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FOOD SYSTEMS AT RISK

NEW TRENDS AND CHALLENGES

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CHAPTER 2.4

RISKS OF NEW PESTS AND DISEASES

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SUMMARY

Climate change will affect the social and environmental determinants of the health of human, animal and plant populations around the world. It will challenge the social and biological capacities of food systems to regulate the emergence of pests and pathogens. Especially in Low-Income (LI) and Lower Middle-Income (LMI) countries, food systems will be dealing with new pests, diseases and emerging pathogens (viruses, bacteria, mycoplasma and fungi) severely threatening the health of vulnerable people and potentially exacerbating social and economic inequalities.

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Effects of climate change on the emergence and prevalence of health risks

Climate change induces the disruption of ecological and sociological patterns. In particular, climate change has the potential to affect disease emergence (Watts *et al.*, 2017) because of its effects on annual and seasonal cycles affecting the spatial distribution of climate-sensitive pathogens. Regarding diseases strongly linked to ecological dynamics, such as vector-borne diseases, climate variations determine the presence and density of pathogen vectors and hosts (whether plant, animal or human) at any given place (Roger *et al.*, 2016). For instance, climate change allows mosquitoes, ticks and other parasites transmitting diseases to move to areas where they were previously unknown, threatening new food systems and populations. Diseases such as malaria, severe acute respiratory syndrome (SARS), dengue and Rift Valley fever are likely to emerge or re-emerge in disease-free areas, threatening the safety and health of human and animal populations.

A recent study has highlighted that most of the important pathogens among protozoa and helminths, vector-borne, food-borne, soil-borne and water-borne transmission routes are sensitive to climatic factors (ranging from 63 percent to 82 percent), particularly temperature and rainfall. Among them, zoonotic pathogens seem to be more sensitive to climate than exclusively human or animal pathogens (McIntyre *et al.*, 2017).

Climate change combined with other global changes such as the intensification of food farming systems, the globalisation of trade and the erosion of biodiversity will undeniably accelerate the emergence of these new health risks, in particular infectious vector-borne zoonotic diseases, crop pests and anti-microbial resistance. Taking into consideration that higher local temperatures are associated with increased rates of resistant infections (Blair, 2018), antibiotic resistance combined with climate change is probably one of the major crises to be faced in the future.

Cascade of impacts on livestock and crop production

These changes induced by climate change in host/pathogen interactions generate a cascade of impacts on livestock and crop production, affecting food security, livelihoods and potentially leading to migrations and social disequilibrium, with a subsequent impact on host/pathogen interactions (Figure 15). In addition, the increase of sanitary and phytosanitary threats resulting from climate change would hamper regional and international trade, especially for LI and LMI countries, if appropriate risk management is not developed (FAO, 2008).

In the case of plants and crops, insect pests are also an important plant health problem, for example locusts in the Sahel zone. Pests and diseases reduce crop productivity, compromise sustainability, reduce food availability and affect the quality of production. These threats are particularly present in tropical agrosystems. Climate change, coupled with global change (such as globalised trade, increased human and animal mobility, biodiversity erosion and drastic land-use change), alters the behaviour of pests and diseases on plants and their geographical distribution (War *et al.*, 2016). There is a genuine risk that pest and disease pressure will increase as a result of environmental and agrosystem disturbances. This is a concern for all agricultural stakeholders, including those in temperate countries where the introduction of new pests, diseases and weeds is widespread.

It is common knowledge that the list of such introductions in Europe is becoming ever longer, with the onset of disturbing phenomena that are a real threat to food security, but it is also the case in tropical countries, where pest and disease distribution areas are increasing at an alarming rate. The impact of climate change on pest populations and their natural enemies in the tropics is even harder and more complicated to grasp; changes in pest status, insect lifecycles, exotic introduction and the dramatic development of diseases or insect populations and extension of their ranges are being observed. Based on examples of insects and diseases affecting several tropical agrosystems, it is clear that the impact of climate change on these pests is important and it is essential to develop new agroecological protection strategies while promoting the conservation of natural regulation services to sustainably reduce pest and disease risks (Carvalho, 2017).

Despite the fact that pest and disease management have made a substantial contribution to the increase in food production over recent decades, plant pests and diseases still reduce the global harvest by between 10 and 16 percent, and are particularly problematic in LI and LMI countries (Chakraborty and Newton, 2011; Campbell *et al.*, 2016). To better assess the effect of climate change on pests and diseases and on food production, more modelling studies are needed (Cilas *et al.*, 2016; Donatelli *et al.*, 2017).

To minimise, prevent and manage the impact of diseases, some breeding programmes are developing disease-resistant varieties to contain the spread of disease and minimise its effects on crops. The introduction of shade trees could be effective for maintaining the air temperature at field level and to protect crops from multiple pests and diseases. Moreover, shading could reduce sudden temperature changes, which are detrimental to the biological balance of agrosystems, thus contributing to the agroecological regulation of pests. Such ecological services can be preserved while mitigating the impact of climate on biodiversity.

With regard to zoonotic diseases (infectious diseases transmitted between animals and humans) drug resistance and environmental pollution are now major public health problems worldwide. They will be exacerbated by climate change because it affects environmental and socioeconomic equilibriums. Social and ecological disruption caused by climate is so complex that it cannot be accurately predicted.

