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Livestock-related trade

The current mobility of people and the volumes of trade in live animals and primary and processed animal products are unprecedented. Together, these developments can be characterized as epidemiological pressures and contribute to a worldwide redistribution of pathogens, vectors and infected hosts, which is setting off novel pathogen–host interactions and triggering new disease complexes. Alongside increases in trade, transport and travel, land-use and climate changes also play roles in these processes. This section assesses general trends in the international trade of animal products that are *not* directly related to disease risk (FAO, 2012a). Among other features, the data presented highlight the recent and continuing surge of Brazil as a global player that is responding more vigorously than other countries to the rapidly expanding global demand for animal-source food.

Increases in exports usually occur in countries with officially confirmed and carefully monitored disease-free status and the absence of disease agents that are notifiable to the World Organisation for Animal Health (OIE) (possible exceptions are discussed under State). The trade volumes considered are for the late 1980s (1987–1989), the late 1990s (1997–1999) and the late 2000s (2007–2009). While official trade figures do not always reflect the precise volumes of animals or animal products exchanged among countries (Box 1), they do provide insights into the main directions of trade among countries and into the onset and extent of major surges in trade volumes.

World *poultry meat* exports have increased dramatically over the last two decades, mainly from the United States of America and, more recently, Brazil, which are currently the two most significant global players (Figure 18). Worldwide, total poultry meat export volumes increased by 520 percent between the late 1980s and the late 2000s, from 2.2 to 13.6 million tonnes/year. In 2007–2009 the United States of America and Brazil together accounted for 55 percent of total global trade. Brazil supplies a rapidly growing number of countries in Asia, the Near East, Europe and Africa, accounting for 27 percent of global trade in poultry meat.

BOX 1

INFORMAL LIVESTOCK TRADE BETWEEN ETHIOPIA AND SOMALIA

Official livestock trade statistics do not record informal trade. For example, a brief on informal cross-border livestock trade between Ethiopia and Somalia, issued in 2012 by FAO, argues that this trade provides a critical source of livelihood support for millions of people, with pastoral communities, traders and intermediaries exchanging 2 to 3.5 million head of ruminant livestock a year (FAO, 2012b). Informal cross-border trade is defined as the movement of goods in which part of the trading activity is unrecorded or unrecognized by the government, and that is carried out without adherence to the procedural requirements of formal institutions. Cross-border livestock trade in the Horn of Africa represents one of the largest movements of live animals for export in the world, with Ethiopia–Somalia cross-border trading as the oldest and most vibrant channel (Figure 17). Clan-based networks support complex trade operations in an environment of civil strife, confiscations, livestock theft, violent attacks and harassment. Risk of the spread of transboundary animal diseases is one of the many issues to be addressed.

From the late 1980s to the late 2000s, world *pig meat* exports rose by 207 percent, from 3.8 to 11.8 tonnes/year (Figure 19). The main exporters are the European Union 15 (EU15)[5] group of countries, the United States of America, Canada and, more recently, Brazil. During this period, pig meat imports into developing countries increased from 0.3 to 2.1 million tonnes/year – a staggering 700 percent.

Global trade in *bovine meat* used to be dominated by Australia, New Zealand, the United States of America and the EU15 countries. India and Latin American countries, particularly Brazil, Argentina, Uruguay and Paraguay, have increased their roles in this trade more recently (Figure 20). From the late 1980s to the late 2000s, exports from Latin America increased by 280 percent, accounting for 31 percent of global trade.

Global *dairy* trade used to be dominated by the EU15 countries, with Australia, New Zealand and the United States of America joining recently (Figure 21). Developing countries generally face growing dairy deficits.

