Animal Markets and Zoonotic Disease in India

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Abstract: India is the second-most populous country in the world with over 1.3 billion people and thousands of animal species, including 14 primate species and at least 109 bat species. India is among the world's largest producers/consumers of dairy and exporters of beef products. It is one of the world's largest producers of eggs and broiler meat. Its relationship with animals is complex and varies across religion, socioeconomic level, geography, and culture. While some farm animals are worshiped, they are also used extensively for protein production and sold for export. India continues to experience increased economic development and growth. It is difficult to gauge the prevalence and risk of zoonotic disease in India because of a lack of data and testing, particularly in poor rural areas with limited access to healthcare, where many residents work or interact closely with animals. Live animal markets operate across India, selling a variety of animals, including livestock and wildlife sold for food, as well as domestic and exotic pets. Animals enter markets from both domestic and international supply chains and are sold in urban and rural areas. Animal markets may operate within larger local markets, existing as standalone stalls in common markets, pet shops, and meat vendors. Some markets operate daily year-round, others seasonally. Other markets involve tourism/recreation, sanctuaries, ritual slaughter, tribal hunting festivals, and wildlife trafficking (whereby animals are killed for sport or are captured to enter India's wildlife trade to be later sold as pets or killed for meat). Domestic and international demand facilitate the legal and illegal trade of wild animals through a variety of supply chains. For example, civet cats are increasingly hunted and captured in India for coffee production. In terms of livestock, the dairy industry in the country is based on a co-operative model whereby small farmers carry out most of the milk production. The poultry industry consists of two operational models with distinct supply chains: highly formalized and informalized.

[Rajendran, S. and Namdev, D.K. **Animal Markets and Zoonotic Disease in India**. *The International Journal of Interpretation, Observation and Analysis*, 2024; Volume 3, Issue 1:73-77 (July-September). ISSN 2349-0713, Peer-reviewed (online/offline), Refereed, Indexed and International Journal (Since 2013), Global Impact Factor: 5.776

Key words: Animal Marcket, Zoonotic diseases, Surveillance, India

INTRODUCTION The first cases of COVID-19 in India were found in January 2020 among medical students who traveled back to India from Wuhan.1 The Indian government responded by enforcing a lockdown two months later when COVID-19 cases reached 500.2 As of the time of writing,3 there have been over 43 million cases of COVID-19 in India and over 500,000 deaths, although the true number could be closer to 3 million killed by the disease.4 5 Inaccurate or incomplete tallies may be attributed to disorganized reporting systems or a desire to downplay the virus' impact; however, the fact remains that India ranks among the worst-affected countries in the world by the COVID-19 pandemic.6 7 Part of this impact may be attributable to the fact that India is ranked much lower than many of its Asian middle-income peers in health security, zoonotic disease prevention, health care access, pandemic preparedness, and capacity of health facilities according to the Global Health Security Index.8 While India has not been identified as the location of COVID-19's origin, the country's many live animal markets operate with significant zoonotic risk potential. Despite a growing "supermarket revolution," India's rural and urban areas continue to house large and traditional open-air markets where meat, pets, and wildlife are purchased.9 High-traffic markets create environments for diseases to spread not only among animals but also to new human hosts. These traditional markets present significant zoonotic concerns due to the sale and slaughter of live animals in public.10 Caged exotic and domestic animals excrete bodily fluids, feces, and other waste, thereby increasing the risk of potential transmission of dangerous pathogens to those who work, shop, and frequent the markets. Several demographic and environmental factors make India particularly vulnerable to zoonotic disease outbreak and reemergence. Prior epidemics were able to spread quickly in India due to the country's poorly resourced healthcare systems, variable literacy levels, economic instability, lack of sanitation, and ever-growing urbanization. In recent years, an increasingly robust economy has led to higher

demand for animal protein with fish, chicken, goat, buffalo, and pork composing the majority of the domestic meat market.11 While the demand for bushmeat (most often the endangered Indian Gazelle) is decreasing in India due to economic development, bushmeat is still considered a luxury food item.12 India's diverse landscape encompasses multiple ecosystems, including wetlands, grassland, desert, forest, as well as marine and coastal areas. While India continues to experience increased economic development, this growth has fueled urban development and encroachment into wildlife habitat, which, in turn, has facilitated the emergence of deadly diseases such as dengue, chikungunya, and Japanese encephalitis.13 Local deforestation in Karnataka, for example, has been linked to Kyasanur Forest Disease, a sometimes fatal, tick-borne flavivirus carried by monkeys, rodents, and shrews.14 Similarly, the Nipah virus has reemerged in India due to the displacement of fruit bats from their habitats, which subsequently led to frequent contact with livestock animals and humans.15 The increasing interaction between humans and bats due to development and land-use changes creates a shift in environmental equilibriums that augments opportunities for zoonotic disease spread.16

