Rinderpest experience

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Summary
Rinderpest, the most dreaded disease of cattle, originated as far back as the domestication of cattle, occurring in Asia more than 10,000 years ago. It has been the main preoccupation of Veterinary Service activities for many centuries and was the major motivation for establishing the first veterinary school in Lyon, France, in 1761. Gaining control of the disease was the impetus for the founding of many regional and international organisations (including the World Organisation for Animal Health). Outbreaks of rinderpest have led to food shortages and starvation, economic losses and poverty, social unrest, and disrupted transport networks in regions where agriculture was dependent on draught cattle. The rinderpest virus, causative agent of the disease, has also been used as a biological weapon in the past. Many regional rinderpest eradication campaigns have been implemented, including Joint Project 15; the Pan-African Rinderpest Campaign (PARC); the South Asia Rinderpest Eradication Campaign; the West Asia Rinderpest Eradication Campaign; and the Pan African Programme for the Control of Epizootics. All of these campaigns were supported by regional and international organisations, and the disease was finally eradicated in 2011. The benefit of PARC in terms of the value of avoided losses in cattle products due to the decrease in the disease's occurrence was estimated to be between 581,000 and 35,433,000 European currency units. Currently, the world is prepared to prevent the deliberate or accidental release of the remaining infectious rinderpest virus material which exists in research and diagnostic facilities across the world.

Keywords
Biological weapon – Cattle – Cattle plague – Eradication – Impact – Outbreak – Rinderpest.

Introduction

Rinderpest, or cattle plague, is renowned as the most dreaded of cattle diseases. It is classified as one of the transboundary animal diseases which has the potential to spread rapidly with very serious consequences; and with mortalities as high as 100% in susceptible herds, resulting in serious socio-economic consequences (1). The disease is therefore of major importance in the international trade of animals and animal products.

In all languages, the name given to the disease reflects its devastating nature in cattle. It is a classic plague; hence the name – cattle plague. English, German, French and Spanish refer to this disease as the terrible pest of cattle, that is: rinderpest, *Rinderpest*, *peste bovine* and *peste bovina*. In Kiswahili, it is called *sotoka*, meaning a debilitating killer disease of cattle (2). In Bambara, it is called *bérébila*, meaning 'losing the cattle stick'.

Scott and Provost (cited in [3]) describe rinderpest as 'the most dreaded bovine plague known, belonging to a select group of notorious infectious diseases that have changed the course of history… from its homeland around the Caspian Basin, rinderpest, century after century, swept west over and around Europe and east over and around Asia with every marauding army, causing the disaster, death, and devastation that preceded the fall of the Roman Empire, the conquest of Christian Europe by Charlemagne, the French Revolution, the impoverishment of Russia and the colonization of Africa'. This is a devastation that continued well into the 20th century (3).

In the early 20th century, control of the disease was the major preoccupation of Veterinary Service activities, and in many countries it was the prime reason for the establishment of Veterinary Services and indeed for the founding of the veterinary profession. It was, for instance, one of the major motivations behind establishing the first veterinary school in Lyon, France, in 1761, a precedent that was followed by other European countries. It was also the impetus for the founding of both the World Organisation for Animal Health (OIE), in 1924, and the Food and Agriculture Organization of the United Nations (FAO) in 1945 (2, 3).

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In Africa, the first veterinary school was founded in Egypt in 1827 as a result of the effects of an epidemic of rinderpest. In 1951, the Interafrican Bureau for Animal Resources (AU–IBAR) was established with the responsibility to eliminate rinderpest from Egypt and sub-Saharan Africa (W.N. Masiga, personal communication). In India, the Indian Veterinary Research Institute was established in 1913 with the objective of producing a vaccine against rinderpest (2, 3).

Finally, the Pan African Veterinary Vaccine Centre of the African Union (AU–PANVAC) began operating in 1986 in response to the need for good quality vaccines for the control of rinderpest in Africa (4).

Historical perspective

Rinderpest is thought to have originated as far back as the domestication of cattle, which was occurring in Asia, probably in the region of the Indus River, 10,000 years ago. The disease spread ubiquitously across the planet through the movement of soldiers and animals in warfare and trade of cattle in Europe and eventually Africa. Moreover, for centuries, rinderpest epidemics deprived people of meat, milk and a means of tilling the land, which led to hunger and starvation, while decimating wildlife populations (3).