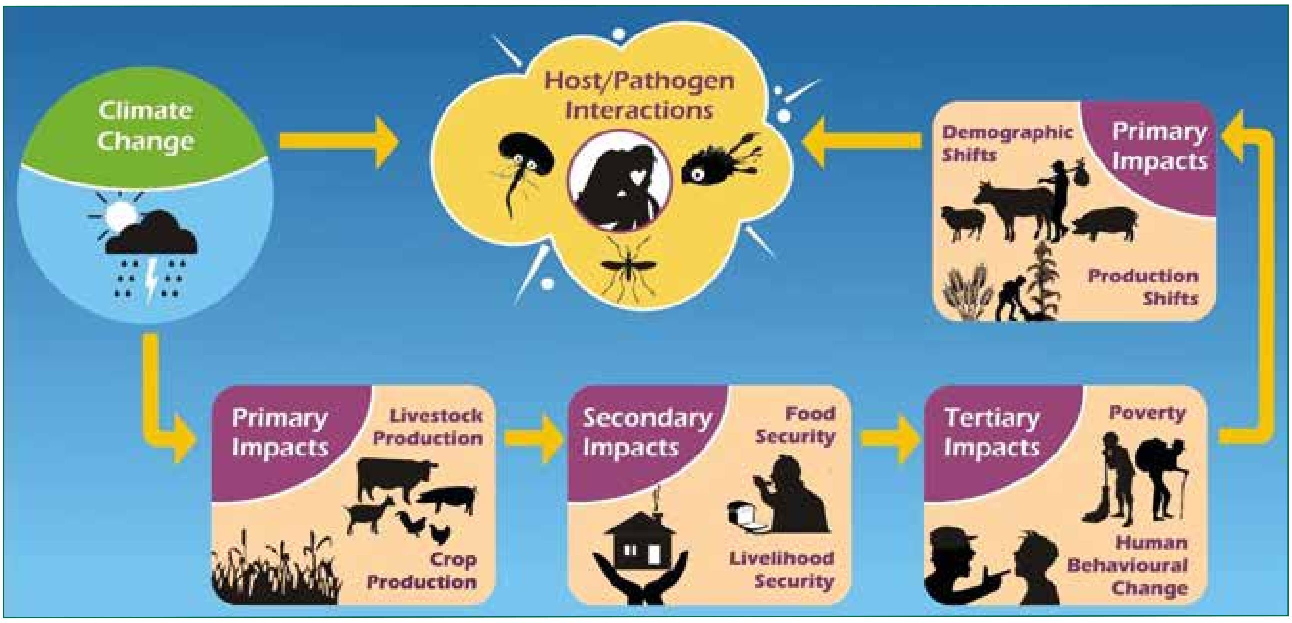

Figure 15: *The infectious disease climate change cascade. Source: Heffernan, 2018.*

Despite the large proportion of climate-sensitive pathogens, their response to climate change depends on complex drivers (McIntyre *et al.*, 2017). Therefore, such risks are particularly difficult to address through conventional sectoral approaches. Given the framework of food systems threatened by climate change and its cascading impacts on health and livelihoods, there is an urgent need for a comprehensive integrated risk mitigation approach to address zoonotic and antimicrobial resistance-related diseases.

Managing such emerging risks requires conceptual and innovative methodological frameworks promoting integrated approaches to health, such as the 'One Health' or 'Ecohealth' approach (Duboz *et al.*, 2017). These integrated approaches acknowledge that human, plant and animal health are interdependent and bound to the health of the ecosystems in which they live. It aims to foster improved cross-sectoral collaboration and involve stakeholders at different levels. It is both a science-based and an institutional movement, promoting systems thinking and involving social and technical sciences sharing knowledge to support and strengthen integrated risk management actions at the agrosystem level.

Addressing the health impacts of climate change directly implies increasing the resilience of human and animal populations — and the underlying economic and food systems such as livestock and crop production — at an ecosystem level. ●

BOX 4
RICE CROPPING: CLIMATE CHANGE-RELATED DISEASE SPREAD

Rice is the most important food crop in LI and LMI countries and the staple food of more than half of the world's population. This cereal is grown in many countries under a variety of climatic conditions, from the wettest areas in the world to the driest deserts. Based on population projections from the United Nations and income projections from the Food and Agricultural Policy Research Institute (FAPRI), global rice demand is expected to rise from 490 million tonnes (milled rice) in 2018 to 555 million tonnes in 2035.

Changing climatic conditions are helping diseases to spread to new localities and exacerbating their impact. In addition to the already widespread diseases affecting rice, emerging diseases are increasingly becoming serious threats. Apart from the major diseases already established (Rice Yellow Mottle Virus in Africa, blast everywhere, tungro and bacterial blight in Asia, hoja blanca in South America, green coal in China, Rhizoctonia in Asia and South America), we are faced with the worldwide re-emergence of helminthosporiosis (caused by the fungus Bipolaris oryzae). This disease caused a famine in Bengal in the 1950s, and its currently high global prevalence is worrying. In South America, a bacterium is expanding (Burkholderia glumae). Many pests also exist in rice and are proliferating; to control them, research has shown the existence of a mechanism in tropical irrigated rice systems that supports high levels of natural biological control (Settle *et al.*, 1996; Sester *et al.*, 2014). These results have supported a management strategy that promotes the conservation of existing natural biological control through a massive reduction in insecticide use and a corresponding increase in habitat heterogeneity.

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