Chapter 6
Five Common Myths About Land Use Change and Infectious Disease Emergence

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Abstract The literature about emerging infectious diseases is often filled with assumptions that are not fully substantiated or not supported by more relational research. Here we present five common myths in research that has linked land use change with the emergence of infectious diseases. Our intention is to raise awareness about points that deserve special attention when contextualizing observations about land use change and its internal relations to the emergence of new infectious diseases.

Keywords Population · Deforestation · Modeling · Land sparing · Pathogen spillover

6.1 Pervasive Social Constructs in Inferences About Land Use Change and Disease Emergence

The concepts of modern population sciences in the western world are interdisciplinary in their sources, including substantial influence by the development of ecology and evolutionary biology [1, 2]. As such, some abstractions that were useful

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to help build a common ground for population sciences reflect biases and misconceptions that got ingrained as inherent to the field. In ecology and evolutionary biology, these may have been mere assumptions that were open to challenge at the time they were introduced [3]. Yet research around topics relating land use change and infectious disease emergence keep repeating, and amplifying, under-substantiated assumptions that need to be carefully assessed in interdisciplinary context when performing research about land-use change and infectious disease emergence. Here, we elaborate on five common 'myths' (in the sense of narratives that are often accepted but not properly evaluated) we have seen repeatedly mentioned in the literature. For each myth we cite at least one article accepting it and one article refuting it.

6.2 The Five Myths

6.2.1 Everything is Driven by Population Growth

Probably one of the most common myths in population sciences is that population growth is at the root of most current environmental crises [4, 5]. For infectious diseases, this idea has been repeated in several instances [6, 7]. Interestingly, little actual reference is made to whether populations are growing, or the scale at which, if population growth is happening, population growth or density might be a problem for the emergence of new infectious diseases. Currently, we can affirm that at a global level, population growth and fertility rates are declining [8, 9]. Much research does show that ideas about either fixed global "carrying capacity" or limits to population growth as originally suggested by Malthus [10] and think tanks like the *Club of Rome* do not reflect the potential to change the internal relations of labour with food production [11] or to create niches and environments that allow higher population densities [12, 13]. Relationships between population and disease emergence are complex, nonlinear, and confounded by processes often not considered in research, such as multi-layered historic and contemporary economic, social and political forces [14, 15]

6.2.2 Deforestation is Due to Landless Peasant Groups

Deforestation has been often referred to as a major driver for infectious disease emergence [16–20]. Another common affirmation is that landless local, or migrant, populations and indigenous groups constitute a major threat to the integrity of forests. Some studies have argued about this point and made contextualized demographic connections, e.g., referring to population growth in the agricultural frontiers [21, 22], which has been an advance in light of previous beliefs about pressures for deforestation where population growth was fully decontextualized [23]. However, little is said about factors driving migrations, for example, how land tenure disparities might drive such a focalized demography [24] and how land use policy for land tenure might drive deforestation [25, 26]. As shown by relational research, major pressures for deforestation increasingly are associated with large scale agribusiness involved in broader global circuits of capital accumulation [27–30]. Given the highly contextualized nature of deforestation a major question when assessing its role on disease emergence is inquiring about its causes and the connections with wider phenomena that also make populations more vulnerable to diseases [31, 32]. For example, we can ask: how might deforestation be one among many expressions of modes of production that release new pathogens into human populations?

6.2.3 All Agricultural Land Use Change is Detrimental to Biodiversity—Intensification of Agriculture and Land Sparing are the Solution

Ecological synthesis and meta-analysis have stressed that land use change for agricultural use is detrimental to biodiversity [33, 19]. Instead of conversion of land into more formal agricultural use, there is pressure to intensify production on existing agricultural land, thereby 'sparing' land. There is a prominent lobby for agricultural intensification and land sparing as the ultimate solution to increasing rates of disease emergence [34] and a necessary condition for biodiversity conservation [35]. These are ideas that were instilled early on in ecology, presented in tandem with the myths of uncontrolled population growth [4] and the benefits to privatizing and commodifying common natural spaces [36, 37, 5].

The types of agricultural intensification are more complicated than are often recognized, however, and they likely differ in their effects on ecology and disease emergence. The FAO noted [38], "Agricultural intensification can be technically defined as an increase in agricultural production per unit of inputs (which may be labour, land, time, fertilizer, seed, feed or cash)." Not all studies have suggested all forms of agricultural intensification reduce disease emergence. Some may actually lead to unprecedented rates and types of disease emergence—intensified livestock operations have come into particular question [18, 39]. Others have found that land use change can decrease disease transmission or have variable impacts depending in the context of infectious disease emergence [40]. Agroecological land use can reduce the abundance of medically important disease vector insects such as sand flies, while increasing their overall diversity [41, 42]; these are patterns that extend to most functional groups of species in ecologically managed agricultural systems [43, 44]. Indeed, land sparing can be associated with forms of intensification that define the plantationocene [45], a system of food production that maximizes economic profit and externalizes the stunting of human development, equally exploiting labour from slaves or marginalized populations. The plantationocene as a food production model is an expression of the need for specialization in agricultural and other economic systems for capital accumulation [46] driving large scale land use change for distant economic growth and benefit [27, 28]. The plantationocene is in conflict with both biodiversity conservation and protection from infectious diseases emergence, considering vulnerabilities to infectious disease are shaped by socio-economic inequities [47].