Historically, rinderpest was registered in 114 countries located in every continent (5).

Europe

Rinderpest was spread in Europe through the movement of soldiers and animals during military campaigns from as early as the 4th century until well into the 20th century. The invasion of the Huns into Europe in 370 resulted in an outbreak of a highly contagious disease suspected of being rinderpest. Pandemics of rinderpest were brought by the Mongol invasions of Western Europe, the first in 1222 with two further incursions occurring in 1233 and 1238. The latter pandemics were introduced into England with trade cattle imported from mainland Europe according to Scott 1996 (cited in [2]).

Throughout the centuries, rinderpest pandemics have raged across Europe from the Mediterranean and the Levant in the south to Scandinavia in the north, and from Ireland in the west to Russia in the east. For many centuries, no European country was consistently free of rinderpest. A particularly severe European pandemic of cattle plague evolved over several years in the early 18th century and extended from Western Europe to Moscow and south to Italy. According to Spinage (2003), the outbreak of rinderpest in 1709 caused even greater terror in humans than the Black Death from which the populations of Europe were only just recovering (cited in [3]). This catastrophe was matched by another pandemic that lasted for a decade from 1745 throughout Europe. These epidemics and pandemics set the pattern for Europe well into the 19th century until rinderpest's eventual eradication in 1908 (3).

Asia

A major resurgence of rinderpest throughout eastern and South-East Asia was recorded during the Second World War (3).

Long known as a devastating disease in China, during the period from 1938 to 1941, more than 1 million cattle died from rinderpest in western China, and the disease occurred widely in that country from 1948 to 1949. Agricultural development could not occur while rinderpest was causing such serious losses; therefore the new Chinese Government in 1948 made the disease's elimination a priority. Success came rapidly with China being outbreak-free since 1955 and vaccination ceasing permanently in 1956 (3).

In Mongolia, China's neighbour to the north, the first official recording of rinderpest was in 1910, at which time annual losses approximated 120,000 cattle and yaks. Repeated reinvasions of the disease, controlled by movement restrictions and immunisation, were noted in the 1930s and 1940s. From the 1950s, the country remained free of the disease until 1992/1993, at which time locally restricted outbreaks of rinderpest occurred on both sides of the Mongolian and Russian border (3).

The first outbreak of rinderpest in Japan is considered to have occurred in 1872. However, a study (2) revealed that records from the Edo period (1603–1867) mention the acute deaths of over 500,000 cattle in 1637–1642 in the Nagato region of the country and concluded that this was the first recorded instance of rinderpest in Japan. It was followed by a new outbreak in the same region between 1672 and 1673.

The aforementioned 1872 outbreak continued until 1873 and probably occurred due to the importation of either live cattle or infected hides from China from 1869 to 1871. Although the invasions of rinderpest in Japan continued to occur in the 20th century, the last cases were recorded there in 1924, while in Korea the last case was recorded in 1931 (2).

In the Indian subcontinent, however, reports of rinderpest occurrence only became frequent in the late 18th century and, increasingly, into the 19th century (3).

Despite heroic attempts at instituting mass vaccination programmes, for many decades from 1913 (following the

establishment of the Indian Veterinary Research Institute), little progress was made in eliminating the infection in the region until the 1990s (3).

Its neighbour, Pakistan, was severely affected by rinderpest throughout most of the 20th century with major upsurges being suppressed by vaccination. The last such dramatic epidemic occurred in 1994 and the last cases of rinderpest in the country were detected in small farms near Karachi in October 2000 (2, 3).

To the west, rinderpest repeatedly swept into Iran from its neighbours, causing great losses. From 1969 to 1973, a particularly severe pandemic in the Near East swept from Afghanistan through Iran to the Mediterranean littoral and into the Arabian Peninsula, invading virtually every country in its path. Another wave of rinderpest engulfed Iraq from 1985. It was the result of 600 affected Indian dairy buffaloes entering the country through the port of Basra (or possibly via Kuwait). The buffaloes were distributed widely in Iraq and caused a countrywide virgin epidemic, killing at least 30,000 buffaloes (3).

