

Original Research Article

Rinderpest Global Eradication Management

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Abstract

The global eradication of rinderpest in 2010 ranked as the second in history after the eradication of smallpox in humans in 1980. Rinderpest (in recent history included also among biological weapons of mass destruction) recurred throughout history causing hundreds of millions of animal deaths. It was recorded in 114 countries of all continents. After the World War II it was still reported from 66 countries in Africa and Asia. After all necessary knowledge about rinderpest virus and its circulation became available, along with excellent vaccine as well as enough experience with anti-rinderpest measures, the global eradication programme was launched in 1986 after a long preparatory period. It was composed of three new regional projects including all national anti-rinderpest programmes. The main method consisted in active search, isolation and *stamping out* of all outbreaks combined with mass prophylactic vaccinations and followed by years-long risk-based surveillance. The transfer of research results into practical reality required an extraordinary complex of a highly demanding system of managerial measures. It included analyses of rinderpest occurrence, identification of objectives/deadlines and control methods, planning, ensuring necessary manpower, material and funds, organizing and implementation of coordinating programmes etc. This complex was represented by a managerial pyramid structure of inter-connected components having the basis at rinderpest affected localities and countries and its top at the Animal Health Service, Food and Agriculture Organization of the United Nations as executive agency responsible for technical assistance and global leadership/coordination.

Keywords: anti-epizootic methods, anti-epizootic planning, anti-epizootic organization, biological weapons, disease-free status, disease emergency, epizootiology, managerial pyramid, UN animal health service, financial support.

INTRODUCTION

The rinderpest (caused by a *Morbillivirus*), the most dangerous animal infection included among biological weapons of mass destruction, recurred throughout history¹ killing hundreds of millions of bovines. It hit Europe hard in the 18th and 19th centuries. At the beginning of the 20th century, the disease occurred widely in Africa, Asia and Europe and was responsible for the death of hundreds of millions of cattle, buffaloes, yaks and wild artiodactyls, and for the loss of people's assets, livelihoods and ability to fend off famines. The rinderpest (known also as "cattle plague") was historically registered in 114 countries of all continents.

After the World War II it was reported from the remaining 66 tropical and subtropical countries in Africa and Asia. An enormous number of specific research results, publications, meetings and conferences recommending rinderpest global eradication resulted up to 1986 only in a theory with good intentions. That year the Food and Agriculture Organization of the United Nations (FAO) as a worldwide competent executive agency started the global eradication programme. It was extremely difficult to select from the very rich sources of

available information that made possible to transfer them into practice, i.e. into a realistic time-bound plan and procedures leading to rinderpest global eradication. This required highly complex studies, experiments, epizootiological and economic analyses, selecting realistic control methods and ensuring necessary inputs such as staff, material, funds and managerial system focused on final global eradication. In June 2011, FAO Conference, the highest body of this United Nations' agency adopted the "FAO Declaration on Global Freedom from Rinderpest". The author was present, being invited as former Chief, Animal Health Service, FAO, temporarily responsible for the management of global rinderpest eradication programme. This invitation and the message "FAO highly values your contribution towards the eradication of rinderpest" represent the impulse to write this paper.

MATERIALS AND METHODS

The documents of FAO Animal Health Service (AGAH), responsible for executing global anti-rinderpest management and for practical assistance to member countries, represented

¹ Bible, The Old Testament: Exodus 9: 1-7 "The plague of the cattle" (fifth plague of Egypt) - during pharaohs' nineteenth dynasty (around 13th century B. C.).



Fig. 1. Rinderpest – map of all countries affected (V. Kouba according to OIE WAHID 2009 data)

the main source of data. The protocols from AGAH meetings, international negotiations and expert consultations on rinderpest eradication were of key importance. Other information were found in the yearbooks on animal disease occurrence in “FAO/WHO/OIE Animal Health Yearbook”² and in “OIE World Animal Health” as well as in “OIE World Animal Health Information Database”. Several other FAO publications on rinderpest (1996, 1998, 2011) were used as well.