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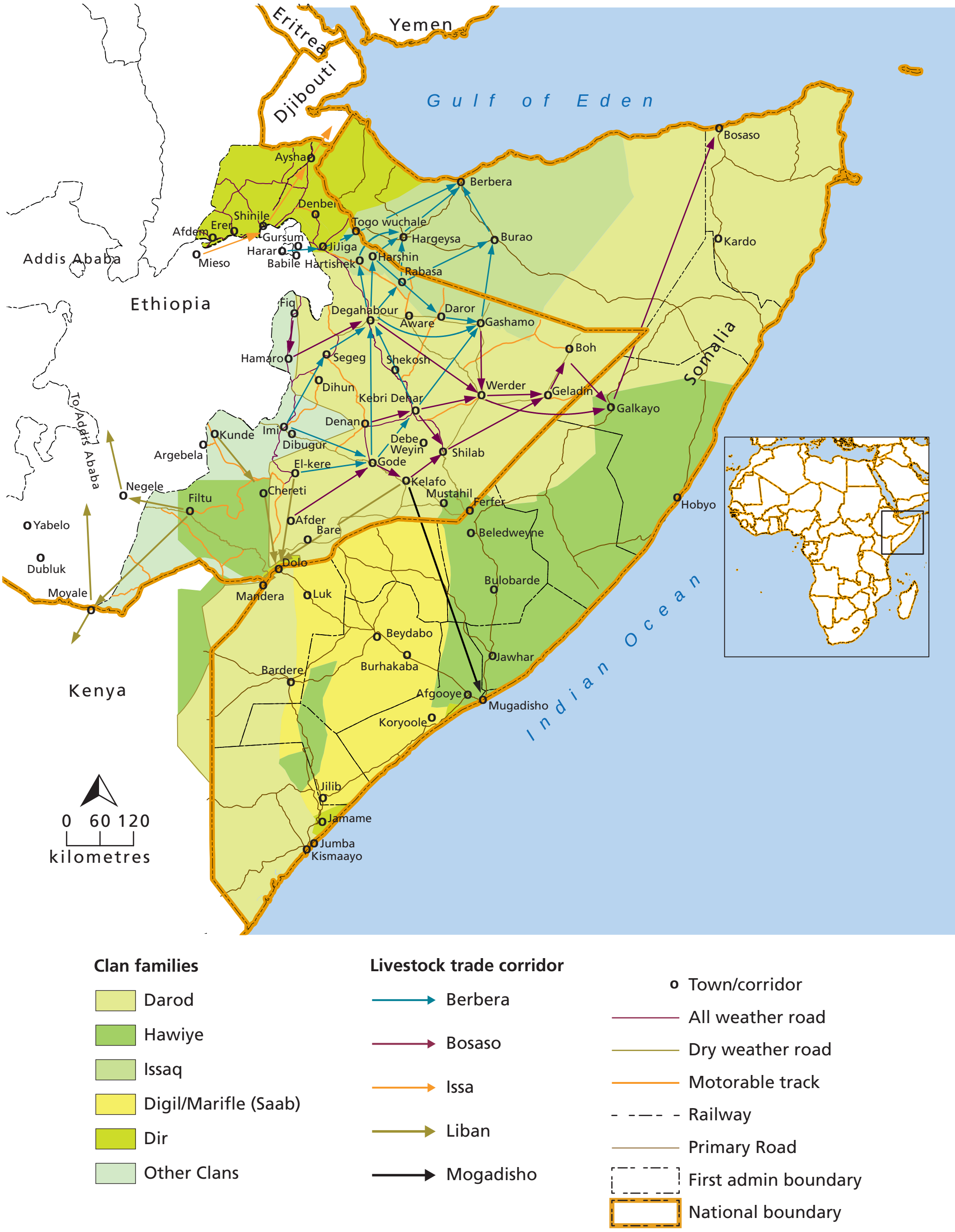
Increases in export volumes of livestock products do not normally imply increased risk of international disease spread. Experience shows that bulk shipments of primary livestock products dispatched from territories or compartments certified as free from notifiable infectious animal