Until the mid-1990s, the persistence of rinderpest in pockets of the Arabian Peninsula was augmented by periodic reintroductions from India and Pakistan. The disease appears to have been endemically established in Saudi Arabia during the 1970s and 1980s. However, the last reintroductions in the peninsula seem to have been into Qatar and Saudi Arabia, most likely through the United Arab Emirates, in 1996. In the same year, the last of the rinderpest introductions into Oman occurred through imported Pakistani fighting bulls.

Rinderpest was reintroduced into Yemen in 1971 and generated an epidemic that persisted for many years with fluctuating incidence. The last recorded outbreaks occurred at the turn of 1994/1995 and the virus ceased to circulate after 1997 (2, 3).

Africa

Rinderpest was first introduced onto the African continent in 1841 when domestic cattle in Egypt were infected by cattle imported from Romania, thereby setting off the first great African rinderpest pandemic which killed 75% of Egypt's cattle and buffaloes.

South of the Sahara, rinderpest first appeared in Ethiopia in 1884, again through cattle imports, this time from India. In 1888 and 1889, the disease spread southwards, covering almost all of Ethiopia as well as neighbouring Somaliland, Kenya, Sudan and Uganda. By the end of 1892, an estimated 90% of the cattle population of Ethiopia had been lost (including wildlife), while Uganda lost an estimated 95% of its total cattle population of 400,000.

From East Africa, rinderpest appears to have spread to West Africa between 1885 and 1886, and to South Africa in 1896. In West Africa, rinderpest outbreaks were a constant threat from 1886 to 1960. Although the creation of Veterinary Services and the development of new vaccines during this period gave added protection and reduced damage to cattle, the spread of rinderpest to other parts of Africa continued to kill cattle and wildlife. As the numbers of infected cattle increased, efforts by national governments, in cooperation with international organisations, to control rinderpest intensified (4, 6).

Residual reservoirs of infection in the Senegal River Basin of Mauritania and Mali, and in the Greater Horn of Africa, were the source of the rinderpest resurgence of the second great African rinderpest pandemic that wreaked havoc throughout the sub-Sahelian zone in the early 1980s (W.N. Masiga, personal communication; 7).

Americas and Australia

The Americas and Australia have recorded only one outbreak each of rinderpest. The first occurred in 1920 in Brazil and the second in 1923 in Australia.

Impact of rinderpest

Rinderpest was responsible for a variety of socio-economic dislocations, particularly in Africa, Asia and the Near East. The disease is considered to be one of the most dangerous animal infections, causing mass destruction. Death rates during outbreaks were usually extremely high and mortality rates could reach 100% in immunologically naïve populations. Outbreaks have led to food shortages and starvation, economic losses and poverty, social unrest, and disrupted transport networks in regions where agriculture was dependent on draught cattle. Limited studies are available on the economic impact of rinderpest or on cost–benefit analyses of attempts to control the disease.

Direct economic impact

An epidemic in the 1890s wiped out 80–90% of all cattle in sub-Saharan Africa. More recently, another rinderpest outbreak that raged across much of Africa between 1982 and 1984 is estimated to have cost at least US$ 500 million (W.N. Masiga, personal communication).

In Nigeria, between September 1980 and June 1984, a total of 1,155 rinderpest outbreaks were recorded causing the exposure of 8,444,743 cattle, the illness of 1,951,208 cattle and the death of 451,279 cattle (Table I) (6).

Table I
Summary of rinderpest outbreaks in Nigeria (1980–1984)

Year	No. of outbreaks reported	No. of cattle exposed	No. of cattle which fell ill	No. of cattle which died and were slaughtered
1980 (Sept.–Dec.)	20	5,661	906	478
1981	11	3,258	831	437
1982	55	23,248	1,901	826
1983	972	7,961,453	1,849,160	418,327
1984 (Jan.–June)	97	451,123	98,410	31,211
Total	**1,155**	**8,444,743**	**1,951,208**	**451,279**

Impact on food security and social stability

In regions that depend on cattle for meat, dairy products and draught power, rinderpest has caused widespread famine and has inflicted serious economic and political damage.

