Ridding the world of rinderpest

Key fact:

Through a combination of scientific expertise and international collaboration and co-ordination, the eradication of the rinderpest virus (cattle plague) can be viewed as an achievement on par with the eradication of smallpox from the human population, the only other time an infectious disease has been eradicated.

Summary:

Concerted effort by national veterinary services in both industrialised and developing countries, aided by international organisations, has brought the once dreaded rinderpest livestock disease to the point of extinction. In its severest form, rinderpest is capable of killing up to 95 per cent of the animals it infects. However, the development of new vaccine technologies, community-based health delivery and disease searching techniques and diagnostic tools over the last 20 years has helped to protect the livelihoods of the livestock-dependent rural poor in developing countries and avoid massive financial losses in terms of milk, meat, and animal traction.

Rinderpest free cattle in Omdurman, Sudan *(Peter Roeder)*

Since 1990, rinderpest control 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, hide production, and household income. Concurrently the control and eradication of rinderpest has also protected Africa's wildlife population, as evidenced by the recovery of wildebeest numbers in East Africa following the removal of rinderpest from local cattle populations.

Facts & figures[1]

- Rinderpest has affected cattle since they were domesticated 10,000 years ago.
- Symptoms include fever, discharges from the eyes and nose, bloody diarrhoea, severe dehydration and in most cases, death within 7-10 days.
- Europe was particularly badly affected by rinderpest during the 18th Century (1709-1720, 1742-1760, and 1768-1786). In Britain, this led to the first attempts to regulate livestock trade.
- Goat-adapted live vaccines made a major impact on rinderpest in the first half of the 20th Century in both Africa and Asia.
- The vaccine developed by Walter Plowright in the 1950s, using the new in vitro techniques for growing viruses, and for which he received many accolades, including the World Food Prize in 1999, was a major factor in making adequate stocks of vaccine available and thereby accelerating rinderpest control.
- In southern Sudan, vaccination and disease surveillance was carried out by community-based animal health workers. These stock owners used a new heat stable vaccine to vaccinate over 4 million cattle between 1993 and 1995. As a result, confirmed outbreaks dropped from 11 in 1993 to one in 1997.
- Rinderpest was detected and confirmed for the last time in Asia (Pakistan) in 2000 and in Africa, in Kenya, in 2001.
- Some 157 countries have been, or are about to be, declared rinderpest free by the OIE and action is in place to finalise the process in the ten or so countries remaining.
- 2011 will mark the culmination of the eradication effort when it is hoped that global freedom from rinderpest will be declared.

Ridding the world of rinderpest

Rinderpest, or cattle plague as it is known in English, is renowned as the most dreaded of cattle diseases, on more than one occasion, changing the course of history. Present since cattle were first domesticated, rinderpest increasingly inflicted devastating losses on livestock populations as the human population grew and, with it, the importance of farmed livestock. Africa remained free of the disease until the 1890s. But in little more than two years, the disease killed more than 90 per cent of cattle, buffalo and related wild animal species from the Horn of Africa down to the Cape. The impact in Ethiopia alone was the loss of a third of its human population.

Rinderpest symptoms *(Tim Leyland)*

Related to the human measles virus, rinderpest not only affects ruminants and swine, but also ungulate wildlife, which can act as a short-lived reservoir for the disease. For communities reliant on ruminant livestock for meat, milk, skins, draught power and manure, the impact of rinderpest is always severe. However, coordinated efforts in both developed and developing countries over many decades, along with the development of an effective vaccine, have brought this disease to the point of extinction.

The first breakthrough in developing an effective vaccine dates back more than 100 years when scientists in Russia and South Africa in the 1890s, discovered that a combination of immune serum (serum taken from a recovered animal) and virulent blood from an infected animal would give long-term immunity. Despite the risk of infecting animals, the use of this method, in combination with quarantine of infected premises, successfully eliminated rinderpest from southern Africa by 1905 and Europe by 1928.

New and improved vaccines continued to be developed throughout the 20th Century, but it wasn't until the late 1950's that Walter Plowright, working at the East African Veterinary Research Organisation in Kenya, developed a novel live attenuated tissue-culture vaccine. The first vaccine that did not cause lesions or fever, it was also effective in all breeds and ages of cattle. The only disadvantage was that the vaccine had to be kept at a low temperature, which tended to constrain its use in remote areas of Africa and Asia.

