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## **Controlling Spillover Effects of Local Food Consumption on Global Health Pandemics**

*A case study on Chinese 'wet markets' as a source of the COVID-19 pandemic*

**Abstract:** Multiple zoonotic diseases originate from our food consumption behaviour, but only little is known about spillover effects resulting in global health pandemics. This paper discusses these effects, analysing policy measures that might prevent zoonoses from spreading in the future.

Although spillover properties of zoonotic diseases are a complex issue, wildlife trade seems to be the most pressing driver and asks for serious regulation. In response to the recent COVID-19 pandemic, which is believed to originate from a 'wet market' in China, influential people and organisations have called for a full ban on these markets. However, this is a bad idea because of their socio-economic and cultural importance, not all wet markets sell wildlife products or live animals, and prohibition often involves criminality, corruption and black markets. Banning wildlife trade could be more effective, yet still problematic regarding the negative effects of prohibition. Several other policy options could reduce the risk of zoonotic disease spillovers more successfully, ranging from supply-side and transactional to demand-side measures. More research on specific policies, as well as case studies in other regions, will be necessary to put the right regulation in place internationally and to prevent future pandemic outbreaks.

**Keywords:** consumption spillovers, zoonoses, wet markets, wildlife trade, pandemics



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# 1. Introduction

What does COVID-19 have in common with ebola, aids, influenza, MERS and SARS? These, as well as many other infectious diseases, are zoonoses; they are transmitted from animals on human beings. Although zoonotic disease emergence is a complex process with ecological, political, economic, as well as social drivers, one factor that might be underestimated is our own food consumption behaviour: the dead and live animals a lot of people locally consume might contain diseases and spread them globally, causing a so-called ‘spillover effect’ to the rest of the world.

Spillover effects from our consumption patterns, such as environmental pollution or the pressure on natural resources and our health system, have been widely researched in the field of agricultural and food policy. However, even with the evidence of multiple zoonotic diseases originating from our food consumption behaviour, only very little is known about spillover effects resulting in global pandemics. It is crucial that more research is conducted on this topic, as it will lead to effective policy options that minimise the risk of these spillover effects (and, consequently, future disease outbreaks).

Between 1940 and 2004, more than 60 percent of emerging infectious diseases (EIDs) have been zoonoses. The majority of these (71.8%) originate in wildlife (Jones et al., 2008). According to research of the International Livestock Research Institute (ILRI), thirteen zoonoses globally account for 2.2 million deaths per year (Grace et al., 2012). Zoonoses do not come from a few specific animals, but from large and various animal groups, such as bats and rodents (which together already make up for almost half of all mammal species). The increase in zoonoses is thus more likely to come from our globalised overall consumption pattern.

Although intensive livestock in Europe and the US could also be a source of zoonoses, the most likely source of the recent corona pandemic is, according to most research, a ‘wet market’ — where living and dead animals, among which (illegal) wildlife, is traded — in Wuhan, China. COVID-19 is now said to be transmitted by a bat on a pangolin, which transmitted it to a human being. While bats are especially consumed as food in China, pangolins are additionally purchased to use the scales for health purposes; they are believed to be useful for treatments against impotence, cancer and other ailments. These examples indicate that there are many (uses of) animals to be taken into account, when looking at the sources of zoonoses and regulations that might prevent them from spreading.

Within the field of agricultural and food policy, zoonoses can be considered as a negative spillover from our consumption patterns; the COVID-19 pandemic and its source in a Chinese wet

market are a good example of this. Putting new policies in place could be a solution to mitigate these negative effects. However, there is more to be taken into account than the possibility of disease spreading, such as the need for and consumption of food, income and welfare from the animal trade, the medicinal use of the animals, and the danger of illegal underground markets.