The Great Famine of the 1880s in Ethiopia is believed to have lasted from 1888 to 1892. In reference to the plague, Pankhurst states: 'at all events the rinderpest of 1888, which was very probably of a variety then little known in the country, appeared with unusual virulence and spread like wildfire soon affecting almost all parts of Ethiopia as well as much of the neighbouring Somali country to the south…. Livestock mortality undoubtedly reached immense proportions' (cited in [8]). While Fesseha went on to say that 'the loss of cattle, especially oxen that are used for plowing, brought agricultural activity to a halt, paralysing and devastating the national economy by depleting capital (oxen and seed). The high number of cattle carcasses on the land created a fertile ground for unhygienic conditions and infectious diseases. Smallpox, typhus, cholera and influenza epidemic[s] decimated the population... The malnourished and overworked bodies of the peasants were unable to combat the combination of hunger and epidemic[s]. It is estimated that one third of the population perished from hunger and epidemic[s]. The unusually high number of animal carcasses and the human bodies brought vultures and the wild animals out of the forest. The weak had to fight hunger, illness, hyenas, lions, and leopards and found themselves at the losing end' (8).

The effect of rinderpest contributed to the expansion of the tsetse fly, found primarily in central and western African countries and later expanding to the east and south. The tsetse fly affects humans and animals causing destruction to countless lives. The effect on the human population was so great that the economic framework of many nations failed, causing disruption in the social structure (3; W.N. Masiga, personal communication).

Economic and social impacts of rinderpest control

The most widely cited study in the context of the Pan-African Rinderpest Campaign (PARC) was conducted in Africa by Tambi *et al.* (7). The authors conducted a cost–benefit analysis of a subset of ten of the 27 PARC countries (namely Benin, Burkina Faso, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Mali, Senegal, Tanzania and Uganda) for the period of 1989 to 1997. The principal benefits were defined as the physical losses avoided by reducing the incidence of rinderpest, which included the loss of meat and dairy products, draught labour and manure. Avoided losses due to rinderpest control were estimated as the difference between the losses incurred with PARC and those that would have been expected to occur without PARC. The total production savings due to PARC were estimated at 125,597 tonnes of beef, 39,003 tonnes of milk, 13,893 tonnes of manure and 86,000 hectares of animal traction (Table II). The value of avoided losses (benefits) in cattle products varied from 581,000 European currency units (ECU) in Benin to ECU 35,433,000 in Ethiopia (Table III).

John Omiti and Patrick Irungu, on request from the AU–IBAR, undertook a study to evaluate the costs and benefits of rinderpest eradication from Ethiopia and Kenya (9). The study's key findings are discussed below.

The total benefits of rinderpest eradication from Ethiopia and Kenya were US$ 951.3 million and US$ 433.97 million, respectively. In Ethiopia, the largest proportion of these benefits (65%) was contributed by PARC through gains from beef production. In Kenya, the largest proportion of the benefits (43.7%) came from the Pan African Programme for the Control of Epizootics (PACE), the successor to PARC, mainly due to its effect on milk production. In both countries, the net present values were large and positive, indicating that rinderpest eradication generated substantial returns to both economies. Over all, rinderpest eradication contributed 2.4% and 0.5% to the Ethiopian and Kenyan economies, respectively. PARC-Ethiopia had the highest

Table II
Quantity and value of losses in cattle products due to rinderpest in ten sub-Saharan African countries: 1989–1997

Product	Quantity of losses			Value of losses (in ECU)		
	With PARC	Without PARC	Avoided losses	With PARC	Without PARC	Avoided losses
Beef (tonnes)	18,262	143,859	125,597	10,814,000	91,813,000	80,999,000
Milk (tonnes)	10,781	49,784	39,003	2,515,000	14,121,000	11,606,000
Animal traction (ha)	11,831	98,291	86,460	397,000	6,607,000	6,210,000
Manure (tonnes)	387	14,280	13,893	10,000	374,000	364,000
Total				**13,736,000**	**112,915,000**	**99,179,000**

ECU: European currency units
PARC: Pan-African Rinderpest Campaign

Table III
Value of losses in cattle products due to rinderpest in ten countries of sub-Saharan Africa, 1989–1997, in European currency units