The papers published in 2011 by Slingenbergh; Chibeu and El-Sawalhy; Kamata; Mathur; Njeumi and Roeder; Sasaki, Rajasekhar, Raja and Hussain; Knop, Miyagishima and Vallat in a special issue of FAO EMPRES Bulletin³ on rinderpest eradication represented important global and continental historical data on anti-rinderpest actions. Among many papers on rinderpest monitoring the contribution of Mariner et al. (2003) was of major importance.

Personal information of AGAH virologists who were in charge of the rinderpest projects, i.e. Y. Ozawa and K. J. Wojciechowski, represented another source of useful data. Finally, the author’s own experience was used (Kouba, 2003 and 2012). Numeric data for global cost/benefit analysis were unfortunately not available.

History of rinderpest control

The development of rinderpest control had a long history. A more or less passive approach consisted in *stamping out* of outbreaks and cattle movement control complemented after the World War II by specific vaccination in the areas under specific risk. *Stamping out* consisted in sanitary slaughtering of specifically diseased and suspected animals. Mass vaccination using attenuated tissue culture vaccine developed in the 1950s by W. Plowright and R.D. Ferris had an extraordinary role. About 3 billion doses were administered to animals. Fixing the 2010 deadline for global eradication of rinderpest was possible only after having proved that its virus stops circulating among wild animals several years after eradicating individual outbreaks in domestic cattle and buffaloes living in the same zone. Identifying limits of rinderpest territories, all outbreaks and zones under specific risk required extensive clinical and serological monitoring in domestic and wild animal populations of susceptible species.

Global eradication of rinderpest represented a complex of difficult-to-solve problems being multiplied by the fact that every case was different under different conditions requiring different application of anti-rinderpest principles.

² The author as its Editor-in-Chief was regularly evaluating rinderpest occurrence in the world and introduced reports on “Pan African Rinderpest Campaign” and on “West Asia Rinderpest Eradication Campaign”.

³ EMPRES: “Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases”

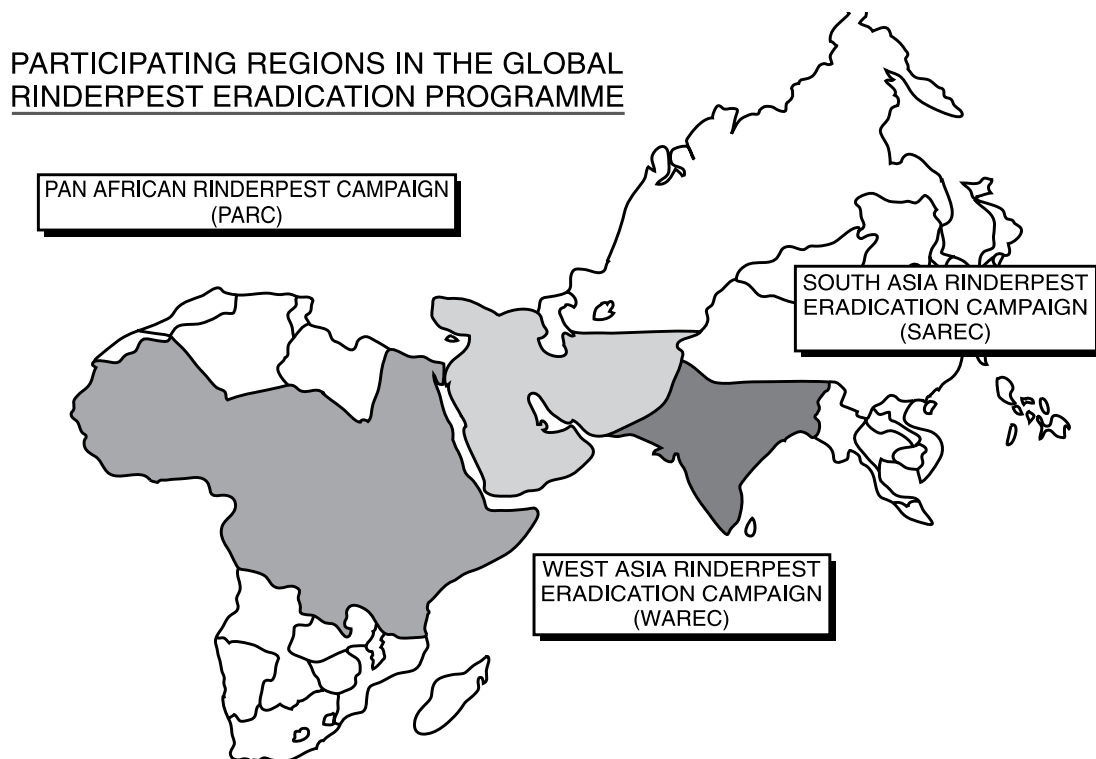


Fig. 2. Rinderpest – map of global eradication programme in 1986 (FAO archive)