In the light of all of these interlinked problems, a critical analysis will be conducted on the different policy measures that could be taken on wet markets in China to prevent zoonoses from spreading in the future, using the market in Wuhan leading to the COVID-19 pandemic as a case study. What will the positive and negative effects of a total ban on wet markets in China and other policy proposals be, not only for the potential of new zoonosis spreading, but also for human health in general, food consumption, employment, cultural habits and (illegal) trade? This study will attempt to give a comprehensive overview of this by conducting literature research from scientific articles as well as journalistic sources, given the timely topic and relevant new information.

Before going on, some critical remarks about the purpose and remainder of this paper have to be made. First, it should be clear that zoonoses can emerge from anywhere in the world, not only from China. Additionally, they are not only transmitted through wet markets, but in every place where people interact with animals. More case studies will need to be conducted to be able to draw broader conclusions policy-wise. However, this paper will attempt to make a significant contribution to this broader range of research.

Second, it is crucial to understand the difference between a wet market and wildlife markets. While wildlife trade did occur on the wet market in Wuhan, this seems to be rather exceptional than common. Most wet markets in China are comparable to food markets in Europe and the US. The characteristics of wet markets will be elaborated upon, but it should be clear that they are vital for food consumption in China (and elsewhere). It is thus questionable whether a full ban on wet markets should be discussed at all. Still, the policy option will be taken into account, because a number of influential people and organisations have called for such a ban — so especially if it is a bad suggestion, this should be explained. Moreover, the COVID-19 crisis shows that nothing can be considered as ‘business as usual’ anymore; even the most radical ideas should be taken seriously, if they might prevent or reduce the risk of future pandemics.

This paper will first provide some background information on the spillover effects of food consumption. Second, it will focus on zoonotic diseases and their spillover properties. Third, the main policy option will be critically discussed: a total ban on wet markets. Fourth, alternative options will follow in the discussion section. Lastly, the paper will be concluded with some policy recommendations.

## 2. Spillover effects of food consumption

Spillover effects often refer to the impact that seemingly unrelated events in one country can have on other countries. They are related to externalities in general, which refer to a cost or benefit that affects any third party who did not choose to incur that cost or benefit. When talking about spillover effects, these are mostly negative impacts a domestic event has on other parts of the world. Such an event can be heavy weather, an economic crisis, or a human health pandemic (Kenton, 2019).

Food consumption patterns can also cause spillover effects, three of which will now be explained. First, it puts pressure on natural resources if food is not consumed in a sustainable manner; the natural resource providing the food might get depleted if there is no sufficient reproduction, or it might be deteriorated if not treated well enough (eg intoxication of lakes and fields by fertilisers, nutrient deficiency of plants and undernourishment of animals). Second, it can cause environmental pollution, affecting nature as well as people; industries of consumed products may pollute the air we breathe and the waters we drink from. An environmental spillover effect that is linked to food consumption more directly could be the trash from food packaging. Third, food consumption puts pressure on the health sector; indirectly because of the environmental pollution, but also directly because of what we consume. Food products that are high in sugar, fats or cholesterol, for example, can cause severe health issues when consumed in large amounts. Furthermore, the food and live animals we consume (also for medicinal or ‘recreative’ use) might contain and spread diseases — this is the spillover effect this study will elaborate upon. All of these spillover effects can be linked to production as well, but this is often just a matter of conception: without consumers there will be no production, and vice versa.

Consumption spillovers are essentially market failures: without regulation in place, the market generates negative externalities that impose costs on third parties who did not choose to incur that cost. In order to minimise these spillovers, food policies must thus be implemented. The Food and Agriculture Organisation (FAO, 2020) states the following about this:

*In all countries, food is governed by a complexity of laws and regulations which set out the government’s requirements to be met by food chain operators to ensure the food is safe and of adequate quality. (...) Minimum quality requirements are included in the food law to ensure the foods produced are unadulterated and are not subjected to any fraudulent practices intended to deceive the consumer. In addition, food law should cover the total chain beginning*

*with provisions for animal feed, on-farm controls and early processing through to final distribution and use by the consumer.*

Food policies can be implemented on any level, from local to global, and by government agencies, businesses or other organisations. Common policy categories are incentives (through information campaigns, pledges, education, labelling or nudging), regulations (such as total bans, taxes and subsidies) and standards (with vending, guidelines or requirements), although they are often closely linked to each other.