Country	Losses incurred with PARC	Losses incurred without PARC	Avoided losses (benefits)
Ethiopia	7,070,000	42,503,000	35,433,000
Tanzania	2,433,000	15,560,000	13,127,000
Mali	35,000	10,643,000	10,608,000
Uganda	2,076,000	12,494,000	10,418,000
Burkina Faso	25,000	7,862,000	7,837,000
Senegal	26,000	6,997,000	6,971,000
Côte d'Ivoire	29,000	6,762,000	6,733,000
Kenya	2,001,000	6,228,000	4,227,000
Ghana	24,000	3,268,000	3,244,000
Benin	18,000	599,000	581,000
Total	**13,737,000**	**11,2916,000**	**99,179,000**

PARC: Pan-African Rinderpest Campaign

contribution (1.5%) to Ethiopia's economy, while PACE-Kenya had the highest contribution (0.18%) to Kenya's economy. Rinderpest eradication expanded the final demand for livestock products in the rest of the economy. In Ethiopia, this amounted to US$ 457,594.80, while in Kenya the final demand expanded by US$ 231,379.30. Rinderpest eradication also increased the household incomes of livestock keepers in Ethiopia and Kenya by US$ 366,352.30 and US$ 2,822.80, respectively.

Felton and Ellis evaluated the economic consequences of the rinderpest vaccination campaign in Nigeria (cited in [7]). Using mortality losses avoided, improved reproductive rate and improved productivity in meat and milk as benefits, a discounted cost–benefit ratio of 2.48 and an internal rate of return of 4.8% were estimated.

Owing to the devastation caused by the ravages of rinderpest, many of the Fulanis of West Africa committed suicide.

Rinderpest virus as a potential biological weapon

Rinderpest is categorised as a biological weapon of mass destruction, the use of which has recurred throughout history, killing hundreds of millions of cattle (5).

According to Scott (2000), rinderpest was probably the first agro-biological weapon ever to be employed. He stated that 'the secret weapons of the invaders were Grey Steppe oxen. Their value was a strong innate resistance manifested by slow spread of virus and by the absence of clinical signs. A troop of Grey Steppe cattle could shed rinderpest virus for months provoking epidemics that devastated buffalo and cattle populations of invaded countries. The sequelae were no transport, untilled fields, starving peasants, and overthrown governments' (cited in [2]).

Files also revealed that, during the Second World War, the United Kingdom developed secret biological weapons, which included the rinderpest virus.

Other impacts of rinderpest control

In addition to macro-level impacts, rinderpest control provided a number of micro-level impacts. These included the particularly important impact of livestock's role in pastoral settings as a source of wealth and as a means of social cohesion. Catley *et al*. (2005) report a number of positive micro-level benefits resulting from rinderpest control, including significant increases in milk production, improved human health, an increase in the population of sheep and goat flocks of 40% (attributable to the rinderpest control programme), and a decline in cattle mortality rates, attributed to the programme, of 39–72% (cited in [3]).

Rinderpest control and eradication

Europe

Strict enforcement of zoosanitary procedures in Europe saw the disease defeated early in the 20th century, including in European Russia, west of the Ural Mountains, by 1908. This region has stayed rinderpest free, apart from upsurges after the First World War, thought to have taken place in Poland, and rapidly dealt with introductions into Belgium in 1920 and the Rome Zoological Gardens in 1950 (2).

Asia

The first major campaigns aimed at eliminating rinderpest began in Asia as the world recovered from the Second World War. In addition to a coordinated effort that saw rinderpest eliminated by an FAO-supported regional programme backing national efforts across South-East Asia, two major national campaigns stand out. The first took place in China in 1951, and by 1955 had achieved rapid success. However, it was not until 2008 that China was accredited by the OIE as being free of rinderpest. The other major national campaign that stands out was on the Indian subcontinent, and took almost 50 years to achieve its target (2, 3).

India mounted a valiant effort to eliminate rinderpest for almost the whole of the 20th century. The disease was repeatedly pushed out of the northern part of the subcontinent only to resurge periodically, as it did in the 1950s and 1980s. The last infection was finally eliminated in 1995 (2).

India's neighbour Bangladesh appears to have been free from rinderpest as early as 1958, while Nepal, after being invaded by rinderpest from India between 1952 and 1989, has been free of the virus since 1990. Finally, Bhutan has remained free of rinderpest infection since 1969 (2, 3).

