Many agriculture-associated diseases are characterized by complexity, uncertainty and high potential impact. They call for both analytic thinking, to break problems into manageable components that can be tackled over time, and holistic thinking, to recognize patterns and wider implications as well as potential benefits.

The analytic approach is illustrated in the new decision-support tool developed to address Rift Valley fever in Kenya. In savannah areas of East Africa, climate events trigger a cascade of changes in environment and vectors, causing outbreaks of Rift Valley fever among livestock and (ultimately) humans. Improving information on step-wise events can lead to better decisions about whether, when, where and how to institute control (Anon 2010). An example of holistic thinking is pattern recognition applied to disease dynamics, recognizing that emerging diseases have multiple drivers. A synoptic view of apparently unrelated health threats—the unexpected establishment of chikungunya fever in northern Italy, the sudden appearance of West Nile virus in North America, the increasing frequency of Rift Valley fever epidemics in the Arabian Peninsula, and the emergence of bluetongue virus in northern Europe—strengthens the suspicion that a warming climate is driving disease expansion generally.

Complex problems often benefit from a synergy of various areas of expertise and approaches. The foresight groups successfully bring together experts in health, environment, agriculture and social development to look at emerging issues (see, for example, http://www.bcgsc.gov.uk/foresight). Complex problems also require a longer term view, informed by the understanding that short-term solutions can have unintended effects that lead to long-term problems—as in the case of agricultural intensification fostering health threats. Not every problem requires this broad-spectrum approach, so a first task is to identify specific problems that call for integrative solutions.

New institutions

New, integrative ways of working on complex problems, such as One Health and EcoHealth, require new institutional arrangements. The agriculture, environment and health sectors are not managed in silos, but require new ways of working and institutional arrangements. New, integrative ways of working on complex problems, such as One Health and EcoHealth, require new institutional arrangements. The agriculture, environment and health sectors are not managed in silos, but require new ways of working and institutional arrangements. New, integrative ways of working on complex problems, such as One Health and EcoHealth, require new institutional arrangements.

Conclusions

Agriculture and health are intimately linked. Many diseases have agricultural roots—food-borne diseases, water-associated diseases, many zoonoses, most emerging infectious diseases, and occupational diseases associated with agrifood chains. These diseases create an especially heavy burden for poor countries, with far-reaching impacts. This brief views agriculture-associated disease as the dimension of public health shaped by the interaction between humans, animals and agroecosystems. This conceptual approach presents new opportunities for shaping agriculture to improve health outcomes, in both the short and long terms.

Understanding the multiple burdens of disease is a first step in its rational management. As agriculture-associated diseases occur at the interface of human health, animal health, agriculture and ecosystems, addressing them often requires systems-based thinking and multi-disciplinary approaches. These approaches, in turn, require new ways of working and institutional arrangements. Several promising initiatives demonstrate convincing benefits of new ways of working across disciplines, despite the considerable barriers to cooperation.

References

IFPRI and ILRI. 2010. Agriculture for improved nutrition and health, Washington, DC. (IFPRI and Nairobi ILRI:http://csp4change.org/)

Agriculture-associated diseases: Adapting agriculture to improve human health

John McDermott and Delia Grace

Agriculture is critical for human welfare, providing food, employment, income and assets. In the past, agricultural research and development largely focused on improving the production, productivity and profitability of agricultural enterprises. The nutritional and other benefits of agriculture were not always optimized, while the negative impacts on health, well-being and the environment were often ignored. This was especially problematic for livestock systems, with especially complex negative and positive impacts on human health and well-being.

An important negative effect of agricultural intensification is disease. Highly pathogenic avian influenza (HPAI) is a notorious example of a disease that was fostered by intensified agricultural production and spread through lengthened poultry-value chains and the global movement of people and animals. Large-scale irrigation projects, designed to increase agriculture productivity, have created ecosystems conducive to schistosomiasis and Rift Valley fever.

The responses to disease threats are often compartmentalized. Instead of analysing the tradeoffs between agricultural benefits and risks, the agriculture sector focuses on productivity, while the health sector focuses on managing disease. A careful look at the epidemiology of diseases associated with agriculture, and the effectiveness of control efforts, shows that successful management must be systems-based rather than sectorally designed.

What are agriculture-associated diseases?

Any disease related to agrifood value chains can be considered agriculture-associated. Such diseases may be associated with agriculture inputs, primary agricultural production, post-harvest processing and handling along marketing chains, or even final preparation by the consumer. The category also includes diseases influenced by ecosystem change for food production (such as large dams) and those associated with incursion of agro-ecosystems into natural ecosystems (such as harvesting wildlife).

The link between agriculture and disease has long been established. This brief examines the range of agriculture-associated diseases to discover commonalities that can be leveraged to achieve better health outcomes. To frame the discussion, we present a typology of four categories of these diseases (Box 1) based on causation and transmission pathways, ranking them by overall impact on human health as measured in DALYs. As with any typology of disease, there are overlaps and ambiguities; the categories are not intended to be absolute but rather to have pragmatic relevance for policy and practice.