While most of the spillovers mentioned above have been investigated extensively in the literature, little is known about how our food consumption pattern may result in local and global health pandemics such as the COVID-19 pandemic, let alone if and how food consumption should be regulated to reduce the risk of future disease outbreaks. This is particularly true when it comes to wet markets as the origin of zoonotic disease spreading. Hence, the remainder of this paper will fill this research gap, as it is crucial to determine what kind of policy will be most effective.

### **3. Zoonotic diseases and their spillover properties**

Before discussing different policy options that have been suggested in response to the COVID-19 pandemic, it is vital to understand what drives zoonotic diseases and what their spillover properties are. First, it should be emphasised that zoonotic disease emergence is a complex process. A range of external drivers allow pathogens (infectious agents) to expand and adapt to a new environment. They can be ecological, political, economic, and social, and can operate at a local, national, regional, and global level. Places where all of these forces are most actively present, which might be the case for wet markets, can be denoted as zoonotic disease hotspots (Keusch et al., 2009).

The emergence of the disease often occurs in stages, with an initial series of spillovers, after which small outbreaks in people occur, followed by pathogen adaptation for human-to-human transmission. Each spillover stage might have a different driver, resulting in different control measures (Keusch et al., 2009). A good example of the drivers of a particular zoonotic disease is how human immunodeficiency virus-1 (more widely known as HIV) emerged from chimpanzees in Africa, spilling over to humans repeatedly before it spread globally. The first phase was driven by bushmeat (wildlife) hunting, whereas the second phase was driven by increased urbanisation and road expansion in Central Africa. In the third phase, HIV entered the rapidly expanding air travel network to turn into a global health pandemic. Lastly, virus spreading was accelerated by sexual behaviour, drug use, blood trade, and population mobility (Hahn et al., 2000).

One important and more specific driver of zoonotic disease transmission and infection is food preferences — or, in another word, taste. It is not only a cultural phenomenon that influences food preparation, but also facilitates parasitic zoonoses. In many parts of the world (such as China and Indonesia), a preference for the consumption of fresh meat (to the extent that live poultry is slaughtered on the spot, or even after purchase at home) attracts people to wet markets. This puts humans in contact with live and freshly killed animals, among which also wild animals such as primates, reptiles and bats. The cultural preference of these people for such fresh products of wet markets complicates the reduction of the associated health risks (Keusch et al., 2009).

Another complicating factor is that with food insecurity, the bushmeat market (where wildlife is traded for human consumption) becomes “more essential and more lucrative, creating more opportunities for transmission of pathogens to humans” (Keusch et al., 2009). Research shows that 71.8% of zoonotic EID events were caused by pathogens with a wildlife origin, such as the Nipah virus in Malaysia and SARS in China. The number of these EID events originating in wildlife has increased significantly over time (Jones et al., 2008).

Also, viruses transmitted by direct contact with hunted and consumed wildlife were found to be more likely to possess human-to-human transmissibility. Hunting of high-risk host species carries an increased probability of spillover of zoonotic versus that can be further spread by human-to-human transmission (Kreuder Johnson et al., 2015).

Part of the wild-animal products are traded with the purpose of health promotion and disease treatment, known as ‘zootherapeutics’. These products are perceived as having medicinal value, enhancing virility and treating illnesses in humans as well as domestic animals. Evidence shows that wildlife trade has already led to the repeated introduction of invasive species that endanger human and animal health, agricultural production, and biodiversity, and this ‘pathogen pollution’ is only expected to continue to increase through even more global travel and trade in the future (Keusch et al., 2009).