International campaigns against rinderpest

Joint Project 15

The first major programme for the eradication of rinderpest in Africa was initiated at a meeting held in Kano, Nigeria, in May 1961, by the Co-ordinating Committee for Technical Co-operation and the Foundation for Mutual Assistance in Africa. Known as Joint Project 15 (JP15), the programme was financed by aid from various international and individual country sources. The aim of JP15 was to eradicate rinderpest from Africa through a continent-wide vaccination campaign, using low-cost vaccines to confer lifelong immunity to cattle (7).

The JP15 programme was implemented in several phases within West and Central Africa. Phase I of JP15 was implemented in West and Central Africa from 1962 to 1965 and covered Cameroon, Chad, Niger and Nigeria, an area in which cross-border cattle trade was increasing. Based on reports of outbreaks in Nigeria, Niger and other countries to the west, Phase II of the programme was extended westward to cover Dahomey (now Benin), Ghana, Upper Volta (now Burkina Faso), Togo and parts of Mali and the Ivory Coast (now Côte d'Ivoire). Phase III of JP15 covered the remainder of Mali and the Ivory Coast, Chad, the Gambia, Guinea, Liberia, Mauritania and Sierra Leone during the period from 1966 to 1969. The remaining three Phases (IV, V and VI) were implemented in East Africa. Phase IV was implemented between 1968 and 1971, and involved Kenya, southern Somalia, Sudan, Tanzania and Uganda. Phase V between 1970 and 1973 involved Ethiopia and the rest of Somalia, and finally Phase VI, between 1973 and 1976, again covered Ethiopia and Sudan.

The JP15 campaign cost an estimated US$ 16.4 million. It was evident at the end of the programme that the campaign had not only succeeded in reducing mortality rates during outbreaks, but it also promoted the development of Veterinary Services which could undertake other major disease control and eradication programmes. However, JP15 did not achieve the aim of rinderpest eradication (W.N. Masiga, personal communication). After this success in the 1970s, more than half of the countries in Africa that participated in JP15 started reporting increased numbers of rinderpest outbreaks during the early and mid-1980s.

Pan-African Rinderpest Campaign

As the renewed resurgence and spread of rinderpest throughout Africa became increasingly evident in the early 1980s, concern over control of the disease motivated the establishment of PARC in 1986 under the aegis of the African Union–Interafrican Bureau for Animal Resources (W.N. Masiga, personal communication).

In 1986, PARC was launched as a continent-wide campaign against rinderpest and its main objective was to control and ultimately eradicate rinderpest from the continent. The agreement for the implementation of PARC was signed in July 1986 between the European Economic Community and the Organization of African Unity/IBAR. In 1986, activities began in five countries where rinderpest had spread extensively, namely: Burkina Faso, Ethiopia, Mali, Nigeria and Sudan. Emergency activities followed in 1987 in Togo, Kenya and Uganda (7).

The PARC programme was also divided into phases and after these preliminary interventions, Phase 1 of PARC commenced in 1988/1989 with funding amounting to ECU 50 million. The project was renewed and Phase II of PARC began in 1990, ending in 1994/1995, with funding for the phase totalling ECU 7.5 million. The project entered Phase III in 1994/1995, and ended in March 1999 with the remaining funds for this phase being received from the European Development Fund (3; W.N. Masiga, personal communication).

After 12 years of programme implementation, PARC effectively addressed the problem of rinderpest in Africa. As of 1999, the region had been free from the disease for over ten years; the last outbreak being reported in July 1988 on the border between Ghana and Burkina Faso (3; W.N. Masiga, personal communication).

At the end of PARC in 1999, the rinderpest virus was known to still be circulating in Africa but only in southern Sudan and north-west Kenya as well as in southern Somalia and north-east Kenya; a remarkable achievement (3; W.N. Masiga, personal communication).