Not only the rinderpest territorial occurrence and spreading tendency must be considered but also the size and space distribution populations of susceptible of animal species. Influencing factors such as ecological, economic, social and political conditions as well as public, government and support of donors must be considered as well. The degree of demandingness was multiplied by the fact that the time-bound programme required to reach the eradication prior to the deadline. This was much more difficult than the previous practice without a fixed global final term. A complex system approach when applying action-oriented epizootiological principles was of extraordinary importance. International management of global eradication programme had different work/resources/time consuming phases.

Global preparatory phase consisted in: rinderpest aetiology, immunology and epizootiology research; field investigations to identify all outbreaks and threatened territories; identification of control/eradication strategy and methodology (including laboratory diagnosis procedures); identification of specific objectives; high quality vaccine development, production and control; creation of necessary conditions (manpower, material, funds, transport; information and logistics systems; public, legislation and

political support, etc.); strengthening animal health services; education and training; establishing international rinderpest reference laboratories⁴ for confirmatory diagnosis; attraction of donors; clearance procedures, etc.

Global pilot phase. Initially the eradication efforts took place largely on an individual country basis facilitating to accumulate national experience with the tested methods. Mass vaccination proved its effectiveness. Major campaigns in Asia throughout the 1960s brought the disease largely under control. At the beginning of the 1960s, a programme called JP 15 (*Joint Campaign against Rinderpest in Africa*) attempted to vaccinate all cattle in participating countries. This programme supported by German government brought significant improvements in the years 1962-1976. However, its premature termination (due to economic reasons) led to a flare and spread of this infection from the residual “pockets” in Sudan to the north up to Egypt, to the west up to Senegal, to the east up to Djibouti and to the south up to Zambia killing millions of cattle, as well as wildlife. In Asia the rinderpest spread to the west up to Turkey.

Global attack phase, combined with protective measures including mass vaccination, internationally organized as “FAO g l o b a l rinderpest eradication programme” was

⁴ Institute for Animal Health, Pirbright Laboratory, United Kingdom; Kenya Agricultural Research Institute, Muguga Laboratory, Nairobi; Institut sénégalais agricole, Laboratoire nationale de l'élevage et de recherches vétérinaire, Dakar and Plum Island Animal Disease Center, New York, USA.

launched in 1986. The AGAH, under the leadership of Dr Y. Ozawa, after rinderpest global situation analysis, could finally set a realistic deadline for its eradication – “Horizon 2010” thus creating an attractive motivation for all participants and donors. Time-bound strategy gave a new important impulse to global rinderpest eradication campaign at all levels resulting in the intensification of control/eradication measures aiming at the final common objective. At that time the AGAH created, merged and technically backstopped three new regional projects: “*The Pan African Rinderpest Campaign (PARC)*” – (FAO Project GCP/RAF/218/JPN), “*The South Asia Rinderpest Eradication Campaign (SAREC)*” – (FAO Project RAS/86/023) and “*The West Asia Rinderpest Eradication Campaign Coordination (WARECC)*” – (FAO Project RAB/86/024) including all existing and new national anti-rinderpest programmes in the affected countries. The campaign required to interlink local, national, regional and global programmes thus creating a worldwide management structure “pyramid” with its top at FAO HQs in Rome.

In 1994, the **final eradication phase** started with the goal to terminate the eradication programmes in remaining rinderpest countries. The FAO Council approved the establishment of EMPRES within the FAO Animal Health Service. Under EMPRES a special unit was established - GREP (“Global Rinderpest Eradication Programme”) as a programme aimed at the evidence-based global eradication of rinderpest virus by 2010. A scientific verification that the virus was no longer circulating in the wild was necessary. The foundation of the GREP represented a new very important impulse for the programme. The last confirmed case of rinderpest was registered in a wild buffalo population in Kenya in 2001.

