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Ecohealth research in Africa: Where from—Where to?

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ABSTRACT

Epidemiological mapping and risk profiling build on the idea that diseases are tied to social-ecological systems that govern the distribution and abundance of transmissible pathogens, vectors and hosts. This is the heart of the emerging field of ecohealth, which examines how biological, cultural, demographic, economic, physical, political and social environments change and how these changes affect the health and wellbeing of humans, animals and ecosystems and the services they provide. This paper is an overview of a special issue of *Acta Tropica*, whose 15 publications reflect a geographically and epidemiologically diverse landscape of ecohealth. Nowhere is an ecohealth approach better suited than in Africa and its myriad of landscapes that include contexts varying from profuse expanses of tropical rain forests to the world's greatest desert. The publication of African ecohealth-related projects displays a biological, cultural and social diversity in health system contexts and a wide variety of contributions pertaining to different, often neglected, tropical diseases, including brucellosis, Buruli ulcer, fascioliasis, malaria, Q fever, rabies, Rift Valley fever and schistosomiasis. Pursuing an ecohealth approach provides a platform that brings together community members, decision makers, scientists and other stakeholders with a view to understand how ecosystem changes affect health conditions. Taken together, the presentation of this variety of papers dealing with environmental variables associated with health inaugurates the vital concept of ecohealth. By emphasizing that all organisms are part of social-ecological systems, the long-term wellbeing of both people and animals depending on healthy and productive ecosystems is highlighted.

1. Introduction

Recognising the inextricable linkage of human and animal health within social-ecological systems (Rapport, 1998; Forget and Lebel, 2001), epidemiological research should no longer exclusively deal with the study and analysis of the patterns, causes and effects of health and disease conditions in populations. Now, the approach requires the creation, synthesis, integration and application of inter- and transdisciplinary knowledge to foster public, global and planetary health (Whitmee et al., 2015). This wider scope of scientific inquiry constitutes the new discipline of ecohealth, as embraced by the International Association for Ecology and Health (http//:www.ecohealth.net). Ecohealth approaches add precision and predictive power to observations pertaining to infectious diseases and risk factors in humans and animals, as they include the whole chain of dependent organisms from pathogens to intermediate hosts, vectors and definitive hosts. In addition, cultural, demographic, ecological, economic, political and social transformations fall within this new branch of research making ecohealth a crossroad bringing together stakeholders, such as biologists, ecologists, epidemiologists, health economists, mathematical modellers, physicians, politicians, public health specialists, social scientists, veterinarians and not the least, the humans living in the context under study. Ecohealth research employs systemic approaches to health and wellbeing with the aim to sustain health services, promote social and political stability and facilitate the peaceful coexistence of humans and animals in their environments. To achieve this, all political actors involved (e.g. authorities, communities, non-governmental organisations, private sector and civil society) must be engaged in a participatory transdisciplinary approach (Charron, 2012; Nguyen-Viet et al., 2015).

How did the new science of ecohealth come about? What made us start to see the world in a different light? To try answering those questions, one must step more than 150 years back. Although the interaction between biology and the environment was always there for everyone to see, its real effect was not fully appreciated until the publication of 'On the origin of species' in 1859, when Darwin introduced the then totally novel view that populations evolve through a process issuing from pressures exerted by the environment. One would have thought that this view should have rapidly initiated ecological research but this did not happen, partly due to the considerable controversy caused by the idea that new species, including our own, could be created by natural forces. Although 'Darwinism' is now the unifying concept of the life sciences, it took more than 70 years before rival ideas had finally been refuted. This drawn-out argumentation postponed the arrival of an interest in contemporary effects of environmental changes by decades. Indeed, this field of inquiry was felt to be unimportant until it finally dawned on the scientific community that also short-term outcomes that were insufficient for species creation and having more to do with epidemiology and social behaviour would be worthwhile to study. An important incitement was the insight that the climate is not stable but exhibits both short- and long-term patterns making it urgent to find tools to reliably measure and record even subtle changes, which is particularly important in the current era of anthropogenic climate change (Huang et al.,

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2000; Zhang et al., 2007; Bergquist, 2017). As it turned out, such tools already existed thanks to unparalleled advances in the last few decades in such widely different areas as satellite science and computer technology. Never before have highly accurate measurements of environmental parameters been available in such amounts, with such ease and almost in real-time.

The widespread use of the Internet for information exchange has created a broad acceptance of risk assessment approaches using digital geospatial data resources and epidemiological mapping and risk profiling of diseases, particularly directed at organisms restricted by their environmental requirements. Various developments incurred a period of extremely rapid growth in this field: (i) instruments onboard Earth-observing satellites became the main source of environmental information; (ii) the personal computer made it possible to bundle cartographic records and data from field research together with remotely sensed information (Hay et al., 1996; Bergquist and Rinaldi, 2010); and (iii) the growth of geographical information systems (GIS) facilitated processing of this kind of data by producing map 'overlays' with various datasets capable of rapid, visual display of collected data in relation to the geographical background, demographic, environmental and socioeconomic factors (Karagiannis-Voules et al., 2015; Lai et al., 2015).

