ResearchGate

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/341525356

Hypothesising on the emergence of SARS-CoV-2 through bats: Its relation to intensive pig-factory farming and the agro-industrial complex

Article · May 2020

CITATIONS
0

READS
2,185

3 authors:

Immo Fiebrig
University of Nottingham
22 PUBLICATIONS **319** CITATIONS
SEE PROFILE

Larissa Mies Bombardi
University of São Paulo
11 PUBLICATIONS **49** CITATIONS
SEE PROFILE

Pablo Nepomuceno
University of São Paulo
4 PUBLICATIONS **3** CITATIONS
SEE PROFILE

Some of the authors of this publication are also working on these related projects:

Project
Mucuna pruriens for PD patients View project

Project
SOCIO-ENVIRONMENTAL ATLAS OF LENÇÓIS MARANHENSES / ATLAS SOCIOAMBIENTAL DOS LENÇÓIS MARANHENSES View project

All content following this page was uploaded by Immo Fiebrig on 20 May 2020.

The user has requested enhancement of the downloaded file.

Hypothesising on the emergence of SARS-CoV-2 through bats: Its relation to intensive pig-factory farming and the agro-industrial complex

Immo Fiebrig • Larissa Bombardi • Pablo Nepomuceno

Abstract

The emergence of SARS-CoV-2 and the resulting disease, COVID-19, is possibly related to bats, which have been shown to be a reservoir for many kinds of viruses, including coronaviridae, due to their physiological peculiarities. However, it remains controversial how, if at all, the virus evolved from bats to become infectious to humans, turning the resulting disease into a pandemic. The current discussion is based on some facts around the agro-industrial complex, such as intensive pig-factory farming in the city of Wuhan and its surroundings. A putative triangular relationship between bats, pigs and humans is described as a striking fictional story first, serving to illustrate the hypothesis. Then the history of current globalised animal farming from its beginnings during the 'Green Revolution' and its detrimental impacts are summarised. With COVID-19 research in its infancy, this is followed by mappings of pig-factory farming in the state of Santa Catarina, in the south region of Brazil and outbreaks of COVID-19 in humans. The triangle hypothesis, if proven true, might add risks to the pandemic, if factory animal farming remains in its current form. The authors recommend more sustainable farming practices within a framework of degrowth.

Dr. Immo Fiebrig (✉)
Honoarary Associate Professor, NCMH, School of Biosciences, University of Nottingham, Sutton Bonington Campus, LE12 5RD Sutton Bonington,
e-mail: immo.fiebrig@nottingham.ac.uk

Dr. Larissa Bombardi
Professor at Department of Geography, University of São Paulo, Av Professor Lineu Prestes, 338 Cidade Universitária - São Paulo - SP 05508-000;
e-mail: larissab@usp.br

Dr. Pablo Luiz Maia Nepomuceno
Department of Geography, University of São Paulo, Av Professor Lineu Prestes, 338 Cidade Universitária - São Paulo - SP 05508-000; e-mail: pablo.nepomuceno@usp.br

Introduction

The increase in food production after World War II led to intensifying agriculture, with the factory farming of animals, mostly beef, pork and chicken, as a means of mass production of affordable meat. At the time, the related technologies were largely developed in the USA and later transferred to many other parts of the world, including Europe, Brazil and China amongst others. Whether this kind of meat mass production is actually called intensive animal husbandry or mass livestock farming is essentially irrelevant. The essence of this kind of meat production is the lack of ethics and the absence of compassion for the species-specific needs of the animals, which are raised in the confined and contaminated spaces of factory hangars. The animals become highly and chronically stressed and thus immuno-depressed, more susceptible to the epidemic spread of infectious diseases. In addition, their excreta pose detrimental risks to the environment.

Due to a variety of restrictions, including travel and research opportunities, the authors merely speculate about the evolution of

Copyright © is with the authors.

COVID-19 in or around Wuhan, China. They propose no direct connection to any alleged 'artificial engineering' by any putatively 'devious' research laboratory.