Anti-rinderpest actions managed by the FAO Animal Health Service consisted in global initiative, organization, international coordination, gaining necessary external support and in providing technical **assistance to member countries** according to their requirements. This assistance usually consisted in: identification of rinderpest situation; elaboration of anti-rinderpest strategy and contingency plans; realization of specific protective, control/eradication measures and risk-based surveillance (e.g., serological monitoring of rinderpest situation, confirmation of rinderpest-free status and post-eradication control); rinderpest diagnosis (establishing and strengthening diagnostic laboratories including equipment and experts); provision of methodologies (including manuals); production and control of anti-rinderpest vaccines⁵, establishing cold

Table 1: Examples of anti-rinderpest activities of Animal Health Service, Food and Agriculture Organization of the United Nations

FIELD REGIONAL PROJECTS BACKSTOPPED BY THE ANIMAL HEALTH SERVICE IN 1990
Technical support to Pan-African Rinderpest Eradication Campaign (PARC) PARC: Communication and Training (OAU Countries) PARC: Training on National Communication Officers (OAU Countries) Veterinary Vaccine Production and Quality Control in Africa Technical Support for National Mass Communication Activities (PARC) Improvement of Vaccine Production in Eastern, Central and Southern Africa Communication Coordination (PARC) Program regional de serosurveillance de la peste bovine Western Asia Rinderpest Eradication Campaign Coordination (WARECC) South Asia Rinderpest Eradication Campaign (SAREC)
RINDERPEST CONTROL MEETINGS ORGANIZED BY THE ANIMAL HEALTH SERVICE
1981: Joint FAO/OAU/OIE Meeting on Rinderpest Eradication in Africa 1983: Second Informal Meeting on the Pan-African Rinderpest Campaign 1984: Expert Consultation on Rinderpest Diagnosis and Vaccine Production/Control 1987: Expert Consultation on Global Strategy for Control and Eradication of Rinderpest 1992: Expert Consultation on Strategy for Global Rinderpest Eradication 1995: Emergency Preparedness and Contingency Planning for Rinderpest in Africa 1995: Emergency preparedness and contingency planning for Rinderpest and other diseases emergencies 1996: Technical Consultation on the Global Rinderpest Eradication Programme “The Word without rinderpest” 1998: Technical Consultation on the GREP “The challenge ahead” 2000: Verification of rinderpest freedom 2002: Consultation on the Global Rinderpest Eradication “Maintaining momentum and commitment” 2007: GREP Ad Hoc Group Workshop 2009: GREP Experts Consultation Meeting “Will rinderpest virus ever die? What lies beyond 2010?” 2009: GREP Experts Consultation Meetings “Rinderpest virus and vaccines sequestration” 2010: FAO workshop on post-eradication activities with participation of OIE 2010: GREP Symposium and High Level Meeting “Lessons learnt from the eradication of rinderpest for controlling other transboundary animal diseases”
FAO PUBLICATIONS AND DOCUMENTS ON RINDERPEST CONTROL
1967: Diagnostic of Rinderpest (author: D.R. Scott) 1985: A Practical Guide for Rinderpest Campaign Field Personnel 1986: Manual on the Diagnosis of Rinderpest 1994: Quality Control Testing of Rinderpest Cell Culture Vaccine

⁵ PANVAC – African Union Pan-African Veterinary Vaccine Center in Debre Zeit (Ethiopia) and Dakar (Senegal). Introduction of thermo-stable vaccine significantly reduced dependency on a cold chain system.

chain; strengthening veterinary services; providing means of transportation and communication; capacity building; education and training, legislation etc.

FAO anti-rinderpest projects budget structure usually consisted of the following components: personnel (professional, non-professional and administrative support), travel, sub-contracts (specifying types of goods and services), training (fellowship, study tours, group training, in-service training, etc.), equipment (expendable, non-expendable), premises and miscellaneous (operation and maintenance, cost of equipment, reporting costs etc.).