diseases carry relatively low risks, providing that adequate risk management protocols are in place. The same cannot be said of the international trade in live animals.

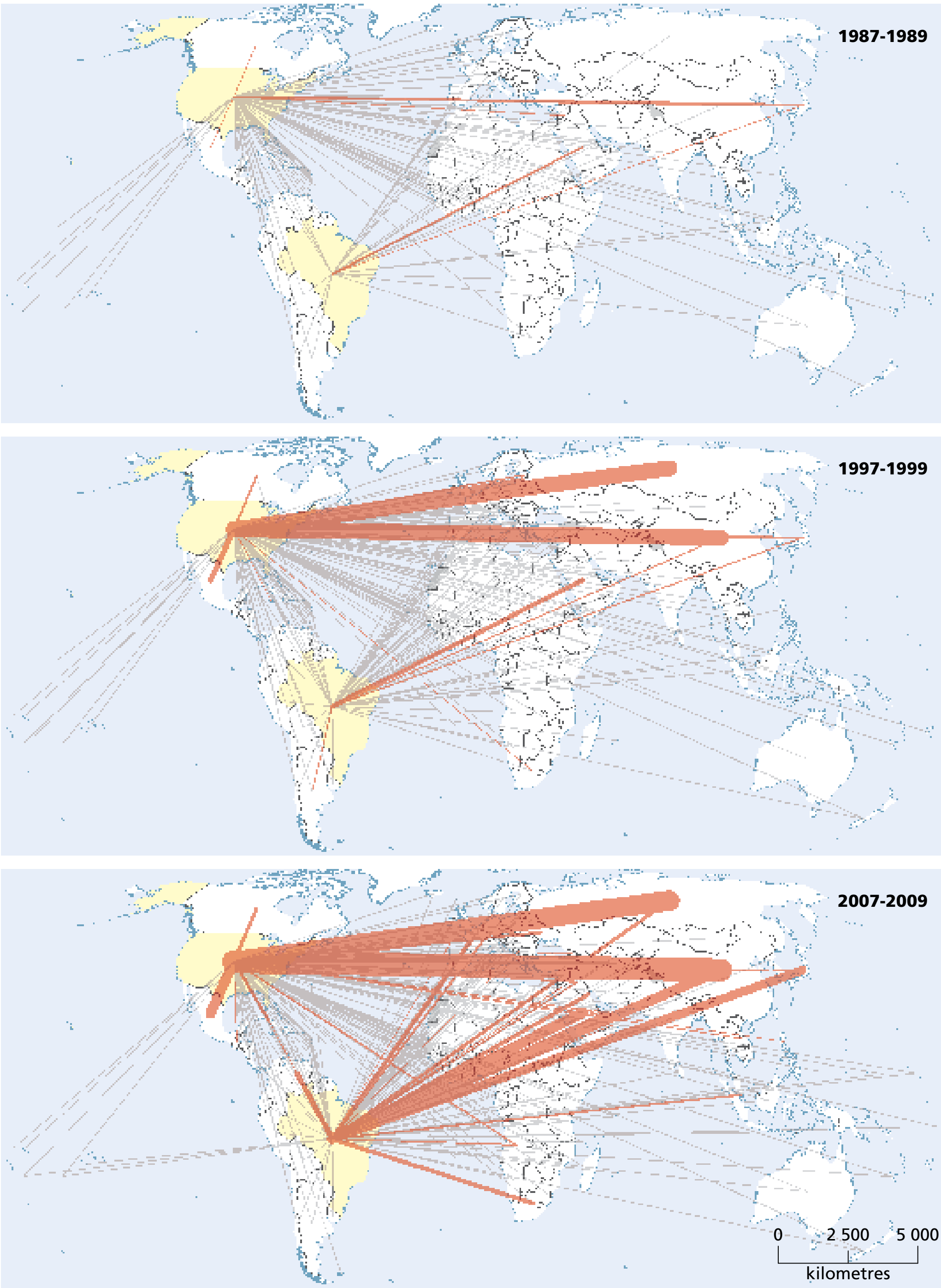
[5] Prior to the accession of 13 more countries, the EU15 member countries were Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom of Great Britain and Northern Ireland.