The expansion of international food trade in general has also led to a series of disease outbreaks and the emergence of new pathogens. For example, earlier disease outbreaks in the US were caused by Mexican strawberries, Guatemalan raspberries, Peruvian carrots and Thai coconut milk. In the US, food-borne diseases account for 76 million illnesses, 325,000 hospitalisations, and 5,200 casualties every year (CDC, 2005). On top of that, as a secondary effect of agricultural production, antibiotics in animal waste and constructed dams for irrigation have also led to increases in infectious diseases (Ghebreyesus et al., 1999).

An analysis of Jones et al. (2008) on the relationship between the spatial pattern of different EID events and socio-economic variables, environmental variables and the ecological variable of species richness found that human population density is the common most significant independent predictor of all EID events. “This supports previous hypotheses that disease emergence is largely a product of anthropogenic and demographic changes, and is a hidden ‘cost’ of human economic development” (Jones et al., 2008). However, origins are also significantly correlated with the other factors for the EIDs. Zoonoses from wildlife represent the most significant and growing threat to global health (Jones et al., 2008).

To sum up, spillover properties of zoonotic diseases are a complex issue and it is not well understood how the drivers interact and change over time. What we do know is that the coexistence of humans and animals on earth increasingly lead to challenges that spillovers present for when, how, and where zoonotic diseases will emerge (Keusch et al., 2009). The hunting, trade and consumption of wildlife seem to be the most pressing drivers and ask for serious regulation. Whether or not a full ban on wet markets in China is a good government intervention to reduce the risk of these spillovers, is subject to the following chapter.



## 4. A total ban on wet markets?

We now arrive at the case study of this paper, focusing on COVID-19 (or SARS-CoV-2) and its potential source in ‘wet markets’ in China; the sale of wild animals here may have led to zoonotic infection and the ongoing outbreak of viral pneumonia (a lung infection). Similar wet markets were implicated to be involved in the SARS outbreak of 2002. It seems likely that in the case of the newest coronavirus, wild animals are equally involved in its emergence (Lam et al., 2020).

SARS-CoV-2 probably originated from Chinese horseshoe bats, but it seems unlikely that the virus was transmitted directly from bats to humans, because of a lack of direct contact. This means that some kind of intermediate host must have existed (Qiu et al., 2020). The exact species has not been confirmed yet, but coronaviruses in Malayan pangolins, seized in anti-smuggling operations in southern China, have strong similarities with SARS-CoV-2. Pangolins should thus be considered as possible intermediate hosts in the emergence of novel coronaviruses (Lam et al., 2020). However, the virus carried by pangolins does not have the same unique ‘furin cleavage motif’ as the human SARS-CoV-2 virus, indicating that it also did not come directly from pangolins (Li et al., 2020). In other words, it is still uncertain which exact wildlife species have been the direct and indirect hosts of the coronavirus that led to the current global health pandemic.

What we do know, is that Chinese wet markets have been considered as major sources of pathogen dissemination. Pathogenic bacteria account for 0.81% to 8.02% of the entire microbial community (measured from different air samples) at a typical Chinese wet market. Not only wildlife, but also poultry manures are demonstrated to be important microbial contamination sources in wet markets (Gao et al., 2020). For COVID-19 specifically, several studies point out that a wet market in Wuhan very likely was the initial source for the global pandemic. Food and animal disease expert Peter Ben Embarek of the World Health Organisation (WHO) similarly believes that the wet market played a significant role in the outbreak, although he acknowledged that more research is needed to determine precisely how (VOA, 2020).

Regardless from what is true about the origin of COVID-19, it is undeniable that wet markets selling live or wild animals are a risk for disease transmission. This is probably why influential people and organisations have recently advocated for a full ban on wet markets. Among the people who want to shut down all wet markets is Anthony Fauci, Director of the National Institute of Allergy and Infectious Diseases in the US (Northam, 2020). He gets the support from a bipartisan group of more than 60 US lawmakers (Wise, 2020). Australia’s prime minister Scott Morrison has called for a closure as well (The Economist, 2020). The United Nation’s biodiversity chief,

Elizabeth Maruma Mrema, wants to ban the sale of all live animals — not just wild animals (Greenfield, 2020). The Wildlife Conservation Society calls on governments across the globe to “permanently close markets that commercially trade in wildlife for human consumption,” explicitly referring to the market in Wuhan (WCS, 2020).