Testing blood samples *(Andy Catley)*

A further breakthrough was achieved in the late 1980s when scientists developed a heat-stable vaccine formulation of Plowright's vaccine, which could be stored at ambient temperatures for up to four weeks. This proved particularly useful in areas lacking cold chain facilities. As vaccine production was scaled-up, countries began to implement large-scale eradication campaigns. However, while some countries were able to eradicate the disease alone, international cooperation and coordination was generally required to assist many developing countries in their eradication efforts. Co-ordination for the final eradication of rinderpest from Africa was provided by the African Union-backed Pan-African Rinderpest Campaign (PARC). Launched in 1986, PARC took the approach initially of mass vaccination programmes, subsequently leading into focused vaccination programmes to contain the virus within remaining reservoirs, as identified by strengthened surveillance.

Key to this strategy was the use of community-based animal health workers to both detect disease outbreaks and vaccinate against the disease. These workers proved particularly effective in remote and insecure areas where lack of veterinary services for livestock keepers had long been a hindrance to eradication efforts. In southern Sudan, where armed conflict had disrupted cold chains and brought vaccination efforts to a standstill by 1992, animal health workers were able to vaccinate over 4 million cattle between 1993 and 1995. As a result of this vaccination and effective surveillance, confirmed outbreaks dropped from 11 in 1993 to one in 1997, the last case of rinderpest to be confirmed there.

Rinderpest free cattle in Pakistan *(Peter Roeder)*

Coordination of eradication efforts

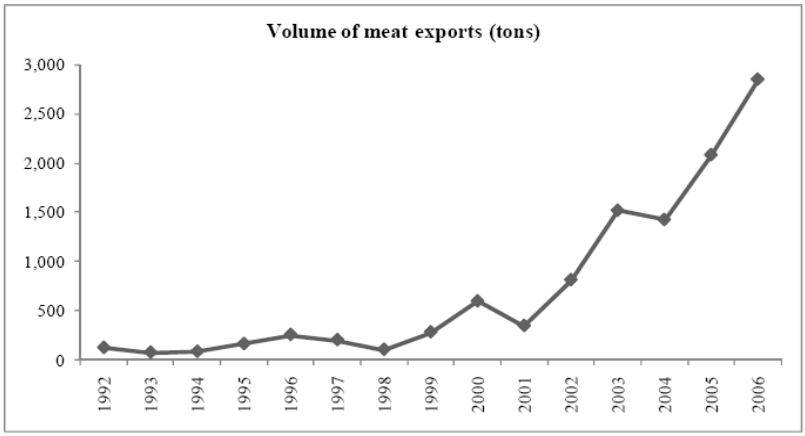
Global coordination was achieved through the Global Rinderpest Eradication Programme (GREP) established under the auspices of the United Nations Food and Agriculture Organization in 1993. Identification of the remaining reservoirs of infection led into internationally coordinated eradication programmes in Africa, West Asia and South Asia. Once free of the disease, national governments were able to undergo a process of official recognition of freedom from rinderpest (termed accreditation). This process was monitored by the World Organisation for Animal Health (OIE) and focussed on surveillance.

Global accreditation is not yet complete, yet there is no reason to suspect the presence of rinderpest in its natural hosts anywhere in the world. Some 157 countries have been, or are about to be, declared rinderpest free by the OIE and action is in place to finalise the process in the ten or so countries remaining. With the last known case of rinderpest detected in Kenya in 2001, the eradication of the disease can be viewed as an achievement on a par with the eradication of smallpox from the human population, the only other time an infectious disease has been eradicated.

Impact

The eradication of rinderpest has prevented the illness and death of millions of livestock, avoiding losses in the production of beef, milk and animal traction which has increased food security, confidence in food production, and trade in livestock and their products. In Pakistan, for example, the declaration of provisional freedom in 2003 allowed export markets to be opened, particularly to the Middle East, which had previously banned imports. As a result, exports tripled within three years.