ZOONOTIC DISEASE, EMERGENCE, AND REEMERGENCE

India continues to suffer the effects of the COVID-19 pandemic; however, this outbreak is only the most recent chapter of India's long history of zoonotic diseases, many of which continue to re-emerge or have become endemic to the region.17 The bubonic plague first arrived in India on September 23, 1896. Within 25 years, an estimated 12 million Indians died.18 While the plague originated in Yunnan, China, spilling over through fleas that transmitted the virus from infected rodents to humans, the disease thrived in India due to overcrowded cities, lack of hygiene in public transportation and common areas, and societal factors.19 Areas such as the Punjab region were most affected due to ongoing battles with other diseases such as malaria, smallpox, and cholera. Although the plague began to subside after millions of vaccinations were administered in 1902–1903, India continues to be threatened by the emergence. In 1994, the plague reappeared in Gujarat, causing panic and population exodus. In 2004, a localized outbreak in Uttarakhand led to eight cases and three deaths.20 Other notable re-emerging zoonotic viruses include the Nipah virus, which was first identified in 1999 among pig farmers in Malaysia, but also caused several outbreaks in India in 2001.21 Since then, Nipah has reappeared in India on an almost annual basis, with mortality rates from these outbreaks reaching as high as 91% and averaging 75% over the last two decades.22 23 Additionally, Chikungunya fever, first reported in Tanzania, caused outbreaks in India from 1963 to 1973, and it continues to reappear today.24 H1N1, Crimean-Congo hemorrhagic fever, and certain forms of encephalitis are other zoonotic diseases that persist in and spread across several Indian states.25 In India, brucellosis, a flu-like disease that can transfer from livestock to humans, causing fever, headaches, and back pain, is found in many large, organized dairy farms. The virus is considered endemic in all states of India and the recent rise in incidence is due to the intensification of India's dairy industry.26 The true impact of zoonotic disease in India is likely significantly understated because such disease spread often affects poor rural communities with limited access to healthcare, many of whom also work closely with animals. While One Health policies have made strides in India, the implementation of such policies has been challenging due to the low visibility of these issues combined with limited federal guidance and cross-discipline collaboration.27 Unless national policy frameworks are strengthened to improve disease surveillance and interventions while accounting for sociopolitical and cultural nuances, India will continue to face public health challenges from infectious disease.28

LEGAL AND REGULATORY FRAMEWORK OF ANIMAL PROTECTION

Enacted in 1949, the Constitution of India is composed of 25 "Parts" and each Part is divided further into Articles. A total of 395 Articles exist in the Indian Constitution. Additionally, 12 "schedules" of the Constitution elaborate on government policy with respect to certain Articles. Within the Constitution, Fundamental Rights (Part III) are enforceable, while Directive Principles of State Policy (Part IV) and Fundamental Duties (Part IVA) are unenforceable by courts.disease's re Fundamental Rights of Animals (enforceable in any court) While fundamental rights are given to "persons" under Article 21 of Part III of the Constitution of India, the Supreme Court has given a widely accepted expanded definition to the term "life" to include the right to a healthy environment.29 In the landmark judgment of Animal Welfare Board of India v. A. Nagaraja & Ors., the right to a healthy environment, under the expanded definition of "right to life," was interpreted as inclusive of the welfare of animals.30 While Article 21 of the Constitution states that "no person shall be deprived of his life or personal liberty except according to the procedure established by law," the Supreme Court

