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Agriculture, health and climate change: Towards a "One Health" vision

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► **To cite this version:**

Marie-Isabelle Peyre, Didier Lesueur, Flavie Goutard, Alexandre Hobeika, Alexis Delabouglise, et al.. Agriculture, health and climate change: Towards a "One Health" vision. Blanfort Vincent (ed.); Hrabanski Marie (ed.); Dementois Julien (ed.). Climate impacts and challenges in agriculture, forests and food systems. Perspectives on the Global South, Springer; Ed. Quae, pp.177-187, 2026, 978-3-032-04331-3. <10.1007/978-3-032-04331-3_11>. <hal-05576770>

HAL Id: hal-05576770

<https://hal.science/hal-05576770v1>

Submitted on 2 Apr 2026

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Vincent Blanford · Marie Hrabanski
Julien Demenois *Editors*

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Perspectives on the Global South

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Éditions Cirad, Ifremer, INRAE
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 Springer

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Second Edition

 Springer

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ISBN 978-3-032-04330-6 ISBN 978-3-032-04331-3 (eBook)
<https://doi.org/10.1007/978-3-032-04331-3>

Translation from the French language edition: “L’agriculture et les systèmes alimentaires du monde face au changement climatique” by Vincent Blanfort et al., © Éditions Quæ 2025. Published by Éditions Quæ. All Rights Reserved.

Jointly published with Éditions Quæ, Versailles, France

The original submitted manuscript has been translated into English. The translation was done using artificial intelligence. A subsequent revision was performed by the author(s) to further refine the work and to ensure that the translation is appropriate concerning content and scientific correctness. It may, however, read stylistically different from a conventional translation.

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Chapter 11

Agriculture, Health and Climate Change: Towards a “One Health” Vision



Marisa Peyre, Didier Lesueur, Flavie L. Goutard, Alexandre Hobeika, Alexis Delabouglise, Maxime Tesch, Daan Vink, and François Roger

Abstract Human-induced climate change increases the incidence of infectious and vector-borne diseases by altering ecosystems and expanding pathogen transmission. It also worsens food security and nutrition through impacts on agriculture, while extreme weather and human activities raise risks of respiratory and waterborne diseases. Vulnerable populations suffer most from these health and environmental disruptions. The IPCC recommends a holistic "One Health" approach to address interconnected impacts on human, animal, and environmental health. This chapter explores these links and advocates sustainable agricultural methods that protect health and the environment.

The links between human-induced climate change and the increase in the incidence of infectious diseases have been demonstrated (Romanello et al. 2021; Van de Vuurst and Escobar 2023). The publications of the Intergovernmental Panel on Climate Change (IPCC) highlight the growing dangers related to climate change, including impacts on the health of humans, animals and the environment. The impact of other human activities such as the transformation and fragmentation of

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natural habitats also alters ecosystems and promotes the spread of vectors such as mosquitoes that spread dengue, malaria and the Zika virus, or ticks that cause Lyme disease (Calvin et al. 2023). The increase in temperatures and variations in rainfall extend the transmission periods of these pathogens and introduce diseases, particularly vector-borne ones, into new areas (Caminade et al. 2019; de Souza and Weaver 2024). The intensification of interactions between humans, domestic animals and wildlife, linked to this degradation of ecosystems, also leads to an increase in the circulation and emergence of zoonotic diseases such as Ebola, SARS-CoV (1 and 2), influenza or the Nipah virus (Leroy et al. 2009). The increase in heatwaves induces thermal stress that increases both human and animal mortality, and accentuates these risks of emergence (Ebi et al. 2021).

It is also documented that climate change negatively affects agriculture and indirectly human health (Wheeler and von Braun 2013). It jeopardises food security (more severe and prolonged droughts, increase in floods) and consequently contributes to malnutrition in populations. Fires caused by droughts, but also the very frequent slash-and-burn practices in many countries, combined with rampant urbanisation grouping increasingly large populations in large cities, increase air pollution leading to respiratory conditions (Tran et al. 2023). The lack of access to clean water and the numerous floods lead to an increase in the spread of waterborne diseases such as cholera or leptospirosis (Levy et al. 2018). All these extreme weather conditions, combined with the impact of human activities on nature, have a significant effect on agriculture and biodiversity, thereby increasing the risks to human and animal health (Owino et al. 2022). This also causes psychological trauma and significant stress, increasing the risk of mental illnesses (Hayes et al. 2018). As is often the case, the most vulnerable populations are the first victims of all these disruptions and changes. The IPCC has highlighted in its recommendations the need to promote holistic “One Health” approaches to better account for the multifactorial effects of climate change on agriculture and health (animal, human, and environmental) to implement appropriate actions to prevent and limit global health impacts (Mahon et al. 2024).