Pan African Programme for the Control of Epizootics

The evaluation of PARC in 1996 recommended the continuation of the programme in order to maximise the gains made and to facilitate the stamping-out of rinderpest from remaining foci. This culminated in the formation of the Pan African Programme for the Control of Epizootics coordinated by AU–IBAR with funding from the European Union (9). The PACE project ran from 1999 to 2006 in 32 countries and provided epidemiological and strategic expertise to address the ongoing problem of rinderpest in the Somali pastoral ecosystem (the border between Ethiopia, Kenya and Somalia). It did this by setting up the Somali Ecosystem Rinderpest Eradication Coordination Unit and by accrediting all other Member Countries with freedom from rinderpest.

PACE was terminated in 2006, at which point rinderpest was no longer circulating in wild or domesticated hosts in Africa (3; W.N. Masiga, personal communication).

Asia Rinderpest Eradication Campaign

In the Middle East, concern grew in the 1970s over the economic consequences of rinderpest. These consequences were not limited to mortalities but also involved the disruption of trade by the imposition of quarantine, the cost of vaccinations and other control measures, the cost of disease surveillance and the negative effect of the continual threat of the disease. Consequently, the Third Conference of the Arab Ministers of Agriculture of the States of the Gulf and Arabic Peninsula held in Qatar in 1978 requested the Near East Regional Animal Production and Health Project (MINEADEP) to prepare a plan for the eradication of rinderpest. Even though this aim was not achieved, all Member States intensified vaccinations within their borders in order to limit the spread of the disease. In 1984, the MINEADEP meeting of the heads of veterinary departments held in Baghdad proposed the implementation of a regional rinderpest control and this resulted in the United Nations Development Programme (UNDP) project, the West Asia Rinderpest Eradication Campaign (WAREC), which was drawn up in 1986 and implemented in 1989 involving 12 countries. The project cost US$ 21 million.

In South Asia, India witnessed an unexpected increase in cases of rinderpest in 1982. This prompted an FAO expert consultation meeting in Izatnagar, India, in 1983, to recommend the formation of the South Asia Rinderpest Eradication Campaign (SAREC). The project cost US$ 230 million with the affected countries contributing US$ 182 million.

The FAO participated in coordinating the all-India campaign 'Operation Rinderpest Zero', which was established in early 1990.

International coordination of rinderpest eradication

Conceived in 1992 and operational in 1993, the Global Rinderpest Eradication Programme (GREP) has operated under the auspices of the FAO Animal Health Service's Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases to provide a coordination mechanism and source of technical guidance since 1994. The initial concept of GREP was that rinderpest-control activities would proceed with international coordination on three fronts: PARC in Africa, WAREC funded by UNDP, and SAREC. The latter was never implemented although the European Commission did fund a number of national projects in India, Bangladesh, Nepal and Pakistan that contributed significantly to the South Asian rinderpest eradication process (3).

Accreditation of rinderpest freedom

One of the most difficult elements of the rinderpest eradication process to manage when aiming to verify

rinderpest freedom was making the transition from mass vaccination to surveillance. In 1989, the OIE convened an expert group on rinderpest surveillance systems in Paris, which produced a document entitled 'Recommended Standards for Epidemiological Surveillance Systems for Rinderpest'. This document was subsequently adopted by the OIE, becoming part of the rinderpest chapter of the *Terrestrial Animal Health Code*, and was later referred to as the OIE Pathway. This pathway, which is a three-step process (provisional freedom, freedom from disease and freedom from infection), constitutes a series of verifiable epidemiological objectives against which progress towards eradication can be measured. This measurement can occur over a period of six to seven years from the last case detected, or four to five years from cessation of vaccination. It served very well as a template for countries to follow until 2007, when the accreditation process was amended to a two-year process of surveillance, taking into account the changed global status of rinderpest.

As success was achieved in freeing countries from rinderpest, GREP worked closely with the OIE, becoming increasingly active in encouraging and assisting countries in completing the accreditation process (3). This resulted in global eradication of the disease being achieved in 2011.

Conclusion

Since 1991, rinderpest eradication programmes have protected tens of millions of livestock keepers, particularly pastoralists whose cattle are their main livelihood assets, from experiencing major losses in milk, meat and hide production, and in household income. The programme has also protected Africa's wildlife population.

In 2011, the world was declared free from rinderpest. However, potentially infectious rinderpest virus material remains widely disseminated among research and diagnostic facilities across the world and poses a potential risk for disease recurrence should it be released. Therefore, all stakeholders are urged to collaborate closely with the OIE and FAO in order to maintain the world's freedom from rinderpest and to avoid activities that may lead to the virus's deliberate or accidental release.