The programme required close **collaboration** with different global partners such as the International Atomic Energy Agency (IAEA) that was helping through “Joint FAO/IAEA Division on Nuclear Techniques in Food and Agriculture” with rinderpest diagnosis using Enzyme-Linked ImmunoSorbent Assay (ELISA) and Polymerase Chain Reaction (PCR) techniques. The most important was the International Office of Epizootics (OIE) providing information on rinderpest occurrence, standards for diagnostic tests and vaccines, guidelines for anti-rinderpest measures, guidelines for rinderpest virus sequestration, pathway and basic information for declaration of individual countries as well as of the whole world as rinderpest-free. From the regional partners at least the African Union’s Inter-African Bureau for Animal Resources (AU-IBAR) managing the PARC programme (1986-1998) succeeded by the Pan African Programme for the Control of Epizootics (PACE) must be mentioned. Among important participating partners belonged also the French Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD). Close collaboration with rinderpest country governments represented a key prerequisite.

FAO rinderpest global eradication field projects were supported from different **financial sources**: FAO Technical Cooperation Programmes (TCP) were funded from the own Regular Programme budget of the organization. Among other financial sources belonged United Nations Development Programme (UNDP), Trust Funds (TF), FAO/Government Cooperative Programme (GCP), Unilateral Trust Funds (UTF) etc. Financial support was obtained also from other donors such as several governments (Japan, United Kingdom, France, USA, Italy, Canada, Germany, Ireland, etc.), numerous donor agencies such as the European Development Fund (EDF), Swedish International Development Authority (SIDA) etc. and from several international banks. It should be stressed that without such massive financial support the eradication programme would not have been possible to carry out.

The rinderpest global eradication programme was **implemented or actively supported** by: governments of all affected and threatened countries; hundreds of participating institutions: for national and international

research, for rinderpest vaccine production and control, for laboratory diagnostics, etc. The people of many generations behind the eradication included: incalculable numbers of veterinarians, animal health assistants and laboratory technicians of public and private animal health services; veterinary researchers; teachers and students of veterinary schools; livestock specialists, cattle/buffalo farmers and pastoralists; community, regional and national authority officers and countless other collaborators. They all deserve respect and recognition because without their hard work and enthusiasm it would not have been possible to achieve the global eradication.

FAO Animal Health Service (supported by FAO leadership and relevant FAO HQs units such as the Operation Division) having the responsibility for the management of global rinderpest eradication programme played a principal role as initiator, promoter, organizer, coordinator and executor of concrete assistance to rinderpest affected and threatened member countries. At that time all its Chiefs were responsible for the anti-rinderpest global programme implementation and results during a particular period. Special responsibilities within the FAO Animal Health Service were those of the Infection Diseases Group and from 1994 the EMPRES group with a special GREP unit and their rinderpest virologists. The Chiefs, Animal Health Service, FAO were also supervising and coordinating FAO Regional Animal Health Officers responsible for anti-rinderpest programme within the given regions.

RESULTS

Global issues

The first major global impulse was given in 1985 (remaining 39 rinderpest countries) by identifying the final deadline - 2010. In 1986, the proper global rinderpest eradication programme was started merging three new regional programmes. The second major impulse was given in 1994 (remaining 19 rinderpest countries) by the establishment of the EMPRES/GREP unit. The numbers of countries reporting their last case of rinderpest in individual decades were as follows: during the 1940s – 5, during the 1950s – 5, during the 1960s – 7, during the 1970s – 3, during the 1980s – 26, during the 1990s – 18 and during the 2010s – 2 and thus finalizing successfully the global eradication process. Somali ecosystem in Kenya was the last place where rinderpest had been diagnosed in 2001. The final vaccinations were stopped in 2006 allowing the investigators to disclose eventual reservoirs of rinderpest virus. The last targeting surveillance operations took place in 2009, failing to find any evidence of the disease. FAO halted all field anti-rinderpest operations in October 2010.