Exports of beef products from Pakistan, 1992-2006 (tons)



Source: FAO. 2009. FAOSTAT statistical database

Additional case study information

Costs and benefits:[2]

In Africa rinderpest eradication was spearheaded by the Pan African Rinderpest Campaign (PARC). The total cost of the PARC programme was estimated to be €51.6 million. Approximately 123 million cattle were vaccinated, implying an average cost per animal of €0.42. The losses avoided as a result of the programme were estimated at 126,000 tonnes of beef, 39,000 tonnes of milk, 14,000 tonnes of manure, and 86,000 hectares of animal traction. The total value of these avoided losses was estimated at €99.2 million, implying a benefit-cost ratio of 85:1. Internal rates of return based on benefit-cost ratios range from 11 per cent for Cote d'Ivoire to 118 per cent in Burkina Faso. One study estimated that household income in Ethiopia rose by €38.1 million as a result of PARC. This translates into €34 per household per year, which represents a highly significant contribution to family income (frequently less than €300 per year in Ethiopia), and the ability to survive drought and provide education and health care.

The eradication of rinderpest has generated lasting benefits for people's livelihoods and food security. In addition to increasing confidence in food production through cattle and buffaloes, as in Pakistan, trade in livestock and their products from previously infected countries is increasing, with benefits for producers and consumers.

DFID contribution to research:

- DFID and its predecessor the Overseas Development Administration (ODA) have contributed to rinderpest's eradication through funding for research into epidemiological studies, vaccines and diagnostic tests in the UK and overseas, principally through what is now the Institute for Animal Health's Pirbright Laboratory and through support for the East African Veterinary Research Organisation in Kenya.
- ODA supported the development, trialling, production and application of the "Plowright" tissue culture vaccine that has provided the basis of the eradication effort and eventually led Walter Plowright to win the World Food Prize in 1999.
- ODA funding for The Centre for Tropical Veterinary Medicine in Edinburgh made a significant contribution to rinderpest control in the 1960s to 1980s by training the cadre of veterinarians who contributed to the various national and international control programmes.
- DFID was also a key supporter of the African Union's IBAR (Interafrican Bureau for Animal Resources) and its Pan African Rinderpest Campaign (PARC). DFID provided important funding support to the Community-based Animal Health and Participatory Epidemiology (CAPE) Project that helped remove rinderpest from its few remaining remote and insecure strongholds in the Horn of Africa.
- DFID also contributed to the EC-supported Programme for the Pan-African Control of Epizootics (PACE) that established the veterinary capacity to confirm the final removal of the virus from Africa.
- As a significant funder of FAO, DFID directly supported FAO's role in promoting rinderpest control culminating in the Global Rinderpest Eradication Programme.

Research milestones:

- 1890s South African and Russian scientists independently show that immune serum (serum taken from a recovered animal) and virulent blood (blood taken from an infected animal), when given simultaneously, could produce long-term immunity to rinderpest.
- 1905 The "serum-simultaneous" method eliminates rinderpest from southern Africa.
- 1928 The "serum-simultaneous" method eliminates rinderpest from European Russia.

- 1940s Seminal studies in East Africa on rinderpest pathogenesis and epidemiology are started to facilitate setting strategy for eradication.
- Late 1950s Walter Plowright, working at the East African Veterinary Research Organisation in Kenya, develops the tissue culture rinderpest vaccine (TCRV) which produced neither lesions nor fever and was safe and effective for cattle of all breeds and ages and both sexes.
- 1960s and 1970s A number of African countries join forces in an effort called Joint Project 15, to eliminate rinderpest using intensive, internationally coordinated vaccination campaigns.
- 1980s and 1990s Pirbright scientists developed ELISA tests for rinderpest seromonitoring and serosurveillance; technology transfer was supported by the Joint FAO/IAEA Division.
- Late 1980s Scientists develop a variant of Tissue Culture Rinderpest Vaccine, which could be kept at ambient temperatures in the tropics for up to four weeks. This vaccine was widely used to great effect in community-based vaccination programmes in Africa, particularly in remote areas of Sudan, Somalia, Kenya, Ethiopia, Tanzania, and Uganda, as well as in Afghanistan.
- 1986 The continent-wide Pan-African Rinderpest Campaign (PARC) was initiated.
- 1990s Pirbright scientists develop genetic characterisation techniques which enabled molecular epidemiology to revolutionise rinderpest epidemiology.
- 1993 The Global Rinderpest Eradication Programme (GREP) launched under the auspices of the FAO.
- 1993 FAO and OIE develop the concept of the OIE Pathway to guide accreditation of rinderpest freedom on a country-by-country basis.
- 2000 The Programme for the Pan African Control of Epizootics (PACE) builds veterinary surveillance capacity in Africa, and the Community-based Animal Health and Participatory Epidemiology (CAPE) Project supports development of veterinary service delivery and disease surveillance in remote and conflict-prone areas.
- 2000 The last known case of rinderpest detected and confirmed in Asia in Pakistan.
- 2001 The last known case of rinderpest detected and confirmed in Africa in Kenya and rinderpest ceases to circulate in its natural hosts. In effect, rinderpest eradication achieved everywhere in the world.
- 2001-2010 Accreditation confirming eradication of rinderpest continues across Africa and Asia.
- 2011 OIE and FAO expected to formally announce global freedom from rinderpest has been achieved.