The most elaborate call for a ban on wet markets came from Humane Society International (HSI). Their white paper is titled ‘Wildlife Markets and COVID-19’. Interestingly enough, they use the words ‘wet market’ and ‘wildlife market’ interchangeably throughout the report — which already implies that this international division of The Human Society of the United States is unaware (or ignorant) about the difference between them. The organisation states that any ban on wildlife trade should “include permanent closure of wildlife markets, particularly those selling wild mammals and birds” (HSI, 2020). According to the writers, such bans can be put in place immediately and should be adopted by all ‘relevant’ governments in order to reduce the likelihood of the emergence of future pandemics. They also recommend to offer support to former traders, and to start education campaigns to reduce the demand for wild animals. They claim that buyers in China and elsewhere are “already likely to respond favourably to such initiatives” (HSI, 2020).

A ‘rapid review’ by *The Lancet* looked into wet markets as a continuing source of SARS and influenza in 2004 already, departing from evidence that SARS was found in wet markets in Shenzhen, China. Likewise, these researchers suggest closure of the markets as a solution, although they acknowledge that it would not be a simple matter. Closing the markets would put thousands of legitimate owners and workers out of business and continuing demand for wild animals would drive prices up and the wet market-system underground, where monitoring and surveillance becomes even more problematic. As a more feasible and immediate goal, they propose to reduce the virus burden on wet markets by improving hygiene and sanitation. Also, they want to discourage the sale of wild animals by educating stall owners about the health risks. In the long term, they argue that wet markets will be phased out anyway, because younger customers in Asia would buy their products frozen or chilled. Additionally, “public education about the risks associated with wet markets could foster this trend” (Webster, 2004).

According to research conducted in Nanjing City, more than 90 percent of Chinese households purchase fresh food from wet markets within walking distance. About three quarter of them even visits a wet market at least five days a week (Zhong et al., 2018). Across the country, it has been estimated that wet markets handle 73 percent of all fresh vegetables and meat purchased (The Economist, 2020). It is thus no question that these markets are regarded as highly important among the Chinese. Why is this the case, despite the expansion of ‘modern’ supermarkets?

First of all, the vitality of wet markets in urban China rests in their competitive advantage with regards to the freshness of the available food, corresponding with consumption habits and food culture: “Freshness represents the most desired food quality, and it is for that reason that consumers stated preferences for locally produced food with a short supply chain rather than concerns for sustainability” (Zhong, Crang and Zeng, 2020). Second, these fresh products also tend to be cheaper than in other market places (The Economist, 2020). Third, the frequent social interactions between food vendors and consumers provide some kind of quality assurance in a food system that is characterised by a low level of trust. To reduce the health risks associated, shoppers and vendors establish long-lasting reciprocal relationships through market interactions (Zhong, Crang and Zeng, 2020). Fourth, wet markets are an integral part of the cultural heritage and social life of China. They provide important livelihoods to independent smallholder farmers and are important to Chinese everyday life and well-being (Lynteris and Fearnley, 2020).

Considering its high socio-economic and cultural importance, a permanent shutdown of wet markets would thus have an immense and unpredictable impact on everyday life and well-being in China. However, there are other arguments against a total ban that should be considered as well, the most important one being the simple fact that not all wet markets are like the wholesale market in Wuhan, where exotic and wild animals were indeed traded. Most wet markets are simply markets where you can purchase fresh fruit, vegetables and meat — not very different from the farmers’ markets people go to in Europe or the United States (Beech, 2020).