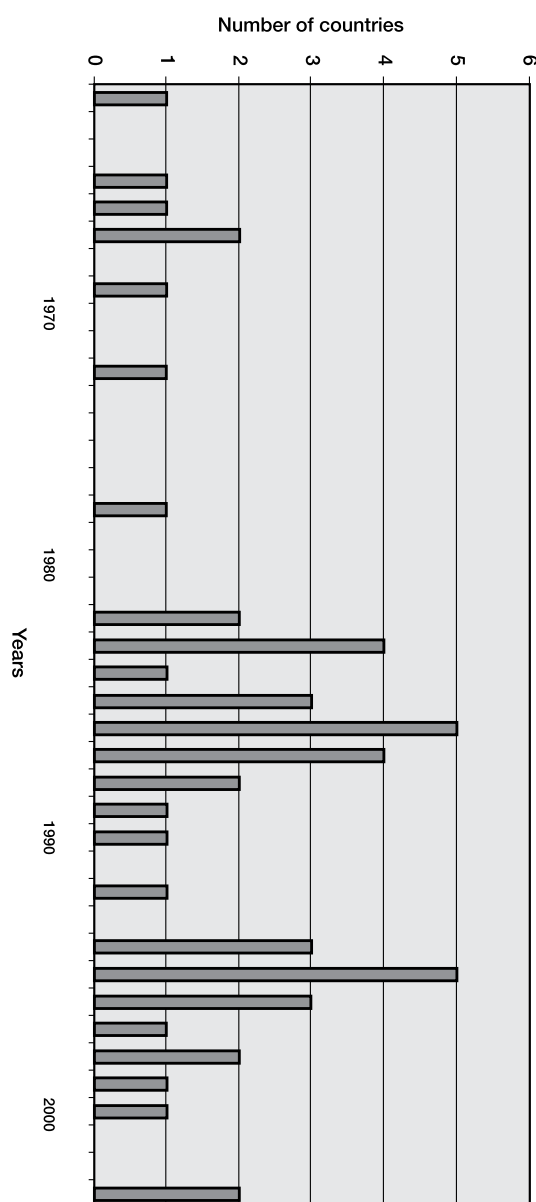


Fig. 3. Countries officially reporting last cases of rinderpest (1963-2003). Source: OIE WAHID data 2009, graph made by V. Kouba.

Substantial disease search and widespread serological surveillance throughout Asia, Africa and Middle East had been conducted without any evidence of virus circulation. This information was based on detailed evidence provided by all countries and territories and had been verified by the OIE recognizing the world as free from rinderpest virus circulation. The FAO noting the conclusions reached by the “*Joint FAO/OIE Committee on Global Rinderpest Eradication*”⁶ adopted

GLOBAL ERADICATION OF RINDERPEST - YEARS OF LAST REPORTED OCCURRENCE

1962	Angola
1963	
1964	
1965	Gambia
1966	Laos
1967	Guinea, Guinea Bissau
1968	
1969	Bhutan
1970	
1971	
1972	Jordan
1973	
1974	
1975	
1976	
1977	Vietnam
1978	
1979	
1980	
1981	
1982	Lebanon, Syria
1983	Somalia, Central African Republic, Izrael, Palestinian Terr.
1984	Chad
1985	Bahrain, Kuwait, Djibuti
1986	Cambodia, Cameroon, Cote d'Ivoire, Mali, Niger
1987	Benin, Egypt, Nigeria, Quatar
1988	Burkina Faso, Ghana
1989	Georgia
1990	Nepal
1991	
1992	Mongolia
1993	
1994	Iran, Uganda, Sri Lanka
1995	Afghanistan, Ethiopia, India, Oman, Yemen
1996	Iraq, Turkey, United Arab Emirates
1997	Tanzania
1998	Russia, Sudan
1999	Saudi Arabia
2000	Pakistan
2001	
2002	
2003	Mauritania, Kenya

OIE WAHID International Animal Health Database, 2010

during the 79th General Session, 2011 a resolution declaring officially that the world had achieved freedom from rinderpest in its natural setting: “*Declaration on Global Freedom from Rinderpest and on the Implementation of Follow-up Measures to Maintain World Freedom from Rinderpest*”. The Declaration called upon FAO to assume its responsibility for undertaking the measures to maintain worldwide freedom from rinderpest. The Declaration required developing a **post-eradication strategy** so as to consolidate success of eradication taking into account the fact that the presence of virulent or attenuated

⁶ The “*Joint FAO/OIE Committee on Global Rinderpest Eradication*”, under the chairmanship of Dr W. Taylor, based its conclusions on the reports of the meetings of the “*OIE Scientific Commission for Animal Diseases*” and on the reports of the meetings of the “*OIE ad hoc Group on Evaluation of Rinderpest Disease Status of Members*”.