17 LIVESTOCK TRADE CORRIDORS BETWEEN ETHIOPIA AND SOMALIA



Source: FAO, 2012b.

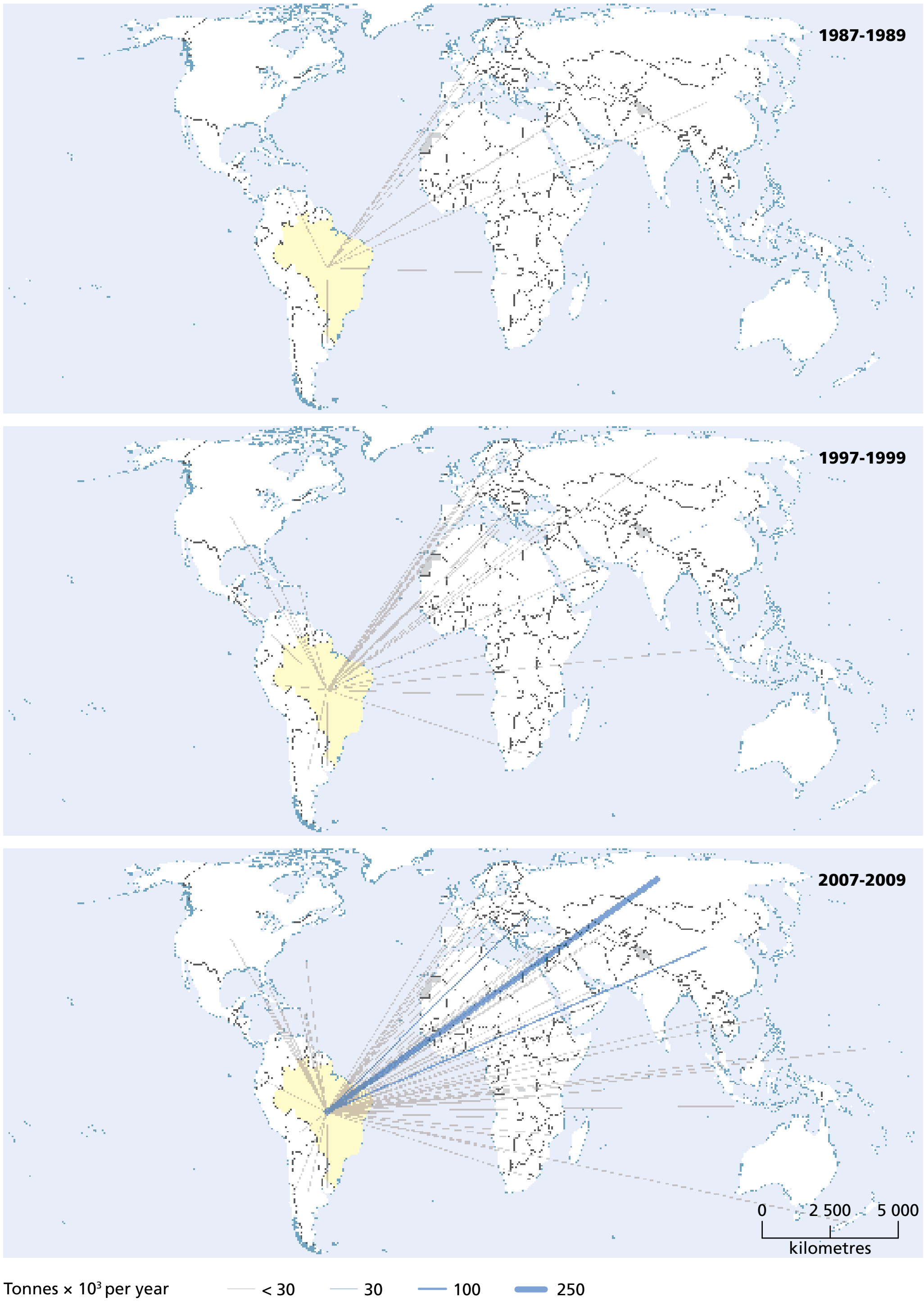
18 EXPORTS OF POULTRY MEAT FROM BRAZIL AND THE UNITED STATES OF AMERICA



Tonnes × 10^3 per year — < 30 — 30 — 100 — 500 — 1 000

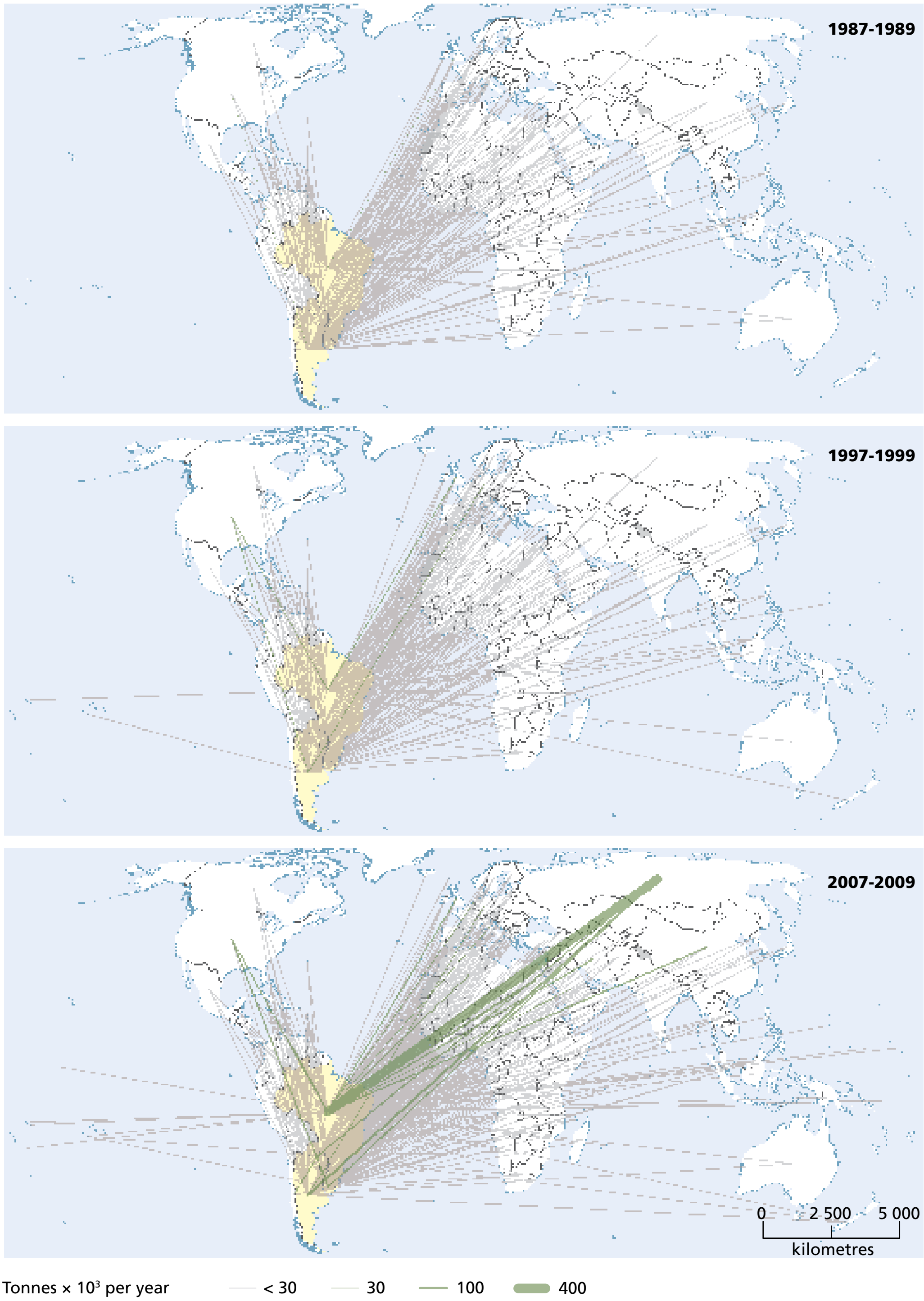
Source: FAOSTAT.