The first tentative evidence points towards a correlation between outbreaks of COVID-19 in humans in locations of intensive pig farming in the state of Santa Catarina in Southern Brazil. An infectious cycle via SARS-CoV-2 may be created through streams of untreated excrement entering water bodies and infecting potable water consumed by humans. Another means of infection from pig to human could be via farm managing staff or staff working in slaughterhouses. Before we move to facts, we present a brief fiction on virus evolution:

Ping-Pong-Pang! SARS-CoV-2, a spiky ball linking a nauseous threesome.

Donald Trump is pointing his finger at China. In his narcissistic quest for re-election, he accuses the People´s Republic of being guilty of launching a deadly pandemic. People believing his potshot might, however, be unable to see the wood for the trees. Within only a few months, the corona virus has unleashed a global health and economic avalanche.

US intelligence services have allegedly been engaged to prove that the frenzied virus had been engineered from infected bats in a Wuhan research laboratory. And, as is being argued, viral material escaped from the lab due to ignorance and negligence. Others still believe the source is to be traced back to Wuhan´s peculiar wet markets selling pitiably caged pangolins or fried bats on a stick, amongst other wildlife meat. Both the US´s and China´s propaganda is probably good at identifying scapegoats and at igniting smoke grenades. Evidence shall surface in due course – once the smoke dissolves.

To set the scene: In pointing his forefinger at Xi Jinping and Beijing´s bureaucrats, Trump might, unwittingly – with his other three fingers – be pointing back at himself and his America. Finger one: agrochemicals - that is, synthetic pesticides and fertilisers, but also antibiotics and other so-called pharmaceutical feed additives. Finger two: genetically modified organisms like GMO soya and GMO maize. Finger three: intensive mass animal farming, for example, pork.

This is an attempt to shed a little light into the darkness by joining dots. The truth may indeed contain a part of Wuhan, a bit of laboratory and an essence of bat, but arranged differently. From a humble view as natural scientists, we should not be looking at a single unfortunate or vile event. We need to think in systems, in population dynamics and in evolutionary processes. What does this mean? Heads up! Let us switch to a dystopian storyline resembling Aldous Huxley´s famous novel, 'Brave New World'.

Joining the dots of a macabre plot the story unfolds as follows: Hubei as a province in central China and Wuhan as its capital are known for their immense industrial mass production of factory pork meat. For example, Globalmeatnews.com[1] states 14 large breeding companies having a joint annual production of 1.5 million pigs in 2018 in Hubei alone. Assuming Wuhan is a place where millions of pigs are raised in massive hangars, this means at least tens of thousands of animals are being held as prisoners in confined spaces per production unit at any time.

These creatures, literally reduced to pork meat-producing machines, suffer as we would suffer under such conditions. They are anxious, they are bored, they are in pain and hugely stressed and as such they are fed to grow until killed. During their time of imprisonment, the immune system has weakened significantly. To survive, they need to be given antibiotics, painkillers and hormones, as well as other drugs we may not even know of. Then they will be shooed to the slaughterhouse. Fat and barely alive. But before this happens, the next player comes into the scene. Bats, or 'microchiroptera' *in scientific terms.*

Driven out of their receding habitats around a growing Wuhan metropolis, bats are

Copyright © is with the authors.

desperate to find food and shelter. It will not take long before they discover both. In Wuhan´s thriving pork factories. Under a ceiling, safe from their usual predators and weather events, bats are free to share the protein-rich soy pellet diet of their inmates. And the bats proliferate. They operate at night, such that their scavenging activities may not appear too disturbing, while sleeping during the day, silently dangling from the ceilings of their new habitats.

Bats are natural carriers of corona viruses – amongst many other viruses. In the present narrative, this is taken as a proven fact. Bats echolocate, meaning they 'see' with sound. Some do this by contracting their voice box (larynx), others click their tongues propagating sound – and probably viruses – through mouth and nostrils as they fly. Picture this: They are airborne, fluttering around freely in swine factories. They are constantly echolocating in a hot, humid and stuffy environment to avoid crashing with fellow bats in their common airspace whilst locating the feedlots. In doing so, they might assiduously be spraying corona viruses over immune-depressed and defenceless mammals, again and again.

Only a year ago in April 2019, China reported an untreatable virus decimating their pork meat production, allegedly from African swine fever virus infection[2]. What if instead it could have been an emerging strain of coronaviridae, mutated and becoming increasingly infective to immune-depressed factory animals?