According to Lynteris and Fearnley (2020), Western media have been reporting on wet markets with a disproportionate focus on ‘exotic’ food consumption, driven by anti-Chinese sentiment. They are portrayed as “emblems of Chinese otherness: chaotic versions of oriental bazaars, lawless areas where animals that should not be eaten are sold as food, and where what should not be mingled comes together” (Lynteris and Fearnley, 2020). However, this image seems to be highly flawed, as most wet markets actually do not sell the wild animals that are most dangerous for food safety and pose the highest risks for spillover effects.

Another important reason for rejecting a complete ban on wet markets is the risk of criminality, corruption and underground markets. In his book ‘The Economics of Prohibition’, Mark Thornton draws lessons that apply not only to the period of alcohol prohibition in the US, but also to any other government attempt to control consumption habits. According to him, the same pattern is repeated again and again, showing that the theoretical premises upon which prohibition advocates depend are fallacious (Thornton, 1991).

The most important of these premises is that prohibition would be simply the best possible policy available for problems such as addiction, compulsive behaviour and public health threats. Given a properly established policy with appropriate penalties and adequate resources, advocates argue, potential users will be discouraged from experimenting, and current users will be isolated or forced to abandon their habits. In the long run, prohibition could then virtually abolish the product from the market. However, as Thornton (1991) clearly explains, this looks different in practice:

*Bureaucracies established by prohibition are inherently inefficient and unable to discover the knowledge required to solve social problems. Prohibition also suppresses the market's ability to solve social problems, so that little or no progress is made while prohibitions are in effect. And finally, prohibitions create profit opportunities which add to the problems prohibition is intended to solve.*

Lastly, prohibition policies also drive crime and corruption rates up. Black markets represent institutionalised criminal exchanges, often involving violent criminal acts. Prohibited markets are also subject to corruption of law-enforcement officers and other public officials, penetrating beyond the enforcement bureaucracy to national governments in general (Thornton, 1991).

Due to the large number of farmers, traders and consumers involved, it is very likely that a rapid expansion of an uncontrollable black market will also be the result of a prohibition of wet markets. In fact, the same already happened in China when such a ban was attempted in 2003 (after SARS), as well as in 2013 (after avian influenza). In other words, evidence shows that a ban on wet markets is potentially an even greater risk to public health (Lynteris and Fearnley, 2020).

Likewise, there are indications of corruption in China as a result of prohibitionist policies. While China banned the trade and consumption of wild animals, there have been loopholes in the ban after the SARS outbreak; wildlife trade was still possible for traditional medicinal purposes, as the government has been pressured by the wildlife farming industry's lobby power (Samuel, 2020).

In sum, because of the wet markets' vital socio-economic and cultural importance for urban China, assuming that not all wet markets sell wildlife or live animals such as in Wuhan, and knowing that there already exists evidence for the risk of criminality, corruption and black markets, implementing a complete ban on wet markets is a bad policy suggestion. "What wet markets in China require is more scientific and evidence-based regulation, rather than being abolished and driven underground" (Lynteris and Fearnley, 2020).

## 5. Discussion: other policy options

Before briefly going into policy proposals other than prohibition, a total ban on worldwide wildlife trade (rather than on all wet markets in China) should be discussed. If only the sale of (certain) wild animals would be prohibited, wet markets could still exist and less socio-economic and cultural problems would arise from such a ban. It is probably also a more effective measure against zoonotic transmission, since especially certain creatures (such as pangolins) are possible hosts in the emergence of novel coronaviruses (Lam et al., 2020).

Although this measure seems effective, a full ban on wildlife trade is equally not that simple. The trade, often originating all the way from Africa, has been enduring for decades (despite numerous campaigns against it). First, the demand for these wildlife products is high, driving up the price. This makes it attractive to operate in the wildlife market. Second, the source countries of these wildlife animals are known for high poverty, weak regulations and corruption, making prohibition even more difficult. Third, global transport has become easier and cheaper over the last decades, which fuels wildlife trade even more (as it becomes more attractive to do business in it). The biggest contributor, finally, is the continuing demand for wildlife products in destination countries (Smith, 2020).