Table 2. List of countries affected by rinderpest and years of reporting last cases (OIE World Animal Health Information Database - WAHID 2010)

<p>Africa: Angola (1962), Benin (1987), Botswana (1899), Burkina Faso (1988), Burundi (1934), Cameroon (1986), Central African Republic (1983), Chad (1984), Congo (1986), Cote d'Ivoire (1986), Djibuti (1985), Egypt (1987), Eritrea (1995), Ethiopia (1995), Gambia (1965), Ghana (1988), Guinea (1967), Guinea Bissau (1967), Kenya (2003), Lesotho (1886), Libya (1966), Mali (1986), Mauritania (2003), Mozambique (1896), Namibia (1907), Niger (1986), Nigeria (1987), Reunion (1902), Ruanda (1932), Senegal (1978), Somalia (1983), South Africa (1904), Sudan (1998), Swaziland (1898), Tanzania (1997), Togo (1986), Uganda (1994), Zambia (1896), Zimbabwe (1898).</p> <p>Americas: Bermuda, Brazil (1921).</p> <p>Asia: Afghanistan (1995), Armenia (1928), Azerbaijan (1929), Bahrain (1985), Bangladesh (1958), Bhutan (1969), Brunei (1950), Cambodia (1986), China (1955), Hong-kong (1950), India (1995), Indonesia (1907), Iran (1994), Irak (1996), Izrael (1983), Kuwait (1985), Japan (1924), Jordan (1972), Kazakhstan (1928), Korea (1931), Korea-DPR (1948), Laos (1966), Lebanon (1982), Malayasia (1924), Mongolia (1992), Myanmar (1957), Nepal (1990), Oman (1995), Pakistan (2000), Palestian Auton. Territories (1983), Philippines (1955), Qatar (1987), Saudi Arabia (1999), Singapur (1930), Sri Lanka (1994), Syria (1982), Taipei China (1949), Thailand (1959), Turkey (1996), United Arab Emirates (1995), Vietnam (1977), Yemen (1995).</p> <p>Europe: Albania (1924), Austria (1881), Belgium (1920), Bosnia and Herzegovina (1883), Bulgaria (1913), Croatia (1883), Czech Republic (1881), Denmark (1782), Finland (1877), France (1870), Georgia (1989), Germany (1870), Greece (1926), Hungary (1881), Ireland (1866), Italy (1949), Latvia (1921), Netherlands (1869), Poland (1921), Romania (1886), Russia (1998), Serbia and Montenegro (1883), Slovakia (1881), Slovenia (1883), Sweden (1700), Switzerland (1871), U.K./Great Britain (1877), U.K. Northern Ireland (1900).</p> <p>Oceania: Australia (1923).</p>

rinderpest virus in laboratories constitutes a potential threat to the global rinderpest-free status. It urged all member countries to maintain appropriate surveillance system for rinderpest, to destroy rinderpest virus-containing materials, to ensure that rinderpest occupies an appropriate place in veterinary education and training programmes and to support all technical measures required to minimize the risk of rinderpest re-emergence.

DISCUSSION AND CONCLUSION

This extraordinary achievement, based on excellent research results, would not have been possible without the joint efforts and strong commitments of FAO, governments, relevant organizations in Africa, Asia and Europe, and without the continuous support of many international agencies and donors. The global anti-rinderpest campaign structure involved incalculable number of participating persons and institutions. The rinderpest global eradication was estimated to have had a cost of about 5 billion USD.

The largest and longest international global programme against the most dangerous animal disease converted successfully the research findings into worldwide practice and a historical result. **Rinderpest is the first animal infection eradicated globally and not only in susceptible species of domestic but also in wild animals.** This achievement in all the world has proved for the first time the

feasibility of global eradication of selected animal infections when theoretical methodology is transferred into reality due to adequate management system under technical leadership of a global competent executing inter-governmental agency. Huge damage that rinderpest has caused in the past will not be repeated. It is a great contribution to global livestock economy development, to international trade and to poverty reduction.

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