To summarise a hypothesis: Wuhan´s swine factories were the actual laboratories of a huge epidemiological experiment – uncontrolled of course. The plot constituting a ping-pong game that went on for months or even years, unnoticed and unintentionally in a friendly bat-pork relationship. A ping-pong game taking place zillions of times, until a corona virus similar to SARS-CoV-2 evolved enough to become successfully adapted, that is, highly virulent within a new species.

From this bat-swine-ping-pong hypothesis, the narrative from swine to humans can be developed in various directions. Pigs and humans have similar digestive systems. The biochemistry of their glycoproteins in the protective linings of, for example throat, nose, bronchia, lungs or gut, are much like humans. With mucosal tissue being the usual gate to hijacking the next body, corona might have found the necessary akin conditions in man.

Combined, diseased pigs could have passed SARS-CoV-2 or its precursor strain to farm workers, who in turn passed it on to their family's local community. However, it is much more likely that meat from diseased animals entered the food chain and infected many more people. Maybe those pigs which died before getting to the slaughterhouse had been sold illegally on a black market, where anything would be possible. In another scenario, the bat populations feeding on pork food might, like a pest, get out of hand. Farm staff would organise bat hunts regularly to keep some control over populations. The reward gets cashed in. And the bats carrying a corona virus strain dangerous to pigs, end up on a frying stick on Wuhan´s wet market, infecting humans before reaching the hot oil.

And not to forget, there is also a massive stream of pig faeces, probably drenching the environment in a more-or-less uncontrolled manner. It might be contaminating the drinking water of humans and pigs alike. Whichever way, ping-pong-pang, an epidemic gets born!

Let us now switch from the above narrative, which is rather more like science fiction, to the principles of industrialised agriculture and some tentative evidence from mapping the spread of COVID-19 in Santa Catarina amongst humans on the one hand and the location of pork factories on the other. The fictional description, however, may in fact be more real than we wish to imagine.

Copyright © is with the authors.

The triumphs of the Green Revolution

Modern industrial agriculture is more about mass producing and trading commodities, less about supplying the world´s population with non-toxic, healthy and nutritious food.

In an attempt to understand the logic of intensive farming of pigs and other farm animals, we have to explain the system of the so-called 'Green Revolution'. It is a term given to the process of 'technification' of agriculture and it includes animal farming. In its technification process, it employs synthetic inputs, that is, chemical raw materials like fertilisers, pesticides, antibiotics and hormones as well as industrialised feed, modified seeds and high-tech agricultural machinery, amongst others. The Green Revolution became established in the period after World War II and from an economic point of view, it industrialised any agricultural and pastoral activities that had previously predominantly been conducted by peasants on a small scale. The aim was to become more productive, provide food, and above all meat, more cheaply.

The model for the industrialisation of agriculture presupposes the standardisation of many inputs and processes: seeds, vegetative cycles of plants and crops are standardised through 'genetic improvement'; growth is additionally standardised by remote control of the pH, moisture content and nutrients of the soil together with control of 'pests'. There is also a standardisation in the growth of meat-producing animals and, whenever possible, a reduction of the production cycle, whether for plants or animals – faster growth is better [3].

This industrialisation of agriculture is a global phenomenon. It has a worldwide dimension as does the economy itself. Multi-national companies producing the agro-chemicals needed for these artificial forms of agriculture and livestock farming are increasingly organising themselves in an oligopolistic manner. Capital concentration is achieved through mergers and acquisitions where, for example, the five largest companies in the sector control 70 % of worldwide sales of pesticides[4].

These enterprises are headquartered in the Global North, primarily in the United States and the European Union. However, a significant part of their sales is aimed at the Global South, particularly Latin America with its extensive, forest-consuming monocultures of soya and maize for example, which is the basis for producing feed for confined animals.

Nowadays, there is not only a worldwide trade in cereals and meat, but both product groups are also traded on the stock exchanges, shifting their purpose from goods for resale for human provisioning into an item of speculation. As such, we have a combined and orchestrated movement: on the one hand, the chemical industry ‘sustains’ agriculture on an industrial scale; on the other, the stock exchanges allow the international commerce of food crops, converting them into commodities.