The WHO wanted to suspend the sale of live wild mammals in marketplaces for food, but not live farmed animals such as poultry and fish, as these pose a lower risk and controls can be introduced here. By now, China has indeed implemented a permanent ban on the sale of all wild live animals except for seafood at its markets. However, it is still unclear whether the regulation also includes animals consumed for traditional medicinal purposes (The Economist, 2020).

China's wildlife trade and consumption industry is valued at about 74 billion US dollars. The new ban on the sale of wildlife is expected to affect millions of people in the industry. "The decision will mean economic losses for breeder, so relevant local governments should support them while they shift into other businesses, and offer financial support," deputy director Yang Heqing of the Office for Economic Law at China's NPC Standing Committee commented (SCMP, 2020).

According to Thornton (1991), alternatives to prohibition involve some measure of decriminalisation. Policy options include nationalisation, licensing requirements, taxation, and education. "Many of these reforms are questionable, however, in terms of their effectiveness, their ability to produce long-term solutions, and their stability as long-term public policy" (Thornton, 1991).

Thornton (1991) even proposes a free-market approach, as this would enable more information about the products, producers would engage in product standardisation and labeling, crime and corruption that result from prohibition would be eliminated, government expenditures on law enforcement, prisons and courts would be reduced, and individuals would be more directly responsible for their own consumption behaviour (Thornton, 1991). Needless to say, this is still all hypothetical and does not present a clear or certain solution for the problem of spillover effects of food consumption on global health pandemics.

According to 't Sas-Rolfes et al. (2019), illegal wildlife trade mitigation measures could reduce activity to levels that are biologically and socio-economically sustainable. These kind of measures can be classified into supply-side, transactional, and demand-side policies. Supply-side measures are those that focus on reducing illegal harvesting or seek to provide legal substitutes. A measure is transactional if it is directed at all activities that take place along the trade chain. Demand-side measures seek to change the behaviour of end users ('t Sas-Rolfes et al., 2019).

Regarding the supply side, it could be argued that classifying species as endangered can result in conservation benefits such as increased protection. Potentially, the trade of these endangered species will consequently decline. However, classifying species by threat status can also be an incentive to hunters responding to increased consumer demand for goods perceived to be rare, hence also valuable. This 'rarity-fuelled demand' can have two undesirable outcomes in itself: the animals may become trapped at a low population size, or hunting efforts may drive them to extinction (Hall, Milner-Gulland and Courchamp, 2008). Not to mention the fact that this will not reduce the spillover effects on health.

On the other hand, a surprising but positive effect of the corona crisis on the supply side is that trade of the pangolin, which is presumably the most traded wild animal that was already illegal, has almost disappeared since the global pandemic. It could thus be that similar events also 'help' certain animal species because of the fear and the growing awareness humans get for the health risks associated (Smith, 2020).

Supply-side measures against illegal wildlife trade that are potentially more effective include legally protected areas, patrols, fences, and more enforcement and monitoring. Furthermore, legal and sustainable alternatives for illegal products can be deliberately provided ('t Sas-Rolfes et al., 2019). It is open for further research whether these measures are successful in mitigating the risk of spillover effects on global health.

Transactional measures can be those that aid physical detection of illegal activities, those that identify enabling networks for illegal wildlife trade, and those that aim to regulate trade ('t Sas-

Rolfes et al., 2019). Also, traders and transporters of wildlife products could be prosecuted more often and face higher charges. However, here too, it is highly uncertain whether these measures reduce the risks of spillover effects on global health.

On the demand side, many virologists prefer a more nuanced approach to wet markets. They advocate for narrow regulation to control their most dangerous aspects, such as better policing of food safety and hygiene standards and regulating the type of animal species sold. Information campaigns for authorities and locals might be beneficial too, according to the WHO (The Economist, 2020). Other demand-side measures can be education, voluntary behaviour change, and the targeting of consumers with key influencers. A limitation here is the lack of use of evidence-based consumer research and behavioural theory (’t Sas-Rolfes et al., 2019).