19 EXPORTS OF PIG MEAT FROM BRAZIL



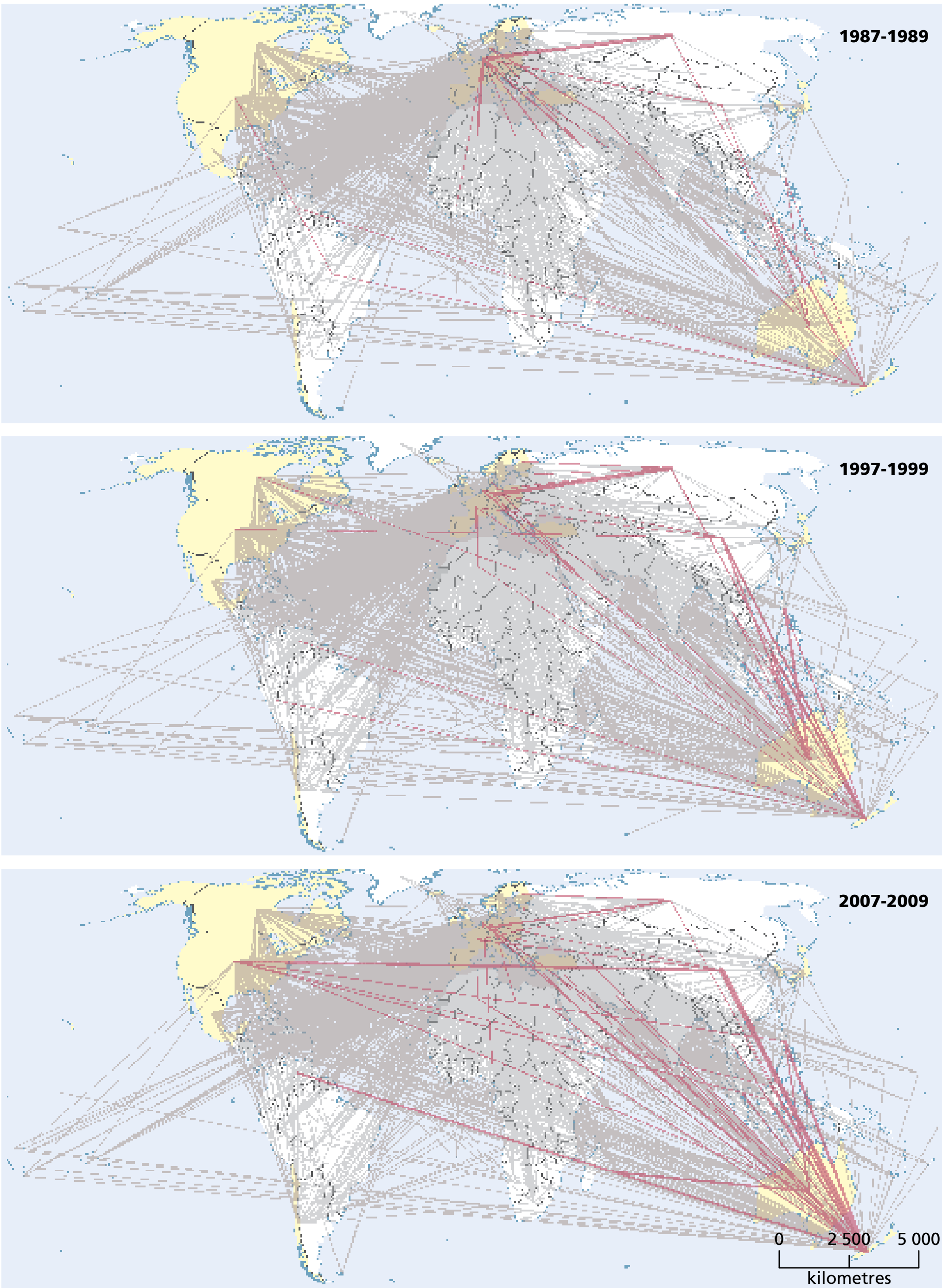
Source: FAOSTAT.

20 EXPORTS OF BOVINE MEAT FROM ARGENTINA, BRAZIL, PARAGUAY AND URUGUAY



Source: FAOSTAT.

21 EXPORTS OF DAIRY PRODUCTS FROM OECD COUNTRIES TO NON-OECD COUNTRIES



Tonnes × 10^3 per year — < 30 — 30 — 100 — 200

Source: FAOSTAT.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In addition, the ongoing globalization of livestock production, animal feed and food supply, makes biological (and chemical) contamination increasingly difficult to manage. This challenge is compounded by the increased international spread of vector-borne animal and zoonotic diseases, resulting from climate change, land-use change and other factors (Kilpatrick and Randolph, 2012). Recent and ongoing bio-invasions include Chikungunya, Japanese encephalitis, bluetongue, Schmallenberg and West Nile viruses (de La Rocque *et al.*, 2011). Many introductions occur inadvertently through trade of pathogen-contaminated feed or food, infected arthropod vectors or hosts.

OIE is responsible for setting animal health standards to support safe and fair livestock trade practices. FAO follows global disease dynamics, designs animal disease prevention and control campaigns, and addresses biosafety concerns in the food chain. FAO/WHO *Codex Alimentarius* develops harmonized international food standards, guidelines and codes of practice to protect the health of consumers and ensure fair practices in international food trade. OIE and Codex support science-based risk assessment in veterinary public health. WHO international health regulations are designed to protect public health and provide a framework for the reporting and management of all events that may constitute a public health threat of international concern. FAO, OIE and WHO invest in building the capacity of member countries to detect, assess, notify and respond to animal health, food safety and public health threats.

International trade statistics usually reflect supply–demand balances between countries, and differences in domestic production and consumption. The presence of disease may pose an obstacle to trade because clinical disease lowers production efficiency and competitiveness and the presence of disease often precludes the provision of export licences. The history of disease control and elimination documents the differential livestock development pathways of rich and poor countries. For example, in most European countries, the livestock sector and public veterinary authorities have engaged in the progressive and ultimately successful control of major high-impact infectious animal diseases; since the nineteenth century, the diseases eliminated across Europe are rinderpest and contagious bovine pleuropneumonia in cattle and sheep, goat pox in small ruminants and glanders in horses. The creation of disease-free areas has paved the way for increased livestock production, encouraging further investment in animal health, food safety and regulation of livestock trade.

