. Hunter-gatherer communities are typically in contact with wild animals a few times a week and thus are usually more exposed to primary infection, especially when zoonoses affect several wildlife species; an example of this is Ebola.
- Currently, transmission of the SARS-CoV-2 virus causing COVID-19 is only reported to be transferred by human-to-human contact, but, preliminary research suggests some wildlife species may be reservoirs for SARS-CoV-2.
- Wet markets" – markets selling fresh meat and fish as well as live animals – are considered to be critical areas where pathogen spillover between humans, wildlife and livestock could occur. The proximity of live animals in these markets could allow the exchange of pathogens between wildlife and domestic species, which may lead to the evolution of wildlife-origin pathogens into new strains able to infect humans and livestock. This must be confirmed by science-based evidence.

CONCLUSIONS AND RECOMMENDATIONS

Emerging infectious diseases are diseases which are new, have increasing incidence or are spreading to new geographical areas. Emerging infectious diseases include COVID-19, Ebola, Middle East Respiratory Syndrome coronavirus (MERS-CoV) and highly pathogenic avian inflenza among others. Emerging infectious diseases impact in livestock production affect the income of farmers and affect food security. The current outbreak of covid-19 affected the livelihood of farmer by decreasing demand on market due to the characteristics of diseases which can persist. The MERS-CoV it affect the health of animal especially, camel and having its zoonotic nature. The ebola virus affect the livelihood of farmers depend on bush meat as only source of protein. The emergences of those diseases depend on having the habit of mixing wild animal with domestic animal which can exaggerate the disease occurrence.

Based on the above conclusions the following recommendations are forwarded:

- Most of the time the highly pathogenic avian influenza occurrence explained as the result of mixing of wild birds with domestic fowl. The mixing of domestic fowl with wild birds should be avoided.
- If as chance HPAI occur at a certain geographical area, the affected poultry should be totally culled and the diseases occur at poultry abattoir all operation should be stopped and reported to disease controlling authority.
- The covid-19 is highly contagious disease in its nature, for safe the disease controlling rule of WHO should be implemented.
- The reason for occurrence of Ebola virus is feed source depend on bush meat. Care should be taken while using bush meat.
- Government should proclaim the policy which could restrict the uses of wild meat.
- Diseases like Middle East Respiratory Syndrome coronavirus primarly affect camel and humanbeing. So implementation of the rule that could control the disease occurrence.

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