Cattle, chickens and pigs as a commodity have to fulfil the following requirements: their meat must be stored whilst not losing its nutritional characteristics, it must be internationally standardised, and as such it can be traded on the stock market.

The transformation of farm animals into mere merchandise, void of any compassion for their fate, has been achieved by this industrial process of farming. As has been said before, such animals are bred in a confined manner, non-appropriate for any species, with no access to the soil, to sunlight, or to a place where they can move around freely. They are crammed into tiny cubicles that prevent them from exercising their most basic habits: grazing, foraging or wallowing.

Globalisation´s catch from China to Brazil

From Wuhan´s putative deadly triangle and global commodity farming for the stock market we shall move to Brazil’s daily reality, where immense amounts of forest are

Copyright © is with the authors.

destroyed to cultivate soy and corn monocultures.

China is the world's leader in pork production, with around 310 million pigs – more than twice the stock of the European Union, which takes second place in the ranking with around 148 million pigs. The United States occupies third place with around 78 million pigs, followed by Brazil in fourth place with 37 million. Today, Brazil is the world's largest exporter of beef and chicken, as well as the fourth largest exporter of pork.

In Brazil, pork production is concentrated in the southern region of the country, providing about 66% of the national production. Santa Catarina is the state that produces most of this pork and is responsible for more than 25% of the total production in Brazil. More than half of the pork exported from Brazil originates in Santa Catarina, which produced more than a million tonnes of this meat in 2018.

This pork production in Brazil is mostly intensive: more than 70% of the animals are raised in a confined way. Such animals are basically given feed produced with two crops: corn and soy. It is estimated that 345 kg of feed is needed to produce a pig weighing around 100 kg, the consumption of its progenitors to be added[5].

This production model has at least two quite obvious and severe environmental impacts: one, upstream of production and another, downstream.

Upstream of pork production: so that the animals can be fed, there are vast monoculture areas of soy and corn that advance over the Amazon and are responsible not only for deforestation and burning, but also for the contamination of this area with pesticides. Today, in Brazil, there is an area the equivalent of Germany which is cultivated with soy (more than 90% of it is transgenic).

It is not a mere coincidence that China, which is responsible for more than 50% of the worldwide pork production, is today the main consumer market for soy produced in Brazil.

Evidence from Santa Catarina´s pork industry

Downstream of pig husbandry, there is very severe environmental contamination. In the 1980s, it was estimated that about 85% of the water consumed in the rural area of Western Santa Catarina, hotspot for pork production in Brazil, was of unacceptable quality.

Currently, in this region, only 15% of the pigs' manure follows adequate storage and treatment protocols.

In addition to these serious socio-environmental impacts, resulting from intensive pig raising, we are possibly facing a new problem related to this model.