Developing countries, which are also plagued by tropical parasitic and protozoan diseases, are at a multiple disadvantage in implementing progressive disease control. Global rinderpest eradication, achieved in 2011, is a striking exception, resulting mostly from the efforts of countries in Africa and Asia. Rather than procuring nationwide disease freedom, livestock industries in developing countries have started to create safe havens for intensive animal production, where bioexclusion regimes are applied within demarcated production zones and/or production plants and food supply chains. Such compartmentalization is gaining importance. For example, Brazil created a globally significant livestock industry in the southern part of the country, generating bulk quantities of poultry products, pork and beef.

Major dairy trade deficits leading to imports are building up across the developing world, while dairy industries in developed countries feature mainly large-scale, high-tech production, processing and supply systems. For various reasons, partly related to disease risks, *large-scale*, intensive dairy production is only very gradually gaining importance in developing countries, which explains the growing dairy import quantities into these countries. In contrast, *smallholder* dairy development is rapidly gaining importance, particularly in South Asia and East Africa. The prospects of a country or region becoming self-sufficient in animal-source food supply, therefore, vary with the livestock subsector concerned, the extent of pathogen circulation, the farming system and the food commodity.

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Climate change

GHGs trap sunlight, thereby warming the planet. While the basic premise of global warming has a solid foundation in fundamental physical chemistry, the precise effects of emissions on climate and weather, and the consequences of these effects, remain difficult to establish. In its latest report issued in September 2013,[7] the Intergovernmental Panel on Climate Change (IPCC) warns that the warming of the climate system is unequivocal, and that many of the changes observed since the 1950s are unprecedented for periods that range from decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea levels have risen, and concentrations of GHGs have increased. Each of the last three decades has been successively warmer on the earth's surface than any preceding decade since 1850. In the Northern Hemisphere, 1983–2012 was likely the warmest 30-year period of the last 1 400 years (medium confidence). Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90 percent of the energy accumulated between 1971 and 2010 (high confidence). Over the last two decades, the ice sheets of Greenland and Antarctic have been losing mass, glaciers have continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent (high confidence). The atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased to levels unprecedented in at least the last 800 000 years. Carbon dioxide concentrations have increased by 40 percent since pre-industrial times, primarily from fossil fuel emissions and secondarily from increased net emissions resulting from land-use change.

Climate, land-use and biodiversity changes need to be considered together. The main pressures driving biodiversity loss include land-use change (e.g., due to agriculture), the expansion of commercial forestry, infrastructure development, human encroachment, and fragmentation of natural habitats, as well as pollution and climate change. Climate change is projected to become the fastest growing driver of biodiversity loss by 2050, followed by commercial for-

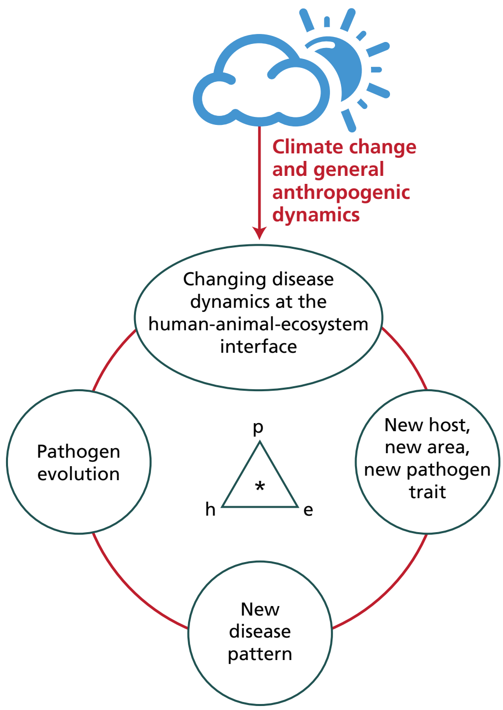
[7] www.climatechange2013.org (accessed 22 October 2013)

estry and, to a lesser extent, bioenergy croplands (OECD, 2012). Declining biodiversity threatens human welfare, especially of the rural poor and indigenous communities, whose livelihoods often depend directly on biodiversity and ecosystem services.

Livestock are increasingly recognized as: i) a main contributor to climate change; ii) a (potential) victim of climate change; and iii) an entry point for mitigating climate change. Overviews of livestock's role in climate change are contained in FAO's 2009 *State of food and agriculture report* (FAO, 2009) and in *Tackling climate change through livestock* (FAO, 2013b). Livestock contribute to climate change by emitting GHGs, either directly from enteric fermentation, or indirectly from deforestation and other activities related to feed production. GHG emissions arise from all the main steps in the livestock production cycle. Emissions from feed crop production and pastures are linked to the production and application of chemical fertilizers and pesticides, to soil organic matter losses and to transport. When forest is converted to pasture and feed cropland, large amounts of carbon stored in vegetation and soil are released. In contrast, when good management practices are implemented on degraded land, pasture and cropland can turn into net carbon sinks, sequestering carbon from the atmosphere. At the farm level, methane and nitrous oxides are emitted from enteric fermentation and manure. In ruminant species (cattle, buffaloes, goats and sheep), microbial fermentation in the rumen converts fibre and cellulose into products that the animals can digest and utilize. The animals exhale methane as a by-product of this process. Nitrous oxides are released from manure during storage and spreading, and methane is also generated when manure is stored in anaerobic and warm conditions. The slaughtering, processing and transportation of animal products also cause emissions, mostly related to the use of fossil fuel and the development of infrastructure.