L'expérience de la peste bovine

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Résumé

La peste bovine, la plus redoutable des maladies bovines, existe depuis l'époque reculée de la domestication des bovins, puisqu'elle est apparue en Asie il y a plus de dix mille ans. Au fil des siècles, cette maladie a été une préoccupation centrale des services en charge de la santé animale et a été le motif principal de la création de la première école vétérinaire, à Lyon (France) en 1761. L'ambition de maîtriser la peste bovine a participé de l'élan qui a vu naître nombre d'organisations régionales et internationales (dont l'Organisation mondiale de la santé animale). Les épidémies de peste bovine ont entraîné des pénuries alimentaires et des famines, des pertes économiques et une pauvreté accrue, une instabilité sociale et l'effondrement des réseaux de transport dans les régions où l'agriculture dépendait des bovidés de trait. Le virus responsable de la peste bovine a également été utilisé en tant qu'arme biologique dans le passé. De nombreuses campagnes d'éradication de la peste bovine ont été mises en œuvre à l'échelle régionale, parmi lesquelles le Projet conjoint 15, la Campagne panafricaine de lutte contre la peste bovine (PARC), la Campagne d'éradication de la peste bovine en Asie du Sud, la Campagne d'éradication de la peste bovine en Asie occidentale et le Programme panafricain de contrôle des épizooties. Ces campagnes ont toutes reçu le soutien d'organisations régionales et internationales et la maladie a finalement été éradiquée en 2011. Les bénéfices du programme PARC en termes de pertes de production évitées dans le

secteur bovin grâce au déclin de l'incidence de la maladie ont été estimés entre 581 000 et 35 433 000 ECU (unité de compte européenne). Aujourd'hui, le monde est prêt à prévenir toute libération délibérée ou accidentelle des stocks restants de produits contenant le virus de la peste bovine détenus dans différents établissements de recherche et de diagnostic répartis dans le monde.

Mots-clés
Arme biologique – Bovins – Éradication – Foyer – Impact – Peste bovine.

La experiencia de la peste bovina

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Resumen
Los orígenes de la peste bovina, que es la más temida de las enfermedades del ganado vacuno, se remontan a la domesticación de los bovinos, que se dio en Asia hace más de 10 000 años. Durante muchos siglos ha sido una de las grandes preocupaciones que han guiado el trabajo de los Servicios Veterinarios, y fue uno de los principales factores que motivaron la fundación de la primera escuela de veterinaria en Lyon (Francia) en 1761. El objetivo de llegar a controlar la enfermedad fue el acicate que llevó a la creación de numerosas organizaciones de ámbito regional e internacional (entre ellas la Organización Mundial de Sanidad Animal). Los brotes de peste bovina han causado episodios de escasez de alimentos y hambruna, pérdidas económicas, pobreza y disturbios sociales, sin olvidar la desorganización de las redes de transporte en regiones donde la agricultura dependía del ganado de tiro. En el pasado el virus de la peste bovina, agente causal de la enfermedad, también ha sido utilizado como arma biológica. Numerosas campañas regionales de erradicación de la peste bovina han visto la luz, entre ellas el llamado Proyecto Conjunto 15, la Campaña panafricana contra la peste bovina (PARC), la Campaña de Erradicación de la Peste Bovina en Asia Meridional, la Campaña de Erradicación de la Peste Bovina en Asia Occidental y el Programa Panafricano de Control de Epizootias. Gracias a todas estas iniciativas, respaldadas por organizaciones regionales e internacionales, en 2011 la enfermedad quedó por fin erradicada. Según las estimaciones, basadas en el valor económico de las pérdidas de productos ganaderos evitadas gracias a la reducción de los casos de enfermedad, la PARC deparó entre 581 000 y 35 433 000 Ecus (unidades de cuenta europeas) de beneficios. En la actualidad el mundo está preparado para evitar toda liberación accidental o deliberada de las muestras infecciosas de virus de la peste bovina que aún se conservan en centros de investigación y diagnóstico de todo el planeta.

Palabras clave
Arma biológica – Brote – Erradicación – Ganado – Peste bovina – Repercusión.

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