The avalanche of spatial data produced by these new technologies, and the statistical methods needed to deal with them, not only corroborates but indeed emphasizes the theory holding that hosts, vectors and transmissible pathogens are all tied to particular geographical niches by sets of environmental determinants controlling their distribution and abundance (Pavlovsky, 1966; Galuzo, 1975). With the maturation of the concepts of landscape ecology and landscape epidemiology, it can be said that the former sorts out the processes and patterns at play in ecosystems across time and space (Kitron, 1998), while the latter analysis reveals the environmental risk factors to be targeted. It is thus clear, that the effect of the prevailing climate for the outcome cannot be understated; apart from being affected by long-term global-warming drivers, the climate also varies due to regional phenomena, such as the El Niño Southern Oscillation (ENSO), which has a direct influence on the occurrence, change and uneven distribution of all communicable diseases, the vector-borne ones in particular (Hay et al., 1996; Johansson et al., 2009). In the longer perspective, the prevailing temperature moves in cycles (short and long) simultaneously and can therefore appear to trend in different directions in different time frames (Sweijd et al., 2015; Bergquist, 2017). It is therefore important to understand how the atmosphere, oceans and the land surface interacts providing predictions for the future. These changes are followed by the World Climate Research Programme (WCRP; https://www.wcrp-climate.org), established in 1980 under the joint sponsorship of the International Council for Science, the World Meteorological Organization and the Intergovernmental Oceanographic Commission of UNESCO, the latter since 1993. WCRP coordinates the current exploration of the Earth's climate system including the global hydrological cycle, cloud formation and the ocean's role in transport and storage of heat. These activities match the priorities identified by the Intergovernmental Panel on Climate Change (IPCC; http://www.ipcc.ch/) and relate to the climate issues raised by the United Nations Framework Convention on Climate Change (UNFCCC; http://unfccc.int/2860.php). From an ecological point of view, the work by all these organisations is essential and the climate changes observed and recorded have been shown to have had a strong impact in many tropical regions; for example, in the sub-Saharan region and other parts of the African continent, while investigation at appropriate spatio-temporal scales are increasingly feasible thanks to improved climate science products and higher resolution epidemiological data (both in space and time) providing support for the study of climate variability and its impact on the health sector.

2. Previous ecohealth-related research activities in Africa

In the 1960s, Dinka pastoralists in Sudan inspired Calvin Schwabe to coin the term 'One Medicine' indicating that there is no difference between human and veterinary medicine (Schwabe, 1984). In 1998, integrated research on human and animals was initiated from a focus on the health of mobile pastoralists and their animals in Chad, Mali and Mauritania. This contributed to extend and rename Schwabe's 'One Medicine' label to 'One Health', and to validate this expression as an added value of closer cooperation and collaboration between public health specialists and veterinarians (Montavon et al., 2013). The first joint human and animal vaccination campaigns carried out in Chad showed that when veterinarians and physicians cooperated closely, they could provide access to health care to previously unreached communities and save resources compared to separate health service provisions (Schelling et al., 2005). Ecohealth, by its extension to the environmental, ecological and social aspects of health, is clearly encompassing One Health as an overarching concept (Zinsstag, 2012).

In the mid-1990s, the Canadian International Development Research Centre (IDRC) launched an ecohealth programme initiative in several African countries, including Benin, Cameroon, Côte d'Ivoire, Kenya, Senegal, Uganda and Tanzania. By the creation of what was called "Community of Practice in Ecohealth in sub-Saharan Africa," (COPEH-SSA), health workers supported by IDRC within the frame of COPEH-SSA spearheaded integrated approaches to health from an ecosystem and a social perspective. In 2010, the first African regional meeting of researchers in ecohealth approach was held in Cotonou, Benin. In 2013, the first African regional conference of the International Association of Ecology and Health (IAEH) and the second African regional meeting of researchers in ecohealth approach was held in Grand-Bassam, Côte d'Ivoire, under the auspice of the Centre Suisse de Recherches Scientifiques en Côte d'Ivoire (CSRS; http://www.csrs.ch/). COPEH-SSA was further strengthened by collaboration with other networks, such as the African capacity building initiative of the Wellcome Trust and other activities in southern Africa. Over the past several years, the UNICEF/UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (TDR), in collaboration with IDRC, has encouraged and fostered ecohealth projects in different parts of Africa, part of which are featured in the current special issue. Today, the University of KwaZulu Natal in South Africa and CSRS with its partner universities in Côte d'Ivoire are the first African institutional partners in the International Association for Ecology and Health. In 2013 by the first African regional conference of the International Association of Ecology and Health (IAEH) and the second African regional meeting of researchers in ecohealth approach.

3. Pursuits of ecohealth in Africa

3.1. Setting the scene

This special issue pertaining to ecohealth in Africa not only deals with how the environment directly affects humans and animals in some of Africa's traditional societies, but also how demographic, economic and social factors influence life patterns in various settings, how people have developed resilience mechanisms and how they react to unusual climate events. The typical approach used when undertaking an ecohealth study – which is common to the research featured in this special issue of *Acta Tropica* – is to initiate the project by bringing key stakeholders from various backgrounds, sectors and scientific disciplines together (Fig. 1). This means that a variety of specialists sit down with residents of the planned study area to share knowledge, adopt a common language, create an enabling environment and encourage a stimulating situation aiming at the joint