The aim of this chapter is to deepen the understanding and analysis of the relationships between climate change, agriculture, and “healths” to promote sustainable agricultural methods that respect human health, as well as the environment, which has been largely overlooked until now (Fig. 11.1). Its objective is also to examine how a comprehensive approach that considers the complex interactions between agriculture and animal, human, and environmental health could effectively implement sustainable production systems without negative consequences for the climate, but also for humans, biodiversity, and the environment (Banerjee and van der Heijden 2023).

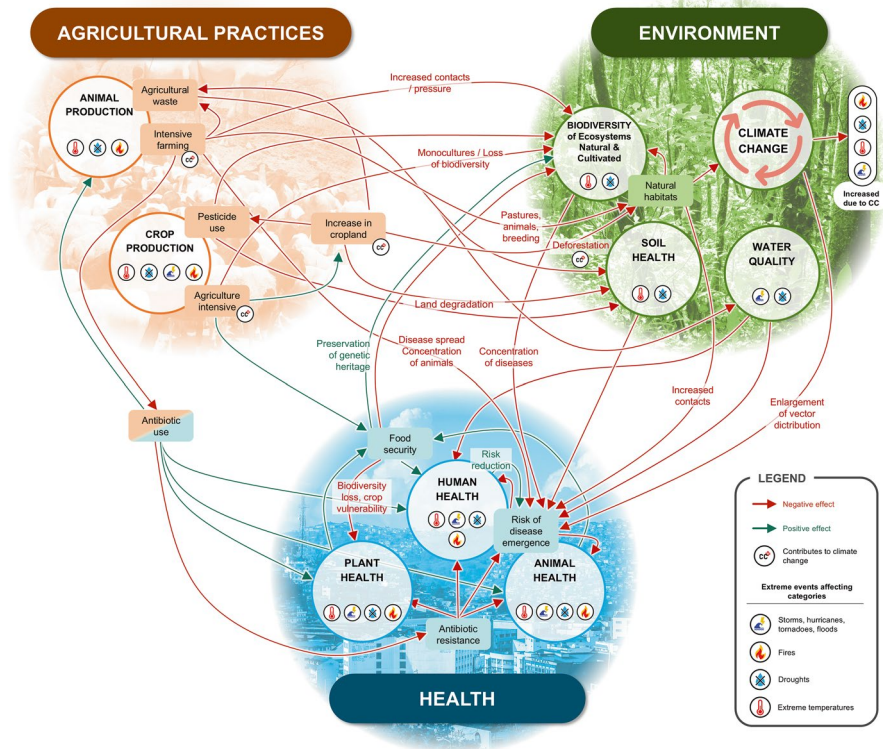


Fig. 11.1 Interconnections between agricultural practices, environment, and healths. The figure presents the relationships between agricultural practices for animal and plant productions (use of pesticides, intensive agriculture, agricultural waste...) the environment (biodiversity, climate change, soil health, water quality) and healths (human, animal, and ecosystem health). The diagram identifies interactions between these three elements, which are classified according to their positive or negative impact and also their links with climate change. Many negative processes are identified such as soil degradation, loss of biodiversity, antibiotic resistance, expansion of vector zones, etc. Some positive interactions are also highlighted, notably food security and preservation of genetic heritage

11.1 Agriculture, Climate Change, and Health

Healthy and sustainable agriculture is essential for human health. It must provide healthy ingredients with high nutritional value for the population’s diet, which guarantees them better health. Otherwise, it can provide food contaminated with harmful chemical residues or with low nutritional value or exposed to polluting and harmful chemical inputs for humans and animals, thus endangering their health. In 2020, the FAO showed how agriculture directly contributes to climate change

through greenhouse gas (GHG) emissions, mainly linked to the excessive application of nitrogen fertilisers (emission of N_2O for example), but also through intensive livestock farming which produces significant methane CH_4 emissions (FAO 2022). All these phenomena contribute significantly to global warming, promoting the spread of zoonotic and vector-borne diseases (Fig. 11.1).

In addition to the direct effects on climate change, intensive agriculture mainly based on the use of chemical inputs to combat crop diseases, but also on antibiotics given to livestock, also promotes the development of pathogen resistance, making their management more complex and their impacts more significant in a context further aggravated by the effects of climate change (negative spiral) (Gilbert et al. 2017). Traditionally, agricultural practices can be classified into three types: conventional practices based on non-renewable resources (E), those integrating renewable resources (S), and those rethinking agroecosystems according to the principles of agroecology (R) (Gliessman 2014; Hill and MacRae 1996). In plant health, agroecological strategies such as agroecological crop protection (Deguine et al. 2023) stand out for their low carbon footprint, avoiding the “waste” of high GHG emission inputs (Lamichhane et al. 2015; Wyckhuys et al. 2022). These approaches, particularly the S and R strategies, are also effective in limiting infectious risks, notably zoonoses, thanks to the biological control by conservation of habitats (Ratnadass and Deguine 2021). Conversely, conventional practices based on agrochemistry exacerbate pesticide resistance, increasing risks related to vectors and disease reservoirs (malaria, leptospirosis) and resistant fungal pathogens (Ratnadass et al. 2023). Rodenticides and Triazole fungicides, widely used in agriculture, also negatively impact public health and environmental health. Sustainable and resilient practices, although imperfect, generally reduce risks to ecosystems and human health, while increasing resilience to climate change. They provide an appropriate response to limit antimicrobial resistance, reduce greenhouse gas emissions, and strengthen the sustainability of agricultural systems in the face of current global challenges. It is by emphasising their adoption that we can hope for an improvement in the current situation.