of India held that "every species has a right to life and security, subject to the law of the land, which includes depriving its life, out of human necessity." The court further stated, "Article 21 of the Constitution, while safeguarding the rights of humans, protects life, and the word "life" has been given an expanded definition, and any disturbance from the basic environment which includes all forms of life, including animal life, which are necessary for human life, fall within the meaning of Article 21 of the Constitution."31 While the Fundamental Duties and Directive Principles of State Policy are not enforceable in a court of law, they do establish an objective framework for law and policy. The Supreme Court also declared that Article 51A(g) of the Directive Principles of State Policy of the Constitution of India is the "Magna Carta of animal rights" in India. Life, according to the Supreme Court, which includes animal life, "means something more than mere survival or existence or instrumental value for human beings, but to lead a life with some intrinsic worth, honor, and dignity."32 Sections of the Directive Principles pertinent to animals include Articles 48, 48A, and 51A(g). Article 48 of Part IV of the Directive Principles of State Policy governs agriculture and animal husbandry and states that the "state shall endeavor to organize agriculture and animal husbandry on modern and scientific lines…and prohibiting the slaughter of cows and calves and other milch and draught cattle." Article 48A concerns the protection and improvement of the environment and the safeguarding of forests and wildlife. Article 51A(g), states that "it shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures."

Laws That Govern Live Animal Markets and Slaughterhouses:

In accordance with the Prevention of Cruelty to Animals Act of 1960, the Government of India enacted The Prevention of Cruelty to Animals (Slaughter House) Rules of 2001. Section 3(1) of the Slaughter House Rules states that "No person shall slaughter any animal within a municipal area except in a slaughterhouse recognized or licensed by the concerned authority." The Rules continue to specify the amenities in slaughterhouses and the processes for slaughter. The FSSAI only permits operations for animal food businesses slaughtering and selling goats, sheep, pigs, bovine animals, poultry, and fish. In addition, the Food Safety and Standards Act of 2006 and the Food Safety and Standards Regulations of 2011 govern the licensing and registration of all food businesses and require a license for all slaughterhouses equipped to slaughter more than 50 large animals or 150 or more small animals or 1,000 or more poultry birds per day. Unable to adhere to safety, sanitation, and hygiene requirements, many slaughterhouses shut down.33 The Slaughter House Rules also require veterinarians to certify that animals are healthy, disease-free, and have access to separate isolation pens in order to prevent infectious disease outbreaks. The Animal Welfare Board of India, per the PCA has the authority to, without notice, inspect any slaughterhouse. Beyond these federal regulations, municipal laws can in some cases provide more protection.34

HUMAN–ANIMAL INTERFACES India is the second-most populous country in the world with over 1.3 billion people and 91,000 species of animals, including high-risk zoonotic carriers such as the Indian pangolin, 14 species of primates, and at least 109 species of bats.36 37 This report focuses on the livestock, wildlife, and pets found in India's live animal markets, so it does not include the full spectrum of diverse animal supply chains in India. As such, our report is only a snapshot of this larger catalog of risks presented by the country's animal use and trade. India's relationship with animals is complex and varies across religion, socioeconomic level, geography, and culture. While some farm animals are worshiped, others are exploited. Both scenarios, and most in between, present human–animal interfaces that present a risk of zoonotic spillover. Livestock (Cattle & Poultry): Human–cattle interfaces, and subsequently zoonotic disease potential between humans and cattle, vary throughout India. The fate of cattle in India is determined by the power delegated by the central government to the states and union territories. In 1950, the Constituent Assembly amended the Directive Principles of State Policy (DPSP) under Article 48 of the Indian Constitution to state: "The State shall endeavor to organize agriculture and animal husbandry on modern and scientific lines and shall in particular take steps for preserving and improving the breeds of cattle and prohibit the slaughter of cow and other useful cattle, specially milch and draught cattle and their young stock."38 Due to widespread religious and traditional reverence by India's Dharmic population, many states explicitly prohibit cow and calf slaughter while less dharmic-populated states permit slaughter for cows who have reached a certain age. Other states have no such regulations.39 In the states that ban cow slaughter, the sale of beef is also banned. While the DPSP under Part IV of the Constitution serve as guidelines for government policy, they remain subject to much debate in India.