The pursuit of ecologically- and socially- sound alternatives to land sparing and agribusiness-led intensification of the plantationocene is important. We suggest biodiversity conservation and infectious disease prevention may come from a focus on the agricultural matrix, the ecological space where food is produced and where organisms interact with the environment [48]. Agroecology, encompassing a variety of historical and current practices of many peoples and places, under constant experimentation and exploration [49–51], offers a framework through which the landscape may suppress and reduce instead of catalyze and amplify disease emergence [52].

6.2.4 Spillover Occurs Because of Wet Markets and People that Eat Wildlife

With the emergence of COVID-19 [34, 53], and other zoonotic diseases [54], increased calls for criminalizing traditional food markets and wildlife consumption have been aired. Similarly, interactions between local populations and wildlife tend to be scrutinized from a limited perspective that sees wildlife animals simultaneously as sources of diseases and biodiversity components threatened by people living nearby [55]. The assertions behind these claims tend to be made without reference to the historical, and current, cultural and social contexts where wet markets exist [56]. They tend to generalize and prejudge traditional practices, failing to even try to understand the roles that wildlife meat might play as sustainable protein source in the context of food sovereignty and security [57], and the sustainability of the markets as not posing threats to species conservation in contexts where they are linked with food sovereignty [58]. For example, capybaras are well adapted to the flooding plains of South America, and this giant rodent has historically been an important protein source for local populations and an important element of food sovereignty [59]. Similarly, the implementation of relatively simple hygiene measures such as having one day of market closure, cleaning at regular intervals, and selling or slaughtering all animals by the end of trading each day can significantly reduce the risk of transmission for highly virulent zoonotic pathogens [60–62]. As it happens with most spatial phenomena, the local context is also important to understand the risk of highly virulent zoonotic pathogens. For example, for avian influenza, markets near areas with rivers and other habitats where birds, pathogens, and sales can co-occur may increase transmission risk [63].

6.2.5 Models Tell "The Truth"

We want to now focus on a problem that has become pervasive in population sciences, the fetishization of simplistic models and quantitative relationships over the less formalized understanding of patterns and processes in populations. The problem is not unique to population sciences, as it has been well identified and discussed in geography [64–66], where for some, quantification and mathematical modelling too easily ended up taking away the value both of philosophical inquiry, on the one hand, and on the other, of empirical descriptions foregrounding (or at least not devaluing) 'mess' and complication exceeding the grasp of models. In population sciences, the fetishization of models become increasingly problematic with the use and abuse of computationally intensive tools that analyze big datasets [67–70]. This type of exercise, too often foregrounding models and results over assumptions, alternative possible assumptions, inherent limitations**,** and what is empirically not well-captured by models tends to generate research results that unconsciously reflect social constructs and beliefs that partially shape life sciences in general and the analytical methods chosen in particular; numbers do not simply speak but respond to the script used to analyze them. As warned by Box [71] "All models are wrong, but some are useful". Moreover, models are valuable tools when they serve the goal of abstraction of natural phenomena [72], when abstractions can be triangulated or checked for robustness [73], in a process where empirical and conceptual work can lead to false dichotomies being debunked [74]. Confronting the risk of oversimplification with the need of abstraction for the apprehension of complexity requires the development of models and techniques that look for drivers able to explain contradictions in quantitative relationships. It also often requires us to think and analyze more systemically, representing the 'internal relationships' between organisms in which what appears to be a bounded entity is understood as always emerging through its relationships in larger environmental networks. Such approaches are being explored by new forms of geographical information systems where the representation of space can be very different from cartesian coordinates, instead focusing on the relations of objects over space defined by interactions [75]. They are also found in research reconceptualizing relationships between land use change and infectious disease emergence by modeling land ownership dynamics and disease transmission in the historical (and perhaps ongoing) formation of large agricultural estates, a.k.a., latifundia [76]. Thus, inherent to the effort of generating "useful" models, perhaps the most pressing needs become the examination of assumptions and the need for pushing down the walls around what is merely assumed, examining what is taken as granted, questioning the unquestionable. In that struggle, the incorporation of different and diverse viewpoints and personal experiences becomes a necessity.

6.3 Inferences About Land Use Change and Disease Emergence and the Society We Can Build

The five myths we discussed are illustrated in Fig. 6.1. As the figure shows the myths often converge together and can lead to narratives that become mythologies, in the sense that the narrative might be appealing for some, used for the oppression of others, but not well grounded on phenomena occurring in nature. At best these "mythologies" end up reflecting beliefs and doctrines that are necessary for the functioning of the world as we know it and limit the ways in which science could help to solve, or even alleviate, major environmental and health problems.

Pushing the boundaries of what is commonly assumed in science is necessary to gain insight and understanding enabling successful solutions to current problems in society. In that sense demystifying truisms, as the myths we just discussed, is a necessary step to remove barriers for an impactful science whose understandings lend themselves to preventing more health problems, conserving species biodiversity, and improving standards of living, often by demonstrating the positive effects of reducing socio-economic and health inequalities. For the problem of land use change and infectious disease emergence, we consider that it is urgent to reframe research within a 'structural one health' [77] that seeks to understand the role that abstractions about capital and its dynamics have in shaping patterns of disease transmission.

Fig. 6.1 Five common myths about land use change and infectious disease emergence. When taken together the five myths we discussed can lead to narratives that can be appealing for certain groups and stakeholders. However, they can obscure the magnitude and the relation between different factors as well as how we can help society to reduce the emergence of diseases and, more generally, to solve any environmental crisis. Illustration by Nicole L. Gottdenker

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