1. Natural ecosystems are self-regulating systems without much direct human interference or manipulation.
2. The DALY (disability-adjusted life year) is a measure of healthy years of life lost due to premature death and disability (WHO 2008).
At least 16% of all infectious disease and 6% of the total burden (zoonoses of domestic animals and food-borne disease) make up income countries, diseases directly associated with agriculture stimulated rich and middle-income countries to invest heavily in impacts. For example, the SARS epidemic cost USD50–100 billion (for comparison, in high-income countries they make up just 4% of the infectious disease burden and only 0.1% of the total disease burden.) The direct economic, social and environmental costs of these diseases are probably proportionate to their adverse political impacts. For example, foot-and-mouth disease (FMD) in food lead to trade losses of up to USD2.1 billion a year. Indirect costs of disease are also important. Impaired human health lowers both labour productivity and human capital accumulation (as through schooling and training), worsening/eliminating outcomes in both the short and long runs. Malnutrition itself is not only responsible for 3% of the disease burden in low-income countries (WHO 2008), but also enhances vulnerability to disease and is in turn exacerbated by diet-related disease symptoms—leading (for example) to a 30-fold increase in the risk for death from diarrhoea (Flint et al. 2005).

Diseases are influenced by socio-economics, environments and policies. There are two broad scenarios that characterize poor countries. At one extreme are neglected areas that lack even the most basic services; in these ‘cold spots’, diseases persist that are controlled elsewhere, with strong links to poverty, malnutrition and powerlessness. At the other extreme are areas of rapid intensification, where new and often unexpected disease threats emerge in response to rapidly changing practices and interactions between people, animals and ecosystems. These areas are hot spots for the emergence of new diseases (of which 75% are zoonotic). They also are more vulnerable to food-borne disease, as agricultural supply chains diversify and outfit workable regulatory mechanisms.

Occupational disease and drug resistance

People working in agrifood systems are directly exposed to a range of bacteria in farm animals is known to contribute to the crisis of drug-resistant in human medicine, although there is debate about its importance and the best way of tackling it. The contribution to disease burden of this category has not been comprehensively assessed; it appears to be an order of magnitude less than the other disease categories.

Why do agriculture-associated diseases matter—and to whom?

As well as sickening and killing billions of people each year, these diseases damage economies, societies and environments. While there is no metric that captures the full cost of disease, assessments of specific disease outbreaks suggest the scale of potential impacts. For example, the SARS epidemic cost USD50–100 billion; the potential costs of an avian influenza pandemic, such as cholera, cryptosporidiosis and chemical intoxication, as well as diseases which breed in irrigation and water storage systems, such as cholera, cryptosporidiosis and chemical intoxication, as well as diseases which breed in irrigation and water storage systems, such as morbidity and mortality. Similarly, agriculture practices that effectively influence policy is the case of smallholder dairy in Kenya. In the light of research by ILRI and partners, assessing both public health risks and poverty impacts, found that the public health sector reaps only about 10% of the benefits (Roth et al. 2003). Brucellosis control would thus appear less attractive than other disease control expenditure options, in an analysis based solely on DALYs averted. But when the benefits for the livestock sector were included, and the costs shared proportionally by the public health and agricultural sectors, the control of brucellosis actually offered a net gain for both sectors.

Improved metrics for estimating the full costs of disease would open new avenues for the public health sector, as well as for the multiple (that is, cross-sectoral) burdens of disease and the expected health and economic returns, and they need to consider the socio-political factors that affect the feasibility, sustainability and acceptability of implementation. In the case of brucellosis, these assessments were relatively straightforward. For other agriculture-associated diseases, however, there are high levels of uncertainty regarding epidemiology, impacts and control options (this is true especially for emerging diseases and diseases sensitive to new drivers, such as climate change and evolving agro-ecosystems and food chains). Other diseases have persisted despite medical interventions—especially the neglected tropical zoonoses—including a need to tackle the underlying causes of disease, such as poverty, inequality, lack of information and powerlessness.

Stronger partnerships

Compiling convincing evidence is only the first step in shaping policy. Strong partnerships and high trust will be needed between researchers, stakeholders and policy-makers. Policy discussions must go beyond specific control measures to examine the incentives that underpin behaviour and behavioural change.

Systems approaches

The complexities of agriculture-associated diseases call for more integrated and comprehensive approaches to analyse and address them, as envisioned in One Health and EcoHealth perspectives (Box 3). These integrated approaches offer a broad framework for understanding and addressing complex diseases: they bring together key elements of human, animal and ecosystem health; and they explicitly address the social, economic and political determinants of health. Both of these global approaches recognize agriculture- and ecosystem-based interventions as key components of multi-disciplinary approaches for managing diseases. For example, food-borne disease requires management throughout the field-to-fork risk pathway. Zoonoses in particular cannot be controlled, in most cases, while disease remains in the animal reservoir. Similarly, agriculture practices that create health risks require farm-level intervention.

Box 1: Agriculture-associated diseases

Box 2: Brucellosis control in Mongolia

Box 3: One Health and EcoHealth

Systemic One Health and EcoHealth approaches require development and testing of methods, tools and approaches to better support management of the diseases associated with agriculture. The potential impacts justify the substantial investment required. An ex ante assessment in Ghana evaluated an integrated package of risk-based measures relating to the use of wastewater for irrigation; it was judged capable of averting up to 90% of an estimated 12,000 DALYs, at an overall cost of less than USD100 per averted DALY (IFPRI and ILRI 2010).