onsumers of dairy and exporters of beef products.40 The reason for these high figures in a country with significant restrictions on cow slaughter is that the slaughter of buffalo, and the export of buffalo meat, is legally permitted throughout India. Dairy farming also presents health risks and a number of potential zoonotic diseases may occur. The dairy industry in the country is based on a co-operative model whereby small farmers carry out most of the milk production. In rural India, it is common for cattle to live in close proximity to farmers and their family members. Cattle are often situated under the same roof where family members sleep, cook and eat; such close proximity exposes farmers and family members to tuberculosis.41 Mycobacterium bovis (M. bovis, or bovine TB), a bacterium found in cows and other hoofstock, including buffalo, is one of the leading causes of death worldwide.42 In developing countries such as India, M. bovis is responsible for 10%–15% of new human TB cases.43 A 2017 study on the prevalence of bovine tuberculosis found that residents living in unsanitary, overcrowded, and TB-endemic regions suffered most from TB—more so than dairy workers and zoo handlers who had direct contact with cattle.44 The majority of the individuals sampled consumed meat from local abattoirs and indicated that no proper inspection of meat and meat products was done prior to consumption. Additional risk factors included poor ventilation, sleeping alongside calves to protect them, raw milk consumption, and living near cattle pens.45 Other bovine zoonotic diseases documented in Indian cattle and water buffalo include schistosomiasis, rotavirus infection, leptospirosis, and brucellosis.46 The impact of human contact with potentially 300 million cattle, of which 21.8 million are potentially infected with bovine tuberculosis, requires significant disease control interventions.47

CONCLUSION Gaps in providing quality healthcare, as well as limited access to disease control facilities, lack of awareness, scarcity of resources, and a shortage of good infrastructure compound the risk of zoonotic outbreaks in India. Identifying these gaps helps to show what reforms are necessary to effectively mitigate the public health cost of live animal markets that can act as a petri dish for pathogens, facilitating high-risk human–animal and animal–animal interactions. Change must begin at the grassroots level by educating those who work with animals directly and those who oversee enforcing animal protection laws. India's laws and regulations are extensive but require better enforcement. The root of these issues lies in poor administration and a lack of infrastructural support. With greater transparency and accountability at each junction of the transaction chain, as well as the incorporation of One Health principles, resiliency can be built into the governance and regulatory framework. Cross-sectoral pollination and strategically tailored policy responses are necessary to shift from a reactionary approach to a responsive and proactive one. India has a strong legal framework to protect against dangerous human–animal health risks, but such laws must be supported by stronger implementation. Violations should be more transparent, including higher bails and penalties to deter illegal trade and operations. The lack of severe penal provisions may deter prosecutors from taking such violations seriously. Additionally, government bodies, committees, and agencies are understaffed and overburdened. Authorities are inundated with a broad scope of responsibilities instead of core specific competency. Law enforcement agencies and authorities should be equipped with adequate infrastructure (forensic tools, research facilities, high-biosafety labs, and data centers) to conduct successful public health investigations that allow medical testing and evidence collection. With only three Biosafety Level-3 labs in India, effective monitoring and research is not feasible.167 And at present, there are no overarching policy and regulatory guidelines in the country that effectively tackle biosafety issues. The inability to trace disease origin and proliferation make it difficult to effectively contain and isolate any contributing animals along the supply chains. Additionally, vendors who violate health and welfare standards should be held accountable for expired licenses or unregistered businesses involving live animals. Under the current system, violators of prescribed standards at live animal markets are more apt to pay penalties for each inspection rather than maintain the upkeep of the market according to rules and regulations. Moreover, repeat offenders are rarely prosecuted. India's animal market regulation and enforcement must shift to being proactive and responsive rather than reactionary. Policy responses should be tailored to the many types of high-risk human–animal and animal–animal interactions at these markets and along the various phases of the supply chains that support them. From procurement to transport to sale, the supply chain is compromised at each step due to the flexibility to comply with the laws designed to protect animals and human health. India's history of zoonotic outbreaks combined with its complex health landscape of emerging and reemerging zoonotic diseases requires modern surveillance technology–sophisticated databases that work in sync with reporting mechanisms. At present, the chain of

reporting starts with local hospitals before going to State health committees and then finally to the Central Government. Inefficiencies in reporting and paperwork create significant gaps and delays through which disease can continue to spill over and spread. There is a critical lag time between when a disease is first reported and the ultimate reaction from the Central Government, making clear the need for a more rapid and responsive emergency alert system. Overall, and to mitigate zoonotic risk, the design and implementation of live animal market policies and guidelines should reflect a deeper understanding of animal markets and supply chains and the risks they pose. Additional support in enforcement, research and policy can be incorporated through building specialized capacity, sensitization, and training. Furthermore, departments or agencies, which share some of the same goals in protecting public health, do not always effectively coordinate their activities. To address complex issues through a One Health framework, bureaucratic interdepartmental collaboration is required.

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