It is likely that some of the greatest negative impacts of climate change on livestock will be felt in grazing systems in arid and semi-arid areas. Exacerbated drought conditions reduce forage and range productivity and may contribute to overgrazing and land degradation. In general, reduced rainfall and increased frequency of drought and other extreme weather events tend to enhance conflicts over scarce resources and affect food security, particularly of pastoral communities. Tackling climate change through improving livestock husbandry and animal health is likely to offer social, environmental and public health benefits. South Asia's total livestock-related GHG emissions are at the same level as those of North America and Western Europe, but its animal-source food production is only half; South Asia's ruminants contribute a correspondingly large share of GHG emissions because of their emission intensity per

22 EFFECTS OF CLIMATE CHANGE ON DISEASE EMERGENCE



* pathogen - host - environment interplay

unit of product. The same is true of ruminants in sub-Saharan Africa.

Climate change has diverse influences on disease behaviour and ecology. Climate change alters temperature, humidity and seasonality, including the onset of spring and/or the duration of the rainy season, thus affecting the interplay of hosts, vectors and pathogens. Climate change, together with land-use changes and globalization, contributes to a global redistribution of disease complexes. The spread of disease may be at the local level and into adjacent areas, such as when a disease-competent vector starts to populate higher altitudes, or it may result from introduction into new environments and across geographic barriers, aided by air and sea transport. The effects of climate change on disease and the health status of people, livestock and wildlife have an almost infinite number of possible outcomes (Figure 22).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Health systems

The extent of disease occurrence in humans and animals is largely a function of the quality of the health systems in place. The malfunctioning of a health system is invariably costly and affects humans, livestock and wildlife. Malfunctioning health systems are a major pressure, keeping countries vulnerable to disease introduction, spread and persistence. In developing countries, scarce resources are allocated preferentially to addressing emergencies and acute problems, thereby neglecting the more chronic and endemic disease burden. WHO has categorized the more prominent neglected tropical diseases, many of which are zoonotic (WHO, 2010). Suboptimal health systems are not restricted to the developing world. Establishing more effective, proactive health systems that involve collaboration across sectors and disciplines, and making use of advances in biomedical science and informatics are tasks to be tackled by all countries. This section outlines the evolution of animal health services in sub-Saharan Africa since the 1980s, reporting on failures and successes. The importance of science-based risk management that reflects the broad, sustainable development-related interests of concerned communities is stressed.

A major transformation of public veterinary services took place in sub-Saharan Africa during the 1980s, responding to the call from funding agencies, particularly the World Bank, for structural adjustment and leaner government. The resulting squeeze on public expenditure drastically affected the public veterinary services. Annual vaccination campaigns that had been routinely carried out against anthrax and blackleg were progressively discontinued. A vast network of thousands of dip tanks for controlling and preventing ticks and tick-borne diseases across much of East and Southern Africa ceased to function. One of the main purposes of this dip tank network was to contain East Coast fever (ECF), a high-impact disease in cattle caused by a protozoan blood parasite. Dip tanks not only aided the control of ticks and tick-borne diseases, but also provided a convenient gathering site for livestock owners bringing their cattle for vaccination or other purposes. As an alternative to dip tanks, an ECF immunization and treatment scheme was introduced. Also during the 1980s, countries started to phase out tsetse fly control. During the 1960s and 1970s, tsetse control based on insecticidal campaigns using both ground and aerial spray had been widespread in Angola, Botswana, Cameroon, Kenya, Mozambique, Nigeria, Uganda, Somalia, Zambia and Zimbabwe, with variable degrees of success. From the early 1980s, the donor community started to finance environmentally friendly, odour-baited devices, requiring minimal quantities of non-residual insecticide in the form of synthetic pyrethroids.

Today, ECF treatment and control schemes are restricted in scale and scope and carried out by the private sector, normally with support from non-governmental organizations (NGOs). ECF continues to pose a major health constraint, mainly in dairy cross-breeds in mountainous East Africa and the Lake Victoria basin, from where the disease has recently spread into South Sudan. Tsetse-transmitted trypanosomosis continues to be a serious obstacle to livestock production, particularly in the cotton belt of West Africa and the mixed crop–livestock farming areas on the Ethiopian highlands. Curative and preventive trypanocidal drugs are widely used to protect cattle against African animal trypanosomosis (AAT), but they are costly and, where frequently applied, select for chemoresistant trypanosomes. Counterfeit drugs are another issue of major concern, particularly in places without animal health services. A study coordinated by FAO and involving four AAT-affected countries in sub-Saharan Africa revealed that 50 percent of the trypanocides sold openly in the market were not up to standard (Tettey *et al.*, 2002). Drug failure is common in countries where quality control and assurance mechanisms and regulation are inadequate.