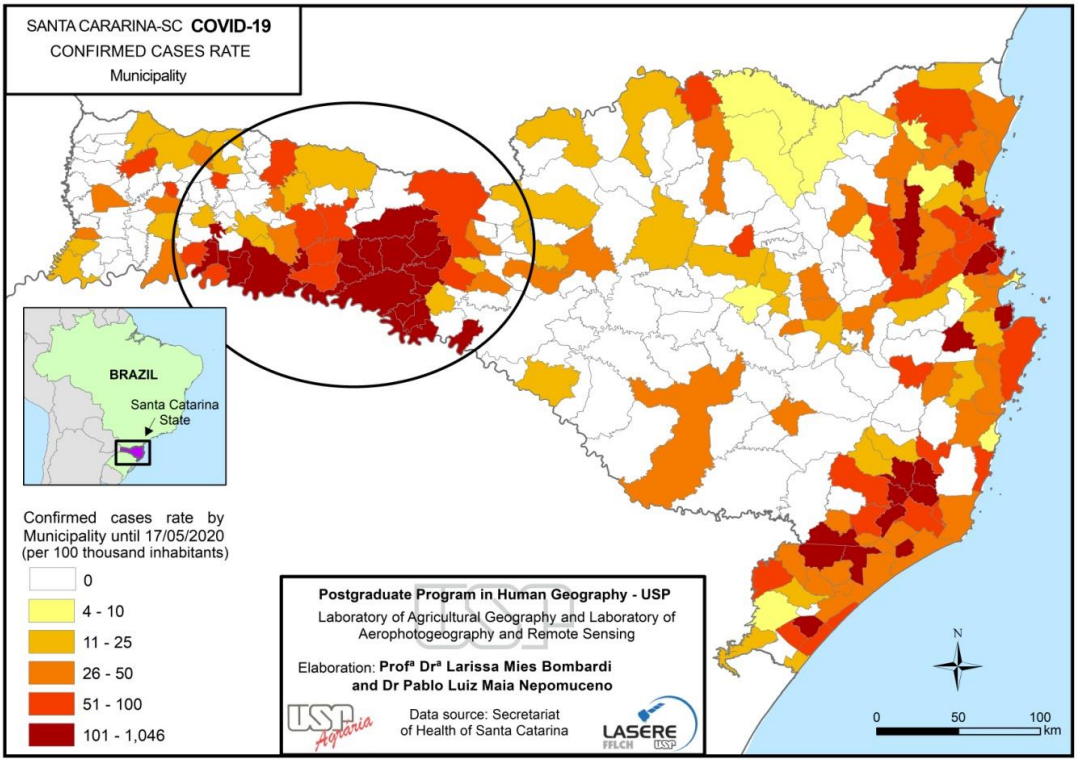
The cruelty with which such objectified animals are bred, together with genetically modified (GM) feed, the concomitant use of antibiotics and their overall unhealthy environmental conditions, make them immune-depressed, as has already been described. They are perfect receptacles for the development of viruses such as SARS-Cov-2.

In recent days, the press has reported that there is a very large number of slaughterhouse workers infected with SARS-Cov-2. Such reports have been described for Germany, the USA and, more recently, Brazil – but they are probably not the only countries affected.

Mapping COVID-19 outbreaks versus intensive pig farming

Analysing the distribution of people infected by COVID-19 in Brazil spatially, particularly in the state of Santa Catarina (Map 1) - the state that produces the most pork in Brazil - we surprisingly find support for the hypothesis developed above.

Copyright © is with the authors.



Map 1 – COVID-19 – People infected in Santa Catarina – Brazil

There are essentially two main areas or 'hotspots' of coronavirus infections in this state. One focus is along the coast. This is to be expected, as this is the location of large cities, where the industrial sector is concentrated and the demographic density is higher *per se*. Notably, there is another affected area in the west, the focus that we are highlighting.

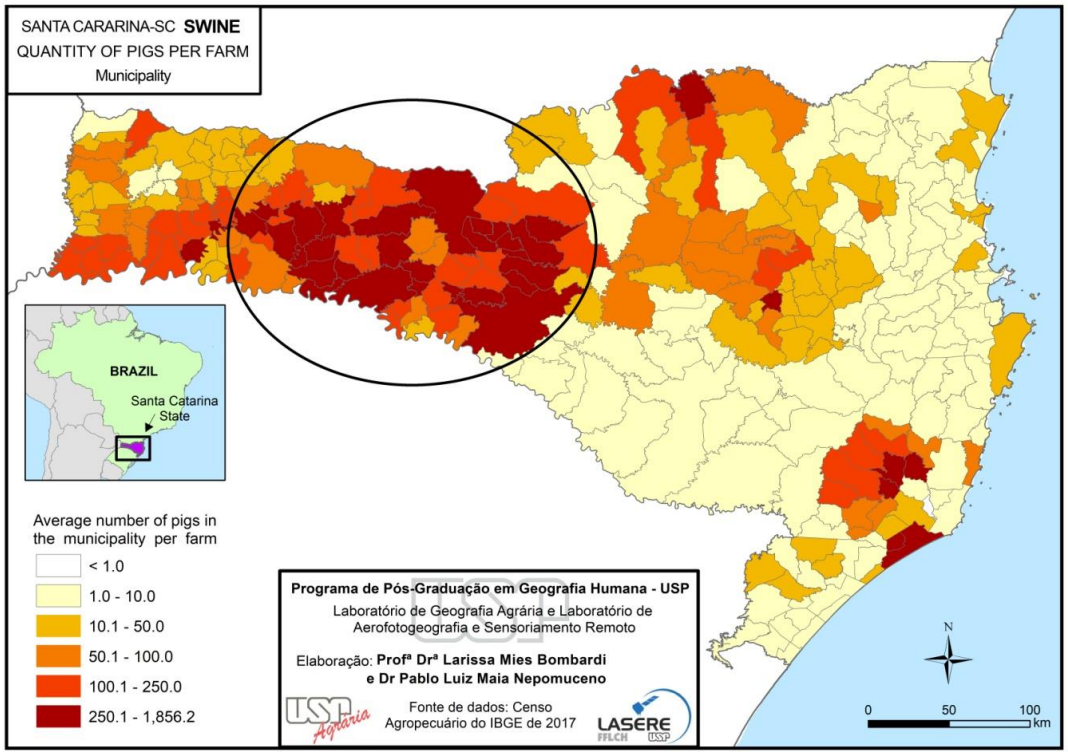
Mapping the municipalities of Santa Catarina with the highest COVID-19 infection rates (Map 1) with those municipalities where there is a high density of pig farming (Maps 2 and 3), municipalities show a tendency to coincide.