The impact of climate change on agriculture and therefore on health differs between women and men, due to their positions within agri-food, health, and social systems. Women are more vulnerable to extreme climate events, as they are often responsible for managing natural resources and family food security. They also have limited access to resources, training, or technologies to cope with these challenges (Lecoutere et al. 2023). If we want suitable and inclusive solutions, it is therefore essential to address the issue of gender in all global initiatives, including the “One Health” approach (Galiè et al. 2024).

11.2 Degradation of Natural Ecosystems and Emergence of Diseases

11.2.1 *Agricultural Practices and the Consequences of Climate Change*

In their quest to find new arable land, humans encroach on existing natural ecosystems. This contributes to intensifying their interactions with wild animals, whose natural habitat is disrupted by human actions, but also by the effects of climate change (droughts, fires, floods), with the direct consequence of an increased risk of disease spread. Deforestation and the transformation of forests into agricultural areas (slash-and-burn agriculture, needs for land for intensive agriculture, especially soy, etc.) contribute to climate change by limiting the capture of carbon emitted into the atmosphere and harm the habitats of many wild species (Seymour et al. 2022). These disturbances bring humans, domestic animals, and wildlife closer together, creating interface zones allowing interspecies transmission and the emergence of diseases such as Ebola, Nipah virus infection, and coronavirus diseases (Magouras et al. 2020).

Extreme weather conditions, such as periods of drought or flooding, alter the distribution and availability of agricultural and natural resources and also intensify interactions between different species (Bartlett et al. 2022; FAO et al. 2020). Food security is affected by these losses in agricultural production, which in some parts of the world promotes an increase in meat consumption and intensive farming of domestic animals (Bonwitt et al. 2018). This consumption constitutes an additional risk of interspecies disease transmission through the handling of contaminated carcasses or animal products or through their ingestion under limited biosecurity conditions (little or no protective equipment, low-temperature cooking) (Cornélis et al. 2022). On the other hand, intensive farming, with limited biosecurity conditions, promotes the transmission and multiplication of pathogens and increases the risks of spread and emergence of animal or zoonotic diseases with pandemic potential (such as avian flu) (Delabouglise et al. 2022; Gilbert et al. 2017).

These disturbances exerted on natural ecosystems also allow the introduction and proliferation of parasites that vector these diseases, in connection with global warming. Higher temperatures increase the periods of activity and extend the geographical areas of mosquitoes and ticks, which are vectors of many diseases such as dengue, malaria, Lyme disease, etc. New animal, zoonotic and human diseases, such as Rift Valley fever or West Nile fever, Crimean-Congo haemorrhagic fever (CCHF) or Zika and Oropouche viruses, etc. (Anikeeva et al. 2024; Morand and Lajaunie 2021), thus emerge in new geographical areas.

11.2.2 Climate Change Exacerbates Soil Deterioration: A Health Hazard Too Long Neglected

Agroecology is a practice that aims to make agricultural production sustainable while preserving the environment. Most often, this involves better soil health, which is characterised by significant natural biodiversity. Soil health is essential for the sustainable sequestration of carbon, thus helping to limit global warming while ensuring sustainable yields. From a “One Health” perspective, soil health is central, as it positively interacts with the health of plants, but also with that of animals and humans in a balanced and healthy environment. It is therefore crucial to implement environmentally friendly agricultural practices to maintain a balance between the Food security, ecosystem health, and general well-being in a changing climate context. For many years, soil health was not considered in the scientific literature related to human or livestock health, but increasingly studies show that it is central and that preserving the health of soils equates to preserving human health (Romano and Zelikoff 2024; Singh et al. 2023; Sun et al. 2023).