Photo credits:

For high res images contact Susanna Thorp (s.thorp@wrenmedia.co.uk)

Multi-media material:

Audio interviews available from Susanna Thorp (s.thorp@wrenmedia.co.uk)

Links:

FAO: www.fao.org/ag/againfo/programmes/en/grep/home.html

Main references:

Roeder, P., and K. Rich, (2009) *Conquering the cattle plague: The global effort to eradicate rinderpest*, in D.J. Spielman and R. Pandya-Lorch (eds.) (2009) *Millions fed: Proven successes in agricultural development*, IFPRI: Washington DC
http://www.ifpri.org/sites/default/files/publications/oc64ch16.pdf

Roeder, P., and K. Rich, (2009) *The global effort to eradicate rinderpest*, IFPRI Discussion Paper 923
http://www.ifpri.org/publication/global-effort-eradicate-rinderpest

Other key references:

Catley, A., T. Leyland, and S. Bishop, (2008) Policies, practice and participation in protracted crises: The case of livestock interventions in South Sudan. In L. Alinovi, G. Hemrich and L. Russo, (eds.), *Beyond relief: Food security in protracted crises*, Practical Action Publishing: Rome, pp. 65-93

Leyland, T., (1996) The case for a community-based approach with reference to southern Sudan. In Food an Agricultural Organization of the United Nations, (eds.) *The World Without Rinderpest.* FAO Animal Production and Health Paper 129, FAO: Rome, pp. 109-120

Roeder, P.L., W.P. Taylor, and M.M. Rweyemamu, (2006) Rinderpest in the 20th and 21st centuries. In Barrett, T., P.P. Pastoret, and W. Taylor (eds.) *Rinderpest and peste des petits ruminants: Virus plagues of large and small ruminants*, Elsevier: Amsterdam

Scott, G.R., and A. Provost, (1992) *Global eradication of rinderpest*. Background paper prepared for the Food and Agriculture Organization of the United Nations expert consultation on the strategy for global rinderpest eradication. Rome, FAO

Tambi, E.N., O.W. Maina, A.W. Mukhebi, and T.F. Randolph, (1999) Economic impact assessment of rinderpest control in Africa. *OIE Scientific and Technical Review* 18(2): 458-477

Taylor, W.P., P.L. Roeder, and M.M. Rweyemamu, (2006) Use of rinderpest vaccine in international programmes for the control and eradication of rinderpest. In Barrett, T., P.P. Pastoret, and W. Taylor (eds.) *Rinderpest and peste des petits ruminants: Virus plagues of large and small ruminants*, Elsevier: Amsterdam

Contacts for further information:

Dr. Juan Lubroth
Chief Veterinary Officer
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome
Italy
Email: juan.lubroth@fao.org

[1] Facts and figures sourced from: Roeder, P., and K. Rich, (2009) *The global effort to eradicate rinderpest*, IFPRI Discussion Paper 923

[2] Roeder, P., and K. Rich, (2009) *The global effort to eradicate rinderpest*, IFPRI Discussion Paper 923

DFID Department for International Development

DFID, the Department of International Development, is the part of the UK government that manages Britain's aid to poor countries and works to get rid of extreme poverty.

WRENmedia on air... on line... in print... in person...

This case study has been commissioned by DFID and produced by WRENmedia, as part of a series demonstrating the impact of DFID's funding to agricultural research. The views expressed do not necessarily reflect the Department's official policies.