In hindsight it may be argued that most of the campaigns against ECF and tsetse-transmitted trypanosomosis were costly and not very effective, and perhaps did not serve the interests of rural communities. Although dip tanks provided a very useful meeting point for a range of livestock-related activities, large-scale dip tank

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operations involved massive quantities of acaricides, with vigorous development of tick resistance. However, when the dip tank infrastructure abruptly collapsed in Zimbabwe in the late 1970s, about 2 million head of cattle, kept mostly by smallholder farmers, reportedly died of tick-borne diseases (Norval, Perry and Young, 1992). Upsurges of tick-borne diseases were attributed to the development of susceptibility to tick-transmitted diseases among cattle that had been kept free from ticks for extended periods – continual tick exposure secures a state of premunity, with cattle becoming regularly infected without suffering major clinical disease. This "living with disease" approach traditionally adopted by rural communities clashed with the need for rigid tick control on commercial beef ranches with susceptible cross-breeds (Norval, Perry and Young, 1992).

Tsetse control also failed to bring the hoped for results. Following a donor ban on DDT ground spraying, and given donors' reluctance to support repeated applications of insecticides via air spray campaigns, bait techniques were widely introduced as an alternative solution. Odour-baited, insecticide-impregnated targets relied on synthetic pyrethroids with low mammalian toxicity but high efficiency against the tsetse fly – a far more environmentally friendly practice. Tsetse traps were also used, requiring no insecticide and enabling a "do-it-yourself" approach in tsetse control. However, despite

BOX 2

RINDERPEST ERADICATION FROM AFRICA

Rinderpest was first introduced into Africa from Asia in the mid-1850s (in Egypt) and then again in the late nineteenth century in Abyssinia (today's Eritrea and Ethiopia), causing a continental-scale pandemic within ten years, with more than 90 percent mortality in cattle and artiodactyl wildlife species, including large antelopes, warthogs and bushpigs (Ford, 1971). During the twentieth century, the disease turned endemic in cattle populations throughout the pastoral areas of sub-Saharan Africa, causing recurrent epidemics in contiguous agropastoral and sedentary populations (Roeder and Taylor, 2002). A coordinated vaccination programme, the JP 15 Campaign, was implemented from 1962 to 1976 with major success. However, the apparent disappearance of rinderpest from large areas of Africa, and expectation of its eventual demise if vaccination were continued led to complacency. Residual reservoirs of infection in the Greater Horn of Africa, and presumably also elsewhere, became the source of resurgence once disease control efforts waned with the withdrawal of donor support. The discontinuation of vaccination, and underreporting by veterinary services of a progressive rinderpest upsurge paved the way for major epidemic waves. The impact on agricultural and rural development was severe and eventually became a major concern, to both the affected countries and the international development assistance community.

The Pan-African Rinderpest Campaign (PARC) was implemented to bring rinderpest back under control. The subsequent, internationally coordinated Pan African Programme for the Control of Epizootics (PACE) focused on the eradication of rinderpest from Africa, along with the control of other high-impact livestock diseases such as contagious bovine pleuropneumonia and African swine fever (ASF), while streamlining veterinary services. To eradicate rinderpest from persisting foci in Africa it was necessary to cease vaccination in a timely manner and install strong vigilance systems based on clinical recognition and reporting and serological surveillance to determine virus circulation in younger cattle populations (which had not received vaccination by veterinary brigades in the previous months or years). These efforts supported the detection of and rapid response to any indication or upsurge of rinderpest activity. At this stage, continued vaccination would have hidden evidence of any virus circulation (Roeder, 2011). The elimination of remaining pockets of rinderpest virus therefore required a carefully managed strategy using the profound epidemiological insight and performance indicators developed by veterinary services and campaign managers.

African rinderpest eradication efforts were an integral part of the Global Rinderpest Eradication Programme (GREP) launched by FAO in 1992. GREP resulted from a broad international expert consultation and turned into an interagency alliance, facilitating global planning and coordination. Ingredients for the success of GREP were vision and political will, increasingly proficient veterinary services, an army of dedicated community animal health workers, broad-based stakeholder support, direct consultation with the pastoral communities concerned, confirmation of the technical feasibility of rinderpest eradication, quality vaccine production, supportive zoosanitary legislation, and productive, sustained regional and international collaboration.

Area-wide, single-target disease campaigns are indicated whenever and wherever the situation is conducive to progressive control of remaining high-impact diseases. Technical feasibility and economic viability are prerequisites for success. However, the current reality suggests that risk scenarios are increasingly complex and heterogeneous because of coevolving extensive and intensive livestock production systems, which may complicate the total elimination of disease agents.

large-scale introduction, these schemes were not successful or sustainable, and were discontinued; fly suppression did not translate into a proportional decrease of disease transmission, and tsetse flies showed high resilience, recovering from a near collapse of the population within a few years.

During the 1980s, research funding from the International Laboratory for Research on Animal Diseases to support the development of improved vaccines against ECF and AAT was progressively withdrawn. The rationale was that ECF and AAT, being protozoan diseases (as is malaria), presented too difficult a target for vaccine development in the short to medium term.

Despite these failures, a major success story gradually unfolded – the progressive elimination of rinderpest, implemented by increasingly proficient, effective and streamlined veterinary services (Box 2). Rinderpest eradication shows that major success is within reach, provided the right policy and science are in place.