11.3 The Urgency of an Integrated “One Health” Approach to Limit Climate Change and Reduce Pandemic Risks

Following the Covid-19 outbreak, which highlighted the links between global warming and the acceleration of disease emergence, both linked to human activities including agriculture, it has become clear that priority should be given to a holistic approach called “One Health” that would take into account all health aspects, their interconnections and the determinants that affect them. A definition of the “One Health” approach, inclusive of the environment, has been adopted internationally (One Health High-Level Expert Panel, Food and Agriculture Organisation of the United Nations, World Health Organisation of the United Nations, World Organisation for Animal Health and the United Nations Environment Programme) (One Health High-Level Expert Panel et al. 2022). In 2023, the COP28 for the first time included in its programme a day specifically dedicated to the health issues of global warming. The Covid-19 pandemic has proven that cooperation between different sectors (agriculture, animal and human health, environment, but also public policy, economy, social, education) is essential to prevent, prepare for and respond effectively to future crises (FAO et al. 2022; Sanga et al. 2024), the frequency and number of which are increasing exponentially, like extreme weather events. However, consideration of prevention and risk reduction is still too limited and it is important to act quickly for things to change positively (Peyre et al. 2021). One Health and prevention of emerging risks have been included in the legally binding International Pandemic Accord adopted by WHO member states in May 2025.

Although the importance of these issues is recognised globally, the lack of action persists mainly due to the delay in financial and political involvement.¹ Given that the origins of climate change and the occurrence of pandemics are intimately linked by common determinants (human impact on nature), it is imperative to re-examine political and economic priorities to establish concrete and effective measures against these global threats. Despite promising progress made in the international climate agenda, with increasingly precise goals and national responsibilities, tangible and operational measures are still too limited. This inertia is mainly due to a lack of political will and dominant economic logics. Moreover, climate policies are too often fragmented and divided by sector, which hinders a global and inclusive approach. To try to harmonise climate and public health management strategies, it is imperative to implement a “One Health” approach, which will aim to align initiatives to combat climate change and prevent pandemics.

In this context, the approach to territorial health, particularly through the Socio-Ecological System Health (SESH) and the One Health in Social-Ecological Systems (OHSES) approaches, allows us to respond to these challenges by providing an operational dimension to these integrated approaches, in connection with the resilience of agricultural and production systems (De Garine-Wichatitsky et al. 2021; Zinsstag et al. 2024). The concept of territory is a complex concept encompassing physical, social, economic and political dimensions, defined by its boundaries, whether physical or symbolic, and by the interactions between its components (see Chap. 21). These interactions are all the more important in the context of climate change, which increases pressures on territorial ecosystems and modifies socio-ecological dynamics (Wilcox et al. 2019). By emphasising interdisciplinarity, resilience and community participation, these frameworks integrate the impacts of climate into disease prevention and management (De Garine-Wichatitsky et al. 2021; Zinsstag et al. 2024). They also use tools such as systems thinking and participatory modelling to analyse the dynamic interactions between climate, ecosystems and human systems (Binot et al. 2015; Duboz et al. 2018; Étienne 2010). The Health and Territories project illustrates this approach by promoting the agroecological transition in *living laboratories* in Senegal, Benin, Laos and Cambodia, combining climate resilience, soil health and sustainable food systems (Duboz et al. 2018). This approach is essential to address the increasing impacts of climate change, while strengthening the health and sustainability of territories.

¹Pandemic: “Funding prevention actions is necessary to avoid future epidemics and limit climate risks”, 2023. *The World*. https://www.lemonde.fr/sciences/article/2023/06/22/pandemie-financer-les-actions-de-prevention-est-necessaire-pour-eviter-les-prochaines-epidemies-et-limiter-les-risques-climatiques_6178682_1650684.html

11.4 Conclusion

The “One Health” approach is a crucial tool for better adaptation to climate change, offering a global perspective on the health of humans, animals, and the environment. It is necessary to confront emerging infectious diseases, whether zoonotic or not, by also addressing the management of socio-ecosystems (agricultural practices, urbanisation, etc.), the preservation of the environment, including biodiversity and soil health. Although the “One Health” approach is gaining recognition, it is still insufficiently integrated into national and local policies. It is hindered by inadequate coordination between the health, agriculture, environment and public policy sectors on the ground, which prevents effective management of climate and health threats. Moreover, funding and management mechanisms, often fragmented and ill-suited to global challenges, hinder the practical implementation of these prevention strategies. The nations most exposed to climate change, particularly those in development, lack the essential resources to establish effective prevention mechanisms. The absence of globally coordinated responses exacerbates the situation, largely dominated by reactive measures rather than preventive ones. The “One Health” approach aims to overcome these obstacles by promoting global and interdisciplinary solutions (Olive et al. 2022). It promotes the establishment of synergies between public health, ecosystem preservation and sustainable agriculture, taking into account the social and environmental aspects of global issues. The implementation of sustainable and resilient agricultural methods in the face of climate change is essential to maintain a balance between food security, the health of socio-ecosystems and overall well-being. Adopting the “One Health” approach in global strategies to combat global warming and health risks would both reduce these risks and improve our resilience to these multiple and simultaneous crises.

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