Map 1 has been generated from the processing of data on the amount of people infected with SARS-CoV-2 leading to COVID-19 (made available by the Santa Catarina Department of Health; SESSC, 2020)[6]. Regarding Maps 2 and 3, agricultural production data by municipality have been used, according to the latest Brazilian agricultural census conducted in 2017 (made available by the Brazilian Institute of Geography and Statistics; IBGE, 2017)[7].

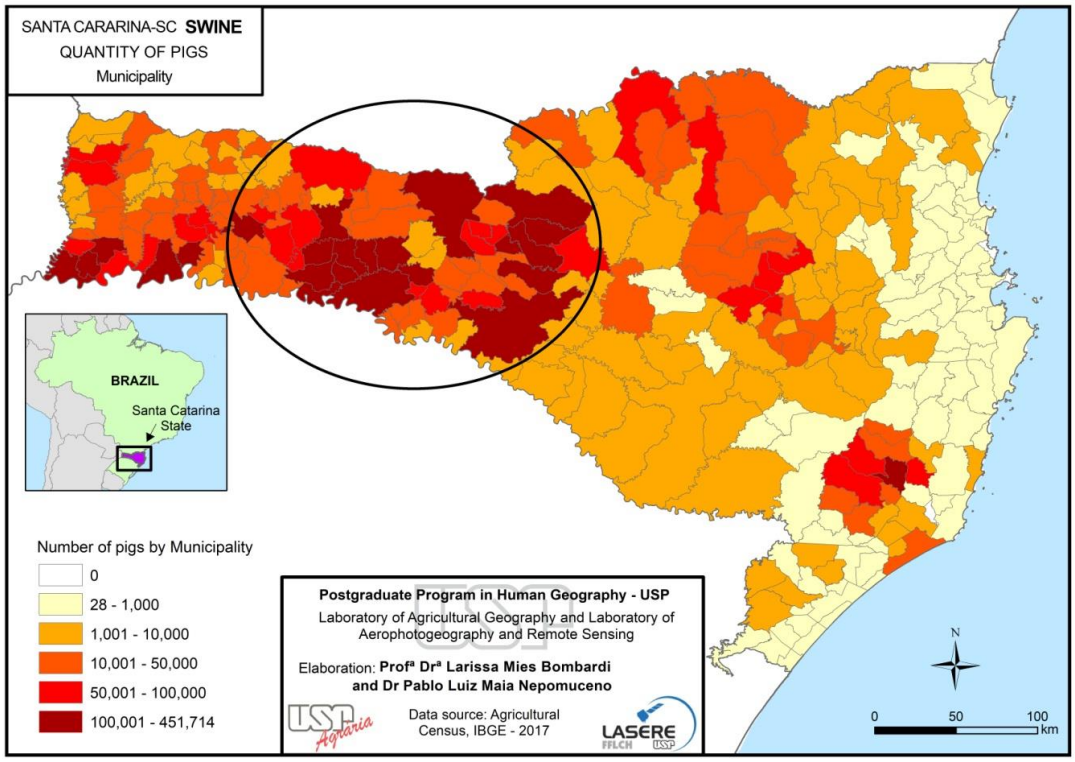
These data have been imported, processed, classified and represented in the form of thematic maps using the resources available in the Geographic Information System (GIS) software, QGIS (Quantum GIS 2.18.7), according to the principles of thematic cartography systematised by Bertin (1967)[8], Salitchev (1979)[9] and Simielli (2007)[10].

