Chapter 68
Rift Valley Fever and the Changing Environment:
A Case Study in East Africa

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ABSTRACT

Rift Valley fever is a severe disease affecting both humans and animals. The Rift Valley fever virus can be transmitted by body fluids, and the most common way for humans to get infected is from animals. The virus is also vector-borne and can be transmitted by many species of mosquitoes. As with other vector-borne diseases, the epidemiology may vary in response to environmental changes. Here the effects of climate and land use changes on Rift Valley fever, as well as on other vector-borne diseases, are discussed. The effect of irrigation in East Africa on inter-epidemic transmission of RVF is discussed in greater detail, followed by recommendations for future research and actions.

INTRODUCTION

The last century has seen a period of ecological change, unprecedented in recent times, with dramatic reductions in pristine habitats, ecosystem services and biodiversity along with equally dramatic increases in numbers of people and of domestic animals. Most land use practices change the environment and are due to human influence, often related to feeding the growing population, such as increased irrigation

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and land deforestation to allow crop cultivation. Environmental change is ubiquitous, and new diseases continue to emerge, while concerns about the impact of environmental change on human health grow. However, while it seems intuitive that degradation of ecosystems will increase the risk of disease, detailed knowledge on how specific environmental changes in a given context affect disease transmission is often lacking. As a consequence, decision makers may inadvertently increase health risks.

This chapter uses the example of Rift Valley fever (RVF) to explore relations between disease dynamics and environmental change. Two main drivers, climate and land use changes, can be identified. We focus on irrigation as a type of land use change. In addition, RVF is characterized, describing the knowns and unknowns about its epidemiology and recapitulating the history and impact of RVF outbreaks in east Africa. Next we discuss relations between RVF and climate and land use change. Findings from an ongoing study, which shows that an irrigated area can support endemic transmission of RVF, without any signs of outbreaks, are also presented and the relevance of this is discussed.

IMPORTANCE AND DRIVERS OF EMERGING DISEASE

Emerging infectious diseases in both animals and humans cause major economic and health burdens in every part of the world. On average, a new human disease appears every four months and around 75% of emerging diseases are zoonotic (Jones et al., 2008). Most originate from wildlife, and the study of disease emergence has a strong focus on wildlife. However, economically important emerging diseases often involve domestic animals. For example, between 1997 and 2009, six major emerging diseases have together cost at least 80 billion USD: the Nipah virus outbreak in Malaysia, West Nile fever in the USA, severe acute respiratory syndrome (SARS, starting in Asia), highly pathogenic avian influenza (HPAI, starting in Asia), bovine spongiform encephalopathy (BSE, starting in the UK) and RVF in East Africa (World Bank, 2012). In all of these, livestock or animals farmed for human consumption provided either a reservoir or a bridge to transmit the disease to people. Later outbreaks of emerging infectious diseases, such as Middle East respiratory syndrome (MERS) and the Ebola outbreak in West Africa, were also caused by viruses with an animal reservoir; in the case of MERS livestock (camels) are an amplifying host, and in the case of Ebola a livestock interface has been suspected (Atherstone, Smith, Ochungo, Roesel, & Grace, 2015; Wong et al., 2015; Yuen, 2015).

The burden of infectious diseases is not uniform, and in low-income countries a high proportion of disease stems from zoonotic diseases and diseases recently emerged from animals (Grace, Gilbert, Randolph, & Kang'ethe, 2012). In Africa, diseases affect poor people disproportionally and further contribute to their poverty in a vicious circle. In particular, zoonotic diseases have the potential to harm both the livelihoods and health of those depending on livestock. Africa is also the continent where more than half of all outbreaks of emerging infectious diseases verified by WHO between 1996 and 2009 occurred, and where the time lags between outbreak detection and public alerts are the longest (Chan et al., 2010).

Moreover, demographic growth is predicted to remain high in Africa, with the continent's population predicted to reach 4 billion in 2100 (from 1 billion in 2014) (Gerland et al., 2014). This rapid population growth is likely to drive equally rapid changes in ecosystems, including crop expansion into marginal areas, irrigation, deforestation, urban sprawl, road building, mining and bush meat harvesting (Grace & Bett, 2014). Depending on how these changes affect the number of susceptible animals and humans, their risks of exposure and the infectiousness of the infected individuals, they may either increase or decrease disease incidence (Lindahl & Grace, 2015). Land-use change often drives disease and has been