Additionally, regarding the demand for wildlife products, governments could impose and increase consumer taxes. Tobacco, another product that is perceived as a threat for public health, has been taxed heavily in different countries lately to suppress demand. A good example of this is Australia, which increased the taxes on tobacco by 25 percent without any warning in 2010. From 2013, they increased the taxes each year with an additional 12.5 percent. These increases have been very effective in reducing smoking, and consequently in reducing the demand for tobacco (Wilkinson et al., 2019). It might thus be a better solution to keep certain wildlife products legal (because prohibition might cause even more problems, as explained before), taxing them heavily.

Lastly, it should be clear that it does not only matter how well-regulated wet markets are: it will not simply put an end to the threat of zoonotic disease spillovers, as this danger fundamentally lies in the logging, hunting and selling of wild animals over the entire world (The Economist, 2020). However, policies such as the ones discussed in this chapter would at least reduce risks locally.

To significantly combat these spillovers globally, measures will also be necessary elsewhere. Recently, for example, doctors of the US Physicians Committee urged the US Surgeon General to shut down all US live animal markets (Physicians Committee, 2020a). In New York, a recently introduced bill would already enact this on a state level (Physicians Committee, 2020b). More measures in other parts of the world, such as in India, Latin America, and Africa (where wet markets also belong to everyday life for most people), but also in the EU and the US (where similar problems arise in farmers’ markets, poultry, livestock and the bio-industry), are vital to effectively minimise the overall risk of a future pandemic outbreak.

## 6. Conclusion

Spillover effects from our consumption patterns have been widely researched in the field of agricultural and food policy. However, even with the evidence of multiple zoonotic diseases originating from our food consumption behaviour, only very little is known about spillover effects resulting in global pandemics. This paper conducted a critical literature review on that topic, focusing on the market in Wuhan leading to the COVID-19 pandemic as a case study.

Spillover properties of zoonotic diseases are a complex issue and it is not well understood how the drivers interact and change over time. What we do know is that the coexistence of humans and animals on earth increasingly lead to challenges that spillovers present for when, how, and where zoonotic diseases will emerge. The hunting, trade and consumption of wildlife seem to be the most pressing drivers of zoonotic disease emergence and ask for serious regulation.

Regardless from what is true about the origin of COVID-19, wet markets selling live or wild animals are a risk for disease transmission. However, implementing a complete ban is a bad policy suggestion. First, wet markets have a vital socio-economic and cultural importance for urban China. Second, not all wet markets sell wildlife or live animals such as in Wuhan. Third, evidence already backs up the theory of a high risk of criminality, corruption and black markets as a result of a ban.

An alternative option would be prohibiting wildlife trade, as wet markets could still exist and less socio-economic and cultural problems would arise from such a ban. It is probably also a more effective measure against zoonotic transmission, since especially certain creatures are possible hosts in the emergence of novel coronaviruses. Nonetheless, the other problems of prohibition would still arise. Also, it would affect millions of people in the industry and it is unlikely that wildlife products for traditional medicinal purposes would be banned by the Chinese government as well.

There are several other policy options that could reduce the risk of zoonotic disease spillovers from wet markets in China. Good examples are legally protected areas, patrols, fences, more enforcement and monitoring, and legal or sustainable alternatives (on the supply side), physical detection of illegal activities and prosecuting the criminals involved (as transactional policies), and food safety standards, education, and imposing or increasing taxes (on the demand side). One or more of these options is the best policy recommendation that can be given at this point.

Determining whether these individual policies are actually successful in reducing the risks of spillover effects on global health is beyond the scope of this paper. More case studies on zoonotic disease spillovers and regulations are necessary to determine the right international policies and, consequently, to effectively prevent pandemic outbreaks in the future.



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