The spatial correlation in this region is surprising: there is an overlap between the municipalities where there is a large number of pigs per farm (Map 2) as well as pigs per municipality (Map 3) in relation to those municipalities where there is a greater number of persons infected with COVID-19 (Map 1).

Copyright © is with the authors.



Map 2 – Quantity of pig per farms – Santa Catarina – Brazil



Map 3 – Quantity of pigs per municipality – Santa Catarina – Brazil

Copyright © is with the authors.

Issues presented for discussion

Could the SARS-CoV-2 strain have found a global reservoir in the pigs we slaughter, process and eat via the bat-pig-human triangle in Wuhan? Might the pigs' faeces be contaminating the water that humans drink, given that the virus survives in faeces?

In this discussion paper, we have proposed the hypothesis of three species whose unnatural habitats have come close enough and under conditions to promote the evolution of a virus which can be infectious to multiple species – possibly including pets like cats and dogs or other farm animal species like cattle and chicken. Is this triangular hypothesis just science fiction or a macabre and fateful reality resulting from ruthless industrialisation of agriculture?

Conclusions

We propose further research by, for example, virologists, epidemiologists, veterinaries, biologists and agro-ecologists in a joint effort to get this pandemic under control, and to avoid the emergence of new viruses with similar potential by implementing a more animal-friendly and environmentally regenerative agriculture and animal husbandry based on agro-ecological principles.

References

[1] https://www.globalmeatnews.com/Article/2018/07/05/Wuhan-pig-farms-to-organise-China-s-pork-industry

[2] https://www.nytimes.com/2019/04/22/business/china-pigs-african-swine-fever.html

[3] OLIVEIRA, A.U. de. *A mundialização do capital e a crise do neoliberalismo: o lugar mundial da agricultura brasileira*. Geousp: Espaço e Tempo. Volume 19. São Paulo, nº 2, pp. 228-244. 2015.

GONÇALVES, C. W. *A Globalização da Natureza e a Natureza da Globalização*. Rio de Janeiro: Civilização Brasileira, 2006.

[4] BOMBARDI, L. M. *A Geography of Agrotoxins Use in Brasil and its Relation to the European Union*. University of São Paulo, 2019. http://www.livrosabertos.sibi.usp.br/portaldelivrosUSP/catalog/book/352

[5] NEGRÃO, S. L. *Uma análise do ciclo de produção agroindustrial de suínos e aves, à luz da ética global*. Tese. Programa Interdisciplinar de Ciências Humanas. UFSC. Florianópolis, 2008.

[6] SESSC - Secretaria de Estado da Saúde de Santa Catarina. Portal de Dados Abertos do Estado de Santa Catarina. COVID-19 - Conjunto de dados brutos. [online] 2020. Access under <http://dados.sc.gov.br/ca/dataset/manifestacoes-de-ouvidoria-sobre-o-coronavirus-covid-19/resource/ce25bcc1-0581-4c7d-971a-30e157ffc7f7. Accessed on 18/05/2020.

[7] IBGE – Instituto Brasileiro de Geografia e Estatística. Dados do Censo Agropecuário. [online] 2017. Available in <https://www.ibge.gov.br/estatisticas-novoportal/economicas/agricultura-e-pecuaria/21814-2017-censo-agropecuario.html?=&t=o-que-e>. Accessed on 15/05/2020.

[8] BERTIN, J. Semiologie graphique. Paris – Neuchatel: Mouton-Gauthiers-Villars. 1967.

[9] SALICHTCHEV, K.A. Cartografía. La Habana: Editorial Pueblo y Educación. 1979.

[10] SIMIELLI, M. E. R. O mapa como meio de comunicação e a alfabetização cartográfica. In: Rosangela Doin de Almeida. (Org.). Cartografia Escolar. São Paulo: Contexto, 2007, v. 1, p. 71-94.

Copyright